PSY592/461 Cognitive Electrophysiology

Spring 2012

Time: 12:00 pm – 1:15 pm Tuesdays and Thursdays
Classroom: Research Hall 202

Instructor of Record: **James Thompson**
2056 David King Hall
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Email: jthompsz@gmu.edu
(please remember to **always** use your gmu account)
Office Hours: 11.00am - 12.00pm Tuesdays.

Objectives:

This class will provide an introduction to the use of electroencephalography (EEG) and event-related potentials (ERPs) to study cognition. These measures of brain electrical activity allow us to index the timing and dynamics of neuronal functioning during cognitive activity with high precision. We will begin the semester with discussions of the issues and considerations involved in the recording of EEG/ERPs. We will then cover a number of commonly studied ERP and EEG components and how they can be used to study cognitive theory. Students will have the opportunity to record, analyze, and present data from a number of standard ERP and EEG paradigms.

Prerequisites.

Due to the nature of the material and the relevance to research, it is important that students have at least Introductory Psychology. Graduate students must have taken Cognitive Psychology (PSYC317 or its equivalent). Undergraduate students are *strongly* advised to familiarize themselves with the basics of cognitive psychology (see Supplementary Readings).

Required Readings:

Luck, S.J. (2005). *An Introduction to the Event-Related Potential Technique.* Cambridge, MA: MIT Press.

Additional weekly readings to be distributed via the course website.

Supplementary Readings:

Goldstein, B.E. (2007). *Cognitive Psychology: Connecting Mind, Research, and Everyday Experience. 2nd Edition.* New York: Wadsworth.

Format:

This class will be taught in a seminar format. You will be expected to have done the weekly readings and preparation before class. Weeks 1 to 6 will consist of a discussion of the fundamentals of ERP studies. In weeks 7 to 13, we will spend one half of the class discussing the background of different ERP components and their contribution to studies of cognition. The second half of each class will then consist of student presentations on these components.

Assessment:

Assessment will consist of class participation (20%), a lab project and class presentation (40%) and an essay paper (40%). These are all mandatory, and penalties will apply for late work unless you have a legitimate, documented excuse. If you are going to be late with an assignment, you must notify the instructor **prior** to its due date.

Class Participation (20%). A large proportion of this class will be dedicated to discussion the readings and issues that arise from them. It is essential that you keep up with the readings and contribute to class discussion every week.

Lab Project and Class Presentation (40%). During week 6 we will go into the EEG lab and record ERPs from a number of standard paradigms. It will then be your job to analyze the ERP data (using EEGLAB and ERPLAB) and present data from one of these paradigms, along with background information about the component(s) and paradigm, during the week in which we discuss your component(s). Instructions on how to use EEGLAB and ERPLAB will be provided in class.

Essay Paper (40%). The final paper (max 3000 words) will consist of an opinion paper arguing how a particular ERP component or set of components can be used to test a cognitive theory. You must choose an ERP component *different* from the one upon which you base your class presentation. You must draw on primary research literature as the basis of this paper.

Attendance Policy:

Although you will not be graded on attendance, this is a graduate level course and I expect to see you in class each week.

GMU Honor Code:

George Mason University has a code of Honor that each of you accepts by enrolling as a

student. You should read and become familiar with this code at http://mason.gmu.edu/%7Emontecin/plagiarism.htm. The expectation is that all of the work you do for this class will be the work of one individual. However, you are fully encouraged to discuss the readings and topics raised in this class with your fellow students.

Disabilities:

If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

Grades:

Total 100 points, letter grades as follows:

A: 90-100	B-: 77-79
A-: 87-89	C: 70-76
B+: 84-86	F: 0-69
B: 80-83	

Important Dates

Last day to drop without penalty January 31; Last day to drop February 24; Spring Break March 12-18.

Schedule of Classes

(Schedule is subject to change, changes announced in class or via email)

Week 1. What Are Event-Related Potentials?

Luck (2005) Chapter 1.

Week 2. The Design of ERP Experiments

Luck (2005) Chapter 2.

Week 3. Basics of ERP Recording

Luck (2005) Chapter 3.

Week 4. **Artifact Rejection & Filtering**

Luck (2005) Chapters 4 & 5

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Week 5. **Data Collection**

EEGLAB tutorial: http://sccn.ucsd.edu/wiki/EEGLAB_TUTORIAL_OUTLINE

ERPLAB tutorial: http://erpinfo.org/erplab/erplab-documentation/manual

Week 6. **Measurement & Analysis**

Luck (2005) Chapter 6.

Week 7. **Common ERP Components - Early Components**

Pratt, H. (2012) Sensory ERP Components. *The Oxford Handbook of Event-Related Components,* S.J. Luck & E. Kappenham (eds), Oxford: Oxford University Press, pp89-114.

Clark, V.P., Fan, S., Hillyard, S.A. (1995) Identification of Early Visual Evoked Potential Generators by Retinotopic and Topographic Analyses. *J Cog Neurosci, 2,*170-187.

Zang, W., Luck, S.J. (2009). Feature-based attention modulates feedforward visual processing. *Nature Neurosci,12,* 24-25. Supplementary Online Materials.

Week 8. **Common ERP Components - The Face-specific N170**

Bentin, S., Allison, T., Puce, A., Perez, E., McCarthy, G. (1996). Electrophysiological studies of face perception in humans. *J Cog Neurosci, 8,* 551-565.

Thierry, G., Martin, C.D., Downing, P., Pegna, A.J. (2007). Controlling for interstimulus perceptual variance abolishes N170 face selectivity. *Nature Neurosci, 10,* 505-511. Response.

Rossion, B., Gauthier, I., Goffaux, V., Tarr, M.J., Crommelinck, M. (2002). Expertise training with novel objects leads to left-lateralized facelike electrophysiological responses. *Psychological Science, 13,* 250-257.

Week 9. Common ERP Components - The Mismatch Negativity (MMN)

Naatanen, R., Kreegipuu, K. (2012) The Mismatch Negativity (MMN). *The Oxford Handbook of Event-Related Components,* S.J. Luck & E. Kappenham (eds), Oxford: Oxford University Press, pp 143-158.

Bekinschtein, T.A., Dehaene, S., Rohaut, B., Tadel, F., Cohen, L., Nacchane, L. (2009). Neural signatures of the conscious processing of auditory regularities. *Proc Nat Acad Sci. 106,* 1672-1677.

Week 10. Common ERP Components - The P300

Polich, J. (2007). Updating P300: An integrated theory of P3a and P3b. *Clinical Neurophysiology, 118*, 2128-2148.

Sellers, E.W., Krusienski, D.J., McFarland, D.J., Vaughan, T.M., Wolpaw, J.R. (2006). A P300 event-related potential brain-computer interface (BCI): the effects of matrix size and inter stimulus interval on performance. *Biological Psychology. 73,* 242-252.

Week 11. Common ERP Components - Readiness Potential(s).

Smulders, F.T.Y., Miller, J.O. (2012) The Lateralized Readiness Potential. *The Oxford Handbook of Event-Related Components,* S.J. Luck & E. Kappenham (eds), Oxford: Oxford University Press, pp 209-230.

Libet, B., Gleason, C.A., Wright, E.W., Pearl D.K. (1983). Time of conscious intention to act in relation to onset of cerebral activity (readiness potential). *Brain, 106,* 623-642.

Rigoni D., Kühn S., Sartori G., Brass M. (2011) Inducing disbelief in free will alters brain correlates of preconscious motor preparation: the brain minds whether we believe in free will or not. *Psychological Science. 22,* 613-618.

Week 12. The Electroencephalogram (EEG) and Cognition

Adrian, E.D., Matthews, B.H.C. (1934). The Berger rhythm: potential changes from the occipital lobes in man. *Brain*, *57,* 355-385.

Week 13. The Relationship between ERPs and EEG

Makeig S, Westerfield M, Jung TP, Enghoff S, Townsend J, Courchesne E, Sejnowski TJ. (2002). Dynamic brain sources of visual evoked responses. *Science. 295,* 690-4.

Shah AS, Bressler SL, Knuth KH, Ding M, Mehta AD, Ulbert I, Schroeder CE. (2004). Neural dynamics and the fundamental mechanisms of event-related brain potentials. *Cereb Cortex. 14,* 476-83.

Mazaheri A, Jensen O. (2006). Posterior alpha activity is not phase-reset by visual stimuli. *Proc Natl Acad Sci U S A. 103,* 2948-52.

Week 14. Source Modeling

Luck (2005) Chapter 7.

Michel CM, Murray MM, Lantz G, Gonzalez S, Spinelli L, Grave de Peralta R. (2004). EEG source imaging. *Clin Neurophysiol. 115,* 2195-222.