PSY 445/545: Brain Mechanisms of Behavior
Fall 2008
CRN: PSY 445: 16177
PSY 545: 16178

The schedule in this syllabus is tentative and subject to change.

Overview

What are the neural mechanisms underlying behavior? How do neural circuits operate to achieve sensory processing, sensorimotor integration, motor control, and behavioral choice? How do neuroscientists investigate these questions? How can basic principles learned from particular species be applied to brain mechanisms in humans? In this course we will read original scientific research articles (many of them at the cutting edge) to try and answer these questions.

Objectives

To develop the tools and knowledge to ask meaningful questions about the neural mechanisms underlying behavior, how to frame these questions, and how one might attempt to answer them. After completing this course, you should be able to describe the neural mechanisms underlying behavior in a variety of model systems. You should also be able to read an original scientific research article, extract the background, main question, main experimental findings, and interpretations in the article, and clearly explain these in writing and orally.

Lectures

Tuesday & Thursday 10:00–11:20 AM; 146 Straub Hall
Lecture notes should be available online or on Blackboard before the lecture.

Instructor

Mike Wehr
wehr@uoregon.edu
Office hours: Monday 10:00-11:00 AM in 206 Huestis
or by appointment.

Teaching Assistant

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Office hours: Tuesday 1:00-2:00 PM IN 419 Straub
or by appointment
Phone: 346-5782

Textbook

none

Readings All required course readings will be available on Blackboard: https://blackboard.uoregon.edu. You should also be able to follow the links in this syllabus.
You should also check Blackboard frequently for announcements, course materials, etc.
There are also some optional readings in the excellent book "Behavioral Neurobiology" by Thomas Carew, which is on reserve at the Science Library.

Plagiarism Is taken very seriously and is grounds for failure or expulsion. You are responsible for understanding what constitutes plagiarism and how to avoid it in your work. Excellent guides on plagiarism can be found at http://libweb.uoregon.edu/guides/plagiarism/students/ and http://www.plagiarism.org. You are required to submit the term paper for this course using Blackboard's anti-plagiarism software plugin ("SafeAssign").

Cell Phones If it rings in class, or if you're talking on it, it's mine.

Grading

Midterm Exam	25%
Final Exam	25%
Paper	25%
Quizzes	25%
	100%

Expectations This course will be difficult. The material is advanced and the pace will be fast. The exams will be very challenging. Nevertheless, I expect that any student who does the readings, shows up to class, and asks questions should be able to master the material and succeed in the course. Typically, the top 20-25% students earn A's in the course. I do not take attendance, but there are no make-ups for in-class quizzes.

Exams
The midterm will be an in-class exam, on Thursday, October 30. The final will be a take-home exam, will cover the material from the entire course, and will be available on Blackboard after the last class on Thursday, December 4, and due by 5 p.m. on Monday, December 8. Both exams will include multiple choice, short answer, and brief essay questions.

Quizzes
You must do the assigned reading *before* each lecture. There will be a quiz every day, except the day of the midterm. There are no make-ups. Quizzes are open book and

open notes. Usually the first question or two will help me make sure you understood the important points from the readings. More importantly, you will often have a chance to share any aspects of the course material that you did *not* understand, were confused by, or had any other kind of trouble with. Your responses about what you *didn't* understand (and you are surely not alone) will help guide lectures. Quizzes will often include some review questions from previous classes, in addition to the readings, so it helps to pay attention in class. For the first three weeks, quizzes will be in-class. After that they will be online, on Blackboard, and due before the start of class. The quizzes together count for 25% of your grade, so you should take them seriously. But because there are 18 of them, any one quiz only counts for 1.3% of your grade, so skipping one or two will not have a big impact on your grade. **There are no make-ups.**

The purpose of the quizzes is threefold: (1) Lots of relatively easy points (if you've done the reading) distributed daily throughout the term. This takes some pressure off the exams, in case you have a bad exam day. (2) Motivation to do the reading, show up to class, and pay attention. (3) Constant feedback to me about how much you're understanding, and what concepts need more emphasis in class.

Paper/Project

The paper or project write-up should be roughly 8-10 pages, double spaced, and is due at the beginning of class on Thursday, November 20 (submit through Assignments on Blackboard). The topic can be anything related to the course. Regardless of which topic you choose, you must submit the topic for approval by Tuesday, November 6. Topic submission should fit on one page, and should include your name, paper title, one paragraph abstract, and a bibliography of no less than 3 of the sources you plan to use. Submit your topic through Assignments on Blackboard.

Format for the term paper:

- The filename must include your last name, for example: wehr-psy445-termpaper.doc
- Include page numbers.
- Include a header with your name and a shortened title (that fits on 1 line).
- Use .doc or .pdf

No matter how cool or interesting your project or paper, it must be well organized, clearly written, and grammatically correct. To get an idea of what criteria I will use to assess your writing, here is a good set of guidelines:
http://www.emich.edu/public/geo/geography/Mayda/gradecriteria.htm

You don't need to write yet another dull term paper on a topic that doesn't really interest you. In fact, you don't need to write a paper at all — below are some ideas for projects or presentations, as well as some starter ideas for paper topics that you can get excited about. *Be creative, find a topic you can get enthusiastic about, and then let that enthusiasm show in your work*. Here are some ideas for paper/project topics:

- Find an original research article that interests you, and read it. A good website to search for neuroscience articles is PubMed: http://www.ncbi.nlm.nih.gov/sites/entrez. Then read another article by a different author on a related topic (the references of the first article would be a good place to look). Compare and contrast the articles: Why did they do these experiments? How are their results related? Do their results agree? Why or why not? Which methodology is better, or are they both flawed? What experiment should they do next, and why?

- Figure out what the next step should be in the series of experiments that have been done, and propose an experiment that can address that next step. This could be a real, doable experiment, or what is sometimes more fun is to imagine impossible thought experiments... if you could record from every neuron in the brain, what might you expect to see? What could you learn? Where are the real limitations in current understanding? The format for a research proposal often has the following sections: Abstract, Specific Aims, Background and Significance, Research Design and Methods. There are many, many websites with guidelines for how to write an effective grant proposal, for example: http://web.wm.edu/grants/PROP/success.htm, http://deainfo.nci.nih.gov/extra/extdocs/gntapp.htm. You may ignore non-scientific aspects of grants, such as budgets and deadlines, if you like (or you could try including a budget for your proposal, why not?).

- Find an issue on which some authors disagree. Controversies always make for a rousing paper. You can lay out the characters and their positions, build suspense, root for the underdog, etc.

- A vanilla review paper can still be fun to write (and to read) if you try to personalize it. Why did you start researching this topic? What were you hoping to find out more about? Did you? What did you learn and how does that relate to what motivated you in the first place? etc.

- Instead of writing a paper, you can give a presentation to the class. For example, you could pick one of the regularly scheduled lectures below, and teach the class. Depending on which one you choose, you may even be able to take advantage of slides and lecture notes that I have already prepared. Or you could choose any relevant article that interests you, make your own slides, and present it to the class. This way you don't have to write a paper at all.

- Creative response. The neural mechanisms of behavior are as intriguing to artists as they are to scientists, and have inspired great science fiction novels and short stories, performance art, and visual art. A creative response can be anything relevant to the course… perhaps a short story, or how about an interpretive dance of the crayfish escape response (in front of the class, of course!).

Tips for reading and presenting research articles:
Focus on the Introduction, Abstract, and Discussion (probably in that order). Try not to get hung up on methodological details or unfamiliar vocabulary. As you read, ask

yourself: What did the authors basically do in the key experiment? Why did they choose to do this particular experiment? What were the major findings of this experiment? How did they intepret these findings, i.e., what did the results tell them? Is their interpretation reasonable? Do the data figures really support the authors' conclusions?

Schedule (subject to change: please be sure to download the Syllabus from http://www.neuro.uoregon.edu/wehr/coursepapers/Syllabus2008.pdf or from Blackboard for the most up-to-date schedule)

Hot new cutting edge research

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1. Tuesday, September 30
Introduction to brain mechanisms of behavior
No reading

2. Thursday, October 2
Optical microstimulation.
Reading: Sparse optical microstimulation in barrel cortex drives learned behaviour in freely moving mice
Daniel Huber, Leopoldo Petreanu, Nima Ghitani, Sachin Ranade, Tomás Hromádka, Zach Mainen & Karel Svoboda, 2008.
http://www.neuro.uoregon.edu/wehr/coursepapers/Huber-Svoboda-2008.pdf
lecture notes

3. Tuesday, October 7
Internally generated cell assembly sequences in the hippocampus.
Reading: Internally generated cell assembly sequences in the rat hippocampus.
Eva Pastalkova, Vladimir Itskov, Asohan Amarasingham, György Buzsáki, 2008.
http://www.neuro.uoregon.edu/wehr/coursepapers/Pastalkova-Buzsaki-2008.pdf
lecture notes

4. Thursday, October 9
Reactivation in Human Hippocampus During Free Recall.
Reading: Internally Generated Reactivation of Single Neurons in Human Hippocampus During Free Recall.
Hagar Gelbard-Sagiv, Roy Mukamel, Michal Harel, Rafael Malach, and Itzhak Fried, 2008.
http://www.neuro.uoregon.edu/wehr/coursepapers/Gelbard-Sagiv-Fried-2008.pdf
lecture notes

5. Tuesday, October 14
Controlling a robot arm with the brain.
Guest lecture by Evan Loehle-Conger
Reading: Cortical control of a prosthetic arm for self-feeding.

Meel Velliste, Sagi Perel, M. Chance Spalding, Andrew S. Whitford & Andrew B. Schwartz, 2008.
http://www.neuro.uoregon.edu/wehr/coursepapers/Velliste-Schwartz-2008.pdf

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Neuroethology

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6. Thursday, October 16
Hormones, waves and sex: electrocommunication in weakly electric fish.
Guest lecture by Janis Weeks.
Reading: Androgen-dependent modulation of the electrosensory and electromotor systems of a weakly electric fish.
Harold Zakon, Alice Mills, and Michael Ferrari, 1991.
http://www.neuro.uoregon.edu/wehr/coursepapers/zakon_et_al_91.pdf
Weakly electric fish as model systems for studying long-term steroid action on neural circuits.
Harold Zakon, 1993.
http://www.neuro.uoregon.edu/wehr/coursepapers/Zakon_93.pdf

Special lecture by Harold Zakon:
Communication in electric fish.
Friday, October 17th, 1-2 p.m., 331 Klamath.

7. Tuesday, October 21
Neural mechanisms of escape behavior in crayfish.
Reading: Neural mechanisms for serial order in a stereotyped behaviour sequence.
Heinrich Reichert and Jeffrey Wine, 1982.
http://www.neuro.uoregon.edu/wehr/coursepapers/Reichert-Wine-1982.pdf
lecture notes

8. Thursday, October 23
Neural mechanisms of echolocation in bats.
Reading: Neural axis representing target range in the auditory cortex of the mustache bat.
Nobuo Suga & William O'Neill, 1979.
http://www.neuro.uoregon.edu/wehr/coursepapers/suga-oneill-1979.pdf
lecture notes

9. Tuesday, October 28
Neural mechanisms of habituation and dishabituation in Aplysia.
Reading: Neuronal Mechanisms of Habituation and Dishabituation of the Gill-Withdrawal Reflex in Aplysia
Vincent Castellucci, Harold Pinsker, Irving Kupfermann and Eric Kandel, 1970.
http://www.neuro.uoregon.edu/wehr/coursepapers/Castellucci-Kandel-1970.pdf

10. Thursday, October 30

Midterm in class
No reading

11. Tuesday, November 4
Place fields, spatial navigation, and the hippocampus.
Guest lecture by Cliff Kentros
Reading: Increased attention to spatial context increases both place field stability and spatial memory.
Cliff Kentros, Naveen Agnihotri, Samantha Streater, Robert Hawkins, and Eric Kandel.
http://www.neuro.uoregon.edu/wehr/coursepapers/Kentros-Kandel-2004.pdf

12. Thursday, November 6
Reading a neural code.
Reading: Reading a neural code.
William Bialek, Fred Reike, Robert de Ruyter van Steveninck, David Warland, 1991.
http://www.neuro.uoregon.edu/wehr/coursepapers/bialek-warland-1991.pdf

13. Tuesday, November 11
Neural mechanisms of odor tracking in *C. elegans.*
Reading: Functional asymmetry in *Caenorhabditis elegans* taste neurons and its computational role in chemotaxis.
Hiroshi Suzuki, Tod R. Thiele, Serge Faumont, Marina Ezcurra, Shawn R. Lockery & William R. Schafer, 2008.
http://www.neuro.uoregon.edu/wehr/coursepapers/Suzuki-Schafer-2008.pdf
lecture notes

Decision-making in primates

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14. Thursday, November 13
Neural mechanisms for forming a perceptual decision.
Reading: Neural mechanisms for forming a perceptual decision.
Dan Salzman & Bill Newsome, 1994.
http://www.neuro.uoregon.edu/wehr/coursepapers/salzman-newsome-1994.pdf

15. Tuesday, November 18
Neural mechanisms of decision-making in somatosensory cortex.
Reading: Neuronal correlates of decision-making in secondary somatosensory cortex.
Ranulfo Romo, Adrian Hernández, Antonio Zainos, Luis Lemus, & Carlos Brody, 2002.
http://www.neuro.uoregon.edu/wehr/coursepapers/Romo-Brody-2002.pdf
Paper topics due in class

16. Thursday, November 20
Neural mechanisms of decision-making in parietal cortex.
Reading: Neural correlates of decision variables in parietal cortex.
Michael Platt & Paul Glimcher, 1999.
http://www.neuro.uoregon.edu/wehr/coursepapers/platt-glimcher-1999.pdf
http://www.neuro.uoregon.edu/wehr/coursepapers/platt-glimcher-1999-nv.pdf
Papers due at 10 a.m. (in Assignments on Blackboard)

17. Tuesday, November 25
Neural mechanisms of game-playing.
Reading: Activity in Posterior Parietal Cortex Is Correlated with the Relative Subjective Desirability of Action
Michael Dorris & Paul Glimcher 2004
http://www.neuro.uoregon.edu/wehr/coursepapers/dorris-glimcher-2004.pdf

Thursday, November 27
No Class

Sex, drugs, and the brain

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18. Tuesday, December 2
Neural mechanisms of drug addiction.
Reading: Addiction as a Computational Process Gone Awry.
David Redish, 2004.
http://www.neuro.uoregon.edu/wehr/coursepapers/Redish-2004.pdf

19. Thursday, December 4
Last class
Neural mechanisms of love.
Reading: Enhanced partner preference in a promiscuous species by manipulating the expression of a single gene.
Miranda Lim, Zuoxin Wang, Daniel Olazábal, Xianghui Ren, Ernest Terwilliger, and Larry Young.
http://www.neuro.uoregon.edu/wehr/coursepapers/Lim-Young-2004.pdf
lecture notes
Take home final exam becomes available

Monday, December 8
Final due by 5 p.m.

Brain Mech **Calendar** **2008**

Monday	Tuesday	Wednesday	Thursday
September 29	30 Day 1 Introduction Quiz 1	October 1 Reading: Huber-Svoboda-2008	2 Day 2 Optical microstimulation Quiz 2
6 Reading: Pastalkova-Buzsaki-2008 Last day to drop	7 Day 3 Hippocampal replay. Quiz 3	8 Reading: Gelbard-Sagiv-Fried-2008	9 Day 4 Hippocampal recall Quiz 4
13 Reading: Velliste-Schwartz-2008	14 Day 5 Robot arm Quiz 5	15 Reading: Zakon et al., 1991 Zakon, 1993	16 Day 6 Electrocommunication in fish Quiz 6
20 Reading: Reichert-Wine-1982	21 Day 7 Crayfish escape Quiz 7	22 Reading: Suga-O'Neill-1979	23 Day 8 Echolocation in bats Quiz 8
27 Reading: Castellucci-Kandel-1970	28 Day 9 Gill withdrawl in *Aplysia* Quiz 9	29 No reading	30 Day 10 **Midterm**
November 3 Reading: Kentros-Kandel-2004	4 Day 11 Place fields Quiz 10	5 Reading: Bialek-Warland-1991	6 Day 12 Spikes in blowflies Quiz 11 **Paper topics due**
10 Reading: Suzuki-Schafer-2008	11 Day 13 Chemotaxis in *C. elegans* Quiz 12	12 Reading: Salzman-Newsome-1994	13 Day 14 Decision-making 1 Quiz 13
17 Reading: Romo-Brody-2002	18 Day 15 Decision-making 2 Quiz 14	19 Reading: Platt-Glimcher-1999	20 Day 16 Decision-making 3 Quiz 15 **Papers due at 10 am**
24 Reading: Dorris-Glimcher-2004	25 Day 17 Decision-making 4 Quiz 16	26 No reading	27 No Class
December 1 Reading: Redish-2004	2 Day 18 Addiction Quiz 17	3 Reading: Lim-Young-2004	4 Day 19 Love Quiz 18 **Final available** **Final is due at 5 pm on Monday, December 8th**