Prof. Irving Biederman Psychology 440

SYLLABUS: INTRODUCTION TO COGNITIVE NEUROSCIENCE

IB's Office: HNB 316, Ext. 0-6094, <u>bieder@usc.edu</u> TA: Ori Amir: Office: HNB 316, Ext, 0-6102, <u>oriacadem@gmail.com</u> **Time:** Class meets: Mon, Wed 2:00-3:50 PM. **Room**: WPH B27 **Final Exam**: Friday, Dec. 12, 2-4 PM

Required Text + Journal Articles (Denoted by *). Other articles (no *) are for background edification and the content not covered in class will not be explicitly tested.

Text: Gazzaniga, M.S., Ivry, R. B., & Mangun, G. R. (2014). Cognitive *Neuroscience: The Biology of Mind*. Fourth Edition. New York, N.Y.: WWNorton. [ISBN: 978-0-393-92795-5] [GIM].

Journal articles can be downloaded (in Adobe Acrobat) from the course Blackboard site. Some readings will be added during the semester.

- **Evaluation:** Evaluation will be based on two midterms (30% each and a cumulative final examination (40%). All the exams will be multiple choice. Approximately 60-70% of the exam will be composed of questions from class lectures.
- **If you miss an exam:** There is no definite penalty but a probabilistic one: If you have taken all the exams and you are near a grade cutoff (e.g., by 3 or 4 points in your average grade), you will get the higher grade. Otherwise the lower one. Unless you are running a high A, there is a fair chance that missing an exam will cost you a grade. We cannot evaluate the adequacy of excuses for missing exams.
- **Extra credit (Experimental Participation)**: Students can earn up to 3% extra credit by participating in the Psychology Department's Subject Pool at the rate of 1% for each "hour's" worth of participation. (Some short web questionnaire studies only yield .5 hour's credit.) To obtain this credit, for each experiment or questionnaire, you are to assume some intellectual "ownership" of the experience by writing a brief reflection, e.g. a paragraph or two. Such reflections could be informed criticism (given the goals of the study as obtained through the feedback, questions posed to the experimenters, etc.) or a description of how the study might be related to course concepts.
- **Extra credit (Class Participation):** (up to 3%) will be awarded for class comments or questions that serve to illuminate the discussion or informed criticism (but not mere attendance). Good answers on those rare occasions when someone is called upon randomly also qualify but bad/inattentive answers can cause a negative credit. (Texting in class can elevate the likelihood of being called upon.)

Topics: Roughly corresponding to weeks. *There will be some reordering/rescheduling of topics and possibilities of additions/subtractions of readings.*

 Aug 24 & 26th: Introduction: Modularity. Brain Development. Cortical visual pathways. Broadbent's Flowchart Model of Attention.
 *GIM Chapters 1 Brief History. (Skim.)

- *GIM Chapter 2 Structure and Function of the Nervous System. (You will not be tested on the specifics of the molecular biology, e.g., of the cell membrane, ion channels, and neurotransmitters on pp. 28-36 but do understand the general principles).
- Cherniak, C. (1994). Component placement optimization in the brain. *Journal of Neuroscience*, 14, 2418-2427. (For background and edification. Not explicitly tested beyond what is discussed in lecture.)
- 2. Aug. 31 & Sept. 2: Sensation and Perception. Early sensory processing. How to get the world into the head. Methodologies.

*GIM Chapter 4. Methods of Cognitive Neuroscience. Rather than discuss methods as a group in class, we will consider them as they arise in particular experiments. *GIM Chapter 5. Sensation and Perception.

Kobatake, E., & Tanaka, K. (1994). Neuronal selectivities to complex object features in the ventral visual pathway of the macaque cerebral cortex. *Journal of Neurophysiology*, 71, 856-867.

Sept 7: Labor Day. No Class

3. Sept 9, 14, & 16: Higher Level Vision I: Object Recognition. Representation. Nonaccidental Properties. Invariances.

*GIM Object Recognition. Chapter 6.

*Hayworth, K. J., & Biederman, I. (2006). Neural evidence for intermediate representations in object recognition. *Vision Research*, 46, 4024-4031.

Kriegeskorte, N. et al. Matching categorical object representations in inferior temporal cortex of man and monkey. *Neuron*, **60**, 1126-1141.

*Biederman, I. (1995). Visual object recognition. In S. M. Kosslyn and D. N. Osherson (Eds.). *An Invitation to Cognitive Science*, 2nd edition, *Volume 2*, *Visual Cognition.* MIT Press. Chapter 4, pp. 121-165.

4. Sept 21 & 23. Higher Level Vision II: Gabor Filtering; Faces, Subordinate-Level Recognition; Scenes; Prosopagnosia vs. Phonagnosia

*Biederman, I., & Kalocsai, P. (1997). Neurocomputational bases of object and face recognition. *Philosophical Transactions of the Royal Society London: Biological Sciences*, 352, 1203-1219. (Background)

5. Sept 28 & 30. Attention & Consciousness. Automaticity. Spatial vs. verbal representations.

*GIM. Chapter. 7. Attention

*GIM. Chapter 4. Hemispheric Specialization

- *GIM. Chapter 14. Consciousness.
- *Sheinberg, D. L., & Logothetis, N. (1997). The role of temporal cortical areas in perceptual organization. *PNAS*, 94, 3408-3413.

6. Oct. 5 First Midterm (30%).

7. Oct 7. Action

*GIM. Chapter 8. Action

8. Oct 12 & 14: Learning and Memory: Clive Wearing. Medial temporal Lobe system.

*GIM Chapter 9. Memory.

9. Oct 19 & 21: Emotion

*GIM. Chapter 10. Emotion.

*Biederman, I., & Vessel, E. A. (2006). Perceptual pleasure and the brain. *American Scientist*, 94, 247-253.

Amir, O., Biederman, I., Wang, Z., & Xu, X. (2013). Ha Ha vs. Aha! A direct comparison of humor to non-humorous insight for determining the neural correlates of mirth. *Cerebral Cortex*, 62, 35-43. Link: http://cercor.oxfordjournals.org/cgi/reprint/bht343?ijkey=QodzmzncQc755UY&keyt ype=ref

10 Oct 26 & Oct 28: Language. Speech Perception. Reading. Syntax.

*GIM. Chapter 11. Language.

*Sahin, N. T., Pinker, S., Cash, S. S., Schomer, D., Halgren, E. (2009). Sequential processing of lexical, grammatical, and phonological processing within Broca's area. *Science*, 326, 445-449.

11. Nov 2 & 4: Cognitive Control. Working Memory.

*GIM. Chapter 12. Cognitive Control.

*Freedman, D. J., Riesenhuber, M., Poggio, T., & Miller, E. K. (2003). A Comparison of Primate Prefrontal and Inferior Temporal Cortices during Visual Categorization. *Journal of Neuroscience*, 23, 5235–5246.

12. Nov. 9 & 11: Social Cognition, *GIM. Chapter 13. Social Cognition.

*Spunt, R. P., Falk, E. B., Lieberman, M. (2010). Dissociable neural systems support retrieval of *how* and *why* action knowledge. *Psychological Science, 21,* 1593-1598.

13. Nov. 16. Second Midterm (30%)

14. Nov 18 & 23. Individual Differences: Working Memory and Intelligence; Behavioral Genetics. Personality, and Morality

*Bouchard, T., Lykken, D.T., McGue, M., Segal, N. L., & Tellegen, A. (1990). Sources of human psychological differences: The Minnesota study of twins reared apart. *Science*, 250, 223-228.

*Haidt, J. (2007). The new synthesis in moral psychology. Science, 316, 998-1002.

Nov. 25. No Class. Thanksgiving.

15. Nov 30 and Dec 2. Last Class. Evolutionary Psychology: Bonding, Love, Sex, Mother-Infant Competition, Murder, Optimal Mating Strategies.

Donalson, Z. R., & Young, L. J. (2008). Oxytocin, Vasopressin, and the neurogenetics of sociality. *Science*, 322, 900-904.
Raine, A. (2013). *The Anatomy of Violence: The Biological Roots of Crime*. Pantheon.

Friday, December 11th, 2-4 PM, FINAL EXAM (40%)

Students requesting academic accommodations based on a disability are required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP when adequate documentation is filed. Please be sure the letter is delivered to me as early in the semester as possible. Their phone number is (213) 740-0776.