2020

Sensory Perception

Adrian Rodriguez-Contreras
CUNY City College

BIO45400 Sensory Perception 3 credits
Summer 2020 Session 1 Syllabus
Instructor: Adrián Rodríguez-Contreras, Ph.D.
Telephone: 212.650.5899
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Class meets online Monday thru Thursday from 11:00 am to 1:30 pm.

We will use blackboard's collaborate tool for online meetings. You will need access to a computer or any other device of your choice with an internet connection, speakers and a microphone. Video streaming is not required.

Keep in mind that even though attendance is not always required, you must participate in class assignments to get credit. Contact the instructor if you are facing issues in meeting the requirements of this course.

Course description: Different types of sensory systems with their functional modalities will be presented. The biological bases for how these functions are generated and modified will then be described. Scientific information will be integrated into the lectures, such that students use critical skills in interpreting data, proposing hypotheses and designing experiments.

Course goals:

- **Students will be able to identify the different sensory systems in humans and other animals.**
- **Students will learn basic mechanisms involved in sensation and perception.**
- **Students will be able to evaluate past and present theories of perception and critically evaluate evidence in favor or against those theories.**

Learning outcomes: After completing this course, students should be able to:

- 1) describe what the different sensory modalities encompass.
- 2) describe the process of transduction in each sensory modality.
- 3) describe the basic brain circuits mediating the different sensory modalities.
- 4) design, perform, and interpret psychophysical experiments.
- 5) plot psychophysical data and generate psychometric functions from them.
- 6) explain how sensory processing can be modified by other brain processes such as attention or memory.
- 7) describe the relationship between brain activity and perceptual (behavioral) state.
- 8) interpret scientific data from primary research papers on sensory perception.
- 9) propose experiments to test hypotheses on sensory perception.
- 10) define a direction to pursue your scientific interests.

Learning components: writing assignments; student led discussions; instructor and student evaluations; and a term paper.

Writing assignments:	**25%**
Student led discussions:	**25%**
Instructor and student evaluations:	**25%**
Term paper:	**25%**
Total:	**100%**

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Grade scale in this course:

%		Letter Grade
96-100	=	A+
93-95	=	A
90-92	=	A-
86-89	=	B+
83-85	=	B
80-82	=	B-
76-79	=	C+
73-75	=	C
70-72	=	C-
60-69	=	D
<60	=	F

Grade breakdown and rubrics

This course is organized in four weekly modules that address different topics related to the scientific study of sensory and perceptual phenomena.

Writing assignments (25%) There are 12 writing assignments in this course. Writing assignments consist of individual and student team write ups that are meant to provide opportunities to practice writing in the following styles and formats: professional etiquette, technical overview, and scientific outreach. Each assignment post consists of a defined task, instructions for submission and a grading rubric.

Student led discussions (25%) Students will have the opportunity to practice their oral communication skills through 4 group discussions at the end of every module in this course. Group discussions will center on assigned course materials such as readings and videos, and on student contributions and questions arising from their engagement in online lectures and written course assignments during each module. Online group discussions will be moderated by the instructor. Discussion guidelines and a grading rubric will be posted ahead of time.

Instructor and student evaluation (25%) There will be 4 evaluation sessions at the end of every module in this course. The instructor will evaluate students through a 30-minute examination that consists of questions to be answered in the short essay format. The main goal of the instructor evaluation is to assess the assimilation of course content by students. Students will have the opportunity to evaluate each module. Student evaluations have two

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components, a self-evaluation component where students can make a statement of topics that were clear and topics that were not clear during their respective presentation dates. A second component of the student evaluation consists in identifying course items that work and items that need to be changed in the course. The main goal of the weekly student evaluation is to set the pace, the breadth and the depth of course content. Each evaluation post consists of a defined task, instructions for submission and a rubric for grading.

Term paper (25%) **Students are expected to write a term paper. The term paper is a group assignment. The paper will be in the format of a research proposal on a topic directly related to sensory perception that is defined by students. The term paper will consist of five sections: 1) BACKGROUND; 2) HYPOTHESIS; 3) APPROACH; 4) SIGNIFICANCE; and 5) REFERENCES. We will discuss the format in more detail in class.**

Statement on Academic Integrity:
The CCNY policy on academic integrity will be followed in this course. The document can be found through the CCNY website at:

https://www.ccny.cuny.edu/it/academic-integrity-policy

Late assignments policy: A deduction of 10% of the grade will apply for every day of delay in turning in an assignment. Contact the instructor ahead of time if you anticipate extenuating circumstances.

Course Schedule

Module	Date	Topic	Assignments due by 10 am on the date
1. Approaches to study sensation and perception	06.01	Research with humans	WA1 due 06.01
	06.02	Research with animals	WA2 due 06.02
	06.03	Research with machines	WA3 due 06.03
	06.04	Student Discussion 1 & Evaluation 1	
2. Body senses	06.08	Transduction and body maps	WA4 due 06.08
	06.09	Electrical stimulation and perception	WA5 due 06.09
	06.10	Brain Machine interfaces	WA6 due 06.10
	06.11	Student Discussion 2 & Evaluation 2	
3. Vision	06.15	Optics, photonics and biology	WA7 due 06.15
	06.16	Neuronal activity and visual system development	WA8 due 06.16
	06.17	On visual perception and ultrasound	WA9 due 06.17
	06.18	Student Discussion 3 & Evaluation 3	
4. Hearing	06.22	Acoustics and biology	WA10 due 06.22
	06.23	Sound localization	WA11 due 06.23
	06.24	On auditory perception	WA12 due 06.24
	06.25	Final Student Presentations & Evaluation 4	

WA=Writing Assignment

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Course readings and materials: There is no required textbook for this course. The instructor will make course materials available to registered students using tools available in blackboard. Students will be required to use public databases and other resources to perform literature searches and research. Tips for accessing these resources will be presented in class. Contact the instructor if you need help finding these resources. A list of readings used in this course is provided below:

1. Rushton WAH, Barlow HB. Single fiber response from an intact animal. Nature. 1943; 152:597-598.

2. Barlow HB. Single units and sensation: a neuron doctrine for perceptual psychology? Perception. 1972; 1:371-394.

3. Akre KL, Farris HE, Lea AM, Page RA, . Signal perception in frogs and bats and the evolution of mating signals. Nature. 2011; 333:751-752.

4. Engels S, Schneider N-L, Lefeldt N, Hein CM, Zapka M, Michalik A, Elbers D, Kittel A, Hore PJ, Mouritsen H. Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird. Nature. 2013; 509:353-356.

5. Chow BW, Nuñez V, Kaplan L, Granger AJ, Bistrong K, Zucker HL, Kumar P, Sabatini BL, Gu C. Caveolae in CNS arterioles mediate neurovascular coupling. Nature. 2020; 579:106-110.

6. Burwell S, Sample M, Racine E. Ethical aspects of brain computer interfaces: a scoping review. BMC Medical Ethics. 2017; 18:60.

7. Gluck JP, Bell J. Ethical issues in the use of animals in biomedical and psychopharmacological research. Psychopharmacology. 2003; 171-6-12.

8. Yuste R, Goering S. Four ethical priorities for neurotechnologies and AI. Nature. 2017; 551:159-163.

9. Lebedev MA, Nicolelis MAL. Brain-machine interfaces: from basic science to neuroprostheses and neurorehabilitation. Physiol Rev. 2017; 97:767-837.

10. Anjum F, Turni H, Mulder PGH, van der Burg J, Brecht M. Tactile guidance of prey capture in Etruscan shrews. PNAS USA. 2006; 103:16544-16549.

11. Romo R, Hernández A, Zainos A, Salinas E. Somatosensory discrimination based on cortical microstimulation. Nature. 1998; 392:387-390.

12. Houweling AR, Brecht M. Behavioural report of single neuron stimulation in somatosensory cortex. Nature. 2008; 451:65-68.

13. Knauer B, Stüttgen MC. Assessing the impact of single-cell stimulation on local networks in rat barrel cortex – A feasibility study. International Journal of Molecular Sciences. 2019; 20:2604.

14. O'Doherty JE, Shokur S, Medina LE, Lebedev MA, Nicolelis MAL. Creating a neuroprosthesis for active tactile exploration of textures. PNAS USA. 2019; 116:21821-21827.

15. Hecht S, Shlaer S, Pirenne MH. Energy, quanta, and vision. The Journal of General Physiology. 1942; 25:819-840.

16. Schuergers N, Lenn T, Kampmann R, Meissner MV, Esteves T, Temerinac-Ott M, Korvink JG, Lowe AR, Mullineaux CW, Wilde A. Cyanobacteria use micro-optics to sense light direction. Elife. 2016; 5:e12620.

17. Galli L, Maffei L. Spontaneous impulse activity of rat retinal ganglion cells in prenatal life. Science. 1988; 242:90-91.

18. Sabesan R, Schmidt BP, Tuten WS, Roorda A. The elementary representation of spatial and color vision in the human retina. Sci Adv. 2016; 2:e1600797.

19. Cuaya LV, Hernandez R, Concha L. Our faces in the dog's brain: functional imaging reveals temporal cortex activation during perception of human faces. PLoS ONE. 2016; 11:e0149431.

20. van Vugt B, Dagnino B, Vartak D, Safaai H, Panzeri S, Dehaene S, Roelfsema PR. The threshold for conscious report: signal loss and response bias in visual and frontal cortex. Science. 2018; 360:537-542.

21. Kubanek J, Brown J, Ye P, Pauly KB, Moore T, Newsome W. Remote, brain region-specific control of choice behavior with ultrasonic waves. Science Advances. 2020; 6:eaaz4193.

22. Montie EW, Manire CA, Mann DA. Live CT imaging of sound reception anatomy and hearing measurements in the pygmy killer whale, *Feresa attenuate*. The Journal of Experimental Biology. 2011;214:945-955.

23. Skoe E, Krizman J, Kraus N. The impoverished brain: disparities in maternal education affect the neural response to sound. The Journal of Neuroscience. 2013; 33:17221-17231.

24. Patel AD, Iversen JR, Bregman MR, Schulz I. Experimental evidence for synchronization to a musical beat in a nonhuman animal. Current Biology. 2009; 19:827-830.

25. Garcia-Garibay O, Cadena-Valencia J, Merchant H, de Lafuente V. Monkeys share the human ability to internally maintain a temporal rhythm. Frontiers in Psychology. 2016; 7:1971.

26. Wade NJ. Early studies of binocular and binaural directions. Vision. 2018; 2:13.

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For students interested in using other resources related to this course they may consult a recent edition of any of the following textbooks:

Blake, Randolph; Sekuler Robert. Perception (5th edition). 2006. McGraw-Hill Companies.

Yantis, Steven. Sensation and *Perception* (2nd edition). 2013. Worth Publishers. New York, NY.

Wolfe, Jeremy; et al. Sensation and Perception (5th Edition). 2018. Sinauer Associates, Inc.