

Biology 410/510 Neural Basis of Cognition

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Office hours: Thursdays 2-4pm (or by appointment)

Class meetings: MW 4:00pm-5:20pm, Lawrence Hall 230

Textbook: Principles of Cognitive Neuroscience (by Purves et al) ISBN: 978-0-87893-573-4

Website: All course content will be available on Canvas.

Course description

The course will examine the neural mechanisms responsible for cognitive processes such as attention, memory and decision making. We will focus on studies that use animal models to relate the activity of single neurons to cognition. The course is intended to bridge the gap between neurobiology, sensory physiology and cognitive neuroscience.

The format of the course includes lectures and activities that introduce each topic, followed by analysis of primary research literature. Students are expected to have a working knowledge of basic neurophysiology.

Course pre-requisites

BI360 Neurobiology or BI353 Sensory Physiology or equivalent.

Expected learning outcomes

The following learning outcomes are intended to help you become a better consumer of science (LO1-LO3) and a better producer of science (LO4-LO6).

1. Gain a working knowledge of modern experimental approaches for studying cognition in animal models.
2. Identify the major gaps in our understanding of the neural mechanisms of cognition.
3. Become a critical reader of scientific research articles in systems neuroscience.
4. Develop the ability to formulate hypotheses about the neural basis of cognitive processes.
5. Become proficient at designing experiments to test hypotheses about the mechanistic bases of cognitive processes.
6. Learn to give a concise and compelling oral presentation that identifies a scientific question, proposes a hypothetical answer to this question, and lays out a novel strategy to test this hypothesis.

Estimated student workload

In addition to attending class and participating in class activities (3h/week), students are expected to spend 2h/week reading materials for online quizzes (generally from the textbook), 2h/week reading primary literature, 10h throughout the term preparing a presentation, 10h working on each of the two major assignments, and 15h preparing and submitting the final exam. Together with 5h for communicating with me via email or office hours, this corresponds to a total of 120 hours of engagement in the course for the term. Please plan accordingly.

Additional work for graduate students (560 section)

In addition to the workload described above, graduate students are expected to dedicate 2h/week reading additional primary literature, 10h preparing an additional presentation about an (advanced) primary literature paper, and 10h preparing additional sections of the written homework assignments. Enrolled grad students do not provide any instruction for the course.

Grading policy

Deadlines will be strictly enforced. Under some circumstances, if you know you won't be able to submit your work on time, please contact me *before the deadline* to discuss options. The course does not have assignments for "extra credit". Instead, I encourage you to plan your work in advance, submit all assignments, and reach out before the deadlines if you need any help. Your grade will be based on your assignments, presentation, and exams as follows:

Presentation (15 min):	20%
Homework #1 (~800 words, <2 pages):	20%
Homework #2 (~800 words, <2 pages):	20%
Final exam (in-person, 1.5 hours):	20%
Online weekly quizzes/mini-homework:	20%

Graduate students will prepare one additional presentation (each presentation will be 10% of the final grade), and have additional sections in each homework (each homework will still be 20% of the final grade).

Grades:

A	90%-100%
B	80%-89%
C	70%-79%
D	60%-69%
F	59% and below

With intermediate grades as in: B- = 80% to 82%, B = 83% to 86%, B+ = 87% to 89%

Course calendar

Week 1. Introduction

1. Introduction to cognition and course overview.
2. Methods for monitoring and manipulating neural activity. Animal Models.
 - Online quiz Week 1: Basic neuroscience (due Sunday)

Week 2. Perception

1. Holiday. No class.
2. Neuronal selectivity, receptive fields, Bayesian inference, perceptual illusions.
 - Readings (9 pages): *von der Heydt et al. (1984)* and *Conway et al. (2005)*
 - Online quiz Week 2: Visual illusions (due Sunday)

Week 3. Analysis of a paper and Decision-making I

1. Discussion of *von der Heydt et al. (1984)* and *Conway et al. (2005)*
2. Reflexes vs. decisions, integration of evidence, confidence.
 - Readings (35 pages): Chapter 3 "Sensory Systems and Perception: Vision"
 - Online quiz Week 3: Perception (due Sunday)

Week 4. Decision-making II

1. Foraging, exploration vs. exploitation, value.
2. *Salzman et al. (1990)*, *Huk and Shadlen (2005)*, *Kepecs et al. (2008)*
 - Readings (24 pages): Chapter 14 "Decision Making" (p.470-494)
 - Online quiz Week 4: Decision making (due Sunday)
 - Homework #1 (due Sunday)

Week 5. Attention

1. Spatial attention, feature attention.
2. *McAdams & Maunsell (1999)*, *Moore & Fallah (2004)*, *Zénon & Krauzlis (2012)*
 - Readings (30 pages): Chapter 6 "Attention and Its Effects on Stimulus Processing" (p.167-198).
 - Online quiz Week 5: Attention (due Sunday)

Week 6. Multiple modalities

1. Multisensory integration and cross-modal attention.
2. *Wimmer et al. (2015)*, *Meredith et al. (1987)*, *Fetsch et al (2012)*, *Song et al. (2017)*
 - No online quiz.
 - Mini-homework: Select a paper for Homework #2 (due Sunday)
 - Readings (5-8 pages): the paper you selected in the mini-homework.

Week 7. Learning

1. Classical conditioning, operant conditioning, reinforcement, reward expectation.
2. *Hollerman & Schultz (1998)*, *Rogan et al. (1997)*, *Herry et al. (2008)*, *Tye et al. (2008)*
 - Readings (34 pages): Chapter 8 "Memory: Varieties and Mechanisms"
 - Online quiz Week 7 (due Sunday)

Week 8. Memory

1. Memory engram. Reading/erasing memories. Creating false memories.
2. *Liu et al. (2012)*, *Ramirez et al. (2013)*, *Johansen et al (2014)*, *Xiong et al (2015)*
 - Readings (38 pages): Chapter 9 "Declarative Memory"
 - Online quiz Week 8 (due Sunday)
 - Homework #2 (due Sunday)

Week 9. Thinking

1. Working memory, sustained neural activity.
2. *Romo et al. (1999)*, *Crowe et al. (2004)*, *Liu et al. (2014)*
 - Readings (6 pages): Chapter 13, section about "Working Memory" (p.458-463).
 - Online quiz Week 9 (due Sunday)

Week 10. Wrap up

1. *Additional student presentations.*
2. Wrap-up: assessment of course objectives.
 - Submit your presentation slides (due Wednesday).

Class courtesy

- Please arrive in class on time. Late arrivals distract the instructor and the other students.
- Please silence your cell phone during the class meeting times, and use your laptop only for class activities.
- Do not leave class early unless you have cleared it with the instructor in advance.
- I encourage you to ask questions if something presented in class was not clear or could not be heard. I will pause throughout the lecture to check if there are questions.
- Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the quarter (or before) so that I may address you properly.

Open inquiry, freedom of expression, and respect for differences are fundamental to a comprehensive and dynamic education. We are committed to upholding these ideals by encouraging the exploration, engagement, and expression of divergent perspectives and diverse identities. Classroom courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Our classroom is a learning environment, and as such should be a safe, inclusive and respectful place. Being respectful also includes using preferred pronouns for your classmates. Disrespecting fellow students and combative approaches are not acceptable. Please make me aware if there are classroom dynamics that impede your (or someone else's) full engagement.

Academic Honesty

Group discussions outside of class are encouraged. However, all work submitted as part of this course must be your own. The use of sources must be properly acknowledged. Copying or paraphrasing information from any source without citation is plagiarism. For more information, see <http://library.uoregon.edu/guides/plagiarism/students/index.html>.

All students will be expected to adhere to the University's guidelines on academic integrity as outlined in the Student Conduct Code: <https://policies.uoregon.edu/vol-3-administration-student-affairs/ch-1-conduct/student-conduct-code>. The consequences of academic dishonesty will be taken seriously (e.g., an 'F' in the course and a report to the Office of Student Conduct) and are noted on student disciplinary records. If you are in doubt regarding any aspect of these issues, please come and speak with me.

Students with disabilities

The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Campus resources to support your learning

If there are aspects of the instruction or design of this course that result in barriers to your participation, please notify me as soon as possible. Here are additional resources to support your learning:

- **Accessible Education Center:** The University of Oregon is working to create inclusive learning environments. If needed, you are encouraged to contact the Accessible Education Center <https://aec.uoregon.edu>. If you are not a student with a documented disability, but you would like to share class issues that will impact your ability to learn, you are encouraged you to visit me during office hours so that we can strategize how you can get the most out of this course.
- **Tutoring and Learning Center (TLC):** Drop-in math and writing support in addition to tutoring, study skills support, and Class Encore. Located in the 4th Floor Knight Library (541) 346-3226, tlc@uoregon.edu.
- **Counseling Center:** Call anytime to speak with a therapist who can provide support and connect you with resources. Located on the 2nd Floor of the Health Center (541)346-3227
- **Center for Multicultural Academic Excellence (CMAE):** its mission is to promote

student retention and persistence for historically underrepresented and underserved populations. The center develops and implements programs and services that support retention, academic excellence, and success at the UO and beyond. Contact: cmae@uoregon.edu.

- **The UO Access Shuttle** is an on-campus ride service provided at no cost to students with conditions that limit mobility. More information and a sign-up form can be found on the parking & transportation department website: <https://parking.uoregon.edu/content/access-shuttle>.

Mental Health and Wellness

Life at college can be very complicated. Students often feel overwhelmed or stressed, experience anxiety or depression, struggle with relationships, or just need help navigating challenges in their life. If you're facing such challenges, you don't need to handle them on your own--there's help and support on campus.

As your instructor, if I believe you may need additional support, I will express my concerns, the reasons for them, and refer you to resources that might be helpful. It is not my intention to know the details of what might be bothering you, but simply to let you know I care and that help is available. Getting help is a courageous thing to do—for yourself and those you care about.

University Health Services help students cope with difficult emotions and life stressors. If you need general resources on coping with stress or want to talk with another student who has been in the same place as you, visit the Duck Nest (located in the EMU on the ground floor) and get help from one of the specially trained Peer Wellness Advocates. Find out more at <http://health.uoregon.edu/ducknest>.

University Counseling Services (UCS) has a team of dedicated staff members to support you with your concerns, many of whom can provide identity-based support. All clinical services are free and confidential. Find out more at <http://counseling.uoregon.edu> or by calling 541-346-3227 (anytime UCS is closed, the After-Hours Support and Crisis Line is available by calling this same number)."

Discrimination and Harassment

Any student who has experienced sexual assault, relationship violence, sex or gender-based bullying, stalking, and/or sexual harassment may seek resources and help at <http://safe.uoregon.edu>. To get help by phone, a student can also call either the UO's 24-hour hotline at 541-346-7244 [SAFE], or the non-confidential Title IX Coordinator at 541-346-8136.

From the SAFE website, students may also connect to Callisto, a confidential, third-party reporting site that is not a part of the university.

Students experiencing any other form of prohibited discrimination or harassment can find information at <http://respect.uoregon.edu> or <http://aaeo.uoregon.edu> or contact the non-confidential AAEO office at 541-346-3123 or the Dean of Students Office at 541-346-3216 for help. As UO policy has different reporting requirements based on the nature of the reported harassment or discrimination, additional information about reporting requirements for discrimination or harassment unrelated to sexual assault, relationship violence, sex or gender based bullying, stalking, and/or sexual harassment is available at Discrimination & Harassment.

Safe Ride: 541-346-7433 ext 2. <http://pages.uoregon.edu/saferide>

Safe Ride is an assault prevention shuttle that works to provide free, inclusive, and accessible alternatives to traveling alone at night for UO students, faculty, and staff.

Reporting

The instructor of this class is a Student-Directed Employee. As such, if you disclose to me, I will respond to you with respect and kindness. I will listen to you, and will be sensitive to your needs and desires. I will not judge you. I will support you. As part of that support, I will direct students who disclose sexual harassment or sexual violence to resources that can help. I will only report the information shared to the university administration when you as the student requests that the information be reported (unless someone is in imminent risk of serious harm or is a minor). Please note the difference between 'privacy' and 'confidentiality.' As a Student-Directed Employee I can offer privacy because I am not required to report certain information to the university. However, I cannot be bound by confidentiality in the same way that a counselor or attorney is. Confidential resources such as these means that information shared is protected by federal and state laws. Any information that I as a student-directed employee receive may still be accessed by university or court proceedings. This means, for example, that I could still be called as a witness or required to turn over any related documents or notes that I keep.

Please note also that I am required to report all other forms of prohibited discrimination or harassment to the university administration. Specific details about confidentiality of information and reporting obligations of employees can be found at <http://titleix.uoregon.edu>.

Mandatory Reporting of Child Abuse

UO employees, including faculty, staff, and GEs, are mandatory reporters of child abuse.

Child abuse pertains to individuals who are under the age of 18. This statement is to advise you that your disclosure of information about child abuse to the instructor may trigger my duty to report that information to the designated authorities. Please refer to the following links for detailed information about mandatory reporting:

<https://hr.uoregon.edu/policies-leaves/general-information/mandatory-reporting-child-abuse-and-neglect>.