EEG Methods and Analyses

PSY 510 Course Syllabus Spring 2021

When / Where

Wednesdays 14:40-17:30

Instructor

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Office hours: please reach out whenever you need to

TA

There will be no TA for this course. I will help each of you and I expect you to help each other.

Prerequisites

See the Information System website

Description

This course is a project-based course in which students will collect data and perform EEG analyses. The first part of the course focuses on EEG experimental design and data collection. This section teaches students how to shape the choices EEG researchers make when designing their experiments according to their research questions. The second part focuses on data analysis and interpretation of results. Students learn preprocessing, event-related potentials and time-frequency power analyses in both univariate and multivariate domains. Students will acquire not only theoretical knowledge but also practical skills.

Course website

Please regularly check the course website because the syllabus is subject to change depending on your progress. The latest updates will be posted on the website.

Materials

Textbook: We will mostly follow Mike X Cohen's Analyzing neural time series data: Theory and practice. However, you are not expected to own the book. Instead, I will go over all important bits and provide the necessary MATLAB code.

Course schedule

Note that the schedule below is tentative; depending on the questions asked during classes and the subjective difficulty of the topics for students we may cover less or more topics than shown here. Please check the course website for the latest updates on the syllabus.

W1: What does EEG measure?

How is the brain signal that the EEG picks up?
What is EEG good for, and not so good for?
Comparison of EEG to other cognitive neuroscience methods.

W2: How to design an EEG experiment?

What to watch out for to make the most of your data? (trial numbers, electrode number and positioning, timing, sampling rate, etc.)
The importance and implementation of Jittering
How to provide the communication between EEG and experiment presentation computers? (event markers)

Also: Introduction to MATLAB

W3: Removing or correcting for EEG artifacts

Types of artifacts (blinks, oculomotor activity, muscle movements, etc)
Removal of noisy data and ocular artifacts
Correction of noisy data and ocular artifacts
Detecting bad electrodes

Also: More on MATLAB and introduction to EEGLAB

W4: Preprocessing of EEG data

Filtering, referencing, epoching
Interpolating bad electrodes

Also: Last bit of extra MATLAB content. ☺ From here on, you will be expected to start using MATLAB and EEGLAB to perform the analyses mentioned below. Of course, I will be guiding you and answering your questions.

W5: Event-related potentials (ERPs)

How to calculate ERPs [involves basic MATLAB coding which will be described]?
How to perform statistical analysis of ERPs?
How to plot ERPs and their standard deviations?

Ws6&7: Time-frequency analyses

What is a time-frequency analysis?
Fourier transform and convolution
Computing time-frequency decompositions
Baseline corrections
Differences between total vs phase-locked vs non-phase-locked power
Statistical analysis of time-frequency data
Plotting time-frequency data

W8: How to collect data?

How to prepare a participant for the session?
How to set up the electrodes?
How to maximize the cleanliness of data in terms of physical preparations and instructions?

W9: Inter-trial and inter-side phase clustering

Understanding what phase is
Computing phase
Computing consistency of phases across trials and electrodes
Plotting and statistical analysis of phase clustering

W10&11: Multivariate analyses

Introduction to multivariate analyses; what they are, what they are for, and how to use them in EEG
Multivariate pattern analysis (a.k.a. Classification or decoding)
Plotting and statistical analysis of decoding
Introduction to inverted encoding models: what is the difference between decoding and encoding?

Performing inverted encoding model analyses
Plotting and statistical analysis of inverted encoding model analyses

W12: Going over your analyses, plots, and interpretations

This week, we will go over each group's analyses and outcomes across short presentations. It will allow sharing all semester's work with others, get feedback, and also experience presenting an EEG study.

W13: Conclusions and future directions

Going over important issues and mistakes encountered during the semester
Going over common analyses methods
Reminding ourselves how to and how not to interpret EEG data

Grading

Assignment	Date	% of final grade
Presentation	On week 12, every group (of two or three students depending on the total size of the class), will present the outcomes of their analyses and their interpretations to their classmates.	90%
Participation	You are expected to demonstrate your progress through the questions you ask AND answer.	10%
Extra credit*		Up to 3%

A	A-	B+	B-	C+	C-	D+	D-	F
>90	85-89.99	80-84.99	75-79.99	70-74.99	65-69.99	60-64.99	55-59.99	<55

Class Presentations:
Each student is expected to form groups of two or three people. As a group, each student will work on different analyses we cover during the semester and give a presentation at the end of the semester. The presentations should be given using a slide presentation to lead the class through the paper. Each presentation is expected to last about 20 minutes with an additional 5-10 minutes of discussions. To facilitate discussions, presenters are expected to come up with discussion questions. See the 'Presentation grading' section below for more details.

Presentation Content:
Describe the research question of the data (which will be previously acquired as part of an existing experiment – but will be unpublished), the method, the results, the conclusions, and then bring up points for discussion. Since this is an EEG course, you will be expected to focus much more on the details of methods and analyses than you would normally do in a project presentation. Also, the plots should be clear, the stats should be accurate and properly explained.

Presentation grading:
Your class presentation is worth 90% of your grade, and is graded out of 100 points.
Describing the research question = 5 points,
Describing the experimental method = 10 points,
Describing the preprocessing steps = 5 points
Describing the artifact removal steps = 5 points
Describing the data analysis steps = 25 points
Describing the results = 25 points
Describing the conclusions reached = 10 points,
Bringing up points for discussion = 5 points.
Clarity of presentation (speaking and slides) = 10 points.

Extra credit:
Through participating in psychology experiments (online), you can receive extra points on top of your final grade, with a maximum of 3 points. I recommend you to volunteer in experiment participation not only (i) to receive extra course credits, but also to (ii) contribute to the scientific advancement performed at Sabancı University, and (iii) experience how psychology and cognitive neuroscience experiments are performed.

For this course, you will be able to earn up to 3 bonus points (1 research point equals ~ 30 minutes of research participation). Six research points (6PRs) will be converted to 3 bonus points added to your overall total at the end of the semester. More information on the available research projects will be provided during the semester. You will be able to sign up for the experiments and get your research participation points through the online Sona system at http://sabanciuniv.sona-systems.com. Please, carefully read the Guide for Students: Sabancı University Experiment Credits System (Sona). Note that this option is subject to availability: There may be not enough experiments available to complete 3 bonus points.

Attendance:
I recommend attending classes and if possible participate during the classes. If you don't understand something, please ask. If you don't agree with something, please raise your concern. Participation will enhance the learning of the whole classroom, will make the classes more fun for you, and also will make teaching more fun for me (instructors are also human ☺). Also, participation will make up 10% of your grade.

Plagiarism (Extremely critical. Make sure you read this part):
If you use someone else's thoughts, sentences, figures, slides, etc. without mentioning that these are not yours, then you are conducting plagiarism. Do not use someone else's idea as if it is yours. That means, no copy pasting, no stealing of ideas without acknowledging that they are someone else's. For more information in plagiarism, check out this link. If you plagiarize you can get zero points for your quizzes or take-home exams. Please, never plagiarize!