Prof. Irving Biederman University of Southern California
Psychology 440 Spring 2021

SYLLABUS (Revised 1/24/21): INTRODUCTION TO COGNITIVE NEUROSCIENCE

Reaching me: Best is by bieder@usc.edu. Contact hours: By appointment. Email me. If urgent 310.614.3903. (I rarely check my office phone which is 213.740.6094)

TA for PSYC 440: Milad Kassaie kassaie@usc.edu. Contact hours: Thursdays 2-3 PM, and by appointment. Zoom meeting link for TA office hours is available on Blackboard.

Time: Class meets: Mon & Wed 2:00-3:50 PM by Zoom.
We will have a ~10-min break at 3 PM during each lecture.
Text: Gazzaniga, M., Ivry, R. B., & Mangun, G. R. (2019). *Cognitive Neuroscience: The Biology of Mind*. Fifth edition, N.Y.: WW Norton. [ISBN: 978-0-393-603170] [GIM]. As a money saver, you can use the Fourth edition [ISBN: 978-0-393-92795-5]. Do let me know if you are using that edition. Journal articles listed on the syllabus are the source of some of the lecture material and will not be explicitly tested but can serve as background edification.

Evaluation: Evaluation will be based on three midterms (20% each) and a cumulative final examination (40%). All the exams will be multiple choice and will tend to assess conceptual understanding rather than rote memorization of lists of items. However, there are specific facts and terms that are the intellectual currency in all sciences so those will be tested as well. A majority of the exam's questions will be assessing understanding of class lectures. I will also distribute a study guide about a week or two prior to each exam. We will use the Zoom capabilities for administering examinations.

If you miss an exam: There is no definite penalty but a probabilistic one: If you have taken all three midterms and you are near a grade cutoff (e.g., by a few points in your average grade), you will get the higher grade. If you miss a midterm, you will get the lower grade. (You have to take the final.) Unless you are running a high A, there is a fair chance that missing an exam will cost you a grade, e.g., from an A- to a B+. We cannot evaluate the adequacy of excuses.

Extra credit (Class Participation): (up to 3%) will be awarded for class comments, questions that serve to illuminate the discussion or informed criticism (but not mere attendance). Finding significant errors in the PowerPoints or lectures also qualify for participation points. Good answers on those rare occasions when someone is called upon randomly or volunteers a comment also qualify but poor class decorum, e.g., Irrelevant or distracting behavior (e.g., talking, etc.) will result in *negative* participation credit.

Extra Credit (Experimental Participation): Up to 3%. Experiments will be available for sign up from the Psychology Department subject pool. For credit you are to submit a brief (less than a page) reflection on your experience in the experiment. Don't simply describe the tests or how well you did but something insightful about the experience hopefully related to course concepts. Informed criticism of the experience also

qualifies. Included in the experimental participation may be opportunities for testing your face recognition proficiency by participation in our lab's experiments.

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

1. Jan 18. No class. MLK day

2. Jan 20 & 25. Introduction: Cortex. Cortical Modularity. Efficiency of neuronal circuits. C. Elegans. Brain Development. Broadbent's Flowchart Model of Attention. Implications for effective study.

*GIM Chapters 1 Brief History. (Skim.)

*GIM Chapter 2 Structure and Function of the Nervous System. (We will not test the specifics of molecular biology, e.g., of the cell membrane, ion channels, and neurotransmitters on pp. 28-36). Most of the detailed anatomy can be skimmed. Anatomy that will be stressed in lecture could be tested.

*GIM Chapter 3. Methods of Cognitive Neuroscience. Rather than discuss methods as a separate topic devoid of specific content we will consider them as they arise in particular studies over the course of the semester. It will help if you have some familiarization with the methods, particularly those for neuroimaging, prior to their presentation in lectures.

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.)

3. Jan 27 & Feb 1: Sensation and Perception. Early sensory processing. Subcortical perceptual processing. How to get the world into the head. V1 and Gabor Filtering. Remarkable case of DF in defining Dorsal vs. Ventral Cortical Visual Pathways.

*GIM Chapter 5. Sensation and Perception.

Biederman, I. (2020). Vision: A Product of a Society of Independent Experts. *Current Biology*, 30, 1043-1045. https://doi.org/10.1016/j.cub.2020.07.017

4. Feb 3, 8, & 10: Higher Level Vision I: Shape Recognition: Objects, RSVP. Temporal parameters. Nonaccidental Properties. Representation of object parts as geons. Representation of objects as structural description of parts + relations. Parallel evolutionary solution to shape and speech recognition. Priming and Invariances. fMRI Event-Related Adaptation. Lateral occipital complex (LOC).

*GIM Object Recognition. Chapter 6.

*GIM. 242-248. Mind reading for semantics. (Will also be discussed in section on Language.)

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*

5. Feb 15. President's Day. No class.

6. Feb 17 & 22. Higher Level Vision II: Subordinate-Level Recognition, Gabor representation of faces, Configural Effects, Prosopagnosia. Scene Perception. Relations between objects.

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).

7. Feb 24 & Mar 1. Attention & Consciousness. Where does the limitation of Broadbent's limited capacity channel arise? Brooks' Mental tracking of spatial and verbal imagery. Automaticity. At what cortical stage do we first become conscious of a visual stimulus? Spatial Attention: Shrink Wrapping. Consciousness.

*GIM. Chapter. 7. Attention.

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

8. Mar 3: First Midterm (20%).

9. Mar 8: Action (Motor Control). Pre-motor vs. supplementary motor functions. Basal ganglia.

*GIM. Chapter 8. Action.

10. Mar 10 &15. Learning and Memory. Memory deficits: HM vs. Clive Wearing. Encoding and Retrieval. Episodic vs. Implicit Memory. What is going on when human memory consolidates? Medial temporal Lobe system. Extraordinary episodic memories.

*GIM Chapter 9. Memory.

11. Mar 17. Emotion. Fear. Perceptual and Cognitive Pleasure. Infovores.

*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.

12. Mar 22, 24, & 29: Language. Semantics. Mind reading through fMRI. The language of space and time. Speech Perception. Syntax. Reading. Dyslexia. Alphabetical (spelling patterns) vs. logographic writing systems.

*GIM. Pg. 242-248. Mind reading: Mapping semantics on the cortex.

*GIM. Chapter 11. Language.

Frankland, S. M., & Greene, J. D. (2015). An architecture for encoding sentence meaning in left mid-superior temporal cortex. *PNAS*, Pp. 1-6. (Early Edition.)

13. Mar 31: 2nd Midterm (20%).

14. April 57: No class. Wellness day.

15. Apr. 5, 7 (No class, Wellness Day) and 12: Cognitive Control. Working Memory. Heuristics for Judgment & Decision Making. Bayes Theorem. Goal Directed Behavior. Delay of reward (Milad presentation).

*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.

16. Apr 14 & Apr 19: Individual Differences. Behavioral Genetics. Intelligence. Social Cognition. Haidt's New Synthesis in Morality Psychology; How liberals and conservatives differ?

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.

17. April 21. Evolutionary Social Psychology: **Bonding, Love, Sex, Mother-Infant Competition, Murder, Autism, Optimal Mating Strategies**. **Theory of Mind.**

*GIM. Chapter 13. Social Cognition.

18. April 26. 3rd Midterm

28. April 28 (Last Class): Review and Overview.

Monday, May 10th, 2-4 PM: CUMULATIVE 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.