

PSY 401A/501A, *Principles of Psychophysiology*
Spring, 2016, Mondays, 2⁰⁰-4⁵⁰ P.M.
Room 341 Education

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 three main goals:

- a) to provide an introduction to major psychophysiological measures, covering their physiological bases, proper recording and signal processing procedures, and appropriate interpretation;
- b) to provide an introduction to theory and research in major areas of human psychophysiology with specific applications to the study of cognition, affect, and psychopathology; and,
- c) 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 PSY 401B/501B, *Psychophysiology Laboratory*.

Course Webpage

Please visit the [course webpage](http://jallen.faculty.arizona.edu/courses) (jallen.faculty.arizona.edu, courses) for links to:

- Copies of lecture slides
- The reading list with links to download pdfs and access the book electronically
- A copy of the paper requirements and guidelines
- Grade information

Any changes to the course content or schedule will be reflected on the course webpage.

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 when they occur to you. 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. The *Handbook of Psychophysiology* 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. This book is also an electronic book (follow link on the class webpage to the [reading list for downloads](#)). The other book is out of print, but is available as a pdf, available for download at that same link. Readings will also be taken from other sources, which are available as pdf files for downloading (from that same link).

The main single source of readings for the course is:

Cacioppo, J.T., Tassinari, 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 for download from the link above:

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 15 February, 2016. 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 on the course webpage, due 2 May, 2016, 2 pm, via email), and your performance on a take-home final (30%, due 9 May, 2016, noon, hard copy in my mailbox). 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.

D2L

We won't use D2L. I don't like it much.

Absences

If you need to miss class, you will lose attendance credit for that day. You can get notes and a video podcast of that day's lecture and activities from the course website.

Students with Special Needs

If you anticipate barriers related to the format or requirements of this course, please meet with me so that we can discuss ways to ensure your full participation in the course. If you determine that disability-related accommodations are necessary, please register with Disability Resources (621-3268; drc.arizona.edu) and notify me of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations.

Academic Integrity

Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog: <http://deanofstudents.arizona.edu/codeofacademicintegrity> Cheating or plagiarism on the 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.

Use of Electronic Gizmos

Computers or tablets may be used for note-taking and downloading lecture notes. As such they can be useful, but alas, they can also be a potent distraction. Please do not use them for other purposes (e.g. social media, e-chatting, shopping, catching up on email) or you will be asked to leave the classroom. Please turn your phones to silent mode and do not use them during class or you will be asked to leave the classroom.

Tentative Schedule of Topics & Readings
Links for all readings available from course website

18 January: Martin Luther King Holiday -- University Closed

25 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.

1 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)

8 February: Electrodermal Activity: Basics and Application to Polygraph Testing

- Dawson, M.E., Schell, A.M., & Filion, 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.
- Lopez, R., Poy, R., Patrick, C.J., & Molto, J. (2013). Deficient fear conditioning and self-reported psychopathy: The role of fearless dominance. *Psychophysiology* 50, 210-218.

15 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.
- Allen, J.J.B. (2013). Never Trust the Polygraph. *The Writ*, the official publication of the Pima County Bar Association.
- Stern, J.A., Walrath, L.C., & Goldstein, R. (1984). The endogenous eyeblink. *Psychophysiology*, 21, 22-33.

22 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.
- Porges, S.W. (2007). The polyvagal perspective. *Biological Psychology*, 74, 116-143.
- Allen, J.J.B., Chambers, A.S., & Towers, D.N. (2007). The many metrics of cardiac chronotropy: A pragmatic primer and a brief comparison of metrics. *Biological Psychology*, 74, 243-262.
- Kogan, A.V., Allen, J.J.B., & Weihs, K.L. (2012). Cardiac vagal control as a prospective predictor of anxiety in women diagnosed with breast cancer. *Biological Psychology*, 90, 105-111

29 February: *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.
- Ray, R.D., McRae, K., Ochsner, K.N., & Gross, J.J. (2010). Cognitive reappraisal of negative affect: Converging evidence from EMG and self-report. *Emotion*, 10(4), 587-592.
- Dimberg, U., & Thunberg, M. (2012). Empathy, emotional contagion, and rapid facial reactions to angry and happy facial expressions. *PsyCh Journal*, 1, 118-127.

7 March: *Psychoneuroimmunology (readings subject to change)*

- Kaltsas, G.A., & Chrousos, G.P. (2007). The neuroendocrinology of stress. In J.T. Cacioppo, L.G. Tassinari, & G.G. Berntson, (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 303-318). Cambridge, UK: Cambridge University Press.
- Nicolson, N.A. (2008). Measurement of cortisol. In L.J. Luecken and L.C. Gallo (Eds.), *Handbook of Physiological Research Methods in Health Psychology*. Los Angeles: Sage Publications.
- Andtzer, R., O'Connor, J.C., Freund, G.G., Johnson, R.W., & Kelley, K.W. (2008). From inflammation to sickness and depression: when the immune system subjugates the brain. *Nature Reviews Neuroscience*, 9, 46-57.

14 March: *Spring Recess!!!!!!!!!!!!*

21 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. Tassinari, & G.G. Berntson, (Eds.). *Handbook of Psychophysiology* (3rd edition; pp. 56-84). Cambridge, UK: Cambridge University Press.
- Allen, J.J.B., Coan, J.A., & Nazarian, M. (2004) Issues and assumptions on the road from raw signals to metrics of frontal EEG asymmetry in emotion. *Biological Psychology*, 67,183-218.
- Allen, J.J.B., & Reznik, S.J. (2015). Frontal asymmetry as a promising marker of depression vulnerability: Summary and methodological consideration. *Current Opinion in Psychology*, 4, 93-97. doi:10.1016/j.copsyc.2014.12.017
- Harmon-Jones, E., Gable, P.A., & Peterson, C.K. (2010). The role of asymmetric frontal cortical activity in emotion-related phenomena: A review and update. *Biological Psychology*, 84, 451-462.
- Peterson, C.K., Shackman, A.J., & Harmon-Jones, E. (2008). The role of asymmetrical frontal cortical activity in aggression. *Psychophysiology*, 45 (2008), 86-92.

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

- Coan, J.A. & Allen, J.J.B.. (2004). Frontal EEG asymmetry as a moderator and mediator of emotion. *Biological Psychology*, 67, 7-50.
- 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.
- Jensen, O., Bonnefond, M., & VanRullen, R. (2012). An oscillatory mechanism for prioritizing salient unattended stimuli. *Trends in Cognitive Sciences*, 16, 200-206.

4 April: (PAPER PROSPECTUS DUE)

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. Tassinari, & 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.

11 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.
- Kutas, M. and Federmeier, K. D. (2011). Thirty years and counting: Finding meaning in the N400 component of the event-related brain potential (ERP). *Annual Review of Psychology*, 62, 621-647.
- 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.
- Hajcak, G. (2012). What we've learned from mistakes: Insights from error-related brain activity. *Current Directions in Psychological Science*, 21, 101-106.
- Trujillo, L. & Allen, J.J.B. (2007). Theta EEG dynamics of the error-related negativity. *Clinical Neurophysiology*, 118, 645-668.
- Proudfit, G.H. (2015). The reward positivity: From basic research on reward to a biomarker for depression. *Psychophysiology*, 52, 449-459.

18 April: Functional Neuroimaging: PET and fMRI (Readings subject to change)

- 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.
- Coan, J.A., Schaefer, J.S., & Davidson, R.J. (2006). Lending a hand: Social regulation of the neural response to threat. *Psychological Science*, 17, 1032-1039.
- Farah, M. J., & Hook, C.J. (2013). The seductive allure of "Seductive Allure." *Perspectives on Psychological Science* 8(1), 88-90.

25 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 psychophysicologists. *Psychophysiology*, 3, 350-367.
- Cohen, M.X. (2011). It's about time. *Frontiers in Human Neuroscience*, 5, doi: 10.3389/fnhum.2011.00002.
- Cavanagh, J.F., Cohen, M.X., & Allen, J.J.B. (2009). Prelude to and resolution of an error: EEG phase coherence reveals cognitive control dynamics during action monitoring. *Journal of Neuroscience*, 29, 98-105.
- Mathewson, K.E., Lleras, A., Beck, D.M., Fabiani, M., Ro, T., & Gratton, G. (2011). Pulsed out of awareness: EEG alpha oscillations represent a pulsed-inhibition of ongoing cortical processing. *Frontiers in Perception Science*, 2(99). doi 10.3389/fpsyg.2011.00099
- Muthukumaraswamy, S.D. (2013). High-frequency brain activity and muscle artifacts in MEG/EEG: a review and recommendations. *Frontiers in Human Neuroscience*, 7(138), <http://dx.doi.org/10.3389/fnhum.2013.00138>

2 May: (PAPER DUE 2 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.
- Miller, G.A., & Chapman, J.P. (2001). Misunderstanding analysis of covariance. *Journal of Abnormal Psychology*, 110, 40-48.
- Chaumon, M., Bishop, D.V.M., & Busch, N.A. (2015). A practical guide to the selection of independent components of the electroencephalogram for artifact correction. *Journal of Neuroscience Methods*, 250, 47-63.

9 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.

PSY 401B/501B
Psychophysiology Laboratory
Spring, 2016

Supervising Instructor: John JB Allen (John.JB.Allen@Arizona.edu)
Laboratory Teaching Assistant: Lauritz Dieckman (lauritzd@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
Jan 26 4:00-5:00	Lab Introduction & Tour
Feb 2 4:00-7:00	Skin Conductance (Feb 16)
Feb 23 4:00-7:00	Cardiovascular (Mar 8)
Mar 22 4:00-7:00	EEG (Apr 5)
Apr 12 4:00-7:00	ERP (Apr 26)

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 (available from [reading list for downloads](#) on class website):

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