Psychology 366
Cognitive Neuroscience: Spring 2017

Class meets: T-Th, 1:15 – 3:00 pm

Olin 02

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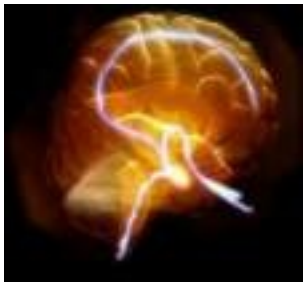


Office Hours: Mondays, 3a, Tuesdays, 12 – 1 pm, Fridays 11 – 1 pm and by appointment.

Cognitive neuroscience is the study of how the brain enables the mind. It is a relatively new field (since the 1970's, when the term was coined by M. Gazzaniga), and as Gazzaniga says, it is a tricky business. This course embodies the two basic approaches that scientists take to answer the question, how does the brain enable the mind?

The first is the study of neurons, brain structures, and neural function. The assumption is that a low-level account of how neurons, brain structures, and neurochemicals are modified by experience is in fact where the "mind" is. In other words, the mind is not in a singular place in the brain, but is represented through intact connections via neural pathways, whereby a change in the current state of chemicals and firing patterns induces an idea, perception, memory, or thought. This approach is accomplished through animal experiments, computer modeling of brain actions with mental actions, and tracking pathways involved in certain cognitive processes (like perception).

The second approach is called cognitive neuropsychology, and assumes that we can understand best how the mind is enabled by the brain by studying human patients with particular brain damaged sites to track where failures occur. The approach to this class is to balance neuroscientific and neuropsychological evidence, cognitive theory and cognitive demonstrations. There is heavy use of patient data (as reflected by cases presented in class, from Ramachandran's Phantoms in the Brain and by Martha Farah's Visual Agnosia).

Texts for this course include:

Ward, J. (2015). The student's guide to cognitive neuroscience. New York: NY, Psychology Press, 3rd edition. [called **W**: in the daily assignments]

Farah, M. J. (2004). Visual Agnosia, 2nd Edition. MIT Press, Cambridge, MA.[called **F:** in the daily assignments.]

Ramachandran, V. (**2011)**. The Tell-Tale Brain: A neuroscientist's quest for what makes us human. Norton & Company, NY. [referred to as **R** in the daily assignments]

An assortment of readings will be included that capture important empirical findings in the area of cognitive neuroscience, generally, and that address these two levels and what each can contribute.

Your assignments to be evaluated in this course are:

- class participation, via questions submitted [**10%**],
- an exam on neurons and brain structure early in the term [**20%**],
- scheduled on **Tuesday, April 18**, in class.
- an annotated bibliography of articles which will contribute to your paper [**10%**].
- Due **Friday May 5th**, end of the day, in the psych offices.
- an oral presentation of your paper idea, which occurs during the last week of term [**20%**]
- occurring **Tuesday, May 23, Thurs May 25 or Tues May 30** – sign up sheet will be available later.
- a project/paper due at the end of the term [**40%**]
- **due Sunday, June 4th, by midnight, via Moodle dropbox**.

Cognitive Neuroscience: Daily Assignments

Psy 366 Spring 2017

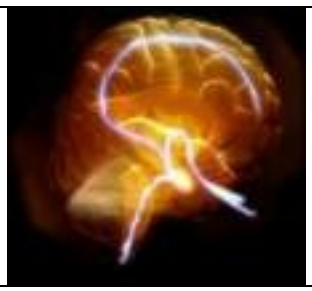
3/28	T	W: Ch. 1, A Brief History of Cognitive Neuroscience W: Ch. 4, The imaged brain. Vegetative state article, Supplement, Locked Inside.
3/30	Th	W: Ch. 2, Introducing the brain W: Ch. 3, The electrophysiological brain Mouse genetic alterations article.
4/4	T	F: Ch 1, 2; Introduction and Visual Form Agnosia. W: Ch 6. The Seeing Brain. John and Larry Videos.
4/6	Th	F: Ch. 3, 4; Dorsal and Ventral Simultanagosia. R:Ch 2, Seeing and Knowing
4/11	T	F: Ch. 6, 7, Associative Visual Agnosia, Prosopagnosia and Topographic Agnosia.
4/13	Th	R: Ch 3, Loud colors and hot babes: Synesthesia Farah, M.J. & McClelland, J.L. (1991). A computational model of semantic memory impairment: Modality specificity and emergent category specificity. Journal of Experimental Psychology: General, 120, 339-357. Review for Brain Exam!!!!!
4/18	T	Brain Exam.
4/20	Th	Attention and Motion. W: Ch. 8, The acting brain R: Ch 1, Phantom limbs and plastic **brains**
4/25	T	W: Ch. 14, executive brain.
4/27	Th	Awareness and Imitation. Ramachandran: Ch. 4, The neurons that shaped civilation. Optional articles to be posted.
5/2	T	Social cognition. W: Ch. 15. The social and emotional brain
5/4	Th	Associated articles on social thinking and moral decision making. Annotated Bibliography Due Friday, May 5.
5/9	T	W: Ch 8, Remembering. Alzheimer's articles.

Cognitive Neuroscience: Daily Assignments

Psy 366 Spring 2017

5/11	Th	AD and memory: continued. See Moodle for posted articles
5/16	T	Students' choice of topics: music, language, math/counting, metacognition, other.
5/18	Th	Students' choice of topics: music, language, math/counting, metacognition, other.
5/23	T	Student presentations of paper ideas.
5/25	Th	Student presentations of paper ideas.
5/30	T	Wrap up: Brain Models. Putting it all together.
Deadline	**Paper**	**Sunday, June 4th, by midnight (see dropbox, Moodle)**

W = Ward F = Farah R = Ramachandran



Psy 366: Cognitive Neuroscience
Term Paper

Helpful Hints

Due Sunday, June 4th by midnight.
The DropBox on Moodle!

Your paper should be 8 - 12 pp in length, double-spaced, written in APA style in terms of writing in the 3rd person, using citations, and listing references, and it should concern a topic in cognitive neuroscience. You can use references from the class, as well as the textbooks (Ward, Farah, or Ramachandran). You should find at minimum 3 articles on your own which are extremely relevant to your topic, which you understand once they are read, and which you feel comfortable reviewing. After a good literature review building to a question in your paper, your goal in writing is one of two outcomes:

1) To propose research to test a critical step/function of the mind and brain, based on your review and remaining unanswered questions, OR
2) To propose a brain model of interconnections to explain a particular psychological process (like language, consciousness, imagination, building false memories, etc).

Theoretical Model

Consider a particular cognitive/mental process in humans. How is it accomplished in the brain? Trace the pathways of information processing from sensory information to producing some psychological result (i.e., seeing, categorizing, identifying, attending, labeling, reasoning, creating, learning, remembering). Use traditional literatures to do the tracing, and they are either animal research, computer modeling which is based on normal human output, or human patient studies in which some dissociation is demonstrated. It is likely that you will find articles concerning particular specific pathways, brain structures, or networks that account for the process you are interested in. It is unlikely that anyone will try to build a full brain model of how the mental event is accomplished. That is your task.

Research Proposal

If you choose this option, you need to review the literature on a particular brain/mind process and then develop an empirical study that would test some of the assumptions made from studies from the past. The research should be new, not a replication of prior work. If the research involves using animals other than humans, make sure that somewhere in the introduction you verify that the animal in question is a good model of human mind processing of this sort, and why/how it is a good model (not your own speculation, but based on prior work and other researchers confirming this). In other words, if your focus is on language processing, you're likely to conduct research on humans unless you can convince us that some aspect of language processing in the way that humans process it is shared with other animals. The research proposal should include a methods section, with a subject description, an apparatus description, and a procedure

description. These should be general descriptions (i.e., rough numbers of subjects, some idea of testing apparatus, and a fairly well-worked out procedure). Measurements of the apparatus, wattage of light bulbs, etc can be neglected in this paper. The proposal paper should end with an "analysis and speculations" section in which you suggest different potential results and what you might conclude based on them.

A few ideas for topics of study are offered here from prior student groups:

Complex and Broad Cognitive/Brain Models:

- the neurological basis of consciousness
- Evaluation of the level of consciousness that can be explained by brain processing
- The Mind of a Murderer: Brain model of violent behavior, concentrating on frontal lobe function, temporal lobe contribution, and amygdala.
- How language is processed in the brain.
- How 2nd languages are processed.

Use of Models to Understand Mind/Brain Function:

- Brain model (structures/paths) of implicit memory
- Attempting a neural network model of the visual system
- Utilizing an animal or genetic engineered model: experiment, outcome, evaluation
- Evaluating specific criticisms against particular models of brain/mind
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Particular Structures in Specific Memory Processing

- Tests of explicit/implicit processing by LTP: A neural network model implementation
- How does the hippocampus and prefrontal cx accomplish long term memory processing?
- What brain processing is involved in episodic memories?
- What brain processing might produce false memories?

Complex but Specific Cognitive-Brain Models

- How we create memories through language, and the connections between visual and verbal representations
- A focus on working memory impairments in brain-damaged patients: Is there a brain model of STM processing?
- How do we recognize famous people?
- How do we recognize familiar people? Is there a difference between famous and familiar?