

Learning Memory and Cognition

SOCS 681

Fall 2019

Tuesdays, 7:00 – 9:30

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Course Overview

What is the best method of studying for a test? Is it possible to build a lie detector? How reliable is eyewitness testimony? Is there such a thing as a photographic memory? Why do people experience déjà vu? Is it possible to repress traumatic memories? This course attempts to answer these questions and more in the context of a broad introduction to the foundational concepts of human memory. Topics covered include short-term memory, encoding and retrieval processes, forgetting, memory distortion, implicit memory, effects of drugs on memory, amnesic syndromes, prospection, and the effects of aging and disease on memory. Students become familiar with theories and data from cognitive, neuroimaging, neuropsychological, and neurobiological perspectives.

Course Assignments

- **Class Attendance and Participation (25%)**
- **Short Papers (three papers at 10% each for a total of 30%)**
 - **Paper 1 – Proposal for final paper due – topic of your choice, cleared with instructor**
 - **Paper 2 – Comprehensive outline of final paper due, including annotated bibliography**
 - **Paper 3 – Full draft of final paper**
- **Long Paper (30%) – Due last day of class**
- **Presentation (15%)**
 - **In class, last two sessions**

Course Texts

- Learning and Behavior: From Brain to Behavior, 3rd Edition, Mark Gluck, Eduardo Mercado, and Catherine Myers
ISBN-13: 978-1464105937
There are several used copies available in good condition online.
- Other readings will be available in Moodle.

Course Schedule

Week	Topic
1 9/10	Introduction and Overview, An Overview of the Brain, Basic Assumptions of Learning
2 9/17	<p>An Overview of the Brain, Basic Assumptions of Learning</p> <p><i>What is learning? Historical ideas and the birth of the modern science of learning. Additional topics include learning/performance, innate behaviors versus adaptation (nature/nurture), critical periods, models and mechanisms, and levels of analysis</i></p> <ul style="list-style-type: none"> • Textbook reading: Gluck, Ch. 1 - The psychology of learning and memory • Watson, J.B. (1994) "Psychology as the Behaviorist Views It" <i>Psychological Review</i>, 101(2), 248-253. • Hull, C.L. (1937) "Mind, Mechanism, and Adaptive Behavior" <i>Psychological Review</i>, 44 (1), 1-32. • Pinker, S. (2004) "Why nature & nurture won't go away" <i>Daedalus</i>, 133(4), 5-17. • Optional Readings (discussed in lecture): <ul style="list-style-type: none"> ○ Phattanasri, P., Chiel, H.J., and Beer, R.D. (2007) "The Dynamics of Associative Learning in Evolved Model Circuits" <i>Adaptive Behavior</i>, 15(4), 377-396. ○ Skinner, B.R. (1950) "Are Theories of Learning Necessary?" <i>Psychological Review</i>, 57 (4), 193-216.
3 9/24	<p>Basic concepts in the neuroscience of learning and memory</p> <p><i>In the following weeks we will explore a number of basic phenomena of learning. However, it is helpful to begin by casting these ideas against the backdrop of contemporary neuroscience. Today's lecture will be a basic whirl-wind tour of the neural processes thought to underly learning and memory.</i></p> <p><i>We'll talk about the function of neurons, the specialization of function in the brain, basic learning mechanisms (hebbian learning, LTP), and modern techniques for studying learning and memory (fMRI, EEG, etc...)</i></p> <p><i>Since this is primarily a introduction/review for students who have no prior exposure to neuroscience or psychology, we will default primarily to the book for neuroscience background, then turn to the paper readings for the evolution of a view of the organization of learning and memory in the brain. If you already know all this, great, but it's always important to look back and realize exactly WHY you know this.</i></p> <ul style="list-style-type: none"> • Textbook reading: Gluck, Ch. 2 - The neuroscience of learning and memory • Lashley, K.S. (1950) "In search of the Engram" <i>Society of Experimental Biology Symposium</i>, 4, 454-482. • Scoville, W.B. and Milner, B. (1957) "Loss of Recent Memory After Bilateral Hippocampal Lesions" <i>Journal of Neurology, Neurosurgery and Psychiatry</i>, 20, 11-21. • Posner, M.I., Peteresen, S.E., Fox, P.T., Raichle, M.E. (1988) "Localization of Cognitive Operations in the Human Brain" <i>Science</i>, 240, 1627-1631. • Squire, L.R. (1992) "Declarative and Nondeclarative Memory: Multiple Brain Systems Supporting Learning and Memory" <i>Journal of Cognitive Neuroscience</i>, 4 (3), 232-243.

<p>4 10/1</p>	<p>Non-associative/perceptual forms of learning</p> <p><i>This lecture will cover basic, non-associative forms of learning including perceptual learning, habituation/sensitization (incl. habituation as a empirical technique for studying learning in non-linguistic animals), latent learning, feature learning, imprinting, priming, repetition suppression, etc....</i></p> <ul style="list-style-type: none"> • Textbook reading: Gluck, Ch. 6 - Non-Associative Learning • Foundational Work: Tolman, E.C. (1948) "Cognitive Maps in Rats and Men" <i>Psychological Review</i>, 55(4), 189-208. • Contemporary Work: Goldstone, R.L. (1998) "Perceptual Learning" <i>Annual Review of Psychology</i>, 49, 585-612. • Grill-Spector, K., Henson, R. and Martin, A. (2006) "Repetition and the brain: neural models of stimulus-specific effects" <i>Trends in Cognitive Sciences</i>, 10(1), 14-23. • Some theory: Barlow, H.B. (1989) "Unsupervised Learning" <i>Neural Computation</i>, 1, 295-311.
<p>5 10/8</p>	<p>Classical Conditioning I</p> <p><i>Pavlov, basic procedure, phenomena and terms (CS/US, etc...), basic findings, blocking and overshadowing, etc..., Resorla-Wagner model, Pearce-Hall model and the role of attention/associability in classical conditioning, basic neural substrates of classical conditioning, interactions with other learning systems (e.g., role of hippocampus in trace conditioning)</i></p> <ul style="list-style-type: none"> • Textbook reading: Gluck, Ch. 4 - Classical Conditioning • Foundational Work: Rescorla, R.A. (1998) "Pavlovian Conditioning: It's not what you think it is" <i>American Psychologist</i>, 43(4), 151-160. • A theory: Rescorla, R.A. and Wagner, A.R.(1971) "A Theory of Pavlovian Conditioning: Variations in the Effectiveness of Reinforcement and Non-reinforcement" in Black, A.H. & Prokasy, W.F. (eds.), <i>Classical conditioning II: Current research and theory</i> (pp. 64-99). New York: Appleton-Century-Crofts. • Example empirical result: Clark, R.E. and Squire, L.R. (1998) "Classical Conditioning and Brain System: The Role of Awareness" <i>Science</i>, 280, 77-81. • More theories: Dayan, P., Kakade, S. and Montague, P.R. (2000) "Learning and selective attention" <i>Nature Neuroscience</i>, 3, 1218-1223.
<p>6 10/15</p>	<p>Instrumental Conditioning</p> <p><i>Law of effect, role of reinforcement, stimulus control, choice behavior, matching law, melioration, concurrent schedules, self control/impulsivity, habits and planning, superstitious responding, habits and planning (model-based and model-free RL), motivation for behavior, instrumental condition and decision theory, matching behavior and the representation of value in the brain</i></p> <ul style="list-style-type: none"> • Textbook reading: Gluck, Ch. 5 - Instrumental (Operant) Conditioning • Dickinson, A. (1994) "Instrumental Conditioning" <i>Animal Learning and Cognition</i>, Chapter 3, pg 45-79. • Herrnstein, R.J. (1970) "On the law of effect" <i>Journal of the Experimental Analysis of Behavior</i>, 13, 243-266. • Skinner, B.F. (1948) "Superstition in the Pigeon" <i>Journal of Experimental Psychology</i>, 38, 168-172.

	<ul style="list-style-type: none"> • Dickinson, A. (1985) "Actions and Habits: The Development of Behavioral Autonomy" <i>Philosophical Transactions of the Royal Society of London. Series B, Biological</i>, 38, 168-172. • Balleine, B.W., Daw, N.D., and O'Doherty, J.P. (2008) "Multiple Forms of Value Learning and the Function of Dopamine" <i>Neuroeconomics: Decision Making and the Brain</i> (Ed. Glimcher, P.W., Camerer, C.F., Fehr, E., and Poldrack, R.A., Chapter 24, 367-387. • Niv, Y., Daw, N.D., Joel, D., Dayan, P. (2006) "Tonic dopamine: Opportunity costs and the control of response vigor" <i>Psychopharmacology</i>, 191(1), 507-520. • Sugrue, L.P. (2004) "Matching behavior and the representation of value in the parietal cortex" <i>Science</i>, 304, 1782. <p>Herrnstein, R.J. and Prelec, D. (1991) "Melioration: A Theory of Distributed Choice" <i>The Journal of Economic Perspectives</i>, 5(3), pg 137-156.</p>
<p>7 10/22</p>	<p>Generalization and Discrimination</p> <p><i>Pearce (configural) vs. R-W (elemental), stimulus generalization, attention learning, context dependent learning</i></p> <ul style="list-style-type: none"> • Textbook reading: Gluck, Ch. 3 - Generalization, Discrimination, Familiarity • Mitchell, T.M. (1980). The need for biases in learning generalizations (Report CBM- TR-5-110). New Brunswick, NJ: Rutgers University, Department of Computer Science. • Shepard, R.N. (1987) "Toward a universal law of generalization for psychological science" <i>Science</i>, 237(4820), 1317-1323. <p>Tenenbaum, J.B. and Griffiths, T.L. (2001) "Generalization, similarity, and Bayesian inference." <i>Behavioral and Brain Sciences</i>, 24, 629-641.</p>
<p>8 10/29</p>	<p>Cognitive Forms of Learning</p> <p><i>Category and concept learning, hypothesis testing behavior, learning with rules or associations, relational processing, causal learning, learning by analogy, prior knowledge and basic learning processes,</i></p> <ul style="list-style-type: none"> • Textbook reading: Gluck, Ch. 8 - Skill Memory • Sloman, S.A. (1996) "The empirical case for two systems of reasoning" <i>Psychological Bulletin</i>, 119(1), 3-22. • Maddox, W.T. and Ashby, F.G. (2004). Dissociating explicit and procedural-learning based systems of perceptual category learning. <i>Behavioral Processes</i>, 66, 309-332. • Johansen, M.K. and Palmeri, T.J. (2002) "Are there representational shifts during category learning", <i>Cognitive Psychology</i>, 45, 482-553. • Erickson, M.A. and Kruschke, J.K. (1998) "Rules and Exemplars in Category Learning", <i>Journal of Experimental Psychology: General</i>, 127 (2), 107-140. • Gopnik, A. et al. (2004). A Theory of Causal Learning in Children: Causal Maps and Bayes Networks. <i>Psychological Review</i>, 111(1), 3-32. <p>Gentner, D. (2003) "Why We're So Smart" in Gentner, D. and Goldin-Meadow, S. (Eds.) <i>Language in mind: Advances in the study of language and thought</i> (pp. 195-235) Cambridge, MA: MIT Press.</p>
<p>9 11/5</p>	<p>Observational Learning</p>

	<p><i>Learning from other people, copying, imitation, mirror neuron systems, observational learning, learning in communicative settings (e.g., pedagogical reasoning)</i></p> <ul style="list-style-type: none"> • Textbook reading: Gluck, Ch. 11 – Social Learning and Memory • Bandura, A. (1965) "Vicarious Processes: A Case of No-Trial Learning" <i>Advances in Experimental Social Psychology</i>, 2, 1-55. • Laland, K. (2004) "Social Learning Strategies" <i>Learning & Behavior</i>, 32(1), 4-14. • Dinstein, I., Thomas, C., Behrmann, M., Heeger, D.J. (2008) "A Mirror Up to Nature" <i>Current Biology</i>, 18(1), R13-R18. <p>Burke, C.J., Tobler, P.N., Baddeley, M., and Schultz, W. (2010) "Neural mechanisms of observational learning" <i>Proceedings of National Academy of Science</i>, 107(32), 14431-14436.</p>
10 11/12	STUDENT PRESENTATIONS
11 11/19	STUDENT PRESENTATIONS
12 11/26	THANKSGIVING RECESS – NO CLASS
13 12/3	STUDENT PRESENTATIONS – We may use 12/10 if more time is needed.