Cognition

CNS/Bi 176 - Spring 2008

Shin Shimojo, Fiona Cowie

12 Units (6-0-6)

TIME: Thursday 4:00 PM - 6:00PM
LOCATION: Broad 200

The cornerstone of current progress in understanding the mind, the brain, and the relationship between the two is the study of human and animal cognition. This course will provide an in-depth survey and analysis of behavioral observations, theoretical accounts, computational models, patient data, electrophysiological studies, and imaging results on mental capacities such as attention, object representation and recognition, memory, cognitive development, and language.

Undergraduates CAN take the course with an instructor's permission. Prerequisite (or preferred background) includes an introduction to experimental psychology, neuroscience, cognitive science, computational vision, biomedical engineering, etc.

General Information

Time and Location
Thursday 4:00 – 6:00 pm, in Broad 200

Instructors
Shin Shimojo: sshimojo@its.caltech.edu x3324
Fiona Cowie: cowie@hss.caltech.edu x3606

Teaching Assistants
Neil Halelamien: neilh@caltech.edu x2025
Office Hours: TBA, in Broad 64
Signe Bray: signe@caltech.edu x8991
Office Hours: TBA, in Broad 64

Class wiki (contains downloadable readings, accessible only to Caltech IPs):
http://wiki.cns.caltech.edu/wiki/index.php/CNS176

Textbooks

(Relevant chapters will be made available)

- An Invitation to Cognitive Science: Visual Cognition Volume 2, Edited by Stephen Kosslyn & Daniel Osherson, MIT Press: 1995, Second Edition
- Cognition, 6th edition. Matlin, M. W. Wiley 2005.

Grading Policy

Faculty members and postdoctoral fellows are welcome to participate in the class discussions and presentations. Undergraduate and graduate students who are taking the class for credit should keep in mind the following exercises upon which their final grade will be determined.

Class Format:

Each class is devoted to a single topic (with few exceptions). Class will begin with a 30-40 minute lecture from one of the instructors. The rest of the class will consist of student presentations (typically two) and discussion.

Class Presentations and Attendance:

Each participant will be responsible for presenting and leading the discussion on material in a topic of their choice from the offered topics. Materials will be one or more of the papers listed as that topic's readings. The organizational meeting will include a survey of individual preferences for class presentations and every effort will be made to allot participants their top choice. Student presentations will count toward 30% of the final grade. These presentations will be peer evaluated. Presenters will be based on the mean of these peer evaluations.

Homework:

Each participant should choose one of the two topics for each two-week period, read relevant papers (starting from the reading list), and write a review paper within the length of 5 single-space pages. Thus all together, four review papers are required (the deadline will be in 1 week after the two weeks). 10% x 4 = 40% of the final grade will be based on these review papers. Please make sure that you come to class on time.

Term Paper:

Each participant should select a topic from among those listed topics and write a 10-15 page term paper. Topics may include proposed psychophysics studies, ongoing research projects, or meta-analysis/review of a specific area. Students should discuss their proposals with the moderator for that topic and submit a one page term paper proposal by a specified date (to be announced later). Near the end of the term students will be asked to present on their term paper. 30% of the final grade will be based on the term paper which is due on June 3rd.

No midterm or final exam.

Schedule and Readings

April 3:	Class Introduction, Crossmodal Perception, Language (Lecture by van Wassenhove)
April 10:	Attention and Memory (Shimojo)
April 17:	Visual Representation and Recognition (Shimojo)
April 24:	Face and Expression (Shimojo)
May 1:	Development of Cognition (Shimojo)
May 8:	fMRI Studies of Learning and Reward (Bray)
May 15:	Using TMS to Influence Vision and Cognition (Halelamien)
May 22:	Niche Construction (Cowie)
May 29:	Situated Cognition and Extended Mind (Cowie)

List of topics and reading list

Readings may be downloaded from the CNS wiki (only accessible from Caltech IP addresses) at this address: http://wiki.cns.caltech.edu/wiki/index.php/CNS176

Crossmodal Perception, Language

- Driver J, Noesselt, T (2008) Multisensory interplay reveals crossmodal influences on 'sensory-specific' brain regions, neural responses, and judgments. Neuron. 57(1):11-23.

- Fujisaki W, Koene A, Arnold D, Johnston A, Nishida S (2006) Visual search for a target changing in synchrony with an auditory signal. Proc. Roy. Soc. London B 273(1588):865-874.
- Schwartz JL, Berthommier F, Savariaux C (2004) Seeing to hear better: evidence for early audiovisual interactions in speech identification. Cognition 93:B69-B78.
- Shimojo, S, Shams, L (2001) Sensory modalities are not separate modalities: plasticity and interactions. Current Opinion in Neurobiology. 11(4):505-509.

Attention and Memory (Lecture by Shimojo)

- Matlin (textbook): Chapters 3 (Perceptual processes II: Attention and Consciousness), 4 (Working Memory), and 5 (Long-Term Memory).
- Rensink, R.A. (2002) Change detection. *Annu Rev Psychol*. 53, 245-277.
- Mack, A., Pappas, Z. Silverman, M., et al. (2002) What we see: Inattention and the capture of attention by meaning. *Conscious Cogn*. 11(4), 488-506.
- Hikosaka, O., Miyauchi, S. and Shimojo, S. (1993) Voluntary and stimulus-induced attention detected as motion sensation. *Perception*, 22, 517-526.
- Posner, M. I., and Cohen, Y. (1984) Components of visual orienting. In Bouma, H. and Bouwhuis, D. J. (eds.), *Attention and Performance X: Control of Language Processes*, 531-556. Laurence Erlbaum, Hillsdale.
- Tipper, S. (1985) The negative priming effect: inhibitory priming by ignored objects. *The Quarterly Journal of Experimental Psychology*, 37, 571-590.
- Watanabe, K., and Shimojo, S. (1998) Attentional modulation in perception of visual motion events. *Perception*, 27, 1041-1054.
- Gabrieli, J. D. E. (1998) Cognitive neuroscience of human memory. *Annual Review of Psychology*, 49, 87-115.
- Graf, P. L. R., Squire, L. R., and Mandler, G. (1984) The information that amnesic patients do not forget. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 10, 164-178.

Visual Representation and Recognition (Lecture by Shimojo)

- Matlin (textbook): Chapter 2 (Perceptual Processes I: Visual and Auditory Recognition)
- von der Heydt, R., Peterhans, E., and Baumgartner, G. (1984). Illusory contours and cortical neuron responses. *Science*, 224, 1260-1262.
- Tanaka, K. (1993) Neuronal mechanisms of object recognition. *Science*, 262, 685-688.
- Biederman, I. (1995). Visual object recognition. *Visual Cognition*, Chapter 4.
- Goodale, M. and Milner, A. D. (1992) Separate visual pathways for perception and action. T*rends in Neuroscience*, 15, 20-25.
- Epstein R, and Kanwisher N. (1998) A cortical representation of the local visual environment, , *Nature*, 392, 598-601.
- O'Regan, J.K. *et al.* (1999) Change-blindness as a result of 'mudsplashes'. *Nature* 398, 34 Scientific Correspondence.
- Rao, R. P. N. and Ballard, D.H. (1999) Predictive coding in the visual cortex: a functional interpretation of some extra-classical receptive-field effects *Nature Neuroscience* 2, 79-87 (1999)

- Koch, C. & Poggio, T. (1999) Predicting the visual world: silence is golden. *Nature Neuroscience* 2, 9-10.

Face and Expression (Lecture by Shimojo)

- Kosslyn & Osherson (textbook): Chapter 3 (Farah, M.J. Dissociable systems for recognition: a cognitive neuropsychology approach)
- Matlin (textbook), Chapter 2 (Perceptual Processes I: Visual and Auditory Recognition)
- Adolphs, R. (2001) The neurobiology of social cognition. *Curr. Opin. Neurobiol,* 11, 231-239.
- Adolphs, R. (2002) Neural systems for recognizing emotion. *Curr. Opin. Neurobiol,* 12, 169-177.
- Kanwisher N., McDermott J., and Chun, M.M. (1997) The fusiform face area: A module in human extrastriate cortex specialized for face perception. *Journal of Neuroscience,* 17, 4302-4311.
- Haxby, J V. Hoffman, E A. Gobbini, M I. (2000) The distributed human neural system for face perception. *Trends Cogn. Sci.,* 4, 223-233.
- Shimojo, S, Simion C, Shimojo E, Scheier C. (2003) Gaze bias both reflects and influences preference. *Nature Neuroscience*, 6, 1317-1322.
- Simion, C, Shimojo, S (2006). Early interactions between orienting, visual sampling and decision making in facial preference. *Vision Research*, 46, 3331-3335.

Development of Cognition (Lecture by Shimojo)

- Matlin (textbook), Chapters 13 (Cognitive Development Throughout the Lifespan).
- Spelke, E. S., Gutheil, G., & Van de Walle, G. (1995). The development of object perception. *Visual Cognition Vol.2*, Chapter 8 (pp. 297-330).
- Meltzoff, A. N. & Borton, R. W. (1979). Intermodal matching by human neonates. *Nature*, 282, 403-404.
- Lockman, J. J. & Thelen, E. (1993). Developmental biodynamics: Brain, body, behavior connections. *Child Development*, 64, 953-959.
- Wimmer, H. & Perner, J. (1983). Beliefs about beliefs: representation and constraining function of wrong beliefs in young children's understanding deception. *Cognition*, 13, 103-128.
- Scheier, C., Lewkowicz, D. & Shimojo, S. (2003) Sound induces perceptual reorganization of an ambiguous motion display in human infants. *Developmental Science*, 6, 233-241.

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fMRI Studies of Learning and Reward (Lecture by Bray)

- Chiu PH, Lohrenz TM, Montague PR (2008) Smokers' brains compute, but ignore, a fictive error signal in a sequential investment task. *Nat Neurosci* advanced online publication.
- D'Ardenne K, McClure SM, Nystrom LE, Cohen JD (2008) BOLD responses reflecting dopaminergic signals in the human ventral tegmental area. *Science* 319:1264-1267.
- Montague PR, King-Casas B, Cohen JD (2006) Imaging valuation models in human choice. *Annual Review of Neuroscience* 29:417-448.
- O'Doherty J, Dayan P, Schultz J, Deichmann R, Friston K, Dolan RJ (2004) Dissociable roles of ventral and dorsal striatum in instrumental conditioning. *Science* 304:452-454.
- O'Doherty JP (2004) Reward representations and reward-related learning in the human brain: insights from neuroimaging. *Current Opinion in Neurobiology* 14:769-776.
- Plassmann H, O'Doherty J, Shiv B, Rangel A (2008) Marketing actions can modulate neural representations of experienced pleasantness. *Proceedings of the National Academy of Sciences of the United States of America* 105:1050-1054.

Using TMS to Influence Vision and Cognition (Lecture by Halelamien)

- Walsh V, Pascual-Leone A (2003). Transcranial Magnetic Stimulation: A Neurochronometrics of Mind. Chapters 4 (Creating Virtual Patients: A Guide to Mechanism and Methodology), 5 (Real-Time Neuropsychology: Single-Pulse TMS), and 6 (Dynamic Neuropsychology: Repetitive-Pulse TMS)
- Chapter 2 (Development of TMS as a Probe — the Instant Replay Effect) of Wu, D.-A. (2005) *How perception adheres color to objects and surfaces: studies using visual illusions and transcranial magnetic stimulation*. Ph.D. thesis, California Institute of Technology.
- Kamitani, Y. & Shimojo, S. (1999). Manifestation of scotomas created by transcranial magnetic stimulation of human visual cortex. *Nat Neurosci* **2**, 767-771.
- Pascual-Leone, A. & Walsh, V. (2001) Fast backprojections from the motion to the primary visual area necessary for visual awareness. *Science* **292**, 510-512
- Boyer, J. L., Harrison, S. & Ro, T. (2005). Unconscious processing of orientation and color without primary visual cortex. *Proceedings of the National Academy of Sciences* **102**, 16875-16879.
- Devlin, Joseph, T., Watkins & Kate, E. (2007). Stimulating language: insights from TMS. *Brain* **130**, 610-622
- Knecht, S. *et al.* (2002) Degree of language lateralization determines susceptibility to unilateral brain lesions. *Nat Neurosci* **5**, 695-699

Niche Construction (Lecture by Cowie)

- Kevin N. Laland, John Odling-Smee, & Marcus W. Feldman (2000) Niche construction, biological evolution, and cultural change BEHAVIORAL AND BRAIN SCIENCES (2000) 23, 131–175
- Sterelny, K. (2005). Made by each other: Organisms and their environment. *Biology and Philosophy, 20*(1), 21-36.
- Laland, K. N., Odling-Smee, J., & Feldman, M. W. (2005). On the breadth and significance of niche construction: A reply to griffiths, okasha and sterelny. *Biology and Philosophy, 20*(1), 37-55.
- Laland, KN, Sterelny, K (2006) Seven reasons (not) to neglect niche construction EVOLUTION, 60 (9): 1751-1762 SEP 2006
- Dawkins, R (2004) Extended phenotype - But not too extended. A reply to Laland, Turner and Jjablonka BIOLOGY & PHILOSOPHY, 19 (3): 377-396 JUN 2004
- Wright, JP and Jones, CG (2006) 'The concept of organisms as ecosystem engineers ten years on: Progress, limitations, and challenges.' BIOSCIENCE, 56 (3): 203-209 MAR 2006
- Barker, G., (2008) Biological levers and extended adaptationism BIOLOGY & PHILOSOPHY, 23 (1): 1-25 JAN 2008

Niche construction and human cognitive evolution

- Mameli, M. (2001). Mindreading, mindshaping, and evolution. *Biology and Philosophy, 16*(5), 597-628. Retrieved March 19, 2008, from Philosopher's Index database.
- Okasha, S. (2005). On niche construction and extended evolutionary theory. *Biology and Philosophy, 20*(1), 1-10.

Situation Cognition and Extended Mind (Lecture by Cowie)

Background: The Language of Thought Hypothesis, Dynamical Systems Theory

- van Gelder, T. What might cognition be, if not computation? *Journal of Philosophy, 92*, 345-381, 1995
- Jerry A Fodor (2001) Language, Thought and Compositionality *Mind & Language* 16 (1), 1–15 doi:10.1111/1468-0017.00153

Situated Cognition: The Extended Mind

- Clark, A., & Chalmers, D. J. (1998). The extended mind. *Analysis, 58*(1), 7-19. *TRENDS in Cognitive Sciences* Vol.10 No.8

- Sutton, J. (2006). Introduction: Memory, embodied cognition, and the extended mind. *Philosophical Psychology, 19*(3), 281-289.
- Clark, Andy (2006) Language, embodiment, and the cognitive niche *TRENDS in Cognitive Sciences* Vol.10 No.8
- Clark, A. (2006). Sensorimotor skills and perception: Cognitive complexity and the sensorimotor frontier. *Aristotelian Society: Supplementary Volume, Supp*(80), 43-65.

Critiques

- Rupert, Robert D. (2004). Challenges to the hypothesis of extended cognition. *Journal of Philosophy* 101 (8):389-428.
- Adams, Frederick R. & Aizawa, Kenneth (forthcoming). Defending the bounds of cognition. In Richard Menary (ed.), *The Extended Mind*. Aldershot, Hants: Ashgate.

Response

- Clark, A. 'Curing Cognitive Hiccups.' (draft)