Department of Psychology - Columbia University

Behavioral Neuroscience

UN2450 / Course Syllabus / Spring 2021

Instructor: Alfredo Spagna, Ph.D.
Class Meets: Monday & Wednesday 1:10 PM - 2:25 PM
Room: Zoom
Linkedin / Researchgate: Alfredo Spagna

Office: Zoom
Office Hours: Tuesday 3 – 5PM
Email: as5559@columbia.edu
Twitter: @spagnaphd

Teaching Assistants:

Basak Akdogan: basak.akdogan@columbia.edu; Office Hours: Wednesday 6 to 8pm
Margaret Krassner: mmk2221@columbia.edu; Office Hours: Thursday 2 to 4pm
Kristen Lewis: kl2954@columbia.edu; Office Hours: Wednesday 4 to 6pm
Rafael Vignoli Lippert: rvl2108@columbia.edu; Office Hours: TBD
Jason Wang: jw3730@columbia.edu; Office Hours: Friday 10 to 12pm

Course Description

Behavioral Neuroscience explores behavior by understanding the influences of biological processes. What does a prototypical neuron look like? How do neurons talk to each other? How does neuronal communication produce behavior? And then moving more into behavioral questions like: what happens in the brain when you want to move? why do we dream? How do we form memories? What are the biological bases of mental disorders? How does the environment interact with our genes? We will explore answers to questions like these by looking at the principles governing neuronal activity, the relationship between brain activity and subjective experience, the role of neurotransmitter systems in memory and motivational processes, and the presumed brain dysfunctions that give rise to mental illnesses like schizophrenia and depression.

Prerequisites

Psych W1001 or W1010 or permission of the instructor. Basic knowledge of biology and chemistry is helpful, but not necessary.

Full Description and learning objectives:

This course aims to provide students with a strong foundation in the field of Behavioral Neuroscience.

- **Historical Introduction, Neurons and Glia (Ch 1, 2):** Be able to contextualize historical and changing understandings of the function and organization of the nervous system with respect to influences of current technological advancements, scientist personalities, and prevailing cultural metaphors

(e.g. the brain as a computer). Understand the functional, anatomical and physiological differences between neurons and glia.

- **Membrane Potentials (Ch 3):** Describe the factors that govern the direction and rate of movement of ions across membranes. Understand the structural and functional differences among categories of membrane proteins including: channels, pumps, receptors, and pores.

- **Action Potential (Ch 4):** Describe the phases of an action potential and the mechanisms underlying each phase in terms of the movement of ions across the cell membrane. Understand roles of K+, Na+, Ca2+, and Cl- in action potential physiology and in releasing neurotransmitters at the synapse.

- **Synaptic Transmission (Ch 5):** Compare and contrast properties and locations of chemical and electrical synapses. Understand the mechanics of chemical synaptic transmission from the point of the action potential reaching the axon terminal to the point of the *postsynaptic* change in membrane potential.

- **Neurotransmitter systems (Ch 6):** Compare and contrast the major neurotransmitter systems, including pathways and the behavioral systems they regulate.

- **Structure of the nervous system (Neuroanatomy) (Ch 7):** Understand definitions, locations, and functions of the components and regions of the central and peripheral nervous systems.

- **Brain control of movement (Ch 14):** Describe how the brain influences the activity of the spinal cord to command voluntary movements. To appreciate the different contributions of the three hierarchical levels to movement, the highest level, represented by the association areas of neocortex and basal ganglia of the forebrain, is concerned with *strategy*; the middle level, represented by the motor cortex and cerebellum, is concerned with *tactics*; the lowest level, represented by the brain stem and spinal cord, is concerned with *execution*.

- **Motivation (Ch 16):** Motivation can be thought of as a driving force on behavior. It can be very abstract but it can also be quite concrete. Much has been learned about what motivates certain behaviors that are basic to survival. In this chapter we will look at he role of hypothalamus in motivated behavior of basic needs (body temperature, energy and fluid balances).

- **Emotion (and 18):** Emotional experiences are a large part of being human. What we know about the brain mechanisms of emotion has been derived from a synthesis of animal and human studies. In animals, brain activity and the effects of brain lesions on behavior have been noted and interpreted in the context of emotions, even though we cannot determine the animals' feelings. Studies in humans have examined brain activity associated with emotional experience and the recognition of emotion in others.

- **Brain Rhythms and Sleep (Ch19):** Brains have evolved a variety of systems for rhythmic control. Sleeping and waking are the most striking periodic behavior. We will explore selected brain

rhythms and summarize what is known about the timers that regulate the everyday ups and downs of our hormones, body temperature, alertness, and metabolism.

- **The Resting Brain, Attention, and Consciousness (Ch21):** The Default mode Network, the task positive networks of attention: how do we become aware of things? This chapter should give you a thorough examination of the neural pathways underlying attention and its interplay with perception and higher-level cognitive functions.

- **Mental Illness (Ch 22):** Health and illness are two points along a continuum of bodily function, and the same can be said for mental health and mental illness. Here, we will discuss some of the most severe and prevalent psychiatric disorders: anxiety disorders, affective disorders, and schizophrenia.

- **Memory Systems (Ch 25):** In this chapter, we discuss the anatomy of memory—the different parts of the brain involved in storing particular types of information. From the moment we take our first breath, we learn an enormous number of things, some are easily stated facts, while others, such as driving or playing soccer, involve ingrained motor patterns. We will see that brain lesions differentially affect different types of remembered information, suggesting that there is more than one memory system.

Role of PSYC UN2450 in the curriculum

PSYC UN2450 Behavioral Neuroscience is an intermediate-level lecture course, open to undergraduates and students in the Post-baccalaureate Psychology program. It fulfills the following degree requirements:

- For the Neuroscience & Behavior major, this course can be used to fulfill either the P2 Course in Neuroscience requirement or the P4 Additional 2000-level Psychology lecture course, but not both.
- For the Psychology major and concentration, and for the Post-baccalaureate Psychology program, this course meets the Group II – Psychobiology & Neuroscience – distribution requirement.

Course website

The most up-to-date information, including changes to the syllabus or to the class schedule, announcements, lecture slides and additional materials are contained on the course website on CourseWorks (Canvas). Be sure you are familiar with it, that you are easily able to login to the website, and that you always have the lecture slides with you (whether in print or digital form). If you have problems accessing the course website at any point during the semester, please let me know.

Readings

- *Required Textbook*

  Neuroscience Exploring the Brain. Mark R. Bear, Barry W. Connors, Michael A. Paradiso, Lippincott Williams and Wilkins, Fourth Edition, 2016; ISBN 9780781778176

Copies of this book are on reserve at the Science & Engineering Library in the Northwest Corner building. Call number: QP355.2 .B425 2016

- Additional Materials:

Various supplemental materials will be provided by the instructor on the course website.

Such material will be selected from:

- Hudspeth, A. J., Jessell, T. M., Kandel, E. R., Schwartz, J. H., & Siegelbaum, S. A. (Eds.). (2013). *Principles of neural science*.

Grades

- Canvas Quizzes: 5% of the final grade
- Exam1 (Feb 8th): 20% of the final grade
- Exam 2 (March 10th): 20% of the final grade
- Exam 3 (April 21st): 30% of the final grade (cumulative)
- Written Assignment: 25% of the final grade
    a. Choice of the topic (5%)
    b. First Draft (10%)
    c. Peer – review Feedback (20%)
    d. Final Submission (65%)

Letter Grade Assignment (in between whole numbers? 0.5+ will be rounded up)

97-100: A+	87-89: B+	77-79: C+	67-69: D+	<60: F
94-96: A	84-86: B	74-76: C	64-66: D	
90-93: A-	80-83: B-	70-73: C-	60-63: D-	

Exams: will be a mix of multiple choice, fill-in, and short-answer questions. The majority of each test will focus on material covered in the lectures, and the corresponding sections in the textbook.

→ While studying, try to emphasize *understanding* and *critical thinking*. Knowing key concepts and definitions is highly valued, of course, but successful students use that knowledge to scaffold a more comprehensive understanding of the material. This is highly advisable for these exams and in general for your career. Rather than simply "memorizing," try to "understand" the material and use your Instructor and the TAs for clarification. Test questions will include more basic definitional / conceptual knowledge as well as application of that knowledge to new scenarios.

→ Slides on the course website should be considered as a study aid, but they may not be "good enough" on their own unless you come to class and take notes. Sometimes I may have to skip slides in the posted lectures if we run out of time in class. If that happens, you should still read the relevant sections in the textbook, as the textbook material may be included in exams.

Make-up exams: will be allowed only with written justification (e.g., by your doctor or advising dean) and must be taken within one week *after* the exam. (Make-up exams will not be offered before the scheduled exam date).

Written Assignment

Good writing is good thinking, and a primary goal of this assignment is to help students enhance writing and critical thinking skills by deepening their understanding of a course-related topic of their choice.

1. **Topic Proposal** (deadline Week 6 – February 15th at 11:59PM): Early in the course students will be asked to identify a topic related to the class and submitting the proposal on Courseworks Assignment Page. The Instructor and the TA will promptly approve the topic or give some suggestions for changes if needed (e.g., if the topic chosen does not fit with the course's content). The topic must be about either:
    - **path 1**. A seminar/colloquium/panel they plan to attend (and motivate which event and why): attend a seminar given by a scientist about their work, and write up a summary of their talk. The schedule of seminars and colloquia of potential interest will be shown in class, but you are also invited to conduct a search on your own, and to check in with your professor / TAs to see if the talk you chose adheres with the goal of this assignment.
    - **path 2**. A literature search they plan to conduct (and motivate which topic and why): conduct a literature search (either on Pubmed, Google Scholar, or look at the "Publications" sections of the various Clinical Neuropsychology at CU and beyond – refer to an attachment called List of Researchers for the Writing Assignment – Short Paper) to find a recent and exciting empirical paper in the current neuropsychology literature, and write up a summary of this study. Review papers are NOT a good fit for this assignment.
2. **First Draft** (deadline week 10 – March 17th at 11:59PM): Once your topic is approved, students can begin work on a first draft of the paper. Generally, -page manuscript (excluding references).
   The instructor will provide comments and suggestions on the first draft, and students will be expected to make substantive changes.
3. **Anonymous peer review** (deadline week 12 – March 31st at 11:59 PM): In order to make this activity also an opportunity for students to actively learn, one of the steps in the revision process will be a round of "anonymous peer review," in which each student will be asked to review the drafts of at least two of their colleagues. This will put each student in the position of the "reviewer," by critically analyzing and understanding pitfalls, shortcomings, but also strengths of the writing of their peers; this is expected to influence also the student's own writing by adjusting the focus and clarifying potential issues. Students will be randomly assigned to anonymously peer review the drafts written by two other students. Comments and suggestions from the peer-review process should be appropriately considered when writing the final paper, based on the student's judgment. Students will be evaluated on their own writing, their feedback provided to other students, as well as their ability to incorporate the feedback into their work. Make sure you provide valuable feedback to your peers in order to get full points on the final writing assignment.

4. **Final submission on Courseworks** (deadline week 14 – April 14th at 11:59PM): The final draft of the paper will be graded not only as a standalone paper but also in how it demonstrates improvement upon the earlier draft.

While the format of the assignment is pretty "free", what we want to know is:

- What you attended or read (include relevant information such as the date of the talk or year of publication)
- Why you chose to attend this talk or read this paper
- Who is the speaker for the talk you attended, or who the lead researcher on the paper is (this is usually indicated as either the first or last author, the latter signifies the senior author)
- What is the field of investigation
- What was the topic about
- What was the potential advancement in the literature proposed by the speaker or author
- What was the take-home message
- What are potential future research ideas that the talk or article inspired in you
- What are the potential societal contributions or effects of the research discussed in the talk or paper

More detailed information about how to successfully write this assignment can be found in the folder "Writing Assignment Rubrics" posted on Courseworks. There will be one rubric per each "path"; make sure you consult both of them before choosing what your writing assignment will be about.

Formatting requirements:

A. Page length: between 8 and 10 pages, references excluded;
B. Double spaced;
C. One-inch margins.

Class policies: Important Information below – please read carefully!

- Disability Services: In order to receive disability-related academic accommodations for this course, students must first be registered with their school Disability Services (DS) office. Detailed information is available online for both the Columbia and Barnard registration processes.
  Refer to the appropriate website for information regarding deadlines, disability documentation requirements, and drop-in hours(Columbia)/intake session (Barnard).
  For this course, students are not required to have testing forms or accommodation letters signed by faculty. However, students must do the following:
  1. The Instructor section of the form has already been completed and does not need to be signed by the professor.
  2. The student must complete the Student section of the form and submit the form to Disability Services.
  3. Master forms are available in the Disability Services office or online:https://health.columbia.edu/services/testing-accommodations

- Religious observances: If you are going to miss class(es) due to religious holidays, you must notify me during the first week of class so that accommodations may be made.

- Academic integrity: As members of this academic community, we are responsible for maintaining the highest level of personal and academic integrity: "Each one of us bears the responsibility to participate in scholarly discourse and research in a manner characterized by intellectual honesty and scholarly integrity. The exchange of ideas relies upon a mutual trust that sources, opinions, facts, and insights will be properly noted and carefully credited. In practical terms, this means that, as students, you must be responsible for the full citations of others' ideas in all of your research papers and projects… [and] you must always submit your own work and not that of another student, scholar, or internet agent" (from the Columbia University Faculty Statement on Academic Integrity) http://www.college.columbia.edu/academics/academicintegrity.

- Cheating and plagiarism – whether intentional or inadvertent – is a serious violation of academic integrity. Plagiarism is the practice of claiming or implying original authorship of (or incorporating materials from) someone else's written or creative work, in whole or in part, without adequate acknowledgement. If you have any questions about what constitutes plagiarism and/or how to properly cite sources, please come to me. I am more than happy to help. Similarly, if you put yourself in a situation in which you think your best option might be to cut some corners, see me. If you feel like you are falling behind, don't understand the material, or are not confident about your ability to take tests, talk to me as soon as possible instead of taking measures that go against principles of academic integrity. We are here to learn, not to merely judge. It is a far better option to come talk to me than compromise your academic integrity and potentially put your academic standing in jeopardy.

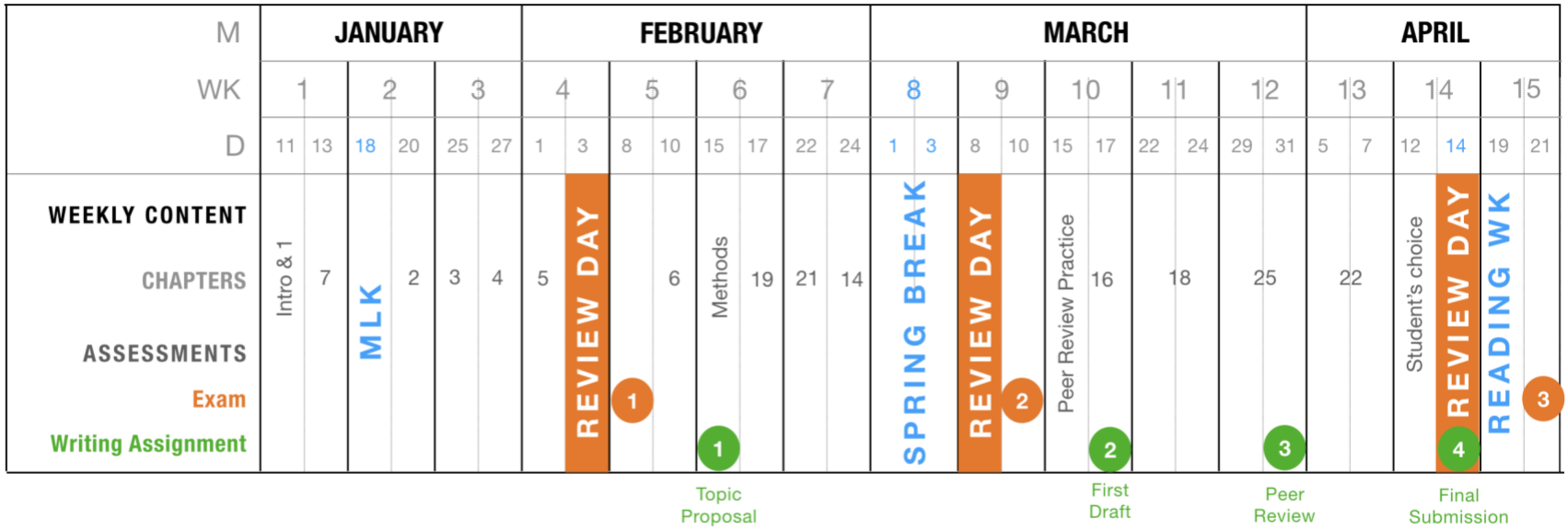
- Sexual Respect: Any form of gender-based misconduct will not be tolerated. Columbia University is committed to fostering an environment that is free from gender-based discrimination and harassment, including sexual assault and all other forms of gender-based misconduct. Visit this website for more information: http://sexualrespect.columbia.edu/

- Attendance: Coming to class is meaningless if class time is spent inappropriately. Chatting with friends, watching videos online, and browsing social media are not appropriate activities for the classroom. Also, remember to silence your cell phone before class. Generally, eliminate distractions as much as possible to respect your classmates, as well as increase your chance of staying focused and learning the material during class.

Schedule

The calendar below details topics, readings, and assignments for each class period. Students are responsible to be prepared to discuss the assigned readings for each class peri

Spring 2021 Timeline



Chapter 7: Structure of the nervous system
Chapter 1 & 2: Neurons and Glial Cells
Chapter 3: Membrane Potential
Chapter 4: Action Potential
Chapter 5: Synaptic Transmission

Chapter 6: Neurotransmitter Systems
Chapter 19: Brain Rhythms and Sleep
Chapter 21: Attention and Consciousness
Chapter 14: Brain Control of Movement

Chapter 16: Motivation
Chapter 18: Emotion
Chapter 25: Memory Systems
Chapter 22: Mental Illnesses

Date(s)	Topic	Readings
January 11 (M)	Info about the Course, historical Intro	Ch 1
January 13 (W)	Structure of the nervous system (Neuroanatomy)	Ch 7
January 18 (M)	**MLK – No Class Scheduled**	
January 20 (W)	Neurons and Glia	Ch 2
January 25 (M)	Membrane Potential	Ch 3
January 27 (W)	Action Potential	Ch 4
February 1 (M)	Synaptic Transmission	Ch 5
February 3 (W)	**Review Day**	**Ch 1 – 5, 7**
February 8 (M)	**Exam # 1**	**Ch 1 – 5, 7**
February 10 (W)	Neurotransmitter systems	Ch 6
February 15 (M)	Methods	Ch 6
	Deadline Submission Topic Proposal	
February 17 (W)	Brain Rhythms and Sleep	Ch 19
February 22(M)	Attention and Consciousness	Ch 21
February 24 (W)	Brain control of Movement	Ch 14
March 1 (M)	**Spring Break**	
March 3 (W)	**Spring Break**	
March 8 (M)	**Review Day**	**Ch 6, 19, 21, 14**
March 10 (W)	**Exam # 2**	**Ch 6, 19, 21, 14**
March 15 (M)	Peer Review Practice	
March 17 (W)	Motivation	Chapter 16
	Deadline Submission Writing Assignment	
March 22 (M)	Emotion	Chapter 18
March 24 (W)	Emotion	Chapter 18
March 29 (M)	Memory System	Chapter 25
March 31 (W)	Memory System	Chapter 25
April 5 (M)	Mental Illness	Chapter 22
	Deadline Submission Peer Review	
April 7 (W)	Mental Illness	Chapter 22
April 12 (M)	Student's choice	
April 14 (W)	**Review Day**	**Ch 16, 18, 25, 22**
	Deadline Submission Writing Assignment	
April 19 (M)	**Reading Week**	
April 21 (W)	**Exam # 3**	**Cumulative**

Any changes will be announced in lecture and posted as an announcement on CourseWorks (Canvas).