

PSYC 401A/501A, *Principles of Psychophysiology*
Spring, 2008, Mondays, 3⁰⁰-5⁵⁰ P.M.
Room 304 Psychology

Instructor

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Course Description

This course will provide an overview of the principles, theory, and applications of psychophysiological assessment. The course has two main goals: a) to provide an introduction to theory and research in major areas of human psychophysiology with a particular emphasis on psychophysiological correlates and physiological substrates of cognition, affect, and psychopathology; and b) to provide an introduction to laboratory techniques and methodological principles in human psychophysiology. The latter goal will be met through didactic as well as experiential means. For this reason, the course is designed to be taken (but not required to be taken) concurrently with PSYC 401B/501B, *Psychophysiology Laboratory*.

Course Structure

The course will involve a combination of lecture, discussion, and demonstrations. I will bring in samples of physiological signals for us to examine, and if you have psychophysiological data you are interested in examining, please let me know. There is no explicit participation requirement, but you will get more out of the course if you ask questions as they arise. We will be covering technical material, and you should feel quite free to interject your questions as they arise. Each class period, you will hand in a 3x5 card with your name and a question or comment that arose for you in the context of the lecture. This feedback mechanism, in addition to serving to keep attendance, will provide me with feedback in terms of how the material is being understood (or not understood!).

Readings

Readings will be taken from two textbooks, which are available at the Student Union bookstore. One is a rather expensive but comprehensive handbook that will serve as a great reference for those of you who have continuing interest in the field. The other book is out of print, but is available as a nominally-priced FastCopy packet, also at the Student Union Bookstore. Readings will also be taken from other sources, which are available as pdf files for downloading.

The main single source of readings for the course is:

Cacioppo, J.T., Tassinary, L.G. , & Berntson, G.G (2007). *Handbook of Psychophysiology* (3rd edition). Cambridge, UK: Cambridge University Press.

The assigned readings from this text are listed below under the schedule of topics and readings. The other textbook is a programmed-learning text in basic electricity that is available as the FastCopy packet:

Ryan, C.W. (1986). *Basic Electricity: A Self-Teaching Guide* (2nd Edition). New York: John Wiley and Sons.

You should complete Chapters 1-5 of this programmed text. There will be a pass/fail test covering this material to be administered at the beginning of class 18 February, 2006. You must score above 80% to pass; you may retake the test should you need to do so.

Evaluation

Students in 401A will be evaluated separately from those in 501A. Your grade will be determined by the electricity test (passing gives you 20% of the total points; failing = no points), attendance (10%), your grade on a research proposal paper (40%, details to follow, due 5 May, 2006, 3 pm), and your performance on a take-home final (30%, due 12 May, 2006, noon). The take-home final will be given to students on the last day of class and be due one week later during the final exam time. Late papers or exams will receive a 10% reduction in possible points for each day such papers or exams are late.

Your letter grade will be determined in the following way: The highest total score (based on the electricity test, attendance, the paper, and the take home final) attained by any student in the class (for 401A and for 501A, considered separately) will become the reference score for grading. There will therefore be one reference score for 401A, and one for 501A. The student(s) with this highest total score will receive a grade of 100%. All other students will receive a percentage grade based upon this highest score, and the following scale will be applied:

90% & above	=	A
80%-89%	=	B
70%-79%	=	C
60%-69%	=	D
Below 60%	=	Fail

Incompletes

Short of major medical illness or global catastrophe, there is virtually no reason I will award an incomplete grade for this course. Incompletes merely move a crisis from one time to another.

Academic Integrity

Cheating and plagiarism on any exam or the paper will result in a failing grade for the course, a notice will be sent to the Dean's office, and expulsion from the University of Arizona can result. Plagiarism is defined as any case where one person tries to take credit for the ideas or work of another, including fellow students, or published authors.

Tentative Schedule of Topics & Readings

[Link to Reading List for Download of pdfs](#)

[Link to Podcasts and Lecture Slides](#)

21 January: Martin Luther King Holiday -- University Closed

28 January: *Overviews*

Cacioppo, J.T., Tassinari, L.G. & Berntson, G.G. (2007). Psychophysiological science: Interdisciplinary approaches to classic questions about the mind. In J.T. Cacioppo, L.G. Tassinari, & G.G. Berntson (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 1-16). Cambridge, UK: Cambridge University Press.

Miller, G.A., (1996). How we think about cognition, emotion, and biology in psychopathology. *Psychophysiology*, 33, 615-628.

4 February: *Foundations: Basic Electricity, Neuroanatomy and Neurophysiology*

Ryan, C.W. (1986). *Basic Electricity: A Self-Teaching Guide* (2nd Edition). New York: John Wiley and Sons. Chapters 1,2,3,4,5.

Matsumoto, R., Walker, B.B., Walker, J.M., & Hughes, H. (1990). Fundamentals of neuroscience. In J.T. Cacioppo & L.G. Tassinari (Eds.), *Principles of psychophysiology: Physical, social, and inferential elements* (pp.58-112), New York: Cambridge University Press. (NOTE THAT THIS IS NOT THE HANDBOOK OF PSYCHOPHYSIOLOGY)

11 February: *Electrodermal Activity: Basics and Application to Polygraph Testing*

- Dawson, M.E., Schell, A.M., & Fillion, D.L. (2007). The electrodermal system. In J.T. Cacioppo, L.G. Tassinari, & G.G. Berntson (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 159-181). Cambridge, UK: Cambridge University Press.
- Lykken, D.T., Rose, B., Luther, B., & Maley, M. (1966). Correcting psychophysiological measures for individual differences in range. *Psychophysiological Bulletin*, 66, 481-484.
- Lykken, D.T., & Venables, P.H. (1971). Direct measurement of skin conductance: A proposal for standardization. *Psychophysiology*, 8, 656-672.
- Lykken, D.T. (1959). The GSR in the detection of guilt. *Journal of Applied Psychology*, 43, 385-388.
- Norris, C.J., Larsen, J.T., & Cacioppo, J.T. (2007). Neuroticism is associated with larger and more prolonged electrodermal responses to emotionally evocative pictures *Psychophysiology*, 44, 823-826.

18 February: *BASIC ELECTRICITY TEST ADMINISTERED AT START OF CLASS*

Catch Up Class: Electrodermal Activity continued, Possibly The Oculomotor System

- Iacono, W.G. (2007). Detection of Deception.. In J.T. Cacioppo, L.G. Tassinari, & G.G. Berntson (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 688-703). Cambridge, UK: Cambridge University Press.
- Stern, J.A., Walrath, L.C., & Goldstein, R. (1984). The endogenous eyeblink. *Psychophysiology*, 21, 22-33.

25 February: *Cardiovascular Psychophysiology*

- Berntson, G.G., Quigley, K.S., & Lozano, D. (2007). *Cardiovascular Psychophysiology*. In J.T. Cacioppo, L.G. Tassinari, & G.G. Berntson, (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 182-210). Cambridge, UK: Cambridge University Press.
- Berntson, G.G., Cacioppo, J.T., & Quigley, K.S. (1993). Respiratory sinus arrhythmia: Autonomic origins, physiological mechanisms, and psychophysiological implications. *Psychophysiology*, 30, 183-196.
- Shalev, A. Y., Sahar, T., Freedman, S., Peri, T., Glick, N., Brandes, D., Orr, S. P., & Pitman, R. K. (1998). A prospective study of heart rate response following trauma and the subsequent development of posttraumatic stress disorder. *Archives of General Psychiatry*, 55, 553-559.
- Porges, S.W. (2007). The polyvagal perspective. *Biological Psychology*, 74, 116-143.
- O' Connor, M., Allen, J.J.B., & Kaszniak, A.W. (2005). Emotional disclosure for whom? A study of vagal tone in bereavement. *Biological Psychology*, 68, 135-146.

3 March: *The Skeletomotor System*

- Tassinari, L.G., Cacioppo, J.T., & Vanman, E.J. (2007). The skeletomotor system: Surface electromyography. The electrodermal system. In J.T. Cacioppo, L.G. Tassinari, & G.G. Berntson, (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 267-299). Cambridge, UK: Cambridge University Press.
- Dimberg, U., Thunberg, M., & Elmehed, K. (2000). Unconscious facial reactions to emotional facial expressions. *Psychological Science*, 11, 86-89.
- Bradley, M.M., & Lang, P.J. (2007). Emotion and motivation. In J.T. Cacioppo, L.G. Tassinari, & G.G. Berntson (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 581-607). Cambridge, UK: Cambridge University Press.
- Ruiz-Padiala, E., Sollers, J.J., Vila, J., & Thayer, J.F. (2003). The rhythm of the heart in the blink of an eye: Emotion-modulated startle magnitude covaries with heart rate variability. *Psychophysiology*, 40, 306-313.

10 March: *The Electroencephalogram, Basics in Recording EEG, Frequency Domain Analysis and its Applications I -- Mood Disorders & Emotions*

- Pizzagalli, D.A. (2007). Electroencephalography and high-density electrophysiological source localization. In J.T. Cacioppo, L.G. Tassinary, & G.G. Berntson, (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 56-84). Cambridge, UK: Cambridge University Press.
- Coan, J.A. & Allen, J.J.B.. (2004). Frontal EEG asymmetry as a moderator and mediator of emotion. *Biological Psychology*, 67, 7-50.
- Porges, S.W., Bohrer, R.E., Cheung, M.N., Drasgow, F., McCabe, P.M., & Keren, G. (1980). New time-series statistic for detecting rhythmic co-occurrence in the frequency domain: The weighted coherence and its application to psychophysiological research. *Psychological Bulletin*, 88:580-587.
- Peterson, C.K., Shackman, A.J., & Harmon-Jones, E. (2008). The role of asymmetrical frontal cortical activity in aggression. *Psychophysiology*, 45 (2008), 86–92.

17 March: *Spring Recess!!!!!!!!!!!!*

24 March: *Frequency Domain Analysis and its Applications II -- Oscillatory and "40 Hertz" Phenomena*

- Spydell, J.D. & Sheer, D.E. (1982). Effect of problem solving on tight and left hemisphere 40 Hertz activity. *Psychophysiology*, 19, 420-425.
- Singer, W. (1993). Synchronization of cortical activity and its putative role in information processing and learning. *Annual Review of Physiology*, 55, 349-374.
- Sauseng, P., Hoppe, J., Klimesch, W., Gerloff, C. & Hummel, F.C. (2007). Dissociation of sustained attention from central executive functions: local activity and interregional connectivity in the theta range. *European Journal of Neuroscience*, 25, 587-593.

31 March: *The Polysomnograph and Issues in Sleep Research*

- Pivik, R.T. (2007). Sleep and dreaming. In J.T. Cacioppo, L.G. Tassinary, & G.G. Berntson (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 633-662). Cambridge, UK: Cambridge University Press.
- Carskadon, M.A., & Dement, W.C. (2005). Normal Human Sleep: An Overview. In M.H. Kryger, T. Roth, & W.C. Dement (Eds.), *Principles and Practice of Sleep Medicine*, 4th edition, (pp 13-23). Philadelphia: W.B. Saunders.
- Carskadon, M.A., & Rechtschaffen, A. (2005). Monitoring and staging human sleep. In M.H. Kryger, T. Roth, & W.C. Dement (Eds.), *Principles and Practice of Sleep Medicine*, 4th edition, (pp 1359-1377). Philadelphia: W.B. Saunders.

7 April: *The Event-Related Potential: Basics and Applications (CNV, early components & P300)*

- Fabiani, M., Gratton, G., and Federmeier, K.D. (2007). Event-related brain potentials: Methods, theory, and applications. In J.T. Cacioppo, L.G. Tassinary, & G.G. Berntson (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 85-119). Cambridge, UK: Cambridge University Press.
- Donchin, E. (1981). Surprise!...Surprise? *Psychophysiology*, 18, 493-513.
- Johnson, R.J. (1986). A triarchic model of P300 amplitude. *Psychophysiology*, 23, 367-384.
- Polich, J.(2007). Updating P300: An integrative theory of P3a and P3b. *Clinical Neurophysiology*, 118, 2128–2148

14 April: *More Applications of the ERP: P300, N400, ERN*

- Kutas, M. & Hillyard, S.A. (1980). Event-related potentials to semantically inappropriate and surprisingly large words. *Biological Psychology*, 11, 99-116.
- Gehring, W. J., Goss, B., Coles, M. G. H., Meyer, D. E., & Donchin, E. (1993). A neural system for error detection and compensation. *Psychological Science*, 4, 385-390.
- Trujillo, L. & Allen, J.J.B. (2007). Theta EEG dynamics of the error-related negativity. *Clinical Neurophysiology*. 118, 645-668.

21 April: Functional Neuroimaging: PET and fMRI

- Wagner, T.D., Hernandez, L., Jonides, J., & Lindquist, M. (2007). Elements of functional neuroimaging. In J.T. Cacioppo, L.G. Tassinary, & G.G. Berntson (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 19-55). Cambridge, UK: Cambridge University Press.
- Amaro, E., & Barker, G.J. (2006). Study design in fMRI: Basic principles, *Brain and Cognition*, 60, 220-232.
- Ryan, T.L., & Alexander, G.E. (2007). Neuroimaging: Overview of methods and applications. In L. Luecken and L. Gallo, Eds., *Handbook of Physiological Research Methods in Health Psychology*. Amsterdam: Elsevier.

28 April: Advanced Signal Processing I

- Gratton, G., Coles, M.G.H., & Donchin, E. (1983). A new method for off-line removal of ocular artifact. *Electroencephalography and Clinical Neurophysiology*, 55, 468-484.
- Cook, E.W., & Miller, G.A. (1992). Digital Filtering: Background and tutorial for psychophysicists. *Psychophysiology*, 3, 350-367.
- Cohen, M.X. (in press). Assessing transient cross-frequency coupling in EEG data. *Journal of Neuroscience Methods*.
- Canolty, R.T., Edwards, E., Dalal, S.S., Soltani, M., Nagarajan, S.S., Kirsch, H.E., Berger, M.S., Barbara, N.M., & Knight, R.T. (2006). High gamma power is phase-locked to theta oscillations in human neocortex. *Science*, 313, 1626-1628. (see also the supplemental material if interested)

5 May: (PAPER DUE 3 PM) Advanced Signal Processing II

- Scherg, M. (1990). Fundamentals of Dipole Source Potential Analysis. In F. Grandori, F. Hoke & Romani, G.L. (Eds.), *Auditory Evoked Magnetic Fields and Electric Potentials. Advances in Audiology*, 6, (pp. 40-69). Switzerland: Basel, Karger.
- Urbach TP, Kutas M. (2002). The intractability of scaling scalp distributions to infer neuroelectric sources. *Psychophysiology*. 39, 791-808.
- Makeig, S., Debener, S., Onton, J., & Delorme, A. (2004). Mining event-related brain dynamics. *Trends in Cognitive Sciences*, 8, 204-210.
- Debener, S., Ullsperger, M., Siegel, M., Fiehler, K., von Cramon, Y., & Engel, A.K. (2005). Trial-by-trial coupling of concurrent EEG and fMRI identifies the dynamics of performance monitoring. *Journal of Neuroscience*, 25, 11730 –11737.

12 May: FINAL EXAM DUE NOON

Other recommended sources for the seriously inclined:

- Lyons, R. G. (1996). *Understanding Digital Signal Processing*. Boston, MA: Addison-Wesley Longman Publishing. (Note, there is also a 2004 edition)
- Rosenbaum, D.A. (2007). *Matlab for Behavioral Scientists*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Ingle, V.K., & Proakis, J.G. (2007). *Digital Signal Processing Using MATLAB* (2nd Ed.). Toronto, CA: Thompson Publishing.
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PSYC 401B/501B
Psychophysiology Laboratory
Spring, 2008

Supervising Instructor: John JB Allen (jallen@u.arizona.edu)
Laboratory Teaching Assistant: Jim Cavanagh (jimcav@email.arizona.edu)

Laboratory Location

Laboratory sessions will take place in the *Psychophysiology Laboratory*, room 409 Psychology. This is a research laboratory, but times will be made available for class members to conduct experiments, under the supervision of the teaching assistant, in the laboratory.

Meeting Times and Important Dates

	Lab Mtg	Report Due
Feb 14	4:00-7:00	Skin Conductance (2/28)
Feb 28	4:00-7:00	Cardiovascular (3/13)
Mar 27	4:00-7:00	EEG (4/10)
Apr 17	4:00-7:00	ERP (5/1)

Description

Psychophysiology Laboratory must be taken concurrently with PSYC 401A/501A, *Psychophysiology Seminar*. The objective of the laboratory is to provide a pragmatic "hands-on" experience in psychophysiological recording and analysis. The laboratory will involve learning the many facets of psychophysiological signal acquisition and analysis. Four experiments will be conducted, each involving different response systems, offering you the opportunity to gain experience acquiring, analyzing, and interpreting autonomic and electrocortical psychophysiological measures.

Evaluation

For each experiment, students will be required to write an APA-style method and results section. These four papers will form the basis of your grade for the lab.

Experiments to be conducted

- Experiment 1: Skin-conductance Guilty Knowledge Technique
- Experiment 2: Electrocardiographic (EKG) responses to stress
- Experiment 3: Frontal electroencephalographic (EEG) spectral changes
- Experiment 4: Event-related brain potentials (ERPs)

Readings:

Readings will be provided as required in addition to the following, which should be read in advance of the first laboratory session:

[Greene, W.A., Turetsky, B., & Kohler, C. \(2000\).](#) In J.T. Cacioppo, L.G. Tassinary, & G.G. Berntson (Eds.). *Handbook of Psychophysiology* (2nd edition; pp. 951-977). Cambridge, UK: Cambridge University Press. (NOTE THIS IS THE PREVIOUS EDITION OF THE TEXT)