

BEHAVIORAL NEUROBIOLOGY (BIOLOGY 4893/5893), FALL 2025

Instructor: Dr. Ari Berkowitz
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Required readings: Available on Canvas (canvas.ou.edu)

Optional books: [Behavioral Neurobiology](#), 3rd ed.—Zupanc, Oxford 2019; [Principles of Neurobiology](#), 2nd ed.—Luo, Garland Science 2020; [The Neuroethology of Predation and Escape](#)—Sillar et al., Wiley 2016 [Governing Behavior](#)—Berkowitz, Harvard 2016

Class: Tu Th 1:30-2:45 PM
Richards Hall 304

Office Hours: 9:30-11:30 AM on M, Tu, & Th, or by appointment

COURSE OBJECTIVES

After completing this course, you should be able to:

- 1) Explain how neuroethologists investigate neural mechanisms of natural animal behaviors.
- 2) Explain neural mechanisms of natural behaviors, including sensory processing, sensorimotor integration, motor control, behavioral choice, and learning in species that have been well studied.
- 3) Extract the background, main question, and main experimental findings and interpretations from your reading of scientific research articles and clearly explain these in writing and orally.
- 4) Interpret graphs and other data and assess which hypotheses are consistent with those data.

GRADING

<u>Course component</u>	<u>Contribution to grade</u>
Quizzes.....	10%
Class participation.....	10%
Written paper (4893: 3-5 pages; 5893: 6-8 pages).....	20%
Oral follow-up questions on paper.....	10%
Midterm exam.....	20%
Final exam	30%

Pop quizzes will include material from previous lectures as well as material from readings assigned for that day or before. There will be no make-up quizzes. **Online quizzes** can be taken as many times as you like within the assigned period; only your highest score will count toward your grade.

Exam grades will not be curved; instead, all scores on an individual exam *may* be scaled up (i.e., the same number of points added to each student's score); the instructor will make this decision for each exam separately.

Grading Errors: If you believe there was an error in a quiz or exam or a mistake in grading, you should give the instructor a *written* description of the apparent mistake and your reasoning within one week of receiving the grade. (You can use email.) The instructor will decide on the complaint and inform you *at a later time*.

IMPORTANT DATES

Midterm exam: October 21

Deadline to receive approval for original research article for paper: October 23

Deadlines for paper: 1st draft-November 6; final version-November 20

No class (Thanksgiving): November 27

Final exam: Tuesday, December 12, 1:30-3:30 PM

NOTES

- 1) **Attendance and class participation are expected.** Some important announcements may also occur during class. **Please do not attend class if you are sick.** Please notify the instructor of any medical absence promptly, within one day of absence, if you wish to make up missed work.
- 2) Required readings will be available on [Canvas](#). Students are expected to access and download readings as required.
- 3) Some communications may be via e-mail. Students are expected to access their OU e-mail account (or set e-mail forwarding appropriately) and check for course-related messages **daily**.
- 4) For the paper you write, select an **original research** (not review) article < **10 years old** on a neuroethology topic **not otherwise covered in class; request and receive instructor approval for this choice by Oct. 19.** In your paper, you should discuss **both a natural animal behavior and its neural mechanisms**. You should review relevant background material on the system in question (e.g., using a recent review article) and then analyze the original research article in depth. The library provides [a good possible starting point for biology articles](#). After the papers are turned in, **you should make an appointment for follow-up questions** by the instructor.
- 5) Regulations and responsibilities stated in the *Student Code* and *Faculty Handbook* will be followed in the event of academic dishonesty. (See <http://integrity.ou.edu/>.) **Papers must be written entirely by the student alone; plagiarism will not be tolerated. Student papers should not copy phrases from publications or quote authors or make use of artificial intelligence software. Student papers will be submitted electronically to Turnitin.com to check for plagiarism. Cases of academic misconduct have been and will be pursued.**
- 6) If a grade of W or I is requested, University policy will be followed.
- 7) **Title IX Resources and Reporting Requirement:** The University of Oklahoma faculty are committed to creating a safe learning environment for all members of our community, free from gender and sex-based discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking, in accordance with Title IX. There are resources available to those impacted, including: speaking with someone confidentially about your options, medical attention, counseling, reporting, academic support, and safety plans. If you have (or someone you know has) experienced any form of sex or gender-based discrimination or violence and wish to speak with someone confidentially, please contact [OU Advocates](#) (available 24/7 at 405-615-0013) or [University Counseling Center](#) (M-F 8 a.m. to 5 p.m. at 405-325-2911)

Because the University of Oklahoma is committed to the safety of you and other students, and because of our Title IX obligations, I, as well as other faculty, Graduate Assistants, and Teaching Assistants, are mandatory reporters. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This includes disclosures that occur in: class discussion, writing assignments, discussion boards, emails and during Student/Office Hours. You may also choose to report directly to the Institutional Equity Office. After a report is filed, the Title IX Coordinator will reach out to provide resources, support, and information and the reported information will remain private. For more information regarding the University's Title IX Grievance procedures, reporting, or support measures, please visit [Institutional Equity Office](#) at 405-325-3546.

- 8) **Office of Access and Opportunity's Belonging Statement:** Why You Belong at the University of Oklahoma: The University of Oklahoma fosters an inclusive culture of respect and civility, belonging, and access, which are essential to our collective pursuit of excellence and our determination to change lives. The unique talents, perspectives, and experiences of our community enrich the learning, and working environment at OU, inspiring us to harness our innovation, creativity, and collaboration for the advancement of people everywhere.
- 9) **Mental health support services:** Support is available for any student experiencing mental health issues that are impacting their academic success. Students can either be seen at the University Counseling Center (UCC) located on the second floor of Goddard Health Center or receive 24/7/365 crisis support from a licensed mental health provider through [TELUS Health](#). To schedule an appointment or receive more information about mental health resources at OU please call the UCC at 405-325-2911 or visit [University Counseling Center](#). The UCC is located at 620 Elm Ave., Room 201, Norman, OK 73019.
- 10) **Adjustments for Pregnancy and Related Issues:** Should you need modifications or adjustments to your course requirements because of pregnancy or a pregnancy-related condition, please request modifications via the [Institutional Equity Office website](#) or call the Institutional Equity Office at 405/325-3546 as soon as possible. Also, see the Institutional Equity Office [FAQ on Pregnant and Parenting Students' Rights](#) for answers to commonly asked questions.
- 11) **Reasonable accommodation policy:** The University of Oklahoma (OU) is committed to the goal of achieving equal educational opportunity and full educational participation for students with disabilities. If you have already established reasonable accommodations with the Accessibility and Disability Resource Center (ADRC), please [submit your semester accommodation request through the ADRC](#) as soon as possible and contact me privately, so that we have adequate time to arrange your approved academic accommodations.
- If you have not yet established services through ADRC, but have a documented disability and require accommodations, please complete [ADRC's pre-registration form](#) to begin the registration process. ADRC facilitates the interactive process that establishes reasonable accommodations for students at OU. For more information on ADRC registration procedures, please review their [Register with the ADRC](#) web page. You may also contact them at (405)325-3852 or adrc@ou.edu, or visit www.ou.edu/adrc for more information.
- Note: disabilities may include, but are not limited to, mental health, chronic health, physical, vision, hearing, learning and attention disabilities, pregnancy-related. ADRC can also support students experiencing temporary medical conditions.
- Religious observances:** It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty. [\[See Faculty Handbook 3.15.2\]](#).
- 12) **Final exam preparation period:** Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU's [Final Exam Preparation Period policy](#).
- 13) **Emergency protocol:** During an emergency, there are official university [procedures](#) that will maximize your safety.

Severe Weather: If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather. Look for severe weather refuge location maps located inside most OU buildings near the entrances. Seek refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building. Go to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows. Get in, Get Down, Cover Up. Wait for official notice to resume normal activities. Additional [Weather Safety Information](#) is available through the Department of Campus Safety.

Fire alarm/general emergency: If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates:

1. *LEAVE* the building. Do not use the elevators.
2. *KNOW* at least two building exits
3. *ASSIST* those that may need help
4. *PROCEED* to the emergency assembly area
5. *ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues.*
6. *WAIT* for official notice before attempting to re-enter the building.

[OU Fire Safety on Campus](#)

Active Threat Guidance: The University of Oklahoma embraces a Run, Hide, Fight strategy for active threats on campus. This strategy is well known, widely accepted, and proven to save lives. To receive emergency campus alerts, be sure to update your contact information and preferences in the account settings section at one.ou.edu.

RUN: Running away from the threat is usually the best option. If it is safe to run, run as far away from the threat as possible. Call 911 when you are in a safe location and let them know from which OU campus you're calling from and location of active threat.

HIDE: If running is not practical, the next best option is to hide. Lock and barricade all doors; turn off all lights; turn down your phone's volume; search for improvised weapons; hide behind solid objects and walls; and hide yourself completely and stay quiet. Remain in place until law enforcement arrives. Be patient and remain hidden.

FIGHT: If you are unable to run or hide, the last best option is to fight. Have one or more improvised weapons with you and be prepared to attack. Attack them when they are least expecting it and hit them where it hurts most: the face (specifically eyes, nose, and ears), the throat, the diaphragm (solar plexus), and the groin.

Please save OUPD's contact information in your phone.

NORMAN campus: *For non-emergencies call (405) 325-1717. For emergencies call (405) 325-1911 or dial 911.*

TULSA campus: *For non-emergencies call (918) 660-3900. For emergencies call (918) 660-3333 or dial 911.*

- 14) **Food pantry:** The OU Food Pantry is committed to supporting all students, staff, and faculty with a selection of shelf-stable food, fresh produce, clothes, home and kitchen items, and books. All items are free and accessible for individuals within the OU community and may be ordered online via our website or through walk-ins during our open hours: 10 AM – 6 PM Tuesday to Thursday every week. For more information, please visit <https://linktr.ee/oupantry>, or stop by our location on campus at 333 Cate Center Dr.

TIPS FOR READING ORIGINAL RESEARCH ARTICLES

When you read an original research article, focus on the Introduction, Summary or Abstract, and Discussion or Conclusions (probably in that order). Try not to get hung up on methodological details or unfamiliar vocabulary. As you read, ask yourself the following questions: What did the author(s) basically do in the key experiment(s)? Why did they choose to do this particular experiment(s)? What was the major finding(s) of this experiment(s)? How did the authors interpret this finding(s) (i.e., what did it tell them about how nervous systems mediate natural behaviors)? Do you think this interpretation of the finding(s) is reasonable? Try to identify the key 1-3 data figures in the article and evaluate whether they really support the authors' conclusions.

When you write an analysis of an original research article, first describe the background and motivation for doing the study. Then describe the main hypothesis tested and the key experiment(s) performed, accurately and precisely, but in as simple language as possible. Explain what the key data demonstrate. Summarize the authors' conclusions and give your own critique of whether or not the experimental data support those conclusions.

TENTATIVE SCHEDULE

WEEK	TOPIC	REQUIRED READINGS	OPTIONAL READINGS
Weeks 1-2: 8/26, 8/28, 9/2	<u>Introduction</u>		
	Neuroethology's parents: Ethology & Neurobiology	Zupanc 3 rd ed. Ch. 3; Purves et al. 2nd ed. on-line Chs. 2-7 or UTHealth Chs. 1-5	Zupanc, 3 rd ed., Chs. 1-2; Tinbergen 1950; Lehrman 1953; Ewert 1980, Ch.1; Bullock 1983; Zupanc & Zupanc 2008; Brenowitz & Zakon 2015
Weeks 2-3: 9/4, 9/9, 9/11	<u>Sensing the world</u>		
	Owl sound localization	Sillar et al. Ch. 3; Linkenhoker & Knudsen 2002; Bergan et al. 2005	Pena & Gutfreund 2014; Zupanc, pp. 149-166; Konishi 2006; Knudsen 2002; Koppl 2009; Carr & Pena 2016; Berkowitz 2016 Ch. 7; Konishi obit
Weeks 4-5: 9/16, 9/18, 9/23	Bat echolocation	Zupanc 3 rd ed. Ch. 5; Sanchez et al. 2008	Ulanovsky & Moss 2008; Pierce & Griffin 1938; Griffin 2001; Suga 1989; Jones & Holderied 2007; Feng 2011; ter Hofstede & Ratcliffe 2016; Berkowitz 2016 Ch. 7; Wohlgenuth et al. 2016
Weeks 5-6: 9/25, 9/30, 10/2	Electric fish jamming avoidance	Zupanc & Bullock 2006; Enikolopov et al. 2018	Zupanc, Chapter 8; Lissmann 1951; Alexander 2006; Rose 2004; Berkowitz 2016 Ch. 7
Weeks 7-8: 10/7, 10/9, 10/14	<u>Sensorimotor integration, motor control, and behavioral choice</u>		
	Cricket singing & responding	Schöneich 2020; Schöneich et al. 2015	Zupanc, pp. 263-280; Hedwig 2006, 2016; Huber 1990; Berkowitz 2016 Ch. 8
10/21	Midterm Exam		
<i>10/23</i>	<i>Deadline for approval of student paper topics</i>		
Weeks 8-10: 10/16, 10/23, 10/28	Crayfish escape	Herberholz 2022; Yeh et al. 1996	Carew, Ch. 7; Edwards et al. 1999; Barinaga 1996; Berkowitz 2016 Ch. 3
Weeks 10-11: 10/30, 11/4, 11/6	Tadpole swimming	Sillar & Li 2020 pp. 153-164; Li et al. 2007	Zupanc, Chapter 6; Roberts et al. 2010; Berkowitz et al. 2010; Berkowitz 2016 Chs. 5-6
Weeks 12-13: 11/11, 11/13, 11/18	Leech behavioral choice	Lamb & Calabrese 2011 pp. 1-5; Briggman et al. 2005	Kristan et al. 2005, pp. 290-320; Briggman & Kristan 2008; Berkowitz 2016 Chs. 5-6
Weeks 13-15: 11/20, 11/25, 12/2, 12/4	<u>Learning</u>		
	Songbird song learning	Mooney 2022; Qi et al. 2025	Zupanc, pp. 281-294; Brainard & Doupe 2013; Mooney 2009; Nottebohm 2014; Barondes & Stryker 2015; Berkowitz 2016 Ch. 9
12/9, 12/11	Catch up or review		
12/16	FINAL EXAM: 1:30-3:30 PM		

Note: This schedule is tentative and may be changed by the instructor as needed.