University of Waterloo
Department of Psychology
PSYCH 390_002
Natural Science Advanced Research Methods in Brain research using EEG/ERP
Winter 2024

Location: PAS 1237

Time: Tuesdays 2.30pm – 5.20pm

Instructor Information

Instructor: Dr. Roxane Itier
Office Hours: by appointment only (in person or through Teams, or see me after class)
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Teaching Assistant

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If you would like to contact us, please use the e-mail addresses above and **make sure you add "PSYCH 390_002" to your message subject line**, to make sure that we do not miss your e-mail, as we receive a lot of emails on a daily basis. Students are responsible for all e-mail that is sent to their official UW e-mail address. Check LEARN and your e-mail regularly for important and time sensitive messages.

Course Description

This course is an "in person" experiential learning lab course that will introduce students to the Event Related Potentials (ERP) technique, derived from Electroencephalography (EEG), one of the most commonly used brain recording technique in human cognitive neuroscience research. Students will first be introduced to the most important theoretical aspects of the technique. They will be able to visit an ERP lab and witness how participants are "prepared" for an ERP experiment (head measurement, choice of cap size, electrode set-up etc.), the type of data one can acquire and EEG artefacts one can see with the naked eye during recordings. To link the theory to the practice, we will focus on an early ERP component of interest, the face-sensitive N170 component. Students will learn about this component and how it has been used in the literature to uncover knowledge about face perception. Through readings of articles and their presentations, students will be able to understand how to read scientific papers using the ERP technique and learn how to conceptualise and design an ERP experiment. Through lab assignments, students will put what they learned into practice. During these hands-on lab sessions, students will learn how to process EEG data under the most widely used data analysis platform (EEGLAB and ERPLAB, working under Matlab). Through specific exercises, students will learn how to process a continuous EEG file and generate ERP files that contain an N170 component, understand individual

variability in brain data and generate different representations of ERP data (scalp map figures, ERP time course graphs etc.).

Course Goals and Learning Outcomes

The goal of this course is to provide students with a basic understanding and hands-on experience with the Event Related Potential (ERP) technique of brain recordings in humans. Upon completion of this course, students should:

A. Have a general understanding of the ERP technique and how it is used to address cognitive neuroscience questions, in particular face perception.
B. Have acquired basic knowledge in how to process EEG data and generate ERPs using common analysis platform (EEGLAB, ERPLab working under Matlab)
C. Be able to interpret and critique primary source material (empirical journal articles) using ERPs.
D. Have solidified their presentation skills through poster presentations.

Required Text

There is no textbook for this course.

Readings and course information available on LEARN

Papers that we will read and present, course syllabus, assignment details and important announcements will all be posted on LEARN. It is your responsibility to check LEARN and your official university email address regularly for course updates.

Course Requirements and Assessment

Assessment	Weight
Participation	6%
Research experience	4%
Lab visit report	5%
Poster presentation	20%
Poster critique	5%
Lab assignment #1	10%
Lab assignment #2	10%
Lab assignment #3	10%
Lab assignment #4	10%
Written assignment	20%
Total	100%

Participation (6%)

Your participation mark will be determined by class attendance and by your participation in attending classmates' poster presentations. Me and the T.A. will monitor your class attendance. You are required to attend every class. If you are sick, let me or the TA know and provide a V.I.F. or self declare on Quest. You are required to be present for all classmates' poster presentations and to ask classmates questions

regarding their poster. Your general engagement in the class and your insightful questions during poster presentations will be evaluated.

Research experience (4%)

You will complete 4 research participation credits or 4 article reviews. Please see Sona Participation and Research Experience Mark Information at the end of the syllabus. The research experience needs to be completed before the last day of lectures (April 8).

Lab visit report (5%)

As part of your hands-on experience, we will visit the Itier ERP lab in the Psychology Department here at Waterloo. You will be witnessing the "preparation" of a participant for an ERP study. There will be two sessions occurring in parallel in 2 different test rooms using two different EEG systems. The class will be roughly divided into 2 groups that will switch test rooms halfway through. At the end of the session, we will come back to the classroom and you will write up a short report on your visit (details will be given on LEARN before the first visit) to be uploaded on a LEARN dropbox at the end of class.

Please note that the ERP lab contains costly equipment. You are not allowed to touch anything during your lab visit. NO FOOD OR DRINKS ARE ALLOWED IN THE LAB ROOMS.

Poster Presentations (20%)

The poster presentation component of the course will consist of the presentation of a research paper in the form of a poster. Poster presentations constitute an important avenue for the communication of research.

The paper you present will be assigned to you during the second week of class. You will be marked both on the poster content and on your presentation performance. Your presentation date will be assigned to you. Further information about how to prepare a poster will be provided in class. When you are not presenting, you are expected to attend the poster session and to ask insightful questions as part of your participation grade.

Please submit your poster to the electronic dropbox on LEARN on the due date.

Poster critique (5%)

You will need to pay careful attention to your classmates' posters and provide a small critique of one of the posters of your choice. Details about the critique will be provided on LEARN before the first poster session. This exercise is to ensure you pay attention to the other posters; this will also help you become a better critique of scientific delivery, thus improving your own future delivery of scientific outcomes (very important for conference presentations).

Please submit the poster critique to the electronic dropbox on LEARN on the due date.

Lab assignments (each 10%, total 40%)

After reading week, the class will exclusively be based on hands-on experience and lab assignments. Students will learn how to preprocess EEG files under the commonly used platforms EEGLAB and ERPLAB toolboxes working under Matlab.

Students will follow a tutorial on the basic steps related to the pre-processing of EEG data. The goal is to move from a continuous EEG file (the type obtained at the end of a testing session with a participant) all

the way to generating actual ERP waveforms that can be analyzed statistically.

Assignment #1 and 2 will focus on the pre-processing of a few datasets. At the end, students will have generated multiple ERP waveforms and will be able to observe an N170 component for two conditions. They will be able to appreciate the individual variability in the data and the effects of the preprocessing pipeline. Students will upload the .set files and .erp files generated on a dropbox on LEARN at the end of class on the due date.

Assignment # 3 and 4 will focus on data analysis at the statistical level and on various ways of visualizing the data. N170 peaks will be measured and amplitudes and latencies compared between the various conditions generated. ERP waveform graphs and topographic maps will be created. Students will upload their results and visualization on the Dropbox on LEARN at the end of class on the due date.

Written assignment (20% of the grade)

Your written assignment is an ERP research experiment proposal of your choice. The critical mindset required to produce a good study proposal is an important research skill, and in turn requires a different approach to reading articles.

Your assignment should be maximum 3-pages long (single spaced, Arial 11 font, "normal" margin in word with 1" on each side). The first 2 pages are the actual proposal and should follow a fixed format with the following headings:

1. Literature review: include a good literature review incorporating one or more of the themes covered during the poster sessions, in addition to extra readings of your choice pertaining to the topic.
2. Claim: what is the novel research idea you are testing? this should follow logically from your literature review. If your literature review is not clear, then your claim will most likely be unclear as well.
2. Study: describe the proposed study to test your claim and the details of your experimental design. Participants sample (gender, age, etc.); how many conditions, how many trials per conditions, stimuli types, acquisition frequency, filtering, planned statistical analysis etc.
3. Hypothesis: describe the expected result of your proposed study if your claim is correct.
4. Implications: if the hypothesis were supported, how would this change our understanding of the research topic addressed. If your hypothesis is not supported, then what implication does it have and what else would you do to follow-up.

What matters as much as the study you propose is the argument you make for its usefulness. Top marks will go to those papers that provide a clear, compelling rationale for why the proposed study would be informative. There are many possible studies that could be conducted; your task is to make a compelling case for the one you have proposed. Avoid proposing follow-up studies of already existing papers that rely on formulaic changes to methodology (e.g., increased sample size, use of more realistic stimuli, change in subject population) unless a clear case can be made for why it would help to address some interesting research question.

The 3rd page is the reference list.
List your references to research articles (the ones we saw in class that inspired you and the ones you found on your own) in the following format:

Itier, R. J. (2015). Attention to eyes in face perception. In J. M. Fawcett, E. F. Risko & A. Kingstone (Eds.), *The handbook of attention* (pp. 369-387). Cambridge, MA, USA: MIT Press.

Bentin, S., Allison, T., Puce, A., Perez, E., & McCarthy, G. (1996). Electrophysiological studies of face perception in humans. *Journal of Cognitive Neuroscience, 8*(6), 551-565.

Please stick to one page of references.

Assignments should be submitted to the corresponding dropbox on LEARN no later than April 16th 11.59pm.

****For ALL dropbox submissions, late submissions will be subject to a 10% penalty per late day. Unsubmitted assignments will receive a 0. Not respecting the format or page limit will be penalized.**

Course Outline

We will progress according to the following tentative schedule, subject to change depending on unforeseeable circumstances, change in enrollment, pace of progression etc. The readings will be posted on LEARN.

week	dates	Class (Tuesdays)
1	January 08-12	January 9 Course overview
2	January 15-19	January 16 Article assignment ERP theory (lecture) Reading; Woodman, 2010
3	January 22-26	January 23 ERP Lab visit + **Lab visit report due**
4	January 29- February 2	January 30 Poster presentations
5	February 5-9	February 6 Poster presentations
6	February 12-16	February 13 Poster presentations **Poster critique due**
	February 19-23	**READING WEEK**

7	February 26- March 1	February 27 LAB
8	March 4-8	March 5 LAB **Lab assignment #1 due**
9	March 11-15	March 12 LAB **Lab assignment #2 due**
10	March 18-22	March 19 LAB
11	March 25-29	March 26 LAB **Lab assignment #3 due**
12	April 1-5	April 2 LAB **Lab assignment #4 due**

April 8: REG SONA credits due

April 16: 11.59pm, written assignment due.

Territorial Acknowledgement

The University of Waterloo acknowledges that much of our work takes place on the traditional territory of the Neutral, Anishinaabeg and Haudenosaunee peoples. Our main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River. Our active work toward reconciliation takes place across our campuses through research, learning, teaching, and community building, and is centralized within the Office of Indigenous Relations.

For more information about the purpose of territorial acknowledgements, please see the CAUT Guide to Acknowledging Traditional Territory.

Declaring absences

For all of the following categories of absence students are responsible for getting in touch with their course instructors as soon as possible to discuss possible accommodations for missed course component(s). The course instructor will determine how the missed work is accommodated. Absences will be accommodated according to the accommodation guidelines section of the undergraduate calendar.

If you are unable to complete a course component due to self-declared COVID-related reasons or a two-day short-term absence then you should submit a self-declaration of absence through Quest.

If your absence is due to an illness not pandemic-related, then a UW Verification of Illness form, completed by a health professional, must be uploaded and submitted through the Verification of Illness or Extenuating Circumstances Process. The VIF is the only acceptable documentation for an absence due to illness. Do not submit the VIF or any other medical documentation to your instructors, teaching assistants, or other course personnel.

If your absence is due to other extenuating circumstances (e.g., bereavement), then you must submit all documentation related to the absence (e.g., obituary) through the Verification of Illness or Extenuating Circumstances Process.

Submission through the VIF or Extenuating Circumstances System, once approved, will notify your instructors of your absence. However, you are responsible for contacting instructors to discuss accommodation arrangements.

Accommodating religious and spiritual observances

The University of Waterloo has a duty to accommodate religious, spiritual, and other creed-based beliefs and practices under the Ontario Human Rights Commission (2015) *Policy on preventing discrimination based on creed*. Students may seek accommodations for missed course components on religious, spiritual, or other creed grounds. In such cases the students should please consult the instructor within two weeks of the announcement of the due date for which the accommodation is being sought.

Mental Health Support

All of us need a support system. The faculty and staff in Arts encourage students to seek out mental health support if they are needed.

On campus supports

For counselling (individual or group) reach out to Campus Wellness and Counselling Services. Counselling Services strives to provide a secure, supportive environment for students of all orientations and backgrounds. They offer confidential counselling for a variety of areas including anxiety, stress management, depression, grief, substance use, sexuality, relationship issues, and much more.

Other on-campus supports

- MATES: one-to-one peer support program offered by the Waterloo Undergraduate Student Association (WUSA) and Counselling Services
- Download the WatSafe app to your phone to quickly access mental health support information
- Empower Me: to access create an account on the Dialogue mobile app or on the web at www.studentcare.ca/dialogue
- Sexual Violence Prevention and Response Centre - supports all members of the University of Waterloo campus community who have experienced or been impacted by sexual violence.

Off campus supports

- Good2Talk: Free confidential help line for post-secondary students. Phone: 1-866-925-5454
- Grand River Hospital: Emergency care for mental health crisis. Phone: 519-749-4300
- St. Mary's Hospital - 519-744-3311
- Here 24/7: Mental Health and Crisis Service Team. Phone: 1-844-437-3247
- 988 Suicide Crisis Helpline: a 24/7 urgent mental health care three-digit helpline
- OK2BME: set of support services for Two-Spirit, lesbian, gay, bisexual, trans, queer, intersex, asexual (@SLGBTQIA+) and questioning kids, teens, adults, and their families in Waterloo Region. Phone: 519-884-0000 or e-mail ok2bme@caminowellbeing.ca
- Sexual Assault Support Centre of Waterloo Region - offers individual counselling to people of all genders, 16+ who have been sexually assaulted at any point in their lives. As well as short-term support for family members or friends of sexual assault survivors. Also, information and referrals

More information about resources and supports for students can be found online in on the Faculty of Arts Student Support page.

Anti-racism statement

The University of Waterloo does not tolerate racism or any other form of discrimination and expects campus community members to contribute to a culture where all members feel safe and valued. Any member of the campus community who has experienced racism or discrimination at the University is encouraged to review available processes for addressing their concerns under Policy 33 – Ethical

Behaviour and to seek guidance from the Equity Office via email at equity@uwaterloo.ca or through their website.

Academic freedom at the University of Waterloo

Policy 33 -- Ethical Behaviour states, as one of its general principles (Section 1), "The University supports academic freedom for all members of the University community. Academic freedom carries with it the duty to use that freedom in a manner consistent with the scholarly obligation to base teaching and research on an honest and ethical quest for knowledge. In the context of this policy, 'academic freedom' refers to academic activities, including teaching and scholarship, as is articulated in the principles set out in the Memorandum of Agreement between the FAUW and the University of Waterloo, 1998 (Article 6). The academic environment which fosters free debate may from time to time include the presentation or discussion of unpopular opinions or controversial material. Such material shall be dealt with as openly, respectfully and sensitively as possible." This definition is repeated in Policies 70 and 71, and in the Memorandum of Agreement, Section 6

Intellectual Property

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo.

Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and
- Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for written permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. It is also forbidden to share the material listed above from a previous iteration of a course with a student presently enrolled in the course, unless you have the instructor's written permission to do so. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

Pronouns and chosen or preferred first name

Students can verify their chosen or preferred first name and pronouns by logging into WatIAM. Your chosen or preferred first name and pronouns listed in WatIAM will be used across campus (e.g., in LEARN, Quest, WaterlooWorks, WatCard, etc). Your legal first name will always be used on certain official documents, such as diplomas and transcripts. For more details, visit Updating Personal Information.

Use of generative AI

This course includes the independent development and practice of specific skills, such as using specific neuroimaging software dedicated to the analysis of ERPs, creating a scientific poster and using the knowledge you learned through lectures and reading of scientific articles to design ERP studies. Therefore, the use of Generative artificial intelligence (GenAI) trained using large language models (LLM) or other methods to produce text, images, music, or code, like Chat GPT, DALL-E, or GitHub CoPilot, is not permitted in this class. Unauthorized use in this course, such as running course materials through GenAI or using GenAI to complete a course assessment is considered a violation of Policy 71 (plagiarism or unauthorized aids or assistance). Work produced with the assistance of AI tools does not represent the author's original work and is therefore in violation of the fundamental values of academic integrity including honesty, trust, respect, fairness, responsibility and courage (ICAI, n.d.).

You should be prepared to show your work. To demonstrate your learning, you should keep your rough notes, including research notes, brainstorming, and drafting notes. You may be asked to submit these notes along with earlier drafts of their work, either through saved drafts or saved versions of a document. If the use of GenAI is suspected where not permitted, you may be asked to meet with your instructor or TA to provide explanations to support the submitted material as being your original work. Through this process, if you have not sufficiently supported your work, academic misconduct allegations may be brought to the Associate Dean.

In addition, you should be aware that the legal/copyright status of generative AI inputs and outputs is unclear. More information is available from the Copyright Advisory Committee: https://uwaterloo.ca/copyright-at-waterloo/teaching/generative-artificial-intelligence

Students are encouraged to reach out to campus supports if they need help with their coursework including:
Student Success Office for help with skills like notetaking and time management
Writing and Communication Centre for assignments with writing or presentations
AccessAbility Services for documented accommodations
Library for research-based assignments

Sona Participation and Research Experience Marks Information and Guidelines

Experiential learning is considered an integral part of the undergraduate program in Psychology. Research participation is one example of this, article review is another. A number of undergraduate courses have been expanded to include opportunities for Psychology students to earn grades while gaining research experience.

Since experiential learning is highly valued in the Department of Psychology, students may earn up to 4% of their final mark in this course through research experience (i.e., course work will make up 96% of the final mark and research experience will make up the other 4% for a maximum grade of 100%). **Be sure to review the guidelines referred to later in this document.**

The two options for earning research experience grades; participation in research through online remotely operated and In Lab studies, as well as article review; are described below. Students may complete any combination of these options to earn research experience grades. For Winter 2023, credits will be permitted to be earned with one credit online, and the other 3.0 from In-lab or Remote Access studies.

Option 1: Participation in Psychology Research

Research participation is coordinated by the Research Experiences Group (REG). Psychology students may volunteer as research participants in remotely operated, In Lab and/or online (web-based) studies conducted by students and faculty in the Department of Psychology. Participation enables students to learn first-hand about psychology research and related concepts. Many students report that participation in research is both an educational and interesting experience. Please be assured that all Psychology studies have been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board.

How to earn extra marks for your Psychology course(s) this term by participating in studies …

- You will earn "credits" which will be converted to "marks" (1 credit = 1%)
- You can schedule your remotely operated (replacing in-lab) and ONLINE studies using the "Sona" website.

Educational focus of participation in research

To maximize the educational benefits of participating in research, students will receive feedback information following their participation in each study detailing the following elements:

- Purpose or objectives of the study
- Dependent and independent variables
- Expected results
- References for at least two related research articles
- Provisions to ensure confidentiality of data

- Contact information of the researcher should the student have further questions about the study
- Contact information for the Director of the Office of Research Ethics should the student wish to learn more about the general ethical issues surrounding research with human participants, or specific questions or concerns about the study in which s/he participated.

Participation in remotely operated (counts as the same as in-lab) studies has increment values of 0.5 participation credits (grade percentage points) for each 30-minutes of participation. Participation in ONLINE studies is worth .25 credits for each 15-minutes of participation. Researchers will record student's participation and at the end of the term the REG Coordinator will provide the course instructor with a credit report of the total credits earned by each student.

How to participate?

Study scheduling, participation and grade assignment is managed using the SONA online system. All students enrolled in this course have been set up with a SONA account. You must get started early in the term.

For instructions on how to log in to your SONA account and for a list of important dates and deadlines please, as soon as possible, go to:

Participating/SONA information: How to log in to Sona and sign up for studies

**** Please do not ask the Course Instructor or REG Coordinator for information unless you have first thoroughly read the information provided on this website.****

More information about the REG program in general is available at:
Sona Information on the REG Participants website or you can check the Sona FAQ on the REG website homepage for additional information.

Option 2: Article Review as an alternative to participation in research

Students are not required to participate in research, and not all students wish to do so. As an alternative, students may opt to gain research experience by writing short reviews (1½ to 2 pages) of research articles relevant to the course. The course instructor will specify a suitable source of articles for this course (i.e., scientific journals, newspapers, magazines, other printed media). *You must contact your TA to get approval for the article you have chosen before writing the review.* Each review article counts as one percentage point. To receive credit, you must follow specific guidelines. The article review must:

- **Be submitted before the** last day of lectures**. Late submissions will NOT be accepted under ANY circumstances.**
- Be typed
- Fully identify the title, author(s), source and date of the article. A copy of the article must be attached.

- Identify the psychological concepts in the article and indicate the pages in the textbook that are applicable. Critically evaluate the application or treatment of those concepts in the article. If inappropriate or incorrect, identify the error and its implications for the validity of the article. You may find, for example, misleading headings, faulty research procedures, alternative explanations that are ignored, failures to distinguish factual findings from opinions, faulty statements of cause-effect relations, errors in reasoning, etc. Provide examples whenever possible.
- Clearly evaluate the application or treatment of those concepts in the article.
- Keep a copy of your review in the unlikely event we misplace the original.