Cognitive Neuroscience
PSY 685
Fall 2021

Time:	Thurs 4:30-7.10pm
Room:	Nguyen Engineering Building 1108
Instructor:	James Thompson
	Room 2056
	David King Hall
	email: jthompz@gmu.edu tel: 703-993-9356

Office Hours: Thurs 3.00pm – 4.00pm or by appointment (email only)

Objectives: Cognitive Neuroscience is an interdisciplinary field that combines the fields of neuroscience and cognitive psychology. This field has developed and uses new approaches and technologies for invasive and noninvasive imaging and stimulating of human brain structure and function. This course aims to provide students with a strong foundation in the theories and findings of Cognitive Neuroscience. Each week of this course will focus on a specific cognitive function, and will address in depth important theories and experimental results that help define the brain basis of cognitive function.

Required Readings:
Readings for this semester will consist of journal articles that will be posted on Blackboard. There will usually be three articles per week to read, and **students are expected to read all three each week ahead of class**.

Class Format: This will be a seminar format class. During each class we will read and discuss three papers that address the neural basis of a particular cognitive function.

As many of the concepts that will be covered may be new to most of you, I expect everyone to have read the assigned papers before the class. A willingness and ability to do extensive research outside the assigned reading, seek assistance if you are finding any area difficult, and participate in class discussion, is essential. It is assumed that students in the class have at least a strong upper-level undergraduate understanding of cognitive psychology. For students less familiar with the basics of cognitive psychology, I recommend reading:

Gazzaniga, Ivry, Mangun (2014). Cognitive Neuroscience: the biology of the mind (see Blackboard)

Assessment: Assessment will consist of a) leading class discussion of two papers (20%); b) writing a summary of the discussion of one additional papers (20%); c) participation in class discussions each week (20%); and d) a final paper (40%).

a) Lead the discussion of two papers (20%) For this assessment, sign up for two papers (from two different weeks) and lead the discussion of the paper(s). During each discussion, spend 5-10mins initially outlining the paper (either the theory presented or the experimental study), and then provide the class with 3-4 questions/prompts to facilitate the discussion. You can post these ahead of the class via Blackboard. Ensure that all members of the class have an opportunity to contribute to the discussion. ***If you are finding the paper you have chosen challenging, please contact me well ahead of the scheduled class time and we can discuss it.***

b) Summarize the discussion of one additional paper (20%) For this assessment, sign up for one paper from a week different to the ones in which you are leading discussion. Take notes during the discussion, and integrate what is discussed during class with your reading of the paper. Write up (1000-1200 words) the discussion and post it on Blackboard ***no later than one week following the discussion***.

c) Participation in class discussions (20%). You are expected to read each of the papers for each week and participate in class discussions of those papers.

d) Final paper (40%). Pick a topic from weeks 2-14, or any combination of weeks, and write a paper discussing the **combination** of theory and empirical findings ***central*** to that topic. Your final paper should go beyond/deeper than the papers we discuss in class, but should (at the very least) include a discussion of those papers. Please consult with me if you have any questions about the topic of your final paper.

Technology: Materials will be distributed via email, in class, and via Blackboard. Students will need to be able to read and refer to the papers during class.

Important Dates: Last day to add: Aug 30. Last day to drop Sep 15. Thanksgiving Nov 24-26

Grades: A (100-90); B (89-80); C (79-70); D (69-60); F (below 59)

Attendance: While you will not be graded on attendance, this is a graduate-level course and you are expected to attend and contribute to class discussion each week.

Honor Code: All exams must follow the guidelines of the GMU Honor Code. George Mason University has an Honor Code, which requires all members of this community to maintain the highest standards of academic honesty and integrity. Cheating, plagiarism, lying, and stealing are all prohibited. All violations of the Honor Code will be reported to the Honor Committee. See honorcode.gmu.edu for more detailed information. Students may consult with other students and use books, notes, and other sources in preparing for exams. However, when taking exams, no books, notes, or student interaction will be allowed. Cheating and plagiarism of any sort will not be tolerated.

Students with Disabilities: If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center C(DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

Access to Computers

Students must have access to their GMU Email account. Students should feel free to communicate with me via email. Updates and notifications will be sent to the class email list using your GMU email address. If you need to use university facilities, you can find out about location and hours of university facilities at http://www.labs.gmu.edu/ or ask at the information desk at the Johnson Center. I will ONLY use your GMU Email address to contact you. Please use and check this address frequently. You may forward your GMU email to another address if you like, but please ensure that you are receiving the email to your GMU Email address.

Cancellation Policy In case class needs to be canceled due to an unexpected event, students will be informed via email as soon as possible. Make-up sessions will be arranged for canceled classes.

SCHEDULE

Aug 26 **Introduction**

Chapter 3 Methods of Cognitive Neuroscience. Gazzaniga, Ivry, Mangun (2014). Cognitive Neuroscience: the biology of the mind.

Petersen, Fox, Posner, Mintun, Raichle (1988). Positron emission tomographic studies of the cortical anatomy of single-word processing. Nature.

Sep 2 **Perception**

Barlow (1961). Possible principles underlying the transformations of sensory messages. W.A. Rosenblith (ed) Sensory Communication.

Olshausen, Field (2004) Sparse coding of sensory inputs. Current Opinion in Neurobiology.

Zamboni, Kemper, Goncalves, Jia, Karlatis, Bell, Giorgio, Rideaux, Goebel, Kourtzi (2020) Fine-scale computations for adaptive processing in the human brain. eLife.

Sep 9 **Object & Face Recognition**

Rust & DiCarlo (2012) Balanced Increases in Selectivity and Tolerance Produce Constant Sparseness along th Ventral Visual Stream. Journal of Neuroscience.

Schwiedrzik & Friewald (2017) High-Level Prediction Signals in a Low Level Area of the Macaque Face-Processing Hierarchy. Neuron.

White, Palmer, Boynton, Yeatman (2019). Parallel spatial channels converge at a bottleneck in anterior word-selective cortex. PNAS.

Sep 16 **Attention**

Desimone, Duncan (1995). Neural mechanisms of selective visual attention. Annual Review of Neuroscience

Corbetta & Shulman (2002) Control of Goal-Directed and stimulus-driven attention in the brain. Nature Neuroscience Reviews

Kay, Weiner, Grill-Spector (2014). Attention Reduces Spatial Uncertainty in Human Ventral Temporal Cortex. Current Biology

Sep 23 **Working Memory**

Goldman-Rakic (1995) Cellular basis of working memory. Neuron.

Harrison, Tong (2009) Decoding reveals the contents of visual working memory in early visual areas. Nature.

Feredoes, Heinen, Weiskopf, Ruff, Driver (2011). Causal evidence for frontal involvement in memory target maintenance by posterior brain areas during distractor interference of visual working memory. PNAS.

Sep 30 **Memory**

Shohamy, Wagner (2008) Integrating memories in the human brain: hippocampal-midbrain encoding of overlapping events. Neuron.

Tambini, Davachi (2013) Persistence of hippocampal multivoxel patterns into postencoding rest is related to memory. PNAS.

Wimmer, Liu, Vehar, Behrens, Dolan (2020). Episodic memory retrieval sucess is associated with rapid replay of episode content. Nature Neuroscience

Oct 7 **Imagination, Prospection, and Metacognition**

Schacter, Addis, Hassabis, Martin, Spreng, Szpunar (2012). The Future of Memory: Remembering, Imagining, and the Brain. Neuron.

Ciaramelli, De Luca, Kwan, Mok, Bianconi, Knyagnytska, Craver, Green, Myerson, Rosenbaum (2021). The role of ventromedial prefrontal cortex in reward valuation and future thinking during intertemporal choice. eLife.

Rouault, Fleming (2020) Formation of global self-beliefs in the human brain. PNAS.

Oct 14 **Language**

Hickok, Poeppel (2007). The cortical organization of speech processing. Nature Reviews Neuroscience

Aziz-Zadeh, Cattaneo, Rochat, Rizzolatti (2005). Covert Speech Arrest Induced by rTMS over Both Motor and Nonmotor Left Hemisphere Frontal Sites. Journal of Cognitive Neuroscience

Assaneo, Poeppel (2018). The coupling between auditory and motor cortices is rate-restricted: Evidence for an intrinsic speech-motor rhythm. Science Advances.

Oct 21 **Motor Function**

Pruszynski, Kurtzer, Nashed, Omrani, Brouwer, Scott (2011). Primary motor cortex underlies multi-joint integration for fast feedback control. Nature.

Gallivan, Stewart, Baugh, Wolpert, Flanagan (2017). Rapid Automatic Motor Encoding of Competing Reach Options. Cell Reports.

Yokoi, Diedrichsen (2019) Neural Organization of Hierarchical Motor Sequence Representations in the Human Neocortex. Neuron

Oct 28 **Executive Function**

Dehaene, Changeux, (1997). A hierarchical neuronal network for planning behavior. PNAS

Shallice, Cipolotti (2018). The Prefrontal Cortex and Neurological Impairments of Active Thought. Annual Review of Psychology

Shenhav, Botvinick, Cohen (2013). The Expected Value of Control: An Integrative Theory of Anterior Cingulate Cortex Function. Neuron

Nov 4 **Value-based decision-making**

O'Doherty, Dayan, Friston, Critchley, Dolan (2003). Temporal Difference Models and Reward-Related Learning in the Human Brain

Daw, Gershman, Seymour, Dayan, Dolan (2011). Model-Based Influences on Humans' Choices and Striatal Prediction Errors. Neuron.

Leong, Radulescu, Daniel, DeWoskin, Niv (2017). Dynamic Interaction between Reinforcement Learning and Attention in Multidimensional Environments. Neuron.

Nov 11 **Emotions**

Phelps (2006). Emotion and cognition: insights from studies of the human amygdala. Annual Review of Psychology

Kragel, Ceko, Theriault, Chen, Satpute, Wald, Lindquist, Barrett, Wager (2021). A human colliculus-pulvinar-amygdala pathway encodes negative emotion. Neuron

Chang, Jolly, Cheong, Rapuano, Greenstein, Chen, Manning (2021). Endogenous variation in ventromedial prefrontal cortex state dynamics during naturalistic viewing reflects affective experience. Science Advances.

Nov 18 **Social Cognition**

Saxe, Kanwisher (2003). People thinking about thinking people The role of the temporo-parietal junction in "theory of mind". Neuroimage.

Frith, Frith (2007). Social cognition in humans. Current Biology.

Gangopadhyay, Chawla, Dal Monte, Chang (2021). Prefrontal–amygdala circuits in social decision-making. Nature Neuroscience.

Nov 25 **Thanksgiving Recess**

Dec 2 **Neural population dynamics**
Ebitz, Hayden (2021). The population doctrine in cognitive neuroscience. Neuron

Shine, Breakspear, Bell, Ehgoetz Martens, Shine, Koyejo, Sporns, Poldrack (2019). Human cognition involves the dynamic integration of neural activity and neuromodulatory systems. Nature Neuroscience.