**Neuroscience & Society**

Department of Psychology – Columbia University

UN3496 - Summer B 2023

3 points

**Instructor**: Trenton Jerde, Ph.D.

**Class Meets**: To be determined

**Email**: taj2128@columbia.edu

**Office Hours**: Virtual by appointment

**Course bulletin description**:This course investigates the ways in which research in human neuroscience both reflects and informs societal issues. Topics include how neuroscience research is interpreted and applied in areas such as healthcare, education, law, consumer behavior, and public policy.

**Prerequisites**: Science of Psychology (PSYC 1001) or Mind, Brain, & Behavior (PSYC 1010), or equivalent introductory psychology course. Students who have not taken one of these courses may also be admitted with instructor permission.

**Full description**: This seminar course considers the role of neuroscience in society by inquiring how our understanding of the brain can be applied – and potentially misapplied – in areas such as social and economic policy, healthcare, education, mental health, and the law. Questions we will explore include the following: How do the neural and cognitive sciences contribute to our understanding of free will and decision making, and what are the implications for the law? How does our understanding of adolescent brain development affect culpability in the juvenile justice system? How does neuroscience inform our understanding of cultural differences on topics such as memory? How can we use neuroscience to offer better treatment for people experiencing mental health issues? What are the connections between neuroscience, artificial intelligence, and society?

Students will participate in group discussions during class and lead discussions of papers, while aiming to engage their classmates as much as possible.

**Instructor**

The instructor is Senior Editor at *Nature Machine Intelligence*, a science journal on artificial intelligence, machine learning, and robotics. He has a BA in psychology from the University of Iowa, a PhD in neuroscience from the University of Minnesota, and postdoctoral training in cognitive neuroscience from New York University. He has worked as a consultant on brain disorders, including at Medtronic on deep brain stimulation for Parkinson’s disease; and held faculty positions at Columbia University, New York University, and the University of Minnesota.

**Learning objectives**:

* Reading and critical thinking are key skills in understanding science. This course will give you training in reading primary research articles, review papers, and book chapters - the majority of what scientists read. These activities are different from reading textbooks.
* You will learn how to review the literature and find relevant peer-reviewed papers, allowing you to keep up to date in any field of science.
* This course will enable you to engage in constructive scientific conversations and debates, which will broaden and deepen your understanding of research in areas of neuroscience that are related to society. We will discuss the sorts of questions you should ask about new results, how to interpret results in the context of other studies, and how to think about neuroscience findings in the context of real-world experiences.
* This course will improve how you communicate in oral presentations and written work.

**Topics and Readings**

**Class 1: Introduction to Neuroscience and Society**

Neuroscience: Past, Present, and Future

Bear M, Connors B, Paradiso MA (2020)

Chapter 1 in *Neuroscience: Exploring the Brain*. ‎Jones & Bartlett Learning, Burlington MA

The emergence and influence of internal states

Flavell SW, Gogolla N, Lovett-Barron M, Zelikowsky M (2022)

*Neuron* 110(16), 2545-2570

The continued need for animals to advance brain research

Homberg JR (2021)

*Neuron* 109, 2374-2379

**Class 2: Morality, decision making, volition, and the law**

For the law, neuroscience changes nothing and everything

Greene J, & Cohen J (2004)

*Philosophical Transactions of the Royal Society of London B* 359, 1775-1785

Severe disturbance of higher cognition after bilateral frontal lobe ablation: patient EVR

Eslinger PJ, Damasio AR (1985)

*Neurology* 35(12), 1731-41

Suffering souls. The search for the roots of psychopathy

Seabrook J (2008)

*New Yorker*, Nov. 10, 2008

Predicting violent behavior: What can neuroscience add?

Poldrack RA, Monahan J, Imrey PB, Reyna V, Raichle ME, et al. (2018)

*Trends in Cognitive Sciences* 22(2), 111-123

**Class 3: Adolescent brain development**

Healthy development as a human right: Lessons from developmental science

Casey BJ (2019)

*Neuron* 102, 724-727

Navigating the social environment in adolescence: The role of social brain development

Andrews JL, Ahmed S, & Blakemore S-J (2020)

*Biological Psychiatry* 89(2), 109-118

Overcoming addiction stigma: Epigenetic contributions to substance use disorders and opportunities for intervention

Szutorisz H, Hurd YL (2022)

*Neuron* 110(10), 1611-1614

**Class 4: Neuroscience and mental health**

Chapter 1 of *On the Heels of Ignorance: Psychiatry and the Politics of Not Knowing*

Whooley O (2019)

University of Chicago Press

Functional Neuroimaging in psychiatry and the case for failing better

Nour MN, Liu Y, Dolan RJ (2022)

*Neuron* 110(16), 2524-2544

The National Institute of Mental Health Research Domain Criteria: An alternative framework to guide psychopathology research

Sanislow CA, Morris S., Pacheco J, & Cuthbert BN (2020)

In J. R. Geddes, N. C. Andreasen, and G. M. Goodwin (Eds). *The New Oxford Textbook of Psychiatry* (3rd Edition). Oxford University Press, Oxford, UK

Smartphones and the neuroscience of mental health

Gillan CM, Rutledge RB (2021)

*Annual Review of Neuroscience* 44, 129-151

**Class 5: Gut and brain—the microbiome**

How gut bacteria alter the brain

Willyard C (2021)

*Nature* vol. 590

Microbiota-brain interactions: Moving toward mechanisms in model organisms

Nagpal J, Cryan JF (2022)

*Neuron* 109(24), 3930-3953

**Class 6: Socioeconomic status and the brain**

The impact of a poverty reduction intervention on infant brain activity

Troller-Renfree SV, Costanzo MA, Duncan GJ, Noble KG (2022)

*Proceedings of the National Academy of Sciences* 119(5), e2115649119

Connecting the brain to the rest of the body: Early childhood development and lifelong health are deeply intertwined

Center for the Developing Child, Harvard University (2020)

Working paper 15

Socioeconomic status and the brain: prospects for neuroscience-informed policy

Farah MJ (2018)

*Nature Reviews Neuroscience* 19, 428–438

**Class 7: Memory: culture, phenomenology, and neurophysiology**

The cultural foundation of human memory

Wang Q (2021)

*Annual Review of Psychology* 72, 151-179

Brain mechanisms underlying the subjective experience of remembering

Simons JS, Ritchey M, Fernyhough C (2022)

Annual Review of Psychology 73, 159-186

Neurophysiology of remembering

Buzsaki G, McKenzie S, Davachi L (2022)

Annual Review of Psychology 73, 187-215

**Class 8: Emotion in animals and machines**

The social effects of emotions

Van Kleef GA, Cote S (2022)

Annual Review of Psychology 73: 629-658

The question of animal emotions

De Waal FBM, Andrews K (2022)

*Science* 375(6587), 1351-1352

Homeostasis and soft robotics in the design of feeling machines

Man K, & Damasio AR (2019)

*Nature Machine Intelligence* 1, 446–452

**Class 9: Neuroscience and consciousness**

Hemisphere deconnection and unity in conscious awareness

Sperry RW (1968)

*American Psychologist* 23 (10), 723-733

The interpretive cortex. The stream of consciousness in the human brain can be electrically reactivated

Penfield W (1959)

*Science* 129 (3365), 1719-1725

Consciousness as a Memory System

Budson AE, Richman KA, Kensinger EA (2022)

*Cognitive and Behavioral Neurology* (ahead of print)

Making the hard problem of consciousness easier

Melloni L, Mudrik L, Pitts M, Koch C (2021)

*Science* 372(6545), 911-912

**Class 10: Brain-machine interface and neural prosthetics**

The brain-reading devices helping paralysed people to move, talk and touch

Drew L (2022)

*Nature* April 20, 2022

Exploring cognition with brain-machine interfaces

Andersen RA, Aflalo T, Bashford L, Gjanes, D, Kellis S (2022)

*Annual Review of Psychology* 73, 131-158

How a revolutionary technique got people with spinal-cord injuries back on their feet

Willyard C (2019)

*Nature* July 31, 2019

**Class 11: Mindfulness, psychedelics, and alternative medicine**

The emerging science of microdosing: A systematic review of research on low dose psychedelics (1955–2021) and recommendations for the field

Polito V, Liknaitzky P (2022)

Neuroscience & Biobehavioral Reviews 139, 104706

Psychedelic drugs: neurobiology and potential for treatment of psychiatric disorders

Vollenweider FX, Preller KH (2020)

*Nature Reviews Neuroscience* 21, 611-624

Electroacupuncture activates neurons to switch off inflammation

Ulloa L (2021)

*Nature* October 13, 2021

A neuroanatomical basis for electroacupuncture to drive the vagal–adrenal axis

Liu S, Wang Z, Su Y, Qi L, Yang W, et al. (2021)

*Nature* 598, 641-645

**Class 12: Brain organoids**

Human brain cells implanted in rats prompt excitement — and concern

Reardon S (2022)

*Nature* October 12, 2022

Human brain organoids influence rat behaviour

Camp JG, Treutlein B (2022)

*Nature* October 12

Maturation and circuit integration of transplanted human cortical organoids

Revah O, Gore F, Kelley KW, Andersen J, Sakai N, et al. (2022)

*Nature* 610, 319-326

Hybrid brains: the ethics of transplanting human neurons into animals

Powell K (2022)

*Nature* August 03, 2022

**Class 13: Neuroscience and artificial intelligence**

Using neuroscience to develop artificial intelligence

Ullman S (2019)

*Science* 363(6428) 692-693

Neuroengineering challenges of fusing robotics and neuroscience

Cheng G, Ehrlich SK, Lebedev M, Nicolelis MA (2020)

*Science Robotics* 5(49) eabd1911

Neuromorphic computing hardware and neural architectures for robotics

Sandamirskaya Y, Kaboli M, Conradt J, Celikel T (2022)

*Science Robotics* 7(67)

**Role of PSYC UN3496 in the Psychology Curriculum**: PSYC UN3496 is a seminar designed especially for undergraduates majoring in Psychology or Neuroscience & Behavior and for students participating in the Psychology Post-Baccalaureate Certificate Program. It will fulfill the following degree requirements:

* For the Psychology major or concentration in the College and in the School of General Studies and for the Psychology Post-Baccalaureate Certificate Program, this class will meet the Group II (Psychobiology & Neuroscience) distribution requirement.
* For the Neuroscience and Behavior joint major, it will fulfill the fifth Psychology requirement for “one advanced psychology seminar from a list approved by the Psychology Department advisor to the program.”
* For the Psychology Post-Baccalaureate students and for Psychology majors who entered Columbia in Fall 2013 or later, it will fulfill the seminar requirement.

**Readings:** There is no textbook required for this course. Readings will comprise scientific articles, book chapters, literature reviews, and commentaries in the fields of neuroscience and psychology; videos and podcasts may also be assigned.

**Schedule**: Please refer to the Modules section on CourseWorks to find the topics, readings, and assignments for each week.

The majority of class time will be devoted to student and instructor-led discussions. The schedule of topics is somewhat flexible and can be altered to reflect the interests of the class; therefore, note that the assignments and dates are subject to change and you should check back frequently.

**Course requirements:**

**Class preparation and participation**. The assigned readings are designed to expand your knowledge in neuroscience and to hone your critical thinking skills. The topics discussed are complex, leaving plenty of space to discuss and debate. Strong preparation and participation will enable us to have high-level and thought-provoking discussions.

**Reading reflections**. On the day of each class by 3 PM, you will be asked to submit a reading reflection on CourseWorks. Your reflections will help the professor prepare for class discussions. Each reflection should be 275-325 words, with references using APA style format. Include at least one citation from the readings or materials of a given week.

The goals of reading reflections are to help students keep current on course topics and to help the instructor understand where students may have difficulty with the readings. The reading reflections will indicate which topics students are most intrigued by and, therefore, which areas may warrant more focus during class time. Since the goal of these assignments is to keep you up to speed and to guide my teaching and our class discussions, the assignments will be graded on a pass/fail basis. (I can only accept responses submitted before the deadline.)

In your reflections, I encourage you to think about aspects of the readings that raise questions for you, or make you feel a certain way, or make you wonder about an issue that you have not thought about. The objective is to help you make sense of the reading. You are also encouraged to make connections between theory, research, and everyday experiences of neuroscience and society by drawing on your life experiences. Reflections should not merely summarize the readings. The instructor will respond in writing to each of your reading reflections. This part of the course is an ongoing dialogue between you and the instructor.

**Reading enables thoughtful discussion**. It is important to engage with the material during class discussions since your active participation in these discussions will contribute to your final grade. If you feel that regularly contributing to class discussions is difficult for you, you should raise this issue with me in private as soon as possible. In such cases, we might be able to work out a way for you to participate thoughtfully through your reading responses or in other ways.

Generally speaking, effective class preparation and participation could include:

* Asking insightful or clarifying questions.
* Connecting the reading to other readings in the course or readings you’ve done on your own, drawing parallels and/or contrasts among ideas.
* Actively listening to fellow classmates and responding to their ideas.
* Offering thoughtful critiques of the research methodology and providing suggestions for how it might be improved.
* Bringing in outside sources – from the news media, blogs, podcasts, magazines, or the scientific literature – that shed light on neuroscience and society or that illustrate ways in which these themes may be interpreted and applied.

**Research paper**. The culmination of this course is a research paper relating to the material of the class. Good writing is good thinking. A primary goal of this assignment is to help you improve your writing and critical thinking skills. The process of writing the research paper follows three steps:

First, you will identify a topic related to the class that you may want to write about. You should email the instructor stating your research topic, so that we can decide whether it is appropriate or fine-tune it. Topic proposals should include a short paragraph about your intended topic and a list of at least five references you intend to use. I will make suggestions regarding the content, resources, etc.

Second, once your topic is approved, you will work on a first draft. Generally, you will want to choose a topic that is appropriately focused for an 8-page paper (minimum 8 pages: double spaced, 11-point font, where the references do not count towards the eight pages; you may include up to 2 figures, which do not count towards the eight pages). The paper may include the following sections: Introduction to the topic; Background in which you review knowledge and advances in the field; sections on specific sub-topics on your project; a Conclusion or Summary where you present your ideas, analysis, and future directions; and a References section.

Third, I will provide comments and suggestions on your first draft, and you will be expected to make substantive changes – not just copy editing, but major edits, such as reworking entire sections, drawing on new sources and providing more analysis. The final draft will be graded not only as a standalone paper but also on how it demonstrates improvement over the earlier draft.

**Grading**

Grades will be calculated based on the percentages outlined below.

* **Class preparation and participation**: 25% of the overall grade.
	+ Reading reflections
	+ Contribution to class discussion
* **Lead discussions on articles**: 25% of the overall grade.
	+ Lead discussions about articles in class
* **Main Project**: Research paper: 50% of the overall grade.
	+ Choose a topic, in consultation with the instructor (date to be determined).
	+ The first draft of a written paper (1/4 of 50%): (date to be determined).
	+ The final version of a written paper (3/4 of 50%): (date to be determined).