

Mental Models and Reasoning

Seminars in Psychology (PSYC 770)
Emory University
Spring 2007

Time and Place

Mondays: 12:00 – 3:00
Psychology 332

Instructor Information

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Office hours: By appointment

Course Description

Mental models are small-scale representations of reality. They allow people to perform mental simulations, to imagine the cause of a broken toaster or the future trajectory of an object after it is hit. Mental models do not specify exact quantities or require precise mathematical calculations. Rather, they capture the qualitative properties of a system. Often, this knowledge is enough to predict how even very complex systems will change and evolve, including weather patterns, ecosystems, geological processes, and political institutions. In this course, we will examine how mental models are constructed, how they are used in reasoning, and how they change over development and vary across cultures.

Format

The course will be conducted as a seminar / workshop. Students will be expected to present papers, write weekly reaction papers and write an end-of-semester paper. Details are provided below.

Course Materials

Articles will be put on electronic reserve. Electronic reserve can be reached at <http://www.library.emory.edu>. Press the “Reserves Direct” button at the top of the page. You will be prompted for your university login and password. After entering these, you will be shown the option “Add a class.” After pressing this, you will be able to “Search by Instructor” for any of the three instructors. Click the appropriate class and you’re all set.

Course Requirements

Class preparation and participation. All participants are required to have read every assigned article carefully prior to class. All class participants should also bring a printout of the assigned readings.

Student presentations. Students will be required to make two presentations during the semester. A presentation should accomplish three objectives. First, it should summarize the paper(s) (~10 minutes). In summarizing a paper, you should be sure to specify 1) the problem being investigated, 2) hypotheses, 3) predictions, 4) the experimental methods used to test these predictions, including details about the stimuli and procedure, 5) the key findings, and 6) conclusions. Second, class presentations should provide a critical reaction to the paper (~5 minutes). In this part of your presentation, you should go beyond what was said in the paper. There are many ways in which you might react to a paper. For example, you might challenge the hypotheses, methodology, or conclusions. Alternatively, you might elaborate on the significance

(or insignificance) of the paper. Finally, your presentation should include 2-3 deep questions for the class. Deep questions often spur class discussion. However, perhaps the most effective way of spurring class discussion is to describe the papers clearly and with sufficient detail. Each presentation should include a 1 page handout. Please do not read a written text for your presentation. Speak from the outline you hand out, and you should know the article well enough to present it from memory. Presentations will be graded on the quality of the summary, critical reaction, and overall coherence.

Tickets. For each class, students must turn in a “ticket.” The tickets should have two parts: a comment and a question. Ask good questions, that is, questions whose answers (if known) would be consequential. In formulating your ticket, you might begin with an observation (the comment part), then raise a question. Alternatively, you might begin with a question, and then propose an answer. Your tickets should be 120 words or less, printed out (not emailed), and turned in at the end of class. Be prepared to read your comments and questions. Your tickets will be graded as either submitted or unsubmitted.

Course paper. If you are taking the seminar for a grade, you will need to write a class paper towards the end of the semester. Your paper should be “thesis-driven.” Start the paper by identifying a problem or question (~ 2 paragraphs). Then state your thesis. A thesis is signaled by a statement like “In this paper I will argue that...” Once you state your thesis, you should then briefly outline how you plan to defend your thesis. The rest of the paper should constitute your defense and final conclusions. Your defense should cite studies and theories from the literature. You are encouraged, but not required, to go beyond the readings covered in the course.

All papers must 7-8 pages long, 1.5 spacing, with 1 inch margins, in 12 point Times-Roman font (or 11 point Arial). Citations and references should be in APA style. Papers not meeting these style requirements will be returned ungraded. Provide subheadings. The paper must concern mental models.

Final papers are due by the 5 PM on Monday, May 7. Papers will be graded on the following dimensions: 1) thesis quality, 2) literature covered, 3) logical coherence, and 4) written presentation.

Grades

Your class grade will be based on your class presentations (30%), tickets (30%), and class paper (40%).

Students taking the course Pass/Fail must attend course meetings regularly, read the assigned articles, turn in the class questions regularly and make two presentations. A class paper is not required.

Schedule and Assigned Readings

Jan.	29	<p>Introduction</p> <p>Instructor r</p> <p>Gentner, D. (2002). Mental models, Psychology of. In N. J. Smelser & P. B. Bates (Eds.), <i>International Encyclopedia of the Social and Behavioral Sciences</i> (pp. 9683-9687). Amsterdam: Elsevier Sciences.</p> <p>Hegarty, M. (2004). Mechanical reasoning by mental simulation. <i>TRENDS in Cognitive Sciences</i>, 8, 280-285.</p> <p>Johnson-Laird, P. (2001). Mental models and deduction. <i>TRENDS in Cognitive Science</i>, 5, 434-442.</p>
Feb.	5	<p>Mental spatial simulation</p> <p>Brent</p> <p>Finke, R. A., Pinker, S., & Farah, M. (1989). Reinterpreting visual patterns in mental imagery. <i>Cognitive Science</i>, 13, 51-78.</p> <p>Jessica</p> <p>Hubbard, T. L., (1995). Environmental invariants in the representation of motion: Implied dynamics and representational momentum, gravity, friction, and centripetal force. <i>Psychonomic Bulletin, and Review</i>, 2, 322-338.</p> <p>Instructor r</p> <p>Freyd, J., & Finke, R. A. (1984). Representational momentum. <i>Journal of Experimental Psychology: Learning, Memory, and Cognition</i>, 10, 126-132.</p> <p>Freyd, J.J., Pantzer, T.M., & Cheng, J.L. (1988) Representing statics as forces in equilibrium. <i>Journal of Experimental Psychology: General</i>, 117, 395-407.</p>
Feb.	12	<p>Mental animation</p> <p>Nicole</p> <p>Hegarty, M. (1992). Mental animation: Inferring motion from static diagrams of mechanical systems. <i>Journal of Experimental Psychology: Learning, Memory, and Cognition</i>, 18, 1084-1102.</p> <p>Instructor r</p> <p>Schwartz, D. L., & Black, J. B. (1996). Analog imagery in mental model reasoning: Depictive models. <i>Cognitive Psychology</i>, 30, 154-219.</p> <p>Todd</p> <p>Schwartz, D. L. (1999). Physical imagery: kinematic vs. dynamic models. <i>Cognitive Psychology</i>, 38, 433-464.</p> <p>Trafton, J. G., Trickett, S. B., & Mintz, F. E. (2005). Connecting internal and external representations: Spatial transformations of scientific visualizations. <i>Foundations of science</i>, 10, 89-106. 😊</p>
Feb.	19	<p>Mental models and physical devices</p> <p>Tanya</p> <p>Kempton, W. (1986). Two theories of home heat control. <i>Cognitive Science</i>, 10, 75-90.</p> <p>Stig</p> <p>Kieras, D. E., & Bovair, S. (1984). The role of a mental model in learning to operate a device. <i>Cognitive Science</i>, 8, 255-273.</p> <p>Gentner, D, & Wolff, P. (2000). Metaphor and knowledge change. In</p>

		<i>Cognitive Dynamics</i> , ed. E Dietrich, AB Markman, pp. 295–342. Mahwah, NJ: Erlbaum
Instructor		
Feb.	26	Mental models of text (Visitor: Rolf Zwaan)
		Zwaan, R. A., Madden, C. J., Yaxley, R. H., & Aveyard, M. E. (2004). Moving words: dynamic representations in language comprehension. <i>Cognitive Science</i> , 28, 611-619.
		Kaschak, M.P., Madden, C.J., Therriault, D.J., Yaxley, R.H., Aveyard, M., Blanchard, A.A., & Zwaan, R.A. (2005). Perception of motion affects language processing. <i>Cognition</i> , 94, B79-B89.
Nicole		Zwaan, R.A. (2004). The immersed experiencer: toward an embodied theory of language comprehension. In: B.H. Ross (Ed.), <i>The Psychology of Learning and Motivation</i> , Vol. 44 (pp. 35-62). New York: Academic Press.
Brent		Zwaan, R. A., & Radvansky, G. A. (1998). Situation models in language comprehension and memory. <i>Psychological Bulletin</i> , 123, 162-185.
March	5	Mental models and naïve physics
Todd		Clement, J. (1983). A conceptual model discussed by Galileo and used intuitively by physics students. In D. Gentner, & A. L. Stevens (Eds.), <i>Mental Models</i> , Erlbaum Hillsdale, NJ.
		McCloskey, M. (1983). Intuitive physics. <i>Scientific American</i> , 248, 122-130.
		Kaiser, M. et al. (1985). Judgments of natural and anomalous trajectories in the presence and absence of motion. <i>Journal of Experimental Psychology: Learning, Memory, and Cognition</i> , 11, 795-803.
Allison		Gilden, D. L. (1991). On the origins of dynamic awareness. <i>Psychological Review</i> , 98, 554-568.
March	12	SPRING BREAK
March	19	Mental models interfacing with the external world and with other people (distributed cognition)
Bryan		Hutchins, E. (1995). How a cockpit remembers its speed. <i>Cognitive Science</i> , 19, 265-288.
		Keysar, B., Lin, S. & Barr, D. J. (2003). Limits on theory of mind use in adults. <i>Cognition</i> , 89, 25-41.
Paul		Norman, D. A. (1991). Cognitive artifacts. In: Carroll, John M. (Eds.) <i>Designing Interaction: Psychology at the Human-Computer Interface</i> . Cambridge University Press.
Maria		Cannon-Bowers, J. A., Salas, E., & Converse, S. A. (1993). Shared mental models in expert decision-making teams. In N. J. Castellan, Jr. (Ed.), <i>Current issues in individual and group decision making</i> (pp. 221-246). Hillsdale, NJ: Erlbaum.

March	26	Mental models of the physical world
Allison		Dunbar, K. and Blanchette, I. (2001). The <i>in vivo/in vitro</i> approach to cognition: The case of analogy. <i>Trends in Cognitive Sciences</i> 5: 334-339.
Instructor		Collins, A. & Gentner, D. (1987). How people construct mental models. In N. Quinn & D. Holland (Eds.), <i>Cultural Models in Language and Thought</i> . Cambridge: CUP, pp. 243-265.
Jessica		Vosniadou, S. & Brewer, W. F. (1992). Mental models of the earth: A study of conceptual change in childhood. <i>Cognitive Psychology</i> , 24, 535-585.
		Gentner, D., & Gentner, D. (1983). Flowing waters or teeming crowds: mental models of electricity. In <i>Mental Models</i> (Ed.), D. Gentner, A.L. Stevens, pp. 99-129. Hillsdale, NJ: Erlbaum.
April	2	Mental models and space
Stig		Tversky, B. (1993a). Cognitive maps, cognitive collages, and spatial mental models. In A. U. Frank & I. Campari (Eds.), <i>Spatial information theory: A theoretical basis for GIS</i> . (pp. 14-24). Berlin: Springer-Verlag.
		Bryant, D. J., & Tversky, B. (1999). Mental representations of perspective and spatial relations from diagrams and models. <i>Journal of Experimental Psychology: Learning, Memory, and Cognition</i> , 25, 137-156.
		Byrne, R.M.J. & Johnson-Laird, P.N. (1989). Spatial reasoning. <i>Journal of Memory and Language</i> , 28, 564-575.
Kelly		David H. Uttal, Joan A. Fisher, Holly A. Taylor (2006). Words and maps: developmental changes in mental models of spatial information acquired from descriptions and depictions, <i>Developmental Science</i> , 9, 221-235.
April	9	Mental models and causation
Bryan		Gopnik, A., Glymour, C., Sobel, D., Schulz, L., Kushnir, T., & Danks, D. (2004). A theory of causal learning in children: Causal maps and Bayes nets. <i>Psychological Review</i> , 111, 1-31.
Instructor		Goldvarg, E., & Johnson-Laird, P. (2001). Naive causality: A mental model theory of causal meaning and reasoning. <i>Cognitive Science</i> , 25, 565-610.
		Wolff, P. (2007). Representing Causation. <i>Journal of Experimental Psychology: General</i> .
April	16	Format of mental models: Embodied representation
		Barsalou, L. W. (2003). Situated simulation in the human conceptual system. <i>Language and Cognitive Processes</i> , 18, 513-562.
Paul		Glenberg, A. M. (1997). What memory is for. <i>BBS</i> , 20, 1-55.
		Johnson-Laird, P. N. (1998). Imagery, visualization and thinking. In Perception and Cognition at Century's End (Hochberg, J., ed.), pp. 441-497, Academic Press.

April	23	Mental models and culture
	Tanya	Nisbett, R. et al. (2001). Culture and systems of thought: holistic versus analytic cognition. <i>Psychological Review</i> , 108, 291-310.
	Kelly	Shore, B. (2001). <i>Culture in mind: Cognition, culture, and the problem of meaning</i> . Oxford University Press: New York (pp. 3-41; 42 – 71).
		Kempton W, Boster JS, Hartley J. (1994). <i>Environmental Values in American Culture</i> . Cambridge, MA: MIT Press.
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April	30	Mental models and explanation (Visitor: Frank Keil)
		Keil, F. C. (2006). Explanation and understanding. <i>Annual Review of Psychology</i> , 57, 227-254.
		Keil, F.C. (2003). Folkscience: Coarse interpretations of a complex reality. <i>Trends in Cognitive Science</i> , 7, 368-373.
	Maria	Danovitch, J. and Keil, F.C. (2004) Should you ask a fisherman or a biologist?: Developmental Shifts in Ways of Clustering Knowledge, <i>Child Development</i> , 75, 918-931.
