Cognitive Science 140: *Perception & Action*

University of California, Merced

Fall 2018

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Lectures: Tue & Thurs, 4:30pm to 5:45pm, COB 102

Readings: Official textbook: Gazzaniga, Ivry & Mangun (2013).

Cognitive Neuroscience: The Biology of Mind 4th Edition

Course Description

This course surveys key theories and experimental procedures for studying perception and action. Topics include psychophysics; perception of color, space, shape and motion; pattern recognition; perceptual attention; principles of human motor action and motor control; perception-action coupling. The course will take a strong neuroscience approach and we will try to ground many of the phenomena learned in the class in terms of brain function.

All our contact with the world around us depends on sensory/perceptual experiences through sight, balance, touch, taste, smell, and hearing. This course explores each of these sensory systems, showing how their biology shapes our perceptual experience of reality.

Similarly, all our interaction with the world is achieved through the human motor system. An important theme in the course is that our sensory systems play a crucial role in the execution of coordinated movements of our bodies, as we navigate in and interact with the environment.

The course assumes some introductory knowledge of the organization and function of the human nervous system and the ways in which we think about cognitive processes.

Course goals

The goals for this course include the exploration of the biological principles underlying human perception and action. Our aim is to study perception and action, the computational and dynamical processes underlying each and the neurophysiology that supports it. The course will introduce the student to cutting-edge research in human cognitive neuroscience.

Although, bulk of the content of this course will be delivered through lectures, I am aiming for a fairly intimate atmosphere with lots of open discussions. Typically, every week there will be a regular lecture and a part of the Thursday class meeting will be devoted to a discussion session.

Course Learning outcomes

1. To provide an advanced framework for understanding the biology of human sensory and motor systems.

2. To understand the interactions between various sensory systems.

3. To develop researching and critical thinking skills in following current literature and debates in perception and action.

4. To develop reading, writing, research and presentation skills necessary for the dissemination of scientific literature.

Cognitive Science Program Learning outcomes

The above Course Learning Outcomes are part of the coherent coursework offerings for the COGS degrees, supporting students in meeting the COGS Program Learning Outcomes (see the COGS website for the entire list). Perception and action are essential topics in the study of cognition, and this class will introduce them as intrinsically related. Students completing this course will gain a fundamental scientific understanding of the perceptual and action systems, and how they are coupled. Course material will focus on well-established laboratory behavioral and brain-imaging studies, and applied examples from case studies.

Grades

There will be three exams for the course.

Thursday Sep 27 - 33%

Tuesday Oct 30 - 33% (cumulative content)

Tuesday Dec 4 - 34% (cumulative content)

THERE WILL BE NO FINAL EXAM

Plagiarism and cheating policy: Papers and exam are expected to reflect the work and writing of the student. Definitive evidence of plagiarism or cheating will result in a grade of zero for the exam.

Extra Credit: Students may add point onto their final grades by participating in experiments via the SONA participant pool. One percentage point will be added onto the final grade for every SONA credit attributed to COGS 140, up to a maximum of five extra credit percentage points. Students who prefer an alternative means of earning extra credit may negotiate an extra credit assignment with the instructor.

Specific lecture schedule with readings:

UNIT 1

Aug 23 Lecture 1: Intro to Motor Control & Basic Anatomy (Readings: Chapter 8 - pg 332-338)

Aug 28 Lecture 2: Basic Anatomy (demo)

Aug 30 Lecture 3: Basic Motor Structures, Reflexes, Deafferentation (Readings: Chapter 8 - pg 332-333 in detail) + subcortical structures (Cerebellum: page 332)

Sept 4 Motor Cortex (Readings: Chapter 8 -Pg - 335 in detail + 342-344 in detail: Population Vectors), Basic brain machine interfaces (pg 352)

Sept 6 Lecture 4: Internal and external loop, Secondary motor Cortical areas (pg 336-337) + Basal Ganglia (pg 333-334; Pg 356-362)

Sept 11 Lecture 5: Basal Ganglia disorders; Parkinson's and Huntington's disease (Pg 356-362 in detail)

Sept 18 Lecture 6: Action observation and Mirror Neurons (Chapter 8: 362-366 in detail)

Sept 20 Lecture 7: Parietal Cortex (Page 336-337) in detail; Dorsal and ventral streams (from Lecture slides + Pg 347-350)

Sept 25 Lecture 8: Parietal Cortex (Neglect and Apraxia: Pg 336-337 + Lecture slides) + Bimanual Coordination and interhemispheric communication (Pg 350-351 + Lecture slides)

Thursday Sept 27: Exam 1 (all materials from Unit 1).

UNIT 2:

Oct 2 Lecture 9: Dopamine, antipsychotic drugs, Strokes/Lesions (Lecture slides)

Oct 4 Lecture 10: Intro to Visual system, receptors, pathways (Chapter 5: Pg 164)

Oct 9 Lecture 11: High-level vision (Chapter 5: Pg 190), Visual cortex (Pg 191-192)

Oct 11 Lecture 12: Deficits in visual perception (Chapter 5: Pg 201-205), Eye movements (Lecture slides)

Oct 16 Lecture 13: Vestibular system, Vestibulo-Ocular reflex (Lecture slides)

Oct 18 Lecture 14: Somatosensation (Page 179-184); Intro the Auditory system (Pg 168- 172)

Oct 23 Lecture 15: Advanced auditory system + Music perception (Lecture slides)

Oct 25 Lecture 16: Multisensory perception (Pg 208-212)

Tuesday Oct 30: Exam 3 (cumulative all materials from Units 1 & 2)

UNIT 3

Nov 1 Lecture 17: Structure of Neurons, Neural communication (Chapter 2: Pg 23-35) + Lecture slides

Nov 6 Lecture 18: Methods for studying Brain Function, Single cell recording, EEG (Chapter 3: Pg 95-104)

Nov 8 Lecture 19: MEG, MRI, fMRI, PET (Chapter 3: Pg 92, 102, 105-110)

Nov 13 Lecture 20: TMS (Chapter 3, Pg 88-89)

Nov 15 Lecture 21: Plasticity: Learning and Memory

Week of Nov 19-23 No class (Thanksgiving)

Nov 27 Lecture 22: Plasticity: Phantom limbs

Nov 29 Lecture 23: Review and synthesis

Tuesday Dec 4: Final exam