

Psychology 450: Cognitive Psychophysiology

Tuesdays and Thursdays, 9:30 am - 10:50 am
Room 17, Psychology Building

Prerequisite: PSYCH 224, Cognitive Psychology (or equivalent);
PSYCH 210, Brain and Mind (or a similar course) is recommended

Credit Hours: 3 (1 graduate unit)

Instructor: Dr. Kara Federmeier
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Course Description and Goals

This course surveys the theory and practice of using recordings of electrical (and magnetic) activity of the brain to study cognition and behavior. It explores what brain-waves reveal about normal and abnormal perception, attention, decision-making, memory, response preparation, and language comprehension. The course aims to give students: (1) knowledge (at both a technical and inferential level) of how electrophysiological techniques can be used to address issues in cognitive psychology, (2) practice with critically reading and evaluating research reports and reviews in the area, and (3) experience in developing research questions, designing experiments to test those questions, and writing research proposals.

Course Web Site

The course website can be found at compass2g.illinois.edu. You will be asked to login with your NetID and password. The website contains:

- a copy of the syllabus and any other handouts
- lecture notes, slides, and review questions
- the gradebook, where I will post your exam scores, paper/homework grades, and final grades (accessible only to you); please make sure to check the gradebook after due dates and exams, and report any problems (e.g., missing scores) within one week.

Readings

For the technical section, some readings will be derived from the textbook “An Introduction to the Event-related Potential Technique (second edition)” by Steven J. Luck. For the rest of the course, required readings primarily consist of review articles and experimental reports, drawn from the primary scientific literature. An ebook version of the textbook and these articles are available online from the library. Go to www.library.illinois.edu (or click on the link from the course webpage) and click on “Course Reserves” (electronic reserves) to access the list. When you click on an item on the list, you will be taken to a screen that will allow you to read or (in some cases) download the document.

*When reading **review articles** keep the following questions in mind:*

- What are the issues that the author takes to be central to his/her area?
- What are some advantages of electrophysiology for addressing those issues?
- How have electrophysiological techniques been used in this area to date?
- What are typical designs for experiments in this area?
- What aspects of the electrophysiological signal have been focused on?
- What insights about cognition/physiology have been obtained?

When reading *experimental reports* keep the following questions in mind:

- What is the general goal of the study? What is the specific hypothesis being tested?
- How does the experimental design address the question?
- What are possible outcomes of the experiment and what would each mean?
- What was the actual outcome?
- What are the authors' conclusions? Are there alternative explanations?
- What are some further questions and how might you address them?

Assessment

70% of a student's grade will be based on his/her performance on two in-class exams, midterm and final, each worth 35% of the final grade. Graduate students will take graduate versions of both exams. Exam questions (short answer and essay format) will be derived from both lecture material and from the assigned readings. Makeup exams will only be given by **prior** arrangement with me, and no exams will be passed out after the first exam has been turned in. The remainder of the grade (30%) will be based on a take-home essay exam (for undergraduate students) or final paper (for graduate students), as detailed next.

Undergraduate students will complete a take-home essay exam. This exam is completely open book: all written materials from the course may be used. However, students **should not** consult with other students about their answers. This is very important; if I determine that two or more students were working together on the exam, **both/all will receive a zero**.

Graduate students will complete a final paper in the form of a short (~5 page) research proposal. In that paper, the student will be required to review some literature in an area of interest, develop a research question based on the review, and propose an experiment, using electrophysiological methods (along with other methods if desired), to test that question. Note that writing *does* count in the evaluation of the paper: students are expected to be able to write clearly and in a manner stylistically appropriate for a scientific paper. Accurate documentation of sources is essential; **plagiarism in any form will result in a failing grade on the paper**. Graduate students will give a brief oral presentation of their research proposal in class (date indicated on the syllabus). The oral presentation (plus attendance at others' presentations) will count for 15% of the final paper portion of the grade.

Undergraduate students can obtain extra-credit in the class by turning in summaries of the graduate student presentations. Each day's summary will be worth an increase of 1% in the final course grade.

Plus/minus grading will NOT be used.

Course Schedule and Readings

January 19: Introduction

January 21: History and Sensory Potentials

(review: eReserves #87409) Munte, Thomas F., Urbach, Thomas P., Duzel, E., and Kutas, M. "Ch.7: Event-related brain potentials in the study of human cognition and neuropsychology" (read only pages 11-16 "Input Processes").

January 26: Physiology

(Luck text: eReserves #87403) Chapter 2: A Closer Look at ERPs and ERP Components

Suggested additional reading for those interested in neural sources of ERPs: (Luck text online) Chapter 14: ERP Localization

http://mitpress.mit.edu/sites/default/files/Ch_14_Localization.pdf

January 28: Technical Aspects of ERP Recording

(Luck text: eReserves #87403) Chapter 5: Basic principles of ERP Recording

February 2: Technical Aspects of ERP Recording, Part II

Suggested readings to supplement lecture notes: (Luck text: eReserves #87403) Chapter 6: Artifact Rejection and Correction and Chapter 8: Baseline Correction, Averaging, and Time-Frequency Analysis (*excluding pages 274-282*)

February 4: Measurement and Inference-drawing

(review: eReserves #87407) Rugg, Michael D. and Michael G.H. Coles. "Ch.2: The ERP and cognitive psychology: Conceptual issues".

For more detail, can also look at: (Luck text: eReserves #87403) Chapter 9: Quantifying ERP Amplitudes and Latencies

February 9: Movement and response generation

(review: eReserves #87422) Coles, M.G.H. (1989). Modern mind-brain reading: psychophysiology, physiology and cognition. *Psychophysiology*, 26, 251-269.

February 11: Movement and response generation, Part II**February 16: Error-related potentials**

(report: eReserves #87421) Nieuwenhuis, S., Ridderinkhof, R., Blom, J., Band, G.P.H., and Kok, A. (2001) Error-related brain potentials are differentially related to awareness of response errors: Evidence from an antisaccade task. *Psychophysiology*, 38:752-760.

February 18: Attention, Part I

(report: eReserves #87427) Hillyard, S. A., Hink, R. F., Schwent, V. L., and Picton, T. W. (1973). Electrical signs of selective attention in the human brain. *Science*, 182, 177-180.

(review: eReserves #87431) Luck, S. J., Woodman, G. E., and Vogel, E. K. (2000). Event-related potential studies of attention. *Trends in Cognitive Sciences*, 4, 432-440.

February 23: Attention, Part II

February 25: Mismatch Negativity

(review: eReserves #87406) Cheour, M., Leppanen, P., and Kraus, N. (2000). Mismatch negativity (MMN) as a tool for investigating auditory discrimination and sensory memory in infants and children. *Clinical Neurophysiology*, 111, 4-16.

March 1: Plasticity

(report: eReserves #87405) Neville, H. J., and Lawson, D. (1987). Attention to central and peripheral visual space in a movement detection task. III. Separate effects of auditory deprivation and acquisition of a visual language. *Brain Research*, 405, 284-294.

(report: eReserves #87414) Roder, B. Teder-Salejarvi, W., Sterr, A., Rosler, F, Hillyard, S.A., & Neville, H.J. (1999) Improved auditory spatial tuning in blind humans, *Nature*, 400, 162-166.

(report: eReserves #87415) Munte, T.F., Kohlmetz, C, Nager, W., Altenmueller, E. (2001) Superior auditory spatial tuning in conductors, *Nature*, 409 N6820:580.

March 3: Review**March 8: MIDTERM EXAM (in class)****March 10: Information Processing**

(review: eReserves #87423) Donchin, E. (1981). Surprise! Surprise? *Psychophysiology*, 18, 493-513.

(report: eReserves #87425) Kutas, M., McCarthy, G., and Donchin, E. (1977). Augmenting mental chronometry: the P300 as a measure of stimulus evaluation time. *Science*, 197, 792-795.

March 15: Information Processing, Part II**March 17: Memory, Part I**

(review: eReserves #87409) Munte, Thomas F., Urbach, Thomas P., Duzel, E., and Kutas, M. "Ch.7: Event-related brain potentials in the study of human cognition and neuropsychology" (read only pages 26-37 "Memory").

(report: eReserves #87417) Gonsalves and Paller, K.A. (2000) Neural events that underlie remembering something that never happened. *Nature Neuroscience*, 3(12): 1316-1321.

March 22 and 24: Spring Break**March 29: Memory, Part II**

Match 31: Memory, Part III

(report: on course website) Rosler, F., Heil, M., and Hennighausen, E. (1995). Distinct Cortical Activation Patterns during Long-Term Memory Retrieval of Verbal, Spatial, and Color Information. *Journal of Cognitive Neuroscience*, 7, 51-65.

April 5: NO CLASS

April 7: Language, Part I

(review: eReserves #87429) Federmeier, K. D., Kluender, R., and Kutas, M. "Ch.6: Aligning linguistic and brain views on language comprehension."

(report: eReserves #87428) Kutas, M. and Hillyard, S. A. (1980). Reading senseless sentences: brain potentials reflect semantic incongruity. *Science*, 207, 203-208.

April 12: Language, Part II

(report: eReserves #87412) Van Petten, C., Coulson, S., Rubin, S., Plante, E., and Parks, M. (1999). Time course of word identification and semantic integration in spoken language. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 25, 394-417.

April 14: Language, Part III

(report: eReserves #87426) van Turennout, M., Hagoort, P., and Brown, C. (1998). Brain activity during speaking: from syntax to phonology in 40 milliseconds. *Science*, 280, 572-574.

April 19: Graduate student paper presentations, Part I

April 21: Graduate student paper presentations, Part II

April 26: Graduate student paper presentations, Part III

April 28: Review

May 3: FINAL EXAM (in class)

Sunday, May 8: TAKE-HOME EXAMS and PAPERS DUE (emailed to me by 11:59 pm)