

**PSY 720**  
**SYSTEMS AND COGNITIVE NEUROSCIENCE**

**PREREQUISITES:** Consent of instructor. Prior coursework in Cognitive Psychology and/or Physiological Psychology is recommended but not required.

**OPTIONAL RECOMMENDED TEXT:** Kandel, E. R., Schwartz, J. H., & Jessell, T. M. (2000). *Principles of Neural Science*. McGraw Hill. ISBN: 0071120009 / 978-0071120005

**(1) COURSE DESCRIPTION AND OBJECTIVES**

**LEARNING GOALS:**

The primary goal of this course is for students to understand behavior and brain function at the systems and cognitive neuroscience levels of analysis, which includes learning about research on both animals and humans. This includes relating behavior to physiological measurements of small numbers of neurons and measurements of larger-scale brain activity, and neurocomputational modeling of behavior and neurophysiology. The course will examine what has been learned using systems and cognitive neuroscience approaches about various forms of perception, cognition, action, and social behavior. The emphasis will be on 1) learning about specific areas that have shown great amounts of progress and/or great amounts of theoretical debate and 2) acquiring scholarly abilities to deeply understand specific areas of research. Thus, rather than just obtaining a general knowledge of Neuroscience, this course should also enable the student to independently learn about areas not covered in the course.

**CLASS FORMAT AND RECOMMENDATIONS:**

The class will be primarily discussion-based. Readings will be assigned mostly from peer-reviewed research articles and review articles. Students at the graduate level should understand that while every effort is made by the instructor to promote learning, how much is learned or taken from a course depends on how much time and effort a student puts into it. It is recommended that students do their part to enhance learning – read critically before class and contribute positively to discussions.

**WEBCAMPUS:**

This course uses WebCampus for a number of useful functions such as posting and updating the syllabus, slides, and readings. You can access WebCampus at <https://webcampus.unlv.edu/>.

**(2) COURSE REQUIREMENTS AND EVALUATION**

**PRESENTATION:**

To promote a deep understanding of systems and cognitive neuroscience and to enhance independent research and teaching skills, each student will lead class once during the semester. This will entail reading the assigned papers in addition to at least 5 additional primary research articles directly relevant to the week's topic, preparing and delivering a lecture on this topic, and leading discussion with the help of the instructor. At 10:00am on the Tuesday a week before the lecture, an email is due with a Word document containing the reference list in APA format <http://www.apastyle.org/> of the 5+ additional papers and an outline of the lecture showing where the 5+ papers will contribute to the lecture. At 10:00am on the Friday before the lecture, an email to the instructor is due containing a complete Powerpoint slide show (complete draft version is ok) to be delivered to the class. The presentation will be graded on the extent of the research conducted, clear and thoughtful presentation of the ideas and findings, and effort in stimulating discussion. It is particularly important to take the

time to truly understand each of the papers used in the presentation and to make sure that the additional papers are relevant and informative to the ideas discussed in the presentation. This means understanding the rationale, methods, results, and implications of the study, especially in relation to the main ideas of the presentation topic, and sometimes discarding papers from the list that in the end do not end up being that relevant. A general goal should be to make a presentation that focuses most on describing the big ideas, the nature of the evidence for these ideas, and stimulating discussion on these ideas. Extensive listing of research findings or excessive technical details about particular studies should be avoided. For general slide presentation tips, see [http://www.cnsmeeting.org/?page=slide\\_guidelines](http://www.cnsmeeting.org/?page=slide_guidelines). The presentation is worth **35 points**.

### **PAPER:**

Students are to write a double-spaced 10-page argument paper (i.e., the paper must use empirical evidence to promote a particular conclusion or to evaluate one or more particular theoretical perspectives on a topic) in APA format using at least 10 primary research articles (in addition to any review papers and papers that were assigned for one of the weekly topics). The paper will be graded on the extent of the research conducted, clear descriptions of the ideas and findings, as well as general quality of writing and clarity of ideas (see Presentation guidelines above for guidance on choosing and understanding papers relevant to the topic). Papers must offer critical evaluation of the studies being described (e.g., methodological problems, problems with interpretation of the data, conflicts with other research described) and propose new experiments that can further test and support (or refute) the ideas being discussed. A complete draft of the paper is due on **April 28, 2014 at 10:00 am**. After receiving instructor feedback, the final paper is due on **May 12, 2014 at 10:00 am**. **Notes:** The topic CAN NOT be the same as the student's presentation. The topic CAN be a topic that is not covered in class. The student CAN write on a topic related to his/her own research, but the paper must go beyond what has been written already for the thesis or dissertation (including new papers being cited and new theoretical issues being addressed), as verified by the student's primary mentor. In addition to not plagiarizing yourself, **do not plagiarize others (see below under Academic Misconduct)**. The paper is worth **35 points**.

### **PARTICIPATION:**

Because graduate courses depend on active involvement in class by all present, students will receive credit for their participation. This is worth a total of **30 points**. These points are earned by attending class, participating in discussion, and submitting to the instructor and presenter (if a student is presenting) one critical question about each of the assigned readings each week by 8am the day of class (except the week of the student's presentation) and being actively involved in the discussion of the readings. Points will be deducted for questions turned in late, because the presenter should have a chance to look them over before class.

### **(3) WEEKLY SCHEDULE & READINGS (CHECK WEBCAMPUS FOR UPDATES)**

#### **Week 1 (1/21): Methods of Systems Neuroscience**

- Optional: Buszáki, G., *Rhythms of the brain* (pp. 80-110). New York: Oxford University Press.
- Hubel, D. H., & Wiesel, T. N. (1998). Early exploration of the visual cortex. *Neuron*, 20, 401-412.
- Buzsáki, G., Logothetis, N., & Singer, W. (2013). Scaling brain size, keeping timing: Evolutionary preservation of brain rhythms. *Neuron*, 80, 751-764. doi: 10.1016/j.neuron.2013.10.002
- Einevoll, G. T., Kayser, C., Logothetis, N. K., & Panzeri, S. (2013). Modelling and analysis of local field potentials for studying the function of cortical circuits. *Nature Reviews Neuroscience*, 14, 770-785. doi: 10.1038/nrn3599
- Lopes da Silva, F. (2013). EEG and MEG: Relevance to Neuroscience. *Neuron*, 80, 1112-1128. doi: 10.1016/j.neuron.2013.10.017

## **Week 2 (1/28): “The explore-exploit dilemma in human reinforcement learning” by Robert Wilson**

### **Week 3 (2/4): Methods of Cognitive Neuroscience**

- Posner, M. I., & DiGirolamo, G. J. (2000). Cognitive neuroscience: Origins and promise. *Psychological Bulletin*, *126*, 873-889.
- Walsh, V., & Cowey, A. (2000). Transcranial magnetic stimulation and cognitive neuroscience. *Nature Reviews Neuroscience*, *1*, 73-79.
- Logothetis, N. K. (2008). What we can do and what we cannot do with fMRI. *Nature*, *453*, 869-878.
- van den Heuvel, M. P., & Sporns, O. (2013). Network hubs in the human brain. *Trends in Cognitive Sciences*, *17*, 683-696. doi: 10.1016/j.tics.2013.09.012

### **Week 4 (2/11): What is the cortical code? Firing rate of neurons.**

- deCharms, R. C., & Zador, A. (2000). Neural representation and the cortical code. *Annual Review of Neuroscience*, *23*, 613-647.
- Nienborg, H., Cohen, M. R., & Cumming, B. G. (2012). Decision-related activity in sensory neurons: Correlations among neurons and with behavior. *Annual Review of Neuroscience*, *35*, 463-483. doi: 10.1146/annurev-neuro-062111-150403
- Barth, A. L., & Poulet, J. F. (2012). Experimental evidence for sparse firing in the neocortex. *Trends in Neurosciences*, *35*, 345-355. doi: 10.1016/j.tins.2012.03.008
- Suthana, N., & Fried, I. (2012). Percepts to recollections: Insights from single neuron recordings in the human brain. *Trends in Cognitive Sciences*, *16*, 427-436. doi: 10.1016/j.tics.2012.06.006

### **Week 5 (2/18): What is the cortical code? Temporal patterns of activity.**

- Ainsworth, M., Lee, S., Cunningham, M. O., Traub, R. D., Kopell, N. J., & Whittington, M. A. (2012). Rates and rhythms: A synergistic view of frequency and temporal coding in neuronal networks. *Neuron*, *75*, 572-583. doi: 10.1016/j.neuron.2012.08.004
- Thut, G., Miniussi, C., & Gross, J. (2012). The functional importance of rhythmic activity in the brain. *Current Biology*, *22*, R658-663. doi: 10.1016/j.cub.2012.06.061
- Lopour, B. A., Tavassoli, A., Fried, I., & Ringach, D. L. (2013). Coding of information in the phase of local field potentials within human medial temporal lobe. *Neuron*, *79*, 594-606. doi: 10.1016/j.neuron.2013.06.001
- Arnal, L. H., & Giraud, A. L. (2012). Cortical oscillations and sensory predictions. *Trends in Cognitive Sciences*, *16*, 390-398. doi: 10.1016/j.tics.2012.05.003

### **Week 6 (2/25): Attention**

- Ptak, R. (2012). The frontoparietal attention network of the human brain: Action, saliency, and a priority map of the environment. *Neuroscientist*, *18*, 502-515. doi: 10.1177/1073858411409051
- Lakatos, P., Musacchia, G., O'Connell, M. N., Falchier, A. Y., Javitt, D. C., & Schroeder, C. E. (2013). The spectrotemporal filter mechanism of auditory selective attention. *Neuron*, *77*, 750-761. doi: 10.1016/j.neuron.2012.11.034
- Saalman, Y. B., Pinsk, M. A., Wang, L., Li, X., & Kastner, S. (2012). The pulvinar regulates information transmission between cortical areas based on attention demands. *Science*, *337*, 753-756. doi: 10.1126/science.1223082
- Ray, S., Ni, A. M., & Maunsell, J. H. (2013). Strength of gamma rhythm depends on normalization. *PLoS Biology*, *11*, e1001477. doi: 10.1371/journal.pbio.1001477

### **Week 7 (3/4): Music**

- Peretz, I., and Zatorre, R. J. (2005). Brain organization for music processing. *Annual Review of Psychology*, *56*, 89-114.

- Patel, A. D. (2003). Language, music, syntax and the brain. *Nature Neuroscience*, 6, 674-681.
- Zatorre, R. J., & Salimpoor, V. N. (2013). From perception to pleasure: music and its neural substrates. *Proceedings of the National Academy of Sciences USA*, 110, 10430-10437. doi: 10.1073/pnas.1301228110
- Fujioka, T., Trainor, L. J., Large, E. W., & Ross, B. (2012). Internalized timing of isochronous sounds is represented in neuromagnetic beta oscillations. *Journal of Neuroscience*, 32, 1791-1802. doi: 10.1523/JNEUROSCI.4107-11.2012

### **Week 8 (3/11): Language**

- Rauschecker, J. P., & Scott, S. K. (2009). Maps and streams in the auditory cortex: Nonhuman primates illuminate human speech processing. *Nature Neuroscience*, 12, 718-724. doi: 10.1038/nn.2331
- Hickok, G., Houde, J., & Rong, F. (2011). Sensorimotor integration in speech processing: Computational basis and neural organization. *Neuron*, 69, 407-422. doi: 10.1016/j.neuron.2011.01.019
- Hickok, G. (2012). Computational neuroanatomy of speech production. *Nature Reviews Neuroscience*, 13, 135-145. doi: 10.1038/nrn3158
- Mottonen, R., Dutton, R., & Watkins, K. E. (2013). Auditory-motor processing of speech sounds. *Cerebral Cortex*, 23, 1190-1197. doi: 10.1093/cercor/bhs110

### **Week 9 (3/25): Multisensory processing in the brain**

- Stein, B. E., and Stanford, T. R. (2008). Multisensory integration: Current issues from the perspective of the single neuron. *Nature Reviews Neuroscience*, 9, 255-266.
- Ghazanfar, A. A., and Schroeder, C. E. (2006). Is neocortex essentially multisensory? *Trends in Cognitive Sciences*, 10, 278-285.
- Lakatos, P., Chen, C. M., O'Connell, M. N., Mills, A., & Schroeder, C. E. (2007). Neuronal oscillations and multisensory interaction in primary auditory cortex. *Neuron*, 53, 279-292.
- Campanella, S., & Belin, P. (2007). Integrating face and voice in person perception. *Trends in Cognitive Sciences*, 11, 535-543.

### **Week 10 (4/1): Neuroplasticity**

- Merabet, L. B., & Pascual-Leone, A. (2010). Neural reorganization following sensory loss: The opportunity of change. *Nature Reviews Neuroscience*, 11, 44-52.
- Dayan, E., & Cohen, L. G. (2011). Neuroplasticity subserving motor skill learning. *Neuron*, 72, 443-454.
- Bavelier, D., Levi, D. M., Li, R. W., Dan, Y., & Hensch, T. K. (2010). Removing brakes on adult brain plasticity: from molecular to behavioral interventions. *Journal of Neuroscience*, 30, 14964-14971. doi: 10.1523/JNEUROSCI.4812-10.2010
- Winkowski, D. E., Bandyopadhyay, S., Shamma, S. A., & Kanold, P. O. (2013). Frontal cortex activation causes rapid plasticity of auditory cortical processing. *Journal of Neuroscience*, 33, 18134-18148. doi: 10.1523/JNEUROSCI.0180-13.2013

### **Week 11 (4/8): Neural mechanisms of short-term memory**

- Pasternak, T., & Greenlee, M. W. (2005). Working memory in primate sensory systems. *Nature Reviews Neuroscience*, 6, 97-107.
- Roux, F., & Uhlhaas, P. J. (2014). Working memory and neural oscillations: Alpha-gamma versus theta-gamma codes for distinct WM information? *Trends in Cognitive Sciences*, 18, 16-25. doi: 10.1016/j.tics.2013.10.010
- Dumontheil, I., Roggeman, C., Ziermans, T., Peyrard-Janvid, M., Matsson, H., Kere, J., & Klingberg, T. (2011). Influence of the COMT genotype on working memory and brain activity changes during development. *Biological Psychiatry*, 70, 222-229. doi: 10.1016/j.biopsych.2011.02.027
- Serences, J. T., Ester, E. F., Vogel, E. K., and Awh, E. (2009). Stimulus-specific delay activity in human primary visual cortex. *Psychological Science*, 20, 207-214.

### **Week 12 (4/15): Neural mechanisms of long-term memory**

- Ranganath, C., & Ritchey, M. (2012). Two cortical systems for memory-guided behaviour. *Nature Reviews Neuroscience*, *13*, 713-726. doi: 10.1038/nrn3338
- Preston, A. R., & Eichenbaum, H. (2013). Interplay of hippocampus and prefrontal cortex in memory. *Current Biology*, *23*, R764-773. doi: 10.1016/j.cub.2013.05.041
- Wimber, M., Maass, A., Staudigl, T., Richardson-Klavehn, A., & Hanslmayr, S. (2012). Rapid memory reactivation revealed by oscillatory entrainment. *Current Biology*, *22*, 1482-1486. doi: 10.1016/j.cub.2012.05.054
- van Kesteren, M. T., Ruiter, D. J., Fernandez, G., & Henson, R. N. (2012). How schema and novelty augment memory formation. *Trends in Neurosciences*, *35*, 211-219. doi: 10.1016/j.tins.2012.02.001

### **Week 13 (4/22): Neural circuits for emotion**

- LeDoux, J. (2012). Rethinking the emotional brain. *Neuron*, *73*, 653-676. doi: 10.1016/j.neuron.2012.02.004
- Hamann, S. (2012). Mapping discrete and dimensional emotions onto the brain: controversies and consensus. *Trends Cogn Sci*, *16*(9), 458-466. doi: 10.1016/j.tics.2012.07.006
- Ochsner, K. N., Ray, R. R., Hughes, B., McRae, K., Cooper, J. C., Weber, J., Gabrieli, J. D. E., & Gross, J. J. (2009). Bottom-up and top-down processes in emotion generation: Common and distinct neural mechanisms. *Psychological Science*, *20*, 1322-1331.
- Zaki, J., & Ochsner, K. (2012). The neuroscience of empathy: Progress, pitfalls and promise. *Nature Neuroscience*, *15*, 675-680. doi: 10.1038/nn.3085

### **Week 14 (4/29): Neural basis of social and economic behavior**

- Stanley, D. A., & Adolphs, R. (2013). Toward a neural basis for social behavior. *Neuron*, *80*, 816-826. doi: 10.1016/j.neuron.2013.10.038
- Kubota, J. T., Banaji, M. R., & Phelps, E. A. (2012). The neuroscience of race. *Nature Neuroscience*, *15*, 940-948. doi: 10.1038/nn.3136
- Lee, D., Seo, H., & Jung, M. W. (2012). Neural basis of reinforcement learning and decision making. *Annual Review of Neuroscience*, *35*, 287-308. doi: 10.1146/annurev-neuro-062111-150512
- Kolling, N., Behrens, T. E., Mars, R. B., & Rushworth, M. F. (2012). Neural mechanisms of foraging. *Science*, *336*, 95-98. doi: 10.1126/science.1216930

### **Week 15 (5/6): Brain mechanisms of cognitive control**

- Aron, A. R., Robbins, T. W., and Poldrack, R. A. (2004). Inhibition and the right inferior frontal cortex. *Trends in Cognitive Sciences*, *8*, 170-177.
- Ridderinkhof, K. R., Ullsperger, M., Crone, E. A., and Nieuwenhuis, S. (2004). The role of the medial frontal cortex in cognitive control. *Science*, *306*, 443-447.
- Munakata, Y., Herd, S. A., Chatham, C. H., Depue, B. E., Banich, M. T., & O'Reilly, R. C. (2011). A unified framework for inhibitory control. *Trends in Cognitive Sciences*, *15*, 453-459.
- Sheth, S. A., Mian, M. K., Patel, S. R., Asaad, W. F., Williams, Z. M., Dougherty, D. D., . . . Eskandar, E. N. (2012). Human dorsal anterior cingulate cortex neurons mediate ongoing behavioural adaptation. *Nature*, *488*, 218-221. doi: 10.1038/nature11239

**We will not cover the following readings due to the Week 2 schedule change, but feel free to read them on your own or include them in your out of class assignments:**

### **Neural mechanisms of high-level cognition**

- Shadlen, M. N., & Kiani, R. (2013). Decision making as a window on cognition. *Neuron*, *80*, 791-806. doi: 10.1016/j.neuron.2013.10.047
- Tang, Y. Y., Rothbart, M. K., & Posner, M. I. (2012). Neural correlates of establishing, maintaining, and switching brain states. *Trends in Cognitive Sciences*, *16*, 330-337. doi: 10.1016/j.tics.2012.05.001

- Mantini, D., & Vanduffel, W. (2013). Emerging roles of the brain's default network. *Neuroscientist, 19*, 76-87. doi: 10.1177/1073858412446202
- Schacter, D. L., Addis, D. R., Hassabis, D., Martin, V. C., Spreng, R. N., & Szpunar, K. K. (2012). The future of memory: remembering, imagining, and the brain. *Neuron, 76*, 677-694. doi: 10.1016/j.neuron.2012.11.001

#### **(4) UNIVERSITY RESOURCES AND POLICIES**

**Academic Misconduct:** Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution. An example of academic misconduct is plagiarism. **Plagiarism** is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: <http://studentconduct.unlv.edu/misconduct/policy.html>.

**Copyright:** The University requires all members of the University Community to familiarize themselves and to follow copyright and fair use requirements. **You are individually and solely responsible for violations of copyright and fair use laws. The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws.** Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at: <http://provost.unlv.edu/copyright/>.

**Disability Resource Center (DRC):** The Disability Resource Center (DRC) determines accommodations that are "reasonable" in promoting the equal access of a student reporting a disability to the general UNLV learning experience. The DRC is located in the Student Services Complex (SSC-A), Room 143, phone (702) 895-0866, fax (702) 895-0651. For additional information, please visit: <http://drc.unlv.edu/>.

**Religious Holidays Policy:** Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor no later than the last day of late registration of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. This policy shall not apply in the event that administering the test or examination at an alternate time would impose an undue hardship on the instructor or the university which could have been avoided.

**Tutoring:** The Academic Success Center (ASC) provides tutoring and academic assistance for all UNLV students taking UNLV courses. Students are encouraged to stop by the ASC to learn more about subjects offered, tutoring times and other academic resources. The ASC is located across from the Student Services Complex, #22 on the current UNLV map. Students may learn more about tutoring services by calling (702) 895-3177 or visiting the tutoring web site at: <http://academicsuccess.unlv.edu/tutoring/>.

**UNLV Writing Center:** One-on-one or small group assistance with writing is available free of

charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>

**Rebelmail:** By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's Official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always [@unlv.nevada.edu](mailto:@unlv.nevada.edu).