

BEP-490/675 Electrophysiology

Fall 2026, The University of Alabama

Instructor: Dr. Firat Soylu (fsoylu@ua.edu)

Room: ALH 229

Meeting Time: Thursdays 2pm-4:50 pm

Office hours: Wednesday 1pm-3pm or please email to make an appointment

Office: Capital Hall 1812

Course Description

The purpose of this course is to introduce cognitive electrophysiology methods used in cognitive neuroscience. The course specifically focuses on EEG (electroencephalogram) and ERP (event-related potentials) methods, and covers central topics and issues; including design of EEG/ERP experiments, filtering, artifact detection and rejection, frequency and time-frequency analyses, ERP analysis, and functional connectivity.

Course Objectives

In this course students will:

- learn about signal processing methods used in cognitive electrophysiology research
- acquire preliminary experiences in experimental research design, data collection, and analysis of EEG and ERP data
- synthesize, criticize and interpret empirical work and theoretical perspectives on cognitive electrophysiology research
- learn about open source research software and open science research practices
- formulate ideas for future empirical research in their field of study

Prerequisites

BEP 220 is a prerequisite for BEP 490. There are no prerequisites for BEP 675. Students who do not meet the prerequisite requirements can take this course with instructor approval, if they have previous introductory-level neuroscience coursework.

Textbooks

Both textbooks are **available full-text as ebooks** (pdf) from the UA library. You will be shown how to access them in the first class. You can also buy hardcopies, if you prefer.

- **ITERP:** Luck, S. J. (2014). An introduction to the event-related potential technique. MIT Press.
- **ANTSD:** Cohen, M. X. (2014). Analyzing neural time series data: theory and practice. MIT Press.
- **AppERP Lab Book:** Applied ERP Data Analysis (free online lab book)

Software

The software listed below need to be installed on your personal computer to complete the class activities. You can also use university computers, which already have MATLAB, and you can just install EEGLAB and ERPLAB as toolboxes. You will learn how to setup these software in class.

- **MATLAB:** You will need to have MATLAB on your laptop to be able to do the in-class activities and assignments. UA has a MATLAB site license, meaning that all students and faculty have free access to MATLAB and all its toolboxes.
- **EEGLAB:** EEGLAB is an open-source and free data analysis toolbox that works on MATLAB. Download EEGLAB
- **ERPLAB:** ERPLAB is an open-source and free data analysis toolbox that works as a plugin to EEGLAB on MATLAB. Download ERPLAB

All additional reading materials are included under the Outline of Topics section.

Summary of Course Activities

Weekly Readings & Discussion Questions

The readings will be from the two textbooks. The e-copies (pdfs) of the textbook chapters are available from the UA library, as well as the course website. You can purchase hardcopy versions online.

Each week you will complete the assigned readings before class. The readings will provide you with a preliminary understanding of the content, but it is likely that aspects of the content will be hard to understand initially. You will post at least one question on the discussion board for the week (the links to the discussion board are in the weekly schedule). We will discuss these questions in class and will make sense of the content together. The questions posted should be directly relevant to the content covered in that week and should help shape the discussion that takes place in class. When posting your questions please consider referring to specific sections in the readings (with page numbers). You are expected to submit your discussion questions by 8:00 am on the day of the class.

Course Sessions

There will be three parts in each class session:

- **Lecture:** Each class will begin with a lecture (~40 min) providing a summary of the content covered in the readings.
- **Discussion:** We will have discussions based on the readings and questions posted by the students. Some weeks a student will present a classical paper and we will have a discussion on it.
- **Lab:** We will conduct hands-on data collection and analysis activities. We will complete the Applied ERP Data Analysis lab book activities. We will have at least one of the class sessions in the Educational Neuroscience Lab in Tom Baner Hall, Room 1057, for hands-on data collection activities.

Pop Quizzes

There will be two in-class quizzes. These will be brief and will cover the content covered in class in the preceding weeks.

Mid-term

There will be a mid-term exam measuring your understanding of the concepts, theories, and methods covered in class. This will be an open book exam and will take place during the class.

Project

For the project, you will analyze data and write a brief research report. The data will be provided by the instructor. Alternatively, you can use data from a public repository. Details on the project will be provided in class.

Deliverables

In addition to the weekly discussion questions, there are three deliverables:

(a) Prospectus: By the seventh week of the class you will submit a two page prospectus for your project that lays out the focus of your project, the research questions and your preliminary ideas for the research design. We will have a one-on-one meeting to discuss your project ideas. The prospectus will also have a tentative bibliography showing the body of literature you will use in your project.

(c) Final paper: You will submit your final paper at the end of the semester (~5000 words).

(d) Poster: You will prepare a digital poster and present it in our last class.

Weekly Schedule & Content

1. Introduction (Aug 20)

- Introduction to EEG research
- Setting up the software environment: MATLAB, EEGLAB, & ERPLAB

2. What are EEG and ERP, and what are they good for? (Sept 27)

What is EEG? What is an ERP? Inspect raw EEG and ERP data; introduction to ERPLAB

- Discussion Board
- ITERP Chapter 1: A Broad Overview of the Event-Related Potential Technique
- ANTSD Chapter 2: Advantages and Limitations of Time and Time Frequency Domain Analyses
- ANTSD Chapter 3: Interpreting and Asking Questions about Time-Frequency Results
- Lab: Ch. 1: First Steps

3. Key Background Issues for EEG & ERP (Sept 3)

Identify common ERP components; relate waveform polarity, latency, and scalp distribution to cognitive processes; Physiological bases of EEG

- Discussion Board
- ITERP Chapter 2: A Close Look at ERPs and ERP Components
- ANTSD Chapter 5: Introduction to the Physiological Bases of EEG
- Lab & student paper presentation

4. Major ERP components (Sept 10)

Examine P1/N1, P2, N2, P3, N400, ERN, etc.

- Discussion Board
- ITERP Chapter 3: Overview of Common ERP Components
- Kappenman, E. S., & Luck, S. J. (2011). ERP components: The ups and downs of brainwave recordings. In S. J. Luck & E. S. Kappenman (Eds.), *The Oxford Handbook of Event-Related Potential Components*. Oxford University Press.
- Lab & student paper presentation

5. The Design and Interpretation of EEG & ERP Experiments (Sept 17)

- Discussion Board
- ITERP Chapter 4: The Design of ERP Experiments
- ANTSD Chapter 6: Practicalities of EEG Measurement and Experiment Design
- Lab & student paper presentation

6. Artifact Detection & Rejection (Sept 24)

- Discussion Board
- ITERP Chapter 6: Artifact Rejection and Correction
- ANTSD Chapter 7: Preprocessing Steps Necessary and Useful for Advanced Data Analysis
- ANTSD Chapter 8: EEG Artifacts: Their Detection, Influence, and Removal
- Lab & student paper presentation

7. Time-Frequency Domain Analysis & Filtering (Oct 1)

- Discussion Board
- ITERP Chapter 7: Basics of Fourier analysis and filtering
- ANTSD Chapter 9: Overview of Time-Domain EEG Analyses
- Lab & student paper presentation

8. Baseline Correction, Averaging & Independent-Component Analysis (Oct 8)

- Discussion Board
- ITERP Chapter 8: Baseline Correction, Averaging, and Time-Frequency Analysis
- Lab & student paper presentation

9. Measurement (Oct 15)

- **Mid-term!**
- Discussion Board
- ITERP Chapter 9: Quantifying ERP Amplitudes and Latencies
- Lab & student paper presentation

10. Statistical Analysis of EEG & ERP Data and Reporting Results (Oct 22)

- Discussion Board
- ITERP Chapter 10: Statistical Analysis
- ANTSD Chapter 32: Advantages and Limitations of Different Statistical Procedures
- Lab & student paper presentation

——Mid-semester study break (Oct 29-30)

11. Scripting in MATLAB for EEG & ERP Analysis (Nov 5)

- Discussion Board
- ANTSD Chapter 4: Introduction to MATLAB Programming
- Lab & student paper presentation

12. Methods for studying brain connectivity (Nov 12)

- Discussion Board
- ANTSD Chapter 25: Introduction to the Various Connectivity Analyses
- Bullmore, E., & Sporns, O. (2009). Complex brain networks: graph theoretical analysis of structural and functional systems. *Nature Reviews. Neuroscience*, 10(3)

13. Writing and publishing a research report (Nov 19)

- Discussion Board
- Keil, A., Debener, S., Gratton, G., Junghöfer, M., Kappenman, E. S., Luck, S. J., . . . Yee, C. M. (2014). Committee report: Publication guidelines and recommendations for studies using electroencephalography and magnetoencephalography. *Psychophysiology*, 51, 1–21. <http://doi.org/10.1111/psyp.12147>

- Friston, K. (2012). Ten ironic rules for non-statistical reviewers. *NeuroImage*, 61, 1300–1310. <http://doi.org/10.1016/j.neuroimage.2012.05.085>
- Noble, W. S. (2017). Ten simple rules for writing a response to reviewers. *PLoS Computational Biology*, 13(10), e1005730. <http://doi.org/10.1371/journal.pcbi.1005730>

14. Project session (Nov 26)

15. Project Presentations (Dec 3)

Final project paper due (Dec 8)

Grading

Class participation (includes posting discussion questions and participating in the class, 3pts/week)	3x14 = 42 pts
Pop Quizzes (x 2)	10 pts
Paper Presentation	5 pts
Mid-term	20 pts
Project Poster Presentation	5 pts
Final Project	25 pts
Total	107 pts

Grading scale (BEP 675): A: 90 - 100, B: 80 - 89, C: 70 - 79, D: 60 - 69, F: 0 - 59

Grading scale (BEP 490): A+: 99 - 100, A: 93-98, A-: 90 - 92, B+: 87 - 89, B: 83 - 86, B-: 80 - 82, C+: 77 - 79, C: 73 - 76, C-: 70 - 72, D+: 67 - 69, D: 63 - 66, D-: 60 - 62, F: 0 - 59

Resources

Neuroimaging Software

- EEGLAB, ERPLAB, SPM12, FSL, AFNI

Statistics Software

- JASP, JAMOVI, R, Rstudio

Image & Media Editing

- Adobe Suite (free to UA members), GIMP

Open Data

- ERP Core (<https://erpinfo.org/erp-core>)
- NIMH Data Archive (<https://nda.nih.gov/>)
- Open fMRI (deprecated; <https://openfmri.org/>)
- OpenNeuro (<https://openneuro.org/>)
- Harvard Dataverse (<https://dataverse.harvard.edu/>)
- OSF (<https://osf.io/>)
- Human Connectome Project (<https://humanconnectome.org/>)
- ABCD Study (abcdstudy.org/; <https://nda.nih.gov/abcd>)
- Brain Imaging Data Structure (<https://bids.neuroimaging.io/>)
- ABIDE (Autism Brain Imaging Data Exchange; https://fcon_1000.projects.nitrc.org/indi/abide/)
- Max Planck Institut Leipzig Mind-Brain-Body LEMON dataset ([Link](#))

Policy Statements

Policy on Missed Exams and Coursework

It is important that students turn in all assignments on time and attend classes. Each week, students are required to complete the readings and submit discussion questions, in addition to attending class. You will not receive any points for class participation, if you don't show up for class. Except in the case of documented severe illness, funeral of a family member, or a personal, catastrophic or religious event (as defined by the University policies), assignments submitted late are not accepted. There will not be any exceptions to the policy stated here.

Attendance Policy

Class attendance is required. It is expected that you undertake appropriate prior preparation for each class period and actively participate during class. Attendance will be taken. You will not get any participation points for unexcused absences.

- Valid reasons for an excused absence include:
 - Medical emergencies or serious illness (doctor's note is required).
 - Death of an immediate family member.
 - Religious observances (with prior notice).
 - Participation in university-sponsored events or activities (with verification).
- Procedure for requesting an excused absence: Students must submit their request for an excused absence by email prior to the absence and ensure to attach any relevant documentation (e.g., doctor's note)
- Make-up Work and Exams: For excused absences, it is the student's responsibility to make arrangements with the instructor to make up missed assignments, quizzes, or exams due to an excused absence. Make-up work must be completed within a timeframe agreed upon by both the student and the instructor. Failure to complete make-up work within the agreed timeframe will result in a grade reduction.
- Unexcused Absences: Absences without a valid reason or without proper notification and documentation will be considered unexcused. Students will not be offered an opportunity to make up missed classes, quizzes, and exams.

Notification of Changes

The instructor will make every effort to follow the guidelines of this syllabus as listed; however, the instructor reserves the right to amend this document as the need arises. In such instances, the instructor will notify students in class and/or via email and will endeavor to provide reasonable time for students to adjust to any changes.

COVID19 Safety & UA Return Plan

All University faculty, staff, and students are expected to maintain a commitment to the health and safety of our campus community. Due to the current COVID-19 pandemic, specific health and safety standards are in place to minimize exposure and community spread on campus. In the interest of your health and safety and that of all UA students, faculty and staff, the University reserves the right to change the mode of instruction or schedule of instruction at any time, based upon prevailing public health and other guidance. While the method of delivery may change, educational instruction and opportunities will continue. As such, the University will not provide a refund of tuition, in whole or in-part, based on any such changes. Detailed information on changes in format or schedule can be found at <https://studentaccounts.ua.edu/> and <https://financialaid.ua.edu/>.

All students must be familiar with and abide by the requirements outlined in the UA Return Plan | UA System Comprehensive Health and Safety Plan. Students must (1) wear a mask or face covering at all times while participating in face-to-face class; (2) adhere to social distancing standards; and (3)

comply with all other health and safety restrictions. If a student refuses to comply with the requirements, the student will be asked to leave the class and reported for a conduct violation. Unless a student has an exemption from the requirement to wear a face covering, (more information can be found at <http://ods.ua.edu/covid-19-disability/>), the student will be reported to Student Life for further disciplinary action. More information on these requirements and UA Healthcheck system and screening can be found at <http://healthinfo.ua.edu/returnplan>. You are expected to visit the site and comply with all noted requirements related to in-person class attendance.

Mission of the College of Education

Our mission in the College of Education is to be a leader in Alabama and across the nation in teaching, scholarship, advocacy, and service by developing professionals with pedagogic and disciplinary expertise who advance the intellectual and social conditions of all learners in a globalized society.

Conceptual Framework Summary

The vision of the College of Education (COE) at The University of Alabama is to develop effective, ethical, and reflective professionals who advance the theme of the COE: Unite, Act, and Lead (UA Leads). By engaging in theoretically informed and intellectually advanced effective practice our graduates will

UNITE with the larger community to collaboratively nurture cultural competence, empathy, and a vision of equity and justice for all learners;

ACT to develop the full potential of all learners to be excellent professionals in their fields; and

LEAD through continuous research-based critical inquiry of policy and reflective practice to enable transformative change in our diverse local and global communities.

Dispositions

We strive to create programs that emphasize Fairness and Equity, Reflective Stance for Professional Practice, a Commitment to Diversity, and a Culture of Collaboration.

Statement on Academic Misconduct

Students are expected to be familiar with and adhere to the official Code of Academic Conduct provided in the Online Catalog (<https://catalog.ua.edu>).

“All students in attendance at The University of Alabama are expected to be honorable and observe standards of conduct appropriate to a community of scholars. Academic misconduct by students includes all acts of dishonesty in any academically related matter and any knowing or intentional help or attempt to help, or conspiracy to help, another student commit an act of academic dishonesty. Academic dishonesty includes, but is not limited to, the following acts, when performed in any type of academic or academically related matter, exercise or activity: ◦ Cheating: Using or attempting to use unauthorized materials, information, study aids or computer-related information. ◦ Plagiarism: Representing the words, data, works, ideas, computer programs or output, or anything not generated in an authorized fashion, as one’s own. ◦ Fabrication: Presenting as genuine, any invented or falsified citation or material. ◦ Misrepresentation: Falsifying, altering or misstating the contents of documents or other materials related to academic matters, including schedules, prerequisites and transcripts.”

Statement on Academic Work Duplication

Any submission of academic work designed to meet the requirements of a particular credit-bearing course is assumed to be work completed for that course and only that course; the same material submission, or material that is substantially similar, may not be used to meet the requirements of another course. Any violation of this rule may result in a referral to the Associate Dean for Student Services and Certification for disciplinary action.

Statement on Disability Accommodations

- Contact the Office of Disability Services (ODS) as detailed in the Online Catalog.
- The Office of Disability Services (ODS) is the central contact point for UA students with disabilities. The goal of ODS is to ensure that University programs and services are accessible to qualified students with disabilities. For student who may require their services more information is available at <http://ods.ua.edu>. ODS is located at 1000 Houser Hall and their phone number is 348-4285 (voice) or 348-3081 (TTY).

Severe Weather Protocol

Please see the latest Severe Weather Guidelines in the Online Catalog. The link for the Severe Weather Guidelines is <https://ready.ua.edu/severe-weather-guidelines/>

Statement on Pregnant and Parenting Students

Title IX is a federal law that prohibits discrimination on the basis of sex in an education program. Among the types of gender discrimination covered by this statute, Title IX protects against discrimination related to pregnancy or parental status. Protection extends to students who are pregnant or who have either had a false pregnancy, termination of pregnancy, have gone through childbirth, or are recovering from any of those conditions. Title IX regulations also prohibit a school from applying any rule related to a student's parental, family or marital status that treats students differently based on their sex. For more information, please visit http://provost.ua.edu/uploads/3/9/7/6/39760652/student_pregnancy_faq_final_8_11_17.pdf

Statement on Religious Observances

The University of Alabama respects the religious diversity of our academic community and recognizes the important of religious holy days and observances in the lives of our community members. For more information, please go to <http://provost.ua.edu/religious-observances.html>

Statement on Academic Work Duplication

Any submission of academic work designed to meet the requirements of a particular credit-bearing course is assumed to be work completed for that course and only that course; the same material submission, or material that is substantially similar, may not be used to meet the requirements of another course. Any violation of this rule may result in a referral to the Associate Dean for Student Services and Certification for disciplinary action.

UAct Statement

The UAct website provides an overview of The University's expectations regarding respect and civility. The website link is <https://www.ua.edu/campuslife/uact/>