Introduction to Cognitive Science (Fall 2024)

(While all of our sessions will be in live 3D, only some will require special viewing glasses!)

What, When, & Where

Course #s   : Cognitive Science 110, Psychology 130
When   : Fall 2024, Tuesdays & Thursdays, 2:30 - 3:45 pm
Where   : Marsh Lecture Hall (entrance at southeast corner of the Yale Science Building)
Pre-Reqs   : None!
Capped?   : Nope (since we have a reasonably large classroom)
Webpage   : **https://perception.yale.edu/IntroCogSci/**

To download readings and other materials, you must be logged in to Canvas via CAS.

Who

Instructor   : Brian Scholl (Professor, Dept. of Psychology; Director, *Perception & Cognition* lab)
Email   : brian.scholl@yale.edu
Web   : https://perception.yale.edu/
Office Hours : Just after most classes, or by appointment

Teaching Fellows

Note: *This list may change as the semester begins. Check the class webpage for up-to-date information! All office hours are held at* **100 College Street**.

Nathaniel Braswell : nathaniel.braswell@yale.edu   (*Infant Mind & Cognition Lab*)   OHs = Wed 10a (1242G/K)
Gloria Feng   : gloria.feng@yale.edu   (*Rutledge Lab*)   OHs = Tue 4:30p (1256)
Huichao Ji   : huichao.ji@yale.edu   (*Perception & Cognition Lab*)   OHs = Fri 3p (1275)
Kathy Shi   : kathy.shi@yale.edu   (*Rutledge Lab*)   OHs = Thu 5p (1256G)

Course Description

Welcome! The goal of cognitive science — and of this course — is to understand **how your mind works**. Trying to understand our own minds is perhaps the most ambitious and exciting (and difficult) project in all of science, and this project requires tools drawn from fields including experimental psychology, computer modeling and artificial intelligence, neuroscience, philosophy, linguistics, anthropology, and behavioral economics (among others). This course will introduce you to the major tools and theories from these areas, as they relate to the study of the mind. We will employ these perspectives while exploring the nature of ... *you* — focusing on parts of you such as perception, reasoning, memory, attention, imagery, language, intelligence, decision-making, morality — and even sexual attraction. In sum, this course will expose you to cognitive science, the assumptions on which it rests, and many of the most important and fascinating discoveries that the field has made so far. By the end of our semester together, you should have gained important new insights into **what you are** and **how you work**!

Expected Work and Grading

1. (**20%**) **Questions on Daily Readings**
    To get the most out of this course, it is essential that you carefully and critically study the readings associated with each lecture. To encourage this — and to give the instructor feedback as to what you thought of the material — you will be asked to respond to a brief question concerning most readings. A sample (if boring) question might be: "Which of the two theories discussed in this article do you think is right, and why?" Your answers to each question — which you must email to your specified TF no later than one hour before the start of the class during which that reading will be discussed — need be no longer than 1 or 2 paragraphs, and should take no longer than 20 minutes to write after you have read the material. The questions due for each class will be assigned by the end of the previous class. I will use these comments to gauge your reactions to (and understanding of) the ideas we'll discuss, and I will occasionally spend the first part of the following class responding to some of the issues you raise in these comments. Note that a significant portion of your grade (20%) will be based on these questions, and that late submissions will not be accepted.

2. (**60%**) **Two Exams**
    60% of your course grade will be determined by two exams. The first exam will be on *Tuesday, October 15th*, and will cover material from August 29th through October 10th. The second exam will be on *Thursday, December 5th* (= our last class meeting), and will cover material from October 22nd through December 3rd. The exam on which you do the best will count for 35% of your grade; the other will count for 25%. There will be no exam during the final exam period. The nature of these exams will be described more fully in class. Make-up exams will be given only in exceptional circumstances, and in all cases may involve completely new questions, possibly in other formats. (Advice: you really want to avoid having to take a make-up exam.) To do well on these exams, you'll have to attend the lectures — especially since our readings and lectures will rarely overlap by more than ~ 20% (since just rehearsing the readings during our class time together wouldn't be much fun).

3. **(20%)** **Short Paper**
You will be required to write one short (7-8 page) paper for this course, on an assigned topic that is discussed near the end of this syllabus. This paper is due no later than one hour before class on *Thursday, November 21ˢᵗ* (= our last class before the November break).

Readings

I have a rather low opinion of existing introductory cognitive science textbooks. But even if there was a good one, I probably still wouldn't like it — since a textbook seems like the single most unexciting and watered-down way to discover and explore a new field. As a result, the readings for this course have been drawn from many different sources, including textbook excerpts, selections from popular books, articles from popular-press venues such as the *New Yorker*, and many articles from the primary scientific literature (plus the occasional music video!). Some of these readings will be classics, and others will come from the bleeding edge. All of the readings will be posted on our class webpage, for you to view or print as you wish. (There is nothing to buy!) Using readings from the primary scientific literature will help us to capture **the vitality and excitement of scientific discovery**. (This includes work that hasn't yet filtered into textbooks, including readings that were only published very recently!) These readings will also be challenging or unsettling, though: they will use terms and refer to ideas with which you are unfamiliar, and they'll often leave you with more questions than answers. This is okay! Though the readings have been carefully chosen to be accessible, I don't expect you to fully understand every aspect of them, and I will frequently provide guidance about what you should try to get out of especially challenging readings. In the end, these challenges will pay off, as you get a direct look at **the science of mind in the making**.

Preliminary Course Outline

Here's a preliminary outline of the material that we'll cover together this semester. The full references for these readings are listed at the very end of the syllabus. We'll start out by spending a few weeks on several key themes of cognitive science as a whole (= the glue that will tie the course together, despite so much breadth!), after which we'll branch out to a representative selection of the various tools cognitive scientists use, and the aspects of the mind that we study. The exact timing of these lectures (and the exact readings) are subject to change. We may end up spending more time than is listed here on topics that strike you as especially interesting or challenging. And the first few lectures in particular won't necessarily correspond to discrete class days: you can think of them instead as one long lecture, despite how they are listed here. Please interact with me regarding the course: if there are topics you would like to add, or cover in more depth, let me know!

Thu 8/29: An Introduction to Your Mind
[No Readings]

Tue 9/3: Foundations of Cognitive Science
Bisson: "They're made out of meat" (*Omni*)
Marcus et al.: "How to study the brain" (*Chronicle of Higher Education*)
Carandini: "From circuits to behavior: A bridge too far?"

Thu 9/5: Crossed Wires (*Brain Damage and the Architecture of the Mind*)
Rafal: "Bálint's syndrome"
Sacks: "Speed" (*New Yorker*)

Tue 9/10: What's Within? (*How Nature Supports Nurture*)
Bouchard: "Genes and human psychological traits" (selections)
Gandhi et al.: "Immediate susceptibility to visual illusions after sight onset"
Sugita: "Face perception in monkeys reared with no exposure to faces"

Thu 9/12: Pieces of Mind (*Modularity and 'Mental Organs'*)
Carston: "The architecture of mind: Modularity and modularization"
Gallistel: "The replacement of general-purpose learning models…" (selection)

Tue 9/17: Mental Circuitry (*Computation and Cognitive Science*)
Pylyshyn: "What's in your mind?"
Marcus & Davis: "Insights for AI from the human mind"
Cowell: "Overlooked no more: Alan Turing…"
Watch this strange movie: https://www.youtube.com/watch?v=E3keLeMwfHY

Thu 9/19: Mysteries of the Mind (*Evolution and Consciousness*)
Churchland: Chapter 2 of *Matter and Consciousness (3rd Ed.)*
Bloom: "The duel Between body and soul" *(NYTimes)*
Nilsson & Pelger: "A pessimistic estimate of the time required for an eye to evolve"

Tue 9/24: Mid-semester Catch-up/Extras #1…
[The chances that we'll be on schedule by this point are slim; we'll use this day to catch up, and/or to explore other topics that are especially engaging or challenging this year!]

Thu 9/26: My Brain Made Me Do It (*Cognitive Neuroscience*)
Skim: Chang & Tsao: "The code for facial identity in the primate brain"
Buckholtz & Faigman: "Promises, promises for neuroscience and law"

Tue 10/1: Brain Scanning and Mind Reading
Greene et al.: "An fMRI investigation of emotional engagement in moral judgment"
Skim: Nishimoto et al.: "Reconstructing visual experiences from brain activity …"
Iacobini and various unhappy people: "This is your brain on politics" (*NYTimes*)
Jonas & Kording: "Could a neuroscientist understand a microprocessor?"

Thu 10/3: "*Goo goo, ga ga*" (*Acquiring Language*)
Jackendoff: Chapters 8-10 of *Patterns in the Mind*
Skim: Enard et al.: "Molecular evolution of *FOXP2*, a gene involved in speech and language"
Kinzler et al.: "The native language of social cognition"

Tue 10/8: Now Hear This! (*Linguistics*)
Everaert et al.: "Structures, not strings: Linguistics as a part of the cognitive sciences"
Optional gentler introduction: Pinker: chapters 4 - 5 of *The Language Instinct*
Dentella et al.: "Systematic testing of three language models…"

Thu 10/10: Mid-semester Catch-up/Extras #2…
[Another day to catch up, and/or to cover other interesting topics that are especially engaging this year!]

Tue 10/15: MIDTERM EXAMINATION!   <⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

(Thu 10/17: No Class: October Recess)

Tue 10/22: Colorless Green Ideas Sleep Furiously (*Syntactic Theory*)
Stillings et al.: "Syntax" and "Universals"

Thu 10/24: Seeing: It's Not What You Think (*Visual Perception*)
Marr: "The philosophy of the approach" (a selection from *Vision*)
Firestone & Scholl: "Cognition does not affect perception…" (selection)

Tue 10/29: She Blinded Me With Science (*Visual Cognition*)
New & Scholl: "Perceptual scotomas: A functional account of motion-induced blindness"
Gao et al.: "The Wolfpack effect"
Watch this music video: https://www.youtube.com/watch?v=m86ae_e_ptU

Thu 10/31: Deep Thought (*Roles of Philosophy in CogSci*) [Guest Lecture]
Goldman & Mason: "Simulation"

Tue 11/5: Bringing Cognitive Science into Focus (*Paying Attention*)
Most et al.: "How not to be seen"
Simons & Levin: "Failure to detect changes to people in a real-world interaction"
Jiang et al.: "A gender- and sexual orientation-dependent spatial attentional effect of invisible images"

Thu 11/7: Elementary, My Dear Watson (*Reasoning and Rationality*)
Osherson: "Probability judgment"
Groopman: "Mental malpractice" *(NYTimes)*
Ariely: "Lessons from our irrationalities"

Tue 11/12: Make Up Your Mind! (*The CogSci of Decision-Making*)
Fischhoff & Broomell: "Judgment and decision making"
Rand & Nowak: "Human cooperation"

Thu 11/14: I, Robot (*AI & and Social Robotics*) [Guest Lecture]
Yang et al.: "The grand challenges of *Science Robotics*"
Scassellati & Vazquez: "The potential of socially assistive robots during infectious disease outbreaks"

Tue 11/19: Frantic End-of-semester Catch-up/Extras #3…
[A final chance to catch up, and/or to cover other interesting topics that are especially engaging this year!]

Thu 11/21: Ooh la la! (*The CogSci of Sex and Attraction*)   *<PAPERS DUE!>*
Berglund & Rosenqvist: "Selective males and ardent females in pipefishes"
Butler et al.: "Physical attraction to reliable, low variability nervous systems…"
Graves: "How our genes could make us gay or straight"

(Tue 11/26 & Thu 11/28: No Class: November Recess)
https://tofurky.com/faqs/

Tue 12/3: The Past, Present, and Future of Cognitive Science
[No readings]

Thu 12/5: FINAL EXAMINATION!   <———————————————————————

Assigned Paper Topic: *CogSci and Everyday Life*

In this short (7-8 page) thought paper, you'll choose a part of cognitive science that we've covered in class, and you'll discuss how the research in that area should (or should not!) impact the real world, and everyday life. In essence, you'll be asking: *Who cares?* Why should (or shouldn't) the 'person on the street' care about this research? This will be a 'thought paper' in part because our readings and lectures will not always discuss these themes explicitly, but I hope that you'll be thinking about them throughout our course. This topic and our expectations for the paper will be described in glorious detail as the due date approaches.

Note also that although this is the 'assigned topic' for the paper, I am also open to letting you write on another topic of your own choosing, if you are particularly engaged by some other idea. The only strict constraint is that this must be a 'thought paper', to be graded primarily on the degree of interesting and careful thought it conveys involving themes from our course. (In contrast, this paper is not meant to be a research paper or a 'book report', in which you summarize others' already-published ideas. Indeed, you needn't — and probably shouldn't — read any new source material at all for this assignment, beyond what is already required for class!) To write on an independent topic, you must get it approved by me, *no later than* <u>Thursday, November 14th</u> (aka a week before the paper is due).

Full References for Readings

Ariely, D. (2010). Lessons from our irrationalities: Why we need to test everything. Chapter 11 of *The Upside of Irrationality: The Unexpected Benefits of Defying Logic*. Harper Perennial.

Berglund, A., & Rosenqvist, G. (1993). Selective males and ardent females in pipefishes. *Behavioral Ecology & Sociobiology, 32*, 331-336.

Bisson, T. (1991). They're made out of meat. *Omni*, April 1991.

Bloom, P. (2004). The duel between body and soul. *New York Times,* 9/10/04.

Bouchard, T. (2008). Genes and human psychological traits. In P. Carruthers, S. Laurence, & S. Stich (Eds.), *The innate mind: Foundations and the future* (pp. 69-90). Oxford University Press.

Buckholtz, J., & Faigman, D. (2014). Promises, promises for neuroscience and law. *Current Biology, 24*, R861-R867.

Butler, E., Saville, C., Ward, R., & Ramsey, R. (2017). Physical attraction to reliable, low-variability nervous systems: Reaction time variability predicts attractiveness. *Cognition*, *158*, 81-89.

Carandini, M. (2012). From circuits to behavior: A bridge too far. *Nature Neuroscience*, *15*, 507-509.

Carston, R. (1996). The architecture of mind: Modularity and modularization. In D. Green et al. (Eds.), *Cognitive science: An introduction* (pp. 53-83). Cambridge, MA: Blackwell.

Chang, L., & Tsao, D. (2017). The code for facial identity in the primate brain. *Cell, 169*, 1013-1028.

Churchland, P. (2013). "The ontological problem (the mind-body problem)." In *Matter and Consciousness, 3rd Ed.* (pp. 11-86). MIT Press.

Cowell, A. (2019). Overlooked no more: Alan Turing, condemned code breaker and computer visionary. *New York Times*, 6/5/19.

Cushman, F., & Greene, J. (2012). Finding faults: How moral dilemmas illuminate cognitive structure. *Social Neuroscience, 7*, 269-279.

Dentella, V., Gunther, F., & Leivada, E. (2023). Systematic testing of three Language Models reveals low language accuracy, absence of response stability, and a yes-response bias. *Proceedings of the National Academy of Sciences*, *120*, e2309583120.

Enard, W., et al. (2002). Molecular evolution of *FOXP2*, a gene involved in speech and language. *Nature, 418*, 869-872.

Everaert, M., Huybregts, M., Chomsky, N., Berwick, R., & Bolhuis, J. (2015). Structures, not strings: Linguistics as a part of the cognitive sciences. *Trends in Cognitive Sciences*, *19*, 729-743.

Fischhoff, B., & Broomell, S. (2020). Judgment and decision making. *Annual Review of Psychology, 71*, 331-355.

Firestone, C., & Scholl, B. J. (2016). Cognition does not affect perception: Evaluating the evidence for 'top-down' effects. *Behavioral and Brain Sciences, e229*, 1-77.

Gallistel, C. R. (2000). The replacement of general-purpose learning models with adaptively specialized learning modules. In M. Gazzaniga (Ed.), *The new cognitive neurosciences* (pp. 1179-1191). Cambridge, MA: MIT Press.

Gandhi, T., Kalia, A., et al. (2015). Immediate susceptibility to visual illusions after sight onset. *Current Biology*, *25*, R345-R361.

Gao, T., McCarthy, G., & Scholl, B. J. (2010). The Wolfpack effect: Perception of animacy irresistibly influences interactive behavior. *Psychological Science, 21*, 1845-1853.

Goldman, A., & Mason, K. (2006). Simulation. In P. Thagard (Ed.), *Philosophy of Psychology [Handbook of the Philosophy of Science]* (pp. 213-239). Elsevier.

Graves, J. (2014). How our genes could make us gay or straight. *Washington Post*, 6/4/14.

Greene, J., et al. (2001). An fMRI investigation of emotional engagement in moral judgment. *Science*, *293*, 2105-2108.

Groopman, J. (2007). Mental malpractice. *New York Times*, 7/2/07.

Iacobini, M., et al. (2007). This is your brain on politics [with response]. *New York Times*, 11/11/07.

Jackendoff, R. (1994). *Patterns in the mind.* Basic Books.

Jiang, Y., Costello, P., Fang, F., Huang, M., & He, S. (2006). A gender- and sexual orientation-dependent spatial attentional effect of invisible images. *Proceedings of the National Academy of Sciences, 103*, 17048-17052.

Jonas, E., & Kording, K. (2017). Could a neuroscientist understand a microprocessor? *PLoS Computational Biology, 13*(1): e1005268.

Kinzler, K., et al. (2007). The native language of social cognition. *Proceedings of the National Academy of Sciences, 104*, 12577-12580.

Marcus, G., & Davis, E. (2021). Insights for AI from the human mind. *Communications of the ACM, 64*, 38-41.

Marcus, G., Marblestone, A., & Freeman J. (2014). How to study the brain. *Chronicle of Higher Education*, 11/12/14.

Marr, D. (1982). "The philosophy of the approach". Chapter 1 of *Vision*. New York: W. H. Freeman.

Most, S. B., Simons, D. J., Scholl, B. J., Jiminez, R., Clifford, E., & Chabris, C. F. (2001). How not to be seen: The contribution of similarity and selective ignoring to sustained inattentional blindness. *Psychological Science, 12(1),* 9-17.

New, J. J., & Scholl, B. J. (2008). 'Perceptual scotomas': A functional account of MIB. *Psychological Science*, *19*, 653-659.

Nilsson, D-E., & Pelger, S. (1994). A pessimistic estimate of the time required for an eye to evolve. *Proceedings of the Royal Society, Biological Sciences*, *256(1345)*, 53-58.

Nishimoto, S., et al. (2011). Reconstructing visual experiences from brain activity evoked by natural movies. *Curr.Biology, 21,* 1641-1646.

Osherson, D. (1995). Probability judgment. In E. Smith & D. Osherson (Eds.), *Thinking*, Vol. 2 of *An Invitation to Cognitive Science*, 2nd Ed (pp. 35-76). Cambridge, MA: MIT Press.

Pinker, S. (1994). "How language works" and "Words, words, words". Chapters 4-5 of *The language instinct* (pp. 83-157). Harper.

Pylyshyn, Z. W. (1999). What's in your mind? In E. Lepore & Z. Pylyshyn (Eds.), *What is cognitive science?* (pp. 1-25). Oxford: Blackwell.

Rafal, R. D. (2001). Bálint's syndrome. In M. Behrmann (Ed.), *Handbook of Neuropsychology* (pp. 121-141). Elsevier Science.

Rand, D., & Nowak, M. (2013). Human cooperation. *Trends in Cognitive Sciences*, *17*, 413-425.

Sacks, O. (2004). Speed. *New Yorker,* 8/23/04, 48-59.

Scassellati, B., & Vazquez, M. (2020). The potential of socially assistive robots during infectious disease outbreaks. *Science Robotics*, *5*, 1-2.

Simons, D. J., & Levin, D. T. (1998). Failure to detect changes to people in a real-world interaction. *Psycho. Bull. & Review, 5,* 644-649.

Slovic, P. (2007). 'If I look at the mass I will never act': Psychic numbing and genocide. *Judgment and Decision Making, 2,* 79-95.

Stillings, N., et al. (1995). "Syntax", "Universals". Sections 6.3 and 6.4 of *Cognitive science: An introduction* (pp. 241-268). MIT Press.

Sugita, Y. (2008). Face perception in monkeys reared with no exposure to faces. *Proc. of the National Academy of Sciences*, *105*, 394-398.

Yang, G-Z., et al. (2018). The grand challenges of *Science Robotics*. *Science Robotics, 3*, 1-14.