



Boston University, Department of Psychology

PS 525 Cognitive Science

Time: MW 11-12:30

Spring 2006

Place: Psychology Dept. Basement 41 (PSY 153)

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Special Topic: Applied Cognitive Science

Are cognitive scientists in a position to provide knowledge that can be used in real-world applications? We will focus on students' interests and applications. Possibilities include:

- What are the implications of cognitive science for clinical psychology (for example: Can neural net modeling shed light on clinical disorders?)
- Assuming we now know how humans learn and how the brain changes with development, do cognitive scientists have advice for theories of teaching and educational practice?
- Can cognitive studies inform debates about the intersection of religion and science?
- How do organizations (businesses, governments) learn? Can cognitive science inform public policy?
- How can we design our environment and use technologies to maximize their fit with human cognition?

Course Description. Cognitive scientists share a commitment to developing theories of human cognition which can integrate findings from diverse fields (psychology, philosophy, linguistics, computer science, neuroscience). Interdisciplinary research methodology, including connectionist modeling, will be reviewed and applied to questions on human decision making, consciousness, creativity, development, social behavior and psychopathology.

Prerequisites. Any one of the following courses: Cognitive Psychology (PS 336), Physiological Psychology (PS 231) Neuropsychology (PS 338), Minds and Machines (PH 265), Mind, Brain and Self (PH 266), Philosophy of Cognitive Science (PH 468), Artificial Intelligence. Prerequisites waived for graduate students. All students should have an understanding of basic statistical concepts (e.g., background in statistics to the level of MA 116 or PS 211). Auditors and visitors welcome.

Overview of class. Much of this class will be student-led. During the first three weeks, class members will discuss possible topics, and come to consensus about readings and topics. Students will join forces with one other classmate to lead the class for one week or can lead one day on their own. Students can choose any presentation day, beginning the week of Feb 13. I have listed tentative readings and topics from prior years. You can choose or modify one of these topics, or develop your own topic.

Topics should be chosen to maximize interdisciplinary themes or those relevant to the “grand philosophical questions” which cognitive scientists began to ask in the second half of the 20th century (see section on choosing topics below).

Course Requirements

- Readings for each class meeting: Read and be prepared to participate in class
- Written comments: email to the class presenter (choose 4 days/topics on which to comment)
- Lead class discussion on topic and day of your choosing
- 8-10 page paper, due end of class (week of May 8).

There is no textbook for the class. Readings are articles which can be downloaded from sciencedirect.com or other sites, as noted in the list of readings. You can obtain other texts for your own background reading (see list at next page).

Contemporary interdisciplinary questions

- What is the evolutionary or adaptive basis for this behavior?
- What is its developmental time course? How do developmental factors influence the shape of this behavior or ability?
- What are the information processing or computational characteristics of this behavior?
- What is the brain basis or physiological underpinnings of the behavior?
- Is this behavior best described by multiple levels (micro/macro)?
- Does this behavior have an abnormal or pathological counterpart?
- Is this topic addressed by multiple disciplines? (Psychology, artificial intelligence, linguistics, neuroscience, philosophy, anthropology, sociology)
- What were the important historical questions about this topic, and how have the questions changed?

Note about topic choice: A possible topic could focus more on one of these question than on the others, e.g., the topic “evolutionary psychiatry” focuses mostly on the first question.)

Cognitive Science Books for Background Reading

Paul Thagard, 1998. *Mind Readings: Introductory Selections on Cognitive Science*. Contains chapters on consciousness, language, mental representation, concepts, analogy, emotion, and computer models of cognition and behavior. religion and the brain.

Patricia Churchland, *Mindwise*. Takes a philosophical perspective: how does cognitive science shed light on classic questions about the mind?

I suggest browsing titles with key words “cognitive science introduction”. The MIT Press bookstore (small shop in Kendall Square) and cognitive science section of Barnes and Nobles are good places for looking at books.

David Lodge, 2001. *Thinks: A novel*. This novel is attempt to present key issues in cognitive science in the guise of a contemporary love story between two professors, one a humanities instructor and a skeptic of attempts to study consciousness scientifically the other a champion of cognitive science.

If you like the idea of reading fiction to learn about science, I also recommend Richard Power’s *Galatea* 2.2, 1995. This is easily ordered from amazon.com.

More on Course Requirements

Email comments. Choose a topic and email the presenters your comments either before or after the presentation (and cc to Prof. Harris). We can also set up a discussion board if class members would like to see each others comments.

Comments do not need to be elaborate and can be as short as a paragraph giving your opinion on the topic. You can raise a question that was unanswered by the reading (something that could be addressed as a group). You could mention related work that you know of from other classes or other reading.

Leading class discussion

Students volunteer to lead class discussion on topic of their choice, and will collaborate with Prof Harris to select readings.

What distribution of articles to pick

When choosing readings for one week, students should aim for 4 articles/chapters. Choose articles that most of the students in the class will benefit from.

Possible distribution of articles

- one article from a popular source (e.g., Discover Magazine, Scientific American, newspaper)

- two contemporary readings, from contrasting disciplines or perspectives
- 1 additional article (such as a historical article)
- You can also suggest supplemental articles. Supplemental articles can be introductions, or advanced reading for people with a special interest in this topic.

Presenters should brainstorm with each other (if a team) and Prof. Harris to find some hands-on applications or activity to do in class for one of the two days. Examples: experiments students can participate in an experiment or provide primary materials to review and analyze. Another idea is to organize a debate or to assign students to act out the roles of leading theorists in a subfield.

What are your responsibilities are for leading class discussion?

- By the third week of class (if possible; we do have flexibility): Choose your topic, propose readings and presentation date. Present to the class the topic, your justification, and justification of the readings. (Readings can be modified if necessary later, at the latest, a week before your presentation date.)
- The week before your presentation date. Prepare and distribute your discussion questions. Meet with Prof. Harris to discuss ideas.
- During your presentation week. Bring relevant materials to class: outline, powerpoint presentation, primary materials for classmates to analyze, etc. After each class, the two leaders meet with Prof Harris briefly (10 minutes) to go over how the class meeting went.

First three weeks of class

Wed Jan 18 Class introduction, discussion of interests

Mon Jan 23 Origins: The cognitive revolution; artificial intelligence (1950-1970)

Lodge, *Thinks*, p. 49-55. Provides examples of famous cognitive science projects. (Prof. Harris will distribute)

Harris, C.L. 2001. Language and cognition. Available from <http://people.bu.edu/charris/encyclopedia.html>. While focusing on language, this article reviews the three time periods we will discuss during the first weeks of class (the cognitive revolution, the connectionism paradigm shift, the contemporary focus on cognitive neuroscience).

-->Browse an on-line site dedicated to cognitive science. Do your own search or try this one: <http://cscs.umich.edu/~crshalizi/notebooks/cognitive-science.html>

Jan 30 The 80s Connectionist Revolution “Brain-style computer modeling”

McClelland, J.L., Rumelhart, D.E., & Hinton, G.E. (1986). The appeal of parallel distributed processing. (chapter from *PDP: Explorations in the microstructure of cognition*). Prof Harris will distribute.

Hinton, G.E., Plaut, D.C., Shallice, T. (1993). Simulating brain damage. *Scientific American*, October 1993. Available from: <http://www.cnb.cmu.edu/~plaut/papers/abstracts/HintonPlautShallice93SciAm.simBrainDam.html>

Feb 6 Other breakthroughs of the mid-80s: Chaos and Dynamical Systems Theory, Complexity, Robotics

Brooks, R.A. (1991). New approaches to Robotics. *Science* (253), September 1991, pp. 1227–1232. Available from: <http://www.ai.mit.edu/people/brooks/papers/new-approaches.pdf> (This paper prints out in very small type; you may want to try to cut and paste it from the screen into some other word processor where you can enlarge the font.)

Gregory Rae, Introduction to chaos theory. Available from: <http://www.imho.com/grae/chaos/index.html>

Fire in the Brain: Can programmable implants help epileptics detect the onset of seizures? By Kathy A. Svitil *DISCOVER* Vol. 23 No. 05 | May 2002 <http://www.discover.com/issues/may-02/features/featfire/>

(Prof Harris will distribute a set of articles on specific topics related to complexity theory; students will select articles to read based on their interests.)

From the 90s to the current day, the dominant paradigm in cognitive science has been cognitive neuroscience, although classic experimental methods from cognitive psychology, and computer modeling, are heavily relied upon. Cognitive scientists also emphasize “the big questions” and interdisciplinary approaches. The topics below reflect current approaches

Other topics, depending on student interests

Categorization: Theories and Brain Damage

How human categorize information is a basic question for cognitive theorists. Rogers & McClelland incorporate theories about categorization, computer modeling, and brain damage (progressive loss of knowledge of categorical hierarchies observed in dementia).

Language and brain development

Birdsong, D., & Molis, M. (2001). On the evidence for maturational constraints in second language acquisition. *Journal of Memory and Language*, 44, 235-249.

Bates, E. (1999). Plasticity, localization and language development. In S. Broman & J.M. Fletcher (Eds.), *The changing nervous system: Neurobehavioral consequences of early brain disorders* (pp. 214-253). New York: Oxford University Press. Available <http://crl.ucsd.edu/~bates/papers.html>

Bates, E., Elman, J., Johnson, M., Karmiloff-Smith, A., Parisi, D., & Plunkett, K. (1998). Innateness and emergentism. In W. Bechtel & G. Graham (Eds.), *A companion to cognitive science* (pp. 590-601). Oxford: Basil Blackwell. Available from <http://crl.ucsd.edu/~bates/papers.html>

Critical periods

Pallier, C., Dehaene, S., Poline, J.-B., LeBihan, D. Argenti, A.-M., Dupoux, E., & Mehler, J. (2003). Brain imaging of language plasticity in adopted adults: can a second language replace the first? *Cerebral Cortex*, 13, 155-161. Available from: <http://www.ehess.fr/centres/lscp/persons/pallier/papers/index.html>

Oh, J.S., Jun, S.-A., Knightly, L.M., & Au, T.K. Holding on to childhood language memory, *Cognition*, 86, B53-B64

Grimshaw, G.M., Adelstein, A., Bryden, M.P., & MacKinnon, G.E. (1998). First-language acquisition in adolescence: Evidence for a critical period for verbal language development. *Brain and Language*, 63, 237-255.

Bailey, D. B. (2002). Are critical periods critical for early childhood education?: The role of timing in early childhood pedagogy. *Early Childhood Research Quarterly*, 17, 281-294.

Savantism / Developmental Disorders

Savantism

Tsimpli, I.-M., & Smith, N. (1998). Modules and quasi-modules: Language and theory of mind in a polyglot savant. *Learning and Individual Differences*, 10, 193-215.

Bates, E. (1997). On language savants and the structure of the mind: A review of Neil Smith and Ianthi-Maria Tsimpli, “The mind of a savant: Language learning and modularity. *International Journal of Bilingualism* 1(2), 163-179. Available from: Bates’ homepage: <http://crl.ucsd.edu/~bates/papers.html>

Williams Syndrome

Johnson, S.C., & Carey, S. (1998). Knowledge enrichment and conceptual change in folk biology: Evidence from Williams syndrome. *Cognitive psychology*, 437, 156-200.

Tager-Flusberg, H., & Sullivan, K. (2000). A componential view of theory of mind: Evidence from

Williams syndrome. *Cognition* 76, 59-89.

For genetic analysis of Williams syndrome, if you are interested, see Bellugi et al, *From cognition to brain to gene* (can borrow from Prof. Harris)

Primate cognition

Depending on student interests, we can modify readings to include evolution of human language, and animal cognition generally.

Michael T. (2000). Primate cognition: introduction to the issue. *Cognitive Science*, 24, 351-361.

Gallup, G.G. (1998) Self-awareness and the evolution of social intelligence. *Behavioural Processes*, 42, 239-247.

Povinelli, D.J., Bering, J.M., & Giambrone, S. (2000). Toward a science of other minds: escaping the argument by analogy. *Cognitive Science*, 24, 509-541.

Heyes, C. M. (1998) Theory of mind in nonhuman primates. *Behavioral and Brain Sciences*. Available from the BBS website, <http://www.bbsonline.org>

Primate Cognition at Emory University -- Click on video and field observation; there is also an overview of primate cognition and a bibliography <http://www.learnlink.emory.edu/~npatel2/>

Shanker, S., & King, B. J. (forthcoming). The emergence of a new paradigm in ape language research. *Behavioral and Brain Sciences*. <http://www.bbsonline.org/Preprints/Shanker/Referees/>

Boysen, S.T., & Hallberg, K.I. (2000). Primate numerical competence: contributions toward understanding nonhuman cognition, *Cognitive Science*, 24, 423-443.

Whiten, A. (2000). Primate culture and social learning. *Cognitive Science*, 24, 477-508.

Byrne, R.W. (2000). Evolution of primate cognition. *Cognitive Science*, 24, 543-570.

Evolutionary Psychology/Psychiatry

Mealey, L. (1995). The sociobiology of sociopathy: An integrated evolutionary model. *Behavioral and Brain Sciences* 18 (3): 523-599. [bbsonline.org/Preprints/OldArchive/bbs.mealey.html](http://www.bbsonline.org/Preprints/OldArchive/bbs.mealey.html)

Abed, R.T. (1998). The sexual competition hypothesis for eating disorders. *British Journal of Medical Psychology* 71(, 525-547. <http://cogprints.ecs.soton.ac.uk/archive/00000800/>. Proposes that eating disorder and pursuit of thinness are manifestations of female intrasexual competition.

Evans, Dylan (1999) From moods to modules: preliminary remarks for an evolutionary theory of mood phenomena. In *Proceedings Naturalism, Evolution and Mind*, Edinburgh. <http://cogprints.ecs.soton.ac.uk/archive/00000814/> An Evolutionary look at emotions and discussion of the modularity debate.

Supplementary articles

Smith, E.A. et al. Controversies in the evolutionary social sciences: a guide for the perplexed. *Trends in Ecology and Evolution*. Short history of evolutionary arguments applied to social sciences.

Social Psychology and Cognitive Science

Monday: Neurobiology of social attachment

Panksepp, J. (2003). Feeling the pain of social loss. *Science*, 302, 237-239.

Johnson, S. (2003). The brain and emotions. *Discover*, May issue. Prof. Harris will circulate electronically.

Carter, C.S. (1998). Neuroendocrine perspectives on social attachment and love. *Psychoneuroendocrinology*, 23, 779-818.

Wednesday: Implicit social information processing; computer models of stereotyping

We could read one of M. Banaji's papers on how the implicit association task taps implicit prejudice, and a chapter from Miller & Read (1998), *Connectionist models of social reasoning and social behavior*. (Can borrow from Prof. Harris)

Consciousness (Two topics: visual awareness; the sense of first-person authorship)

Monday: Change blindness; what are we aware of and why

Simons, D.J., & Levin, D.T. (1997). Change blindness. *Trends in Cognitive Sciences*, 1, 261-267.

Rensink, R. When good observers go bad: Change blindness, inattention blindness, and visual experience. *Psyche*, 6. Available from: <http://psyche.cs.monash.edu.au/v6/psyche-6-09-rensink.html>

Levin, D.T., Drivdahl, S.B., Momen, N., & Beck, M.R. (2002). False predictions about the detectability of visual changes: The role of beliefs about attention, memory, and the continuity of attended objects in causing change blindness. *Consciousness and Cognition*, 11, 507-527.

Wednesday: Consciousness

Spence, S.A. (1996). Free will in the light of neuropsychiatry. *Philosophy, Psychiatry and Psychology*, 3, 75-90. Available from: http://muse.jhu.edu/journals/philosophy_psychiatry_and_psychology/v003/3.2spence01.html

Wegner, D.M. (2003). The mind's best trick: How we experience conscious will. *Trends in Cognitive Sciences*, 7, 65-69.

Wegner, D.M. (2002). *The illusion of conscious will*. Cambridge, MA: MIT Press. Precis available on www.bbsonline.org.

Libet, B. (1985). Unconscious cerebral initiative and the role of conscious will in voluntary actions. *The Behavioral and Brain Sciences*, 8, 529-566. May be available on www.bbsonline.org.

Genes, Memes and the Biology of Religion

Memes are cultural concepts which have unusual fitness, having survived the marketplace (or the battleground) of competing ideas. Memes are a big idea. They straddle genes and culture. They are controversial. Some people say they are nothing more than what anthropologists have always studied. Others say they are a new concept and have the potential for revolutionizing how we think.

Blackmore, S. (2000). The power of memes. *Scientific American*, 283(4), 52--61. Available from: <http://www.susanblackmore.co.uk/SciAm00.html>

For additional reading, browse these websites:

Blackmore's webpage for links to other papers: <http://www.susanblackmore.co.uk/publicat.htm> see also: <http://www.memes.org.uk/> and http://members.tripod.com/~Drahcir/memes/meme_read.html

Biology of Religion

Grinde, B. (1998). The biology of religion: A Darwinian gospel. *Journal of Social and Evolutionary Systems*, 21, 19-28.

Arbib, M.A. (1998). Self and society: between God and brain. *Trends in Cognitive Sciences*, 10.

Atran, S., & Norenzayan, A. (2004). Religion's evolutionary landscape: Counterintuition, commitment, compassion, communion. *Behavioral and Brain Sciences*. Available from [bbsonline.org](http://www.bbsonline.org).

Language, bilingualism and Emotion. Do bilingual speakers feel they are two different people when speaking their two languages? Is one language perceived to be more emotional than the other?

Ross, M., & Xun, W.Q.E., Wilson, A.E. (2002). Language and the bicultural self. *In Personality and Social Psychology Bulletin*, 28, 1040-1050.

Santiago, A.L., and Altarriba, J. (2002). The role of language in therapy with the Spanish-English

bilingual client. *Professional Psychology: Research and Practice*, 33, 30-38.

Harris, C.L. (2004). Bilingual speakers in the lab: Psychophysiological measures of emotional reactivity. *Journal of Multilingual and Multicultural Development*, 25, 223-247.

Pavlenko, A. (2004). 'Stop Doing That, Ia Komu Skazala!': Language Choice and Emotions in Parent-Child Communication. *Journal of Multilingual and Multicultural Development*, 25, 179-203.

Other Topics

Many other topics which could be pursued, depending on student interests. The following have generated a lot of interest in prior years: Emotion, decision making, cognition of literature, racial perception, visual imagery and advertising, computational models of mental disorders, sleep/dreaming, pain perception. A very new topic is the genetics underlying disorders, and the genetics of human evolution.

Discussion Questions for Monday Jan 23

In the novel *Thinks*, Ralph Messenger, head of a cognitive science institute in Great Britain, shows the institute to Helen, a literature professor. The institute features a mural describing some classic questions in the last 30 years of work. Choose one of these and find additional material to flesh out the short description that Helen receives from Ralph.

- Thomas Nagel, What is it like to be a bat?
- Prisoner's Dilemma (compare to current TV game show 'Friend or Foe') and Axelrod's Tit for Tat
- Searle's Chinese Room
- Frank Jackson's Mary, the color scientist who is color blind
- Philosophers' obsessions with "Zombies"
- Does quantum physics have the answer to consciousness?

Discussion Questions for Monday Jan 30

Bring in to share with the class the result of internet searches. What conclusions can you draw about cognitive science? Is this a really just "cog sci on the internet?" What was most surprising to you?

First Day of Class

Divide into groups of 3. Introduce yourself, your background (your major or graduate school program), and state if there is already an area within cognitive science that is your main interest.

The goal of the group meeting: To begin to hone in on the topics for which you would like to lead discussion, and to identify the topics which are of interest to the class as a whole.

In your groups, go over each topic. Topics include those on the syllabus (above), additional topics on the topic list, any topics that interest you. Whoever is knowledgeable about a topic can start by discussing any of the following:

- why does this topic intrigue you
- what do you already know about it (books read about it, material learned in other classes)
- is this topic sufficiently new (not already well covered by other courses)
- what would you like to learn more
- how does learning about this topic fit in with education or career goals
- how could you convince others in the class to include this topic?

Nominate a spokesperson to present your discussion results to the class: three topics you want included, one that could be omitted.

