

**Cognitive Psychology: Cognition and the Brain W2215**  
**Location: Schermerhorn 614**  
**MW 2:40-3:55pm**

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**Course content:** This course is concerned with the study of mind and brain, what is called “cognitive neuroscience”. Cognitive neuroscience is an inter-disciplinary area that represents an attempt by cognitive psychologists and neuroscientists to discover how mental processes are implemented in the brain. The approach focuses on human cognitive and emotional processes and relies heavily on the methods and findings of neuroscience. This is the kind of research that is currently receiving intense coverage in the media, and this course should provide you with a deeper understanding of what you might read and hear outside of the classroom.

The topics covered are the major ones in “higher-level cognition”, and include: object recognition, long-term memory, working memory, attention and executive control, emotion, learning, and decision making. To understand the cognitive-neuroscience approach to these topics, students will be introduced to some elementary neuroanatomy, to the logic of studies with neurological and particularly psychiatric patients, and to functional neuroimaging techniques, particularly Positron Emission Tomography (PET), and functional Magnetic Resonance Imaging (fMRI). The goal is to use these techniques, along with behavioral measures, to understand the topics of interest at both a cognitive (or psychological) and neural level.

**Classes:** Classes meet Monday and Wednesday from 2:40-3:55pm. Between 2-4 classes will be devoted to the discussion of a topic (e.g., long-term memory). The intent is to provide a substantially deeper treatment of each topic than would be available in an introductory-level course.

**Readings:** Concepts discussed in lectures will refer to the reading assigned for that class period. Therefore, the reading associated with each class should be read prior to the class. The readings include (1) chapters from a 2007 textbook, (2) required articles and (3) suggested articles. The textbook is authored by Smith and Kosslyn (hereafter, S&K), and is entitled “Cognitive Psychology: Mind and Brain” (the observant reader may notice a resemblance to the course’s title—no accident). The book is published by Prentice Hall and is available in the Columbia University Bookstore (in Lerner Hall) as well as on the web.

The required articles are sometimes literature reviews, and sometimes original, research papers. The level of these papers is often higher than that of the book chapters. The suggested articles may be even more advanced, and are intended for students who are particularly interested in the topic. All articles will be posted in the Class Files folder on courseworks. The textbook is available at the bookstore.

Textbook: Smith, E. E. and Kosslyn, S. M. (2007). Cognitive Psychology: Mind and Brain. New Jersey: Prentice Hall.

### **Exams/Grading:**

Grades will be based on 3 In-Class Exams, each worth 25%, and a Final Exam, worth 25%. In-class exams will cover material discussed in lectures and readings up to the date of each exam from the last exam (or from the first day of class, for the first exam). The final exam, scheduled for Wednesday, May 9<sup>th</sup> (from 1:10pm – 4pm), is cumulative and will cover material from the entire semester. All exams will be of the same format (definitions and short answer questions, although the final will be longer than the In-Class exams).

You may, if you wish, replace ONE of the 3 In-Class exams with a 8-10 page paper., due the last day of class This means that if, for any reason, you miss one of the exams, you will have an opportunity to make up the grade by writing a paper. However, if you miss a test and do not hand in a paper, for any reason, you will receive a 0 for 25% of your grade. You may take all 3 In-Class exams AND write a paper. In this case, we will take the 3 highest grades to make up 75% of your final grade.

The Paper: You should explore a concept in cognitive psychology, using a minimum of 2 and a maximum of 4 peer-reviewed research articles (eg, newspaper articles are NOT peer reviewed; Blog posts are NOT peer reviewed) to explain the concept. I recommend that you have your topic and references approved by me or one of the TAs prior to writing your paper, but it is not required. The paper should be written for an intelligent lay-person. The maximum length is 10 pages, double spaced, 12 point font with standard margins. We will stop reading after the 10th page.

You may NOT skip the final exam! Under no circumstances can you skip the Final Exam, and you cannot make up the Final exam with any other assignment. If you do not take the final, you will receive a 0 for 25% of your grade.

EXAMS:

1. February 15
2. March 19
3. April 11
4. May 9

Paper due: April 30

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**SYLLABUS**

Below are listed the intended topics of each lecture, along with the readings for that lecture. Please do the readings before the lecture so that you can understand what is being said in class.

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**Week 1**

1/18: *Lecture 1 Introduction to course*

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**Week 2**

1/23: *Lecture 1 Historical overview and basics of cognitive neuroscience*

Required: Gazzaniga, M. S., Ivry, R. B., & Mangun, L. R. (2009). Chapter 1.  
*Cognitive Neuroscience: The Biology of the Mind.*

Suggested: S&K: Chapter 1

1/25: *Lecture 2 Cellular and Molecular basis of Cognition (DR. KATHLEEN TAYLOR)*

Required: Gazzaniga, M. S., Ivry, R. B., & Mangun, L. R. (2009). Chapter 2.  
*Cognitive Neuroscience: The Biology of the Mind.*

Brain Facts: A Primer on the Brain and Nervous System, (2008) *Society for Neuroscience.*

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**Week 3**

1/30: *Lecture 1 Perception: How do we recognize objects?*

Required: S&K: Chapter 2 (Section 4: “Achieving Visual Recognition”)

Haxby, J. V., et al. (2001). Distributed and overlapping representations of faces and objects in ventral temporal cortex. *Science*, 293, 2425-2430.

2/2: Lecture 2      *Perception: Are there specialized brain regions for recognizing faces and places?*

Required: Kanwisher, N., McDermott, J., & Chun, M. M. (1997). The fusiform face area: A module in human extrastriate cortex specialized for face perception. *Journal of Neuroscience*, 17, 4302-4311.

Gauthier, I. et al. (1999). Activation of the middle fusiform 'face area' increases with expertise in recognizing novel objects. *Nature*, 2(6), 568-573.

Suggested: Tanaka, J. W. (2005). Object categorization, expertise, and neural plasticity. In M. S. Gazzaniga (Ed.), *The Cognitive Neurosciences III* (pp. 877-887). Cambridge, MA: MIT Press.

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#### Week 4

2/6: Lecture 1      *Conceptual representations: How do we represent knowledge?*

Required: S&K: Chapter 4

Thompson-Schill, S. L. (2003). Neuroimaging studies of semantic memory: inferring how" from "where." *Neuropsychologia*, 41, 280-292.

Martin, A., Ungerleider, L. G., & Haxby, J. V. (2000). Category specificity and the brain: The sensory/motor model of semantic representations of objects. In M. Gazzaniga (Ed.), *The New Cognitive Neurosciences* (2<sup>nd</sup> ed., pp. 1023-1036). Cambridge, MA, MIT Press.

Lambon-Ralph., et al. (in press). Coherent concepts are computed in the anterior temporal lobes. *Proceedings of the National Academy of Sciences*.

2/8: Lecture 2      *Working Memory (WM): How do we maintain information in an active state?*

Required: Baddeley, A. (1992). Working Memory. *Science*, 225 (5044), 556-559.

Smith, E. E., Jonides, J. (1999). Storage and executive processes in the frontal lobes. *Science*, 283, 1657-1661.

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#### Week 5

2/13: Lecture 1      *WM: How do we deal with distraction; how do we manipulate information in WM?*

Required: S&K: Chapter 6

D'Esposito, M., & Postle, B. (1999). The dependence of span and delayed-response performance on prefrontal cortex. *Neuropsychologia*, *37*, 1303 – 1315.

Dolcos, F., Miller, B., Kragel, P., Jha, A., & McCarthy, G. (2007). Regional brain differences in the effect of distraction during the delay interval of a working memory task. *Brain Research*, *1152*, 171 – 181.

2/15: Lecture 2      EXAM 1

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**Week 6**

2/20: Lecture 1:      *Long-term memory (LTM): Are there different long-term memory systems?*

Required: S&K: Chapter 5

Buckner, R. L. (2000). Neuroimaging of Memory. In M. Gazzaniga (Ed.), *The New Cognitive Neurosciences* (2<sup>nd</sup> ed., pp. 817-828). Cambridge, MA: MIT Press.

2/22: Lecture 2      *Long-term memory: Retrieval*

Required: Squire, L. R., Clark, R. E., & Bayley, P. J. (2005). Medial temporal lobe function and memory. In M. S. Gazzaniga (Ed.), *The Cognitive Neurosciences III* (pp. 931-941). Cambridge, MA: MIT Press.

Wheeler, M. E., & Buckner, R. L. (2003). Functional dissociation among components of remembering: Control, perceived oldness, and content. *The Journal of Neuroscience*, *23*, 3869-3880.

Suggested: Butler, A.C., & Roediger, H.L. (2007). Testing improves long-term retention in a simulated classroom setting. *European Journal of Cognitive Psychology*, *19*, 514-527.

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**Week 7**

2/27: Lecture 1      *Episodic memory: Effects of emotion and stress*

Required: S&K: Chapter 8

Cahill, L. et al (1994). Beta Adrenergic activation and memory for emotional events. *Nature*, 371, 702-704.

Cahill, L., & Alkire, M. T. (2003). Epinephrine enhancement of human memory consolidation: Interaction with arousal at encoding. *Neurobiology of Learning and Memory*, 79, 194-198.

De Quervain, Roozendaal, Nitsch, McGaugh, & Hock. (2000). Acute cortisone administration impairs retrieval of long-term declarative memory in humans. *Nature Neuroscience*, 3, 313-314.

Suggested: Anderson, A. K., Wais, P. E., & Gabrieli, J. (2006). Emotion enhances remembrance of neutral events past. *Proceedings of the National Academy of Sciences*, 103, 1599-1604.

2/29: Lecture 2      *False Memory*

Required: Rajaram, S., & Roediger, H.L. (1997). Remembering and knowing as states of consciousness during retrieval. In J.D. Cohen & J.W. Schooler (Eds.), *Scientific approaches to consciousness* (pp. 213-240). Hillsdale, NJ: Erlbaum.

Roediger, H.L., & McDermott, K.B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 21, 803-814.

Suggested: McDermott, K.B., & Roediger, H.L. (1998). Attempting to avoid illusory memories: Robust false recognition of associates persists under conditions of explicit warnings and immediate testing. *Journal of Memory and Language*, 39, 508-520

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## Week 8

3/5: Lecture 1      *Metacognition (DR. JANET METCALFE)*

Required: Fleming, S.M., Weil, R.S., Nagy, Z., Dolan, R.J. & Rees, G. (2010) Relating introspective accuracy to individual differences in brain structure. *Science*, 329(5998):1541-43

Metcalfe, J. & Dunlosky, J. (2008). Metamemory. In H.L. Roediger, III (Ed.), *Learning and Memory: A Comprehensive Reference* (pp. 349-362). Oxford: Elsevier.

Metcalfe, J. (2009). Metacognitive judgments and control of study. *Current Directions in Psychological Science*, 18, 159-163.

3/7: Lecture 2      *Gradual learning: Role of prediction (DR. DAPHNA SHOHAMY)*

Required: Knowlton, B. J., Mangels, J. A., & Squire, L. R. (1996). A neostriatal habit learning system in humans. *Science*, 273, 1399 – 1402.  
TBD

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**Week 9**      (3/12-3/16)

**NO CLASS – SPRING BREAK**

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**Week 10**

3/19: Lecture 1      *EXAM 2*

3/21: Lecture 2      *Cognitive Control: Attention and inhibition*

Required: S&K: Chapter 7

MacDonald III, A. W. et al. (2000). Dissociating the role of the dorsolateral prefrontal and anterior cingulate cortex in cognitive control. *Science*, 288, 1835-1838.

Nee, D. & Jonides, J. (2008). Dissociable interference-control processes in perception and memory. *Psychological Science*, 19, 490-500.

Egner, T., & Hirsch, J. (2005). Cognitive control mechanisms resolve conflict through cortical amplification of task-relevant information. *Nature Neuroscience*, 8, 1784-1790.

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**Week 11**

3/26: Lecture 1      *Cognitive Control: Switching attention*

Required: Rubinstein, J. S., Meyer, D. E., & Evans, J. E. (2001). Executive control of cognitive processes in task switching. *Journal of Experimental Psychology: Human Perception and Performance*, 27(4), 763-797.

Monsell, S. (2003). Task switching. *Trends in Cognitive Science*, 7, 134-140.

Chambers, C. D., Garavan, H. & Bellgrove, M. A. (2009). Insights into the neural basis of response inhibition from cognitive and clinical neuroscience. *Biobehavioral Reviews*, 33, 631-646.

3/28: Lecture 2      *Cognitive Functioning and Impairment in Substance Users (DR. CARL HART)*

Required:      Hart, C. Marvin, C., Silver, R & Smith, E. (2011). Is Cognitive Functioning Impaired in Methamphetamine Users? A Critical Review. *Neuropsychopharmacology*, 1–23.

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## Week 12

4/02: Lecture 1      *Cognitive Reserve in Aging (DR. YAAKOV STERN)*

Required:      Stern Y. Cognitive Reserve. *Neuropsychologia* 2009;47: 2015-2028.

Stern Y, Zarahn E, Habeck C, Holtzer R, Rakitin BC, Kumar A, Flynn J, Steffener J, Brown T. A common neural network for cognitive reserve in verbal and object working memory in young but not old. *Cereb Cortex*. 2008 Apr;18(4):959-67.

Steffener J, Reuben A, Rakitin BC, Stern Y. Supporting performance in the face of age-related neural changes: testing mechanistic roles of cognitive reserve. *Brain Imaging and Behavior* 2011;5:212–221.

4/04: Lecture 2      *Breakdowns of learning and motivation in psychopathology*

Required:      Gold, J. M., Waltz, J. A., Prentice, K. J., Morris, S. E., & Heerey, E. A. (2008). Reward processing in schizophrenia: A deficit in the representation of value. *Schizophrenia Bulletin*, 34, 835–847.

Juckel, G., et al. (2006). Dysfunction of ventral striatal reward prediction in schizophrenia. *Psychopharmacology*, 187, 222-228.

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## Week 13

4/9: Lecture 1      *Emotion (DR. KEVIN OCHSNER)*

Required:      S&K: Chapter 8

Article TBD

4/11: Lecture 2      *EXAM 3*

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**Week 14**

4/16: Lecture 1      *Decision making: Role of emotion (DR. ELKE WEBER)*

Required:    Sanfey, A. et al. (2003). The neural basis of economic decision-making in the ultimatum game. *Science*, 300, 1755-1758.

McClure, S.M., Laibson, D.I., Loewenstein, G., & Cohen, J.D. (2005). Separate neural systems value immediate and delayed monetary rewards. *Science*, 306, 503-507.

Suggested:    Loewenstein, G. F., et al. (2001). Risk as feelings. *Psychological Bulletin*, 127, 267-286.

4/18: Lecture 2      *Decision making (DR. ERIC JOHNSON)*

Required:    S&K: Chapter 9

Tversky, A. & Kahneman, D. (1974). Judgement under uncertainty: heuristics and biases. *Science*, 185, 1124-1131.

De Martino, B., Kumaran, D., Seymour, B., & Dolan, R. J. (2006). Frames, biases, and rational decision-making in the human brain. *Science*, 313, 684-687.

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**Week 15**

4/23: Lecture 1      *Problem Solving and Reasoning*

Required:    S&K: Chapter 10

Holyoak, K. J. (in press). Analogy and relational reasoning. In K. J. Holyoak & R. G. Morrison (Eds.), *The Oxford handbook of thinking and reasoning*. New York: Oxford University Press.

4/25: Lecture 2      *Tour of the fMRI center*

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**Week 16**

4/30: Lecture 1      *Review session – no readings (TAs)*

