Syllabus for
Cognitive Psychology of Skill and Knowledge Acquisition (PSCH 457)

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<u>Purpose of Course</u>

The purpose of this course is to familiarize students with basic research on cognitive change. There are only a handful of different basic ideas about how knowledge and cognitive skills are acquired, but many variations on each idea. The learning goals for this course are that for each idea about learning, the student should be familiar with (a) its historical source, (b) one or more contemporary formulations, and (c) some recent empirical study or studies. At the end of the course, the student should be able to think with each of those ideas to explain learning phenomena. In addition, the student should have some basis for evaluation, i.e., for choosing whether to believe in any one of these ideas.

Although the focus of the course is on the cognitive psychology of these various change mechanisms, the course has an interdisciplinary flavor, because cognitive change is discussed in a variety of fields: cognitive psychology, developmental psychology, social psychology, educational research, the history and philosophy of science and even artificial intelligence. Scholars in these different fields invent, re-inventing and pass around a limited set of ideas about cognitive change.

<u>Format</u>

The class is taught in a seminar format. The main activity of the class is to read papers, compare the theories and explanatory principles proposed in them and discuss their relations to empirical data. It is assumed that everybody comes to class ready to participate in the discussion about the readings.

Each set of readings will be introduced via a lecture that covers the history and general framework that the readings exemplify.

In addition, each student will undertake a small project (see below).

<u>Schedule</u>

The class is scheduled to meet in room 1076 in BSB, at 2:00 - 4:50, on Wednesdays.

<u>Literature</u>

There is no textbook for this course, because nobody has written one. The literature consists of journal articles and book chapters. There will usually be two readings per week. They consist of a mixture of classical and recent papers.

Examination

Class attendance. The first criterion for successful completion of the course is that you attend. If something prevents you from attending, you need to contact me *ahead of time* to verify that you have a valid reason to miss class. If there is an emergency that prevents you from attending, you need to get in touch with me as soon as possible afterwards. You can miss class exactly once without a valid reason without affect on your grade.

Discussion participation. The second criterion is that you actively participate in the class discussions. Everybody is expected to come to class having read the readings well enough to discuss them. I will sometimes issue a list of questions to keep in mind while you are reading; when I do, I expect you to come to class ready to comment on those questions.

Research project/Presentation. Each of you will be assigned a question about skill or knowledge acquisition. Your task is to go into the literature and try to find the answer. You then report back to the class what the answer is. The report is both oral and written. The oral part is a brief (15 minutes) presentation to the class of what you found. I'll schedule those presentations for the last class sessions in the semester, but if you are ready to report earlier, that's fine. The written part should contain a statement of the question, an explanation of why the question is important, a method section describing how you went about finding the answer, and then a presentation of the answer. You and I negotiate the question you should pursue.

Collaborative learning works, so you can team up with a course mate for this project, if we can find a question that both of you find interesting. I don't want more than two students on any one question.

The written paper is due by 5 pm on the last day of classes.

In summary, grading is based on (a) attendance, (b) active participation in class discussions, (c), and (d) pursuing and reporting on a research question.

READING LIST

Week 1: **Introduction**

Lecture: Classical ideas

Rock, I. (1957). The role of repetition in associative learning. *The American Journal of Psychology*, 70. 186-193.

Smoke, K. L. (1933). Negative instances in concept learning. *Journal of Experimental Psychology*, 16, 583-588.

Week 2: **Skill acquisition-1: Basics**

Lecture: History and conceptual framework

Handout: S. Ohlsson, *Introduction to Skill Acquisition*, 2001.

VanLehn, K. (1996). Cognitive skill acquisition. *Annual Review of Psychology*, **47**, 513-539.

Week 3: **Skill acquisition-2: Rule based systems and learning curves**

Ohlsson, S. (1996) Learning from performance errors. *Psychological Review*, **103**, 241-262.

Delaney, P., Reder, L., Staszewski, J., & Ritter, F. (1998) The strategy-specific nature of improvement: The power law applies by strategy within task. *Psychological Science*, **9**, 1-7.

Week 4: **Skill acquisition-3: Feedback**

McKendree, J. (1990) Effective tutoring content for tutoring complex skills. *Human-Computer Interaction*, 5, 381-413.

Schroth, M. L. (1997). Effects of frequency of feedback on transfer in concept identification. *The American Journal of Psychology*, vol. 110, pp. 71-79.

Week 5: **Skill acquisition-4: Learning from examples**

Carroll, W. M. (1994). Using worked examples as an instructional support in the algebra classroom. *Journal of Educational Psychology*, 86, 360-367.

Catrambone, R. (1996). Generalizing solution procedures learned from examples. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22, 1020-1031.

Week 6:   **Skill acquisition-5: Transfer of training**

Salomon, G., & Perkins, D. N. (1989) Rocky roads to transfer: Rethinking mechanisms of a neglected phenomenon. *Educational Psychologist*, **24**, pp. 113-142.

Bassok, M. (1990) Transfer of domain-specific problem-solving procedures. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **16**, pp. 522-533.

Woltz, D. J., Gardner, M. K., & Bell, B. G. (2000) Negative transfer errors in sequential cognitive skills: Strong-but-wrong sequence application. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **26**, pp. 601-625.

Week 7:   **Skill acquisition-6: Learning in the very long run**

Ericsson, K. A., Krampe, R. Th., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. Psychological Review, 100, 363-406.

Week 8:   **Skill acquisition-7: Wrap Up; What's the Complete Theory?**

Ohlsson, S. (in press). Computational models of skill acquisition. In R. Sun (Ed.), *The Cambridge handbook of computational psychology*. New York: Cambridge University Press.

Week 9:   **Knowledge acquisition-1: Introduction**

Lecture: History and background to complex declarative learning.

Chi, M. T. H., & Ohlsson, S. (2005) Complex declarative learning. In K. J. Holyoak and R. G. Morrison (Eds.), *The Cambridge handbook of thinking and reasoning* (Chap. 16, pp. 371-399). New York: Cambridge University Press.

Week 10:   **Knowledge acquisition-2: Text comprehension**

Kintsch, W. (1994) Text comprehension, memory, and learning. *American Psychologist*, **49**, 294-303.

Graesser, A. C., Millis, K. K., & Zwaan, R. A. (1997). Discourse comprehension. *Annual Review of Psychology*, 48, 163-189.

Week 11:   **Knowledge acquisition-3: Schema theory**

Brewer, W. F., & Nakamura, G. V. (1984) The nature and function of schemas. In R. Wyer & T. Srull (Eds.), *Handbook of social cognition* (pp. 119-160). Hillsdale, NJ: Erlbaum.

Anderson, R. C., Spiro, R. J., & Anderson, M. C. (1978). Schemata as scaffolding for the representation of information in connected discourse. *American Educational Research Journal*, 15, 433-440.

Neuschatz, J. s., Lampinen, J. M., Preston, E. L., Hawkins, E. R., & Toglia, M. P. (2002). The effect of memory schemata on memory and the phenomenological experience of naturalistic situations. *Applied Cognitive Psychology*, 16, 687-708.

Week 12:   **Knowledge acquisition-4: S Self-Explanation**

Chi, M. T. H., de Leeuw, N., Chiu, M.-H., & LaVancher, C. (1994) Eliciting self-explanations improves understanding. *Cognitive Science*, **18**, 439-477.

Ainsworth, S., & Loizou, A. T. (2003).The effects of self-explaining when learning with text or diagrams. *Cognitive Science*, 27, 669-681.

Week 13:   **Knowledge acquisition-5: Conceptual change-1**

Posner, G. J., Strike, K. A., Hewson, P. w., & Gertzog, W. A. (1982) Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, **66**(2), 211-227.

Chinn, A. A., & Brewer, W. F. (1993) The role of anomalous data in knowledge acquisition: A theoretical framework and implications for science instruction. *Review of Educational Research*, **63**(1), 1-49.

McCloskey, M. (1983) Naïve theories of motion. In D. Gentner, & A. L. Stevens (Eds.), *Mental models* (pp. 299-324. Hillsdale, NJ: Lawrence Erlbaum.

Week 14: **Knowledge acquisition-6: Conceptual change-2**

Clement, J. J., & Steinberg, M. S. (2002) Step-wise evolution of mental models of electric circuits: A 'learning aloud' case study. *The Journal of the Learning Sciences*, **11**(4), 389-452.

Opfer, J. E., & Siegler, R. S. (2004) Revisiting preschoolers' living things concept: A microgenetic analysis of conceptual change in basic biology. *Cognitive Psychology*, **49**, 301-332.

Week 15: **Life Span Change**

Baltes, P. B. (1987). Theoretical propositions of life-span developmental psychology: On the dynamics between growth and decline. *Developmental Psychology*, 23, 611-626.

Salthouse, T. A. (2004). What and when of cognitive aging. Current Directions in Psychological Science, 13, 140-144.

Craik, F. I. M., & Bialystok, E. (2006). Cognition through the life-span: mechanisms of change. *Trends in the Cognitive Sciences*, 10, 131-138.

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