

Spring 2023
GS14 1173: Cognitive Neuroscience
Course Director: Scott Lane, PhD

Textbook: The Cognitive Neurosciences, 2020 (6th edition), The MIT Press
Poeppel, Mangun, Gazzaniga, Editors
ISBN: 9780262043250 (electronic version available via MIT Press)

Tuesdays and Thursdays, 10:30 AM – 11:30 AM | Gallick Classroom, BSRB S3.8367

Course structure

1) Students will be responsible for accessing and preparing course materials between each class, and leading other students through the materials by means of prepared outline and lecture/discussion over the assigned readings. For each section of the course (outlined below), chapters from the textbook will be selected by individual students who will prepare a written/electronic summary of that chapter/topic. Students will then provide the summary materials and lead lecture and discussion during course hours. At the end of the course, prepared summary materials from all sections will be compiled into a master document that students can use as a future compendium and reference.

2) Online lectures (primarily via YouTube) will supplement the reading materials and are intended to provide a foundation for the concepts covered in the textbook, which is more detailed and in depth. Students should use the online lecture to support and enhance the book materials on which they will present. Begin by reading the Section Introduction and watching the online lecture, then progress through each chapter.

3) Students who are not lecturing should come prepared with questions and/or discussion points to address during class.

Course Evaluation

Students will be evaluated based on (1) attendance, (2) quality of the assigned summary materials and class presentation of such materials, and (3) in-class participation and quality of in-class questions/discussion points.

The course is designed as an introduction to and survey of the subject of *Cognitive Neuroscience*, which is a hybrid topic merging traditional approaches in neuroscience (e.g., A&P, cell functions and firing determinants, neuroimaging) with domains that have historically been the purview of cognitive psychology and/or neuropsychology (e.g., learning, memory, attention, language). The quality of students' learning experience will be a function of the level of preparation and detail put into each presentation, and the quality and level engagement during in-class discussion. Dr. Lane will facilitate discussion and help clarify principles/concepts with which he is familiar (definitely *not* the entire subject matter), but instruction and learning is expected to be student-driven. Some materials may prove difficult and/or unfamiliar. That is certainly acceptable and to be expected. We will all be learning together in a non-threatening, and hopefully intellectual engaging, environment. Please do not worry if you run across or stumble over new material. You will not be graded or judged negatively for giving your best effort.

The three primary objectives are (1) to provide a broad introduction to the many domains that comprise the field of cognitive neuroscience; (2) to generate a single broad document (compiled across all students' presentations and materials) that can serve as a summary file for future reference; and (3) to provide opportunities for students to prepare and deliver lectures to their peers (and eventually their own students, trainees, and colleagues), and facilitate discussion and group learning in class.

Course Outline:

Intro to Cognitive Neuroscience videos: (*week of January 10*)

<https://www.youtube.com/watch?v=EtxibYcyDz0>

<https://www.youtube.com/watch?v=SvBfAqk70LU>

<https://www.youtube.com/watch?v=1CUlcbgn8IY>

* One presentation per class/chapter, see also Canvas calendar

Section I. *Brain circuits over a lifetime* (January 17, 19, 24, 26)

- Introduction, page 3
- Chapter 2, page 17
- Chapter 3, page 27
- Chapter 5, page 47
- Chapter 7, page 81
- Online videos:
 - https://www.youtube.com/watch?v=vpXrgJ5aj_4
 - <https://www.youtube.com/watch?v=PTMWBKM1UPY>

Section II. *Auditory and visual perception* (January 31, February 2, 7)

- Introduction, page 105
- Chapter 9, page 109
- Chapter 10, page 119
- Chapter 12, page 141
- Online videos:
 - <https://www.youtube.com/watch?v=qXl5jebTiWE&t=763s>
 - <https://www.youtube.com/watch?v=Fsi3Fs2WGZO>
 - <https://www.youtube.com/watch?v=aSfesfGNmVw>
 - <https://www.youtube.com/watch?v=MgMNUne9j9c>

Section III. *Memory* (February 9, 14, 16, 21)

- Introduction, page 193
- Chapter 18, page 207
- Chapter 20, page 233
- Chapter 22, page 255
- Chapter 24, page 275
- Online videos:
 - <https://www.youtube.com/watch?v=J1TYC-I2vN0>
 - <https://www.youtube.com/watch?v=48ojVQNAAeM>
 - <https://www.youtube.com/watch?v=VKUOX9F3mv8>

Section IV. *Attention and working memory* (February 23, 28, March 2, 7)

- Introduction, page 287
- Chapter 25, page 291
- Chapter 27, page 311
- Chapter 30, page 347
- Chapter 31, page 357
- Online videos:
 - <https://www.youtube.com/watch?v=MZUrx5oCQo>
 - <https://www.youtube.com/watch?v=MyLMrTE9cAo>

Section V. *Neuroscience, cognition, and computation* (March 9, 14)

- Introduction, page 379
- Chapter 34, page 399 *
- Chapter 35, page 411 *
- Online videos:
 - <https://www.youtube.com/watch?v=TFyAEHk5asY>
 - <https://www.youtube.com/watch?v=YG5TDRVpCD0&list=PLu02O8xRZn7xtNx03Rlq6xMRdYcQgEpar&index=15>
 - <https://www.youtube.com/watch?v=xHa7idML5xs&list=PLu02O8xRZn7xtNx03Rlq6xMRdYcQgEpar&index=16>

* perhaps best suited for those with math/EE/computer science backgrounds

Section VII. *Reward and decision making* (March 16, 21, 23, 28)

- Introduction, page 571
- Chapter 49, page 587
- Chapter 51, page 607
- Chapter 52, page 617
- Chapter 55, page 651
- Online videos:
 - <https://www.youtube.com/watch?v=n4CRb0p6rko>
 - <https://www.youtube.com/watch?v=zDDUkJRFDVc>

Section IX. *Concepts and core domains* (March 30, April 4, 6, 11)

- Introduction, page 751
- Chapter 63, page 755
- Chapter 66, page 785
- Chapter 67, page 793
- Chapter 69, page 809
- Online videos:
 - <https://www.youtube.com/watch?v=6LQuGYjzXCk>
 - <https://www.youtube.com/watch?v=ZocnSqm4YSg>
 - <https://www.youtube.com/watch?v=KpfBl9ebI2c>

Section X. *Language*

(April 13, 18, 20)

- Introduction, page 837
- Chapter 75, page 869
- Chapter 76, page 879
- Chapter 78, page 899
- Online videos:
 - <https://www.youtube.com/watch?v=bYmti9xTVGM>
 - TBD

Section XI. *Social Neuroscience*

(April 25, April 27)

- Introduction, page 919
- Chapter 83, page 949
- Chapter 86, page 977
- Online videos:
 - <https://www.youtube.com/watch?v=IXzNQs3yvKY>
 - TBD

(pending available time)

(May 2, 4)

Section XII. *Drugs and cognition: psychopharmacology*

- McKim, W.A. Drugs and behavior: An introduction to behavioral pharmacology (5th Ed). New Jersey: Prentice Hall
 - Pages 1-12, 61-65
- Stahl, S.M. Stahl's essential psychopharmacology: Neuroscientific basis and practical applications (4th Ed). New York: Cambridge University Press.
 - Pages 35-49, 51-71
- Recorded Lecture: Scott Lane, *Drugs and cognition: Psychopharmacology*

Additional Details on Reading Materials:

Section I:

BRAIN CIRCUITS OVER A LIFETIME

- * Introduction to Part I:
Sarah-Jayne Blakemore, Ulman Lindenberger
- * Imaging Structural Brain Development in Childhood and Adolescence
Christian K. Tamnes, Kathryn L. Mills
- * Cognitive Control and Affective Decision-Making in Childhood and Adolescence
Eveline A. Crone, Anna C. K. van Duijvenvoorde
- * A Lifespan Perspective on Human Neurocognitive Plasticity
Kristine Beate Walhovd, Martin Lövdén
- * Brain Maintenance and Cognition in Old Age
Lars Nyberg, Ulman Lindenberger

Section II

AUDITORY AND VISUAL PERCEPTION

- * Introduction to Part II
Kalanit Grill-Spector, Maria Chait
- * The Cognitive Neuroanatomy of Human Ventral Occipitotemporal Cortex
Kevin S. Weiner, Jason D. Yeatman
- * Population Receptive Field Models in Human Visual Cortex
Jonathan Winawer, Noah C. Benson
- * Multisensory Perception: Behavior, Computations, and Neural Mechanisms
Uta Noppeney

Section III

MEMORY

- * Introduction to Part III
Tomás J. Ryan, Charan Ranganath
- * Memory and Instinct as a Continuum of Information Storage
Tomás J. Ryan
- * Maps, Memories, and the Hippocampus
Charan Ranganath, Arne D. Ekstrom
- * The Dynamic Memory Engram Life Cycle: Reactivation, Destabilization, and Reconsolidation
Temidayo Orederu, Daniela Schiller

Section IV

ATTENTION AND WORKING MEMORY

- * Introduction to Part IV
Sabine Kastner, Steven J. Luck
- * Memory and Attention: The Back and Forth
A. C. (Kia) Nobre, M. S. Stokes
- * Network Models of Attention and Working Memory
Monica D. Rosenberg, Marvin M. Chun
- * Online and Off-Line Memory States in the Human Brain
Edward Awh, Edward K. Vogel
- * How Working Memory Works
Timothy J. Buschman, Earl K. Miller

Section V

NEUROSCIENCE, COGNITION, AND COMPUTATION: LINKING HYPOTHESES

- * Introduction to Part V
Stanislas Dehaene, Josh McDermott
- * Physical Object Representations for Perception and Cognition
Ilker Yildirim, Max Siegel, Joshua Tenenbaum
- * Constructing Perceptual Events Across Cortex
Roman Rossi-Pool, Jose Vergara, and Ranulfo Romo
- * Executive Control and Decision-Making: A Neural Theory of Prefrontal Function
Etienne Koechlin

Section VII

REWARD AND DECISION-MAKING

- * Introduction to Part VII
Daphna Shohamy, Wolfram Schultz
- * Dopamine Prediction Error Responses Reflect Economic Utility
William R. Stauffer, Wolfram Schultz
- * Neural Mechanisms of Perceptual Decision-Making
Gabriel M. Stine, Ariel Zylberberg, Jochen Ditterich, Michael N. Shadlen
- * Memory, Reward, and Decision-Making
Katherine Duncan, Daphna Shohamy
- * Dopamine and Reward: Implications for Neurological and Psychiatric Disorders
Andrew Westbrook, Roshan Cools, Michael J. Frank

Section IX

CONCEPTS AND CORE DOMAINS

- * Introduction to Part IX
Marina Bedny, Alfonso Caramazza
- * Concepts of Actions and Their Objects
Anna Leshinskaya, Moritz F. Wurm, Alfonso Caramazza
- * Concepts and Object Domains
Yanchao Bi
- * Concepts, Models, and Minds
Alex Clarke, Lorraine K. Tyler
- * Spatial Knowledge and Navigation
Russell A. Epstein

Section X

LANGUAGE

- * Introduction to Part X
Liina Pykkänen, Karen Emmorey
- * The Brain Network That Supports High-Level Language Processing
Evelina Fedorenko
- * Neural Processing of Word Meaning
Jeffrey R. Binder, Leonardo Fernandino
- * The Cerebral Bases of Language Acquisition
Ghislaine Dehaene-Lambertz, Claire Kabdebon

Section XI

SOCIAL NEUROSCIENCE

*** Introduction to Part XI**

Elizabeth Phelps, Mauricio Delgado

*** Neural Mechanisms of Social Learning**

Dominic S. Fareri, Luke J. Chang, Mauricio Delgado

*** The Social Neuroscience of Cooperation**

Julian A. Wills, Leor Hackel, Oriel FeldmanHall, Philip Pärnamets, Jay J. Van Bavel