

Annotated Bibliography Spring 2005, New York University

Instructions: Summarize the most important ideas and questions for each paper and book chapter you have read in approximately one third to one half a page. This is not a reaction paper or an excerpt, but rather your synthesis of the main ideas and related questions

Week of January 31

Smith & Ragan (1999). *Instructional Design*. New York: Wiley. [[Chapters 1, 2](#)] -- alternative download site: [[Chapters 1, 2](#)]

This reading outlined a process that is extremely similar to project planning in any other field, just different jargon. Here, the “users” are more specifically “learners,” which has implications for the more specific analysis and design tasks, and the expected outcomes. The approach seems very dry, overall, seems to be drawn from a project model that has more to do with developing infrastructures than inspiring students.

The general elements of a designer’s job were interesting; how many times have I tried to explain the problem-solving nature of being a “designer” on a technology project?

Constructionism questions: So relating this to the Guenther reading, is knowledge the “output” of a neural net, and is learning the process of strengthening neural connections?

Isn’t contextualism contradictory to abstract thought and objectivity? I just remember reading books on England, though I grew up in Hawaii. I had absolutely no context for facts on England, but I was able to carry on very hilarious conversations with Englishmen much later in life. So did I “learn” anything when I was 6, or did I not truly “learn” about England until I met an Englishman and traveled to England?

Guenther, R.K. (1998). *Human Cognition*. Upper Saddle River, NJ: Prentice Hall. [[Chapter 1](#)] -- alternative download site: [[Chapter 1](#)]

Very helpful background on historical factors in the development of cognitive science, especially in relation to the history of science itself and earlier Greek and Roman work. Relationship of cog sci to evolutionary theory is especially interesting, as I was not aware of the close co-development of the two bodies of work, though in retrospect it seems obvious. I also was very interested by the work done in related fields – psychology and linguistics, having some undergraduate studies in both areas. Finally the connections between these disparate areas of my own study become clearer : a pursuit of how the mind learns and validates and integrates new knowledge. My only bigger question is about how the scientific methods seem to have been focused on studying the individual, in isolation. But doesn’t it seem most knowledge generated and learning done socially? Or at least isn’t a critical step taken socially?

Additionally, the description of neural processes was very simple and enlightening. Having been studying digital/analog signal processing, I found some truth to the human-computer analogy (information processing model). However, it seemed a bit unclear to me how neural nets begin. The model already assumed some connections have more strength than others in any basic decision process. So are we born with some connection pattern already in place that predetermines our maximum capacity for growth?

Driscoll, M. (2005). *Psychology of Learning for Instruction (3rd ed.)*. Boston, MA: Allyn and Bacon. [pp. 71-77]

Short section that expounds upon the Computer Information Processing model. Again, how does this relate to neural network models?

Week of February 7**Human Cognitive Architecture: Sensory, Short-Term, Working Memory Models**

Kirschner, P.A. (2002). Cognitive load theory: Implications of cognitive load theory on the design of learning. [*Learning and Instruction*, 12](#), 1–10.

Limited working memory is described, and tips on working around its limitations (coding many elements as one, automating rules and flipping presentations modes). The idea of competencies seems a key one here - I recently heard someone at the Serious Games Summit describe educators greatest task at this time of great technological change to be "teaching people how to learn." It seems there is overlap here with the idea of teaching "competencies." Cognitive Load Theory - It seems what he is saying here is that true knowledge is stored in long-term memory but accessed through short term memory, so by being aware of how information can both be added and retrieved via schemas, we can optimize the performance of working memory as instructional designers. The abilities of the student, the intrinsic and germane aspects of the task at hand and the environment in which it is carried, out all affect performance. I'm not sure if I understand how information "shifts" from extraneous to "germane." But I understand that extraneous CL is produced by poor design and germane CL is the effort that is made to integrate new information into new schemas or currently existing schemas for long term storage.

Baddeley, A.D. (1992). [*Working memory*](#). *Science*, 255, 556-559.

Perhaps more recent research shows further understanding of short term memory functions as operating from three subcomponents - with a central processing function that handles other functions of verbal-based information processing, and visual/spatial information processing. Two competing theoretical approaches are discussed that deal with this tripartite structure - one focused on psychometrics and predicting overall cognition based on working memory performance, and the other (neuropsychological) based on the interaction between the central function and the two subcomponents.

Driscoll, M. (2005). *Psychology of Learning for Instruction (3rd ed.)*. Boston, MA: Allyn and Bacon. (pp. 77-91)

The more I read in Driscoll the stranger these diagrams seem - how neat and clean they seem in relation to complex processes.

Week of February 14, Spring 2005

Mayer, R.E., Sims, V.K. (1994). [*For whom is a picture worth a thousand words? Extensions of a dual-coding theory of multimedia learning*](#). *Journal of Educational Psychology*, 86, 389-401.

The argument for using visual stimulus of both text and graphic together is presented in terms of dual-coding theory. Basically, when multiple sensory modes are engaged, learning is dependent on the three elements: mental representation of the verbal stimulus, mental representation of the visual stimulus and the successful building of a referential bridge between those two. Tests are summarized in this paper that outline the greater effect that contiguous presentations of verbal and visual have on both high and low ability learners, with concurrent presentation of both visual and verbal enhancing both groups' performance, though with low-ability and low experience students more than the opposite.

In all the examples in this paper, systems are shown in the explanations. But does this imply that dual-coding is used best in educating learners about systems (systems being interlocking elements affected by chains of cause and effect)?

Clark, J.M., & Paivio, A. (1991). [*Dual Coding Theory and Education*](#). *Educational Psychology Review*, 3, 149-210.

I was inspired by the concept of graphic/visual presentation accessing a type of mental processing that is non-linear. Words, sentences and other verbal presentations of information are necessarily linear, governed by

grammar. Visual images, however, allow for simultaneous processing of the information, parallel processing. To me this implies that the linear effect of information presented sequentially in time is useful for understanding sequences, where the non-linear effect of information presented simultaneously may be useful for understanding systems that are not necessarily sequence oriented (interconnected systems or networks?). But is this correct?

The side effects of associative memory are interesting as well. We have learned how poets such as e.e. cummings use the free association of words and images to relate a story, overlaying the initial meaning of an image with related images/words – funny how close this is to just simply thinking or remembering! Its almost as if by reading a cummings poem, you are reading a map of his memory.

Driscoll, M. (2005). *Psychology of Learning for Instruction (3rd ed.)*. Boston, MA: Allyn and Bacon. [pp. 91-110]

I was very interested in the idea of episodic vs. semantic memory - it makes me think about the learning strategies Howard Gardner mentions in *The Unschooled Mind* as occurring in "script play." Script play is ritualistic-type behavior that children engage in that reflects their perception of re-occurring events. These events are perceived by the child as being important to their survival in the social system, and they engage in the narrative of the event by playing it out, testing their own reactions in a safe script. Both girls and boys engage in this type of learning play.

I can see how episodic memory is less helpful than semantic in many ways, in that it is abstracted from its context in memory, and therefore more flexibly applied to changing circumstances.

Week of February 28

Driscoll, M. (2005). *Psychology of Learning for Instruction (3rd ed.)*. Boston, MA: Allyn and Bacon. [pp. 29-49]

Driscoll, M. (2005). *Psychology of Learning for Instruction (3rd ed.)*. Boston, MA: Allyn and Bacon. [Chapter 4]

Driscoll, M. (2005). *Psychology of Learning for Instruction (3rd ed.)*. Boston, MA: Allyn and Bacon. [Chapter 11]

The first reading covers the basics of Behaviorism, which is so radically old-fashioned it seems almost quaint to realize some people used to use this theory actively. Its slightly frightening, to be honest, especially since it seems to take no contextual information into account, treating humans like black boxes regardless of time, space, culture.

Chapter 4 covers schema theory, which is extremely engaging and enlightening. The many examples that illustrate how schema form, how they can be viewed as partially formed under certain circumstances, is very enlightening. I feel there is a natural corollary to the structure of certain clusters of information in networks. I know you said, Jan, that drawing too close an analogy to network structure is dangerous but I can't remember why. There seems to be strong case to compare clustered nodes of information on a network with schemas within a larger cognitive framework.

Chapter 11 describes the Constructivist approach to learning. It is slightly confusing that there is also a learning theory called Constructionism that is often discussed within digital design classes, led by Seymour Papert. How do they differ? They seem similar.

Week of March 7

Paas F.; Renkl A.; Sweller J.(2003). [Cognitive Load Theory and Instructional Design: Recent Developments](#). *Educational Psychologist* 38, 1-4.

I think I understand examples of high element interactivity material would be: a process, a multi-step multi-variable task, a game, perhaps. Are there specific other good examples that you would commonly use to describe high-level interactivity material? Is every process an example of high-level interactivity?

Intrinsic cognitive load: the difference between intrinsic cognitive load (that load which is inherently borne due to the presentation of interacting elements within a learning presentation) and extraneous cognitive load (that load which is borne due to irrelevant elements that do not necessarily interact with each other in the learning of a process). Its unclear to me however, how the "search for a problem solution" in a learning activity is "irrelevant."

I think I automatically start searching for solutions to problems as they are posed, regardless of whether the problems are part of the formal learning activity or not. Is this just a habitual cognitive strategy of my own?

German/effective cognitive load: seems slightly mysterious. The presence of “influence” by the instructional designer may lead to germane cognitive load, and it may lead to better schema acquisition, but its not clear what exactly produces germane cognitive load. I can think of many examples of unclear data or instructions that would lead to extraneous cognitive load, but not many for germane cognitive load.

Brünken, R., Plass, J.L., & Leutner, D. (2003). [Direct measurement of cognitive load in multimedia learning](#). *Educational Psychologist* 38, 53-61.

The articles is about how the cognitive load can be more quantitatively measured in an “authentic” learning environment. Defines free cognitive resources as the difference between total cognitive load and zero cognitive load. Reviews dual-code assumption.

You know, it seems very vague as to how extraneous and germane loads affect the intrinsic load, and unclear why they are additive, as opposed to some other formulaic approach. I mean, why not [COG LOAD = $IN+(EX*GER/2)$]??? Perhaps I have worked too long with information architectures in the computer field, but it seems like what is being described is more like an inherent difficulty (Intrinsic cog load) and two variables which affect it (extraneous and germane). These two variables affect the intrinsic load, either amplifying the difficulty of the problem or facilitating it. For example: in a computer game, you have a goal, which has intrinsic difficulty, and then there are environmental factors which make it harder or easier, such as obstacles or clearly defined paths. The goal itself does not become harder or easier, but the mitigating factors on the WAY to the goal can make the task achievement harder or easier. And if these extraneous or germane factors are simply mitigating factors, they can't be strictly additive, they have to have more subtlety to them. It seems to have a relationship with probability theory.

I would guess that there is some kind of multiplicative or divisive factor, as opposed to additive. Because if they are additive, it implies a kind of equality between the three factors.

$A+B+C$ =cognitive load

But that implies that you can have one without the other two or two without the other one. But can you have heavy germane load without intrinsic load? And no matter how many germane features are provided by a teacher, if the problem itself is too intrinsically hard, you cant solve it.

Mathematic terminology provided is inadequate to describe this memory processing aspect of learning.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. [Learning and Instruction](#), 4, 295-312.

It is truly amazing to me that commonly used terms such as “element” and measurements of element interactivity are used frequently with great fluency, and yet statements such as “we cannot determine what an element is” and “a measurement of interactivity is unobtainable.” Amazing.

This paper reviews some fo the previous content of the other papers, as well as going over a few specific things I found very useful – some specific strategies for reducing extraneous cognitive load, such as providing goal-free problems that allow multiple solutions, providing “worked” examples of contextually solved problems and providing partially completed problems that allow the student agency in completing the solution. These all seem excellent to me, very in line with what I regard as natural learning processes.

Week of March 21

Kalyuga S.; Ayres P.; Chandler P.; Sweller J. (2003). The Expertise Reversal Effect. *Educational Psychologist* 38, 22-31.

This article summarizes various evidence that show that many cognitive load effects are the result of a mismatch between the learner and the material, a situation which produces what is called "expertise reversal."

For example, “physically integrated” examples within a piece of instruction (where text and diagrams are integrated), is shown to reduce cognitive load by reducing the visual search for information. However, these effects are reduced or even reversed when the expertise level of the learner is higher. Overall, many design approaches that have been shown to reduce cognitive load apply differently for novices in a given subject than for learners with a higher degree of prior knowledge. Those with greater expertise experience many elements, -- such as auditory explanations, worked examples, heavily guided materials, mixed instruction, and imagining techniques – as redundant. More experienced learners already have many schemas that they can draw upon within working memory in order to process new information without the need for those elements.

Mayer R.E.; Moreno R. (2003). Nine Ways to Reduce Cognitive Load in Multimedia Learning. *Educational Psychologist* 38, 43-52.

Several specific strategies to reduce cognitive load are reviewed: offloading, segmenting, pretraining, weeding, signalling, aligning, reducing redundancy, synchronizing and individualizing. Most of these I am familiar with, as they correspond with good interface design principles. They also mostly overlap with Edward Tufte’s information design guides.

Renkl A.; Atkinson R.K. (2003). Structuring the Transition From Example Study to Problem Solving in Cognitive Skill Acquisition: A Cognitive Load Perspective. *Educational Psychologist* 38, 15-22.

This article more specifically focuses on the different cognitive loads produced when transitioning between a novice who is helped by specific methods to reduce extraneous load (dual coding, worked examples, etc.) and a more experienced/intermediate learner who is better served by self-explaining and problem solving challenges. Different types of self-explaining strategies are reviewed – identifying the “domain principle,” breaking down goals into subcomponents to see the interrelations, and perceiving conceptual patterns in the information – coherence and dispersion. These types are said to lose their primary effectiveness once a higher degree of expertise is achieved, and “automaticity” is the goal.

Low expertise-----	intermediate expertise-----	higher expertise
<p>Germane load increased by dual coding, worked examples, auditory explanations,</p> <p>Goal is to absorb components of a new schema or develop a schema that may have been partially developed in order to have a conceptual framework for understanding</p>	<p>Germane load increased by self-explaining</p> <ul style="list-style-type: none"> o Understanding underlying principles o Breaking down and identifying sub-goals o Identifying patterns of conceptual coherence and dispersion between different examples <p>Goal is to begin to apply conceptual framework to examples, bridging abstract knowledge and specific examples</p>	<p>Germane load increased by problem-solving examples, mental problem-solving (imagining), and the “fading” out of explanatory information or hints : models, leading to coached problem-solving (one or two steps missing), independent problem solving (fully independent problem devoid of explanation)</p> <p>Goal is often making components of problem-solving automatic, focusing on speed and accuracy</p>

Questions: It is slightly unclear what the “underlying domain principle” refers to. It seems quite broad.

Week of March 29

Mayer, R.E. (2001). *Multimedia Learning*. Cambridge: New York. [Chapters 1, 2, 3, 4]

Mayer covers the cognitive theory of multimedia learning, describing the Dual-channel assumption, the limited capacity assumption and the active processing assumption. It is interesting that Mayer often uses the language of constructionism, even though the processes he describes seem more closely aligned with a cognitivist approach. Perhaps regardless of the actual approach, the learner is always a constructivist of his own learning experience?

Week of April 4

Mayer, R.E. (2001). *Multimedia Learning*. Cambridge: New York. [Chapters 5, 6, 7, 8, 9]

Spatial and temporal contiguity are often described by usability experts such as Edward Tufte and Donald Norman, though perhaps with different jargon. Again, the overlap between some of these principles Mayer outlines and standard heuristics for good design are very striking. The redundancy principle, the coherence principle – there are guidelines that good designers often follow intuitively, so I am glad there is harder theory behind the guidelines. Why don't more people at ITP know about these? Are these principles too obvious to study for designers?

Week of April 18

Mayer, R.E. (2001). *Multimedia Learning*. Cambridge: New York. [Chapter 10]

Honestly, individual differences seems almost unbearably complex a task to tackle at first glance. However, perhaps instead of trying to offer an unlimited number of branching paths for different learners to take within an activity, perhaps simply giving learners varying options within each specific unit in the form of annotation might be useful. If a learner could toggle annotations on and off, wouldn't this serve the purpose of user-defined individual learning?

Plass, J.L., Chun, D.M., Mayer, R.E., & Leutner, D. (2003). Cognitive load in reading a foreign language text with multimedia aids and the influence of verbal and spatial abilities. *Computers in Human Behavior*, 19(2), 221-243.

Plass, J.L., Chun, D.M., Mayer, R.E., & Leutner, D. (1998). [Supporting visual and verbal learning preferences in a second language multimedia learning environment](#). *Journal of Educational Psychology*, 90, 25–36.

Both of these articles support my final theory paper and thesis project, although the results of the actual experiments are complex to understand at first. Also, these seem largely to refer to mixes of pictures and words, I wonder if one can draw the same conclusions for text-based annotations

Week of April 25

Plass, J.L., & Salisbury, M.W. (2002). [A living systems design model for web-based knowledge management systems](#). *Educational Technology Research & Development*, 50, 35-58.

This paper outlines the systematic approach used to evaluate needs and create a plan for developing a knowledge management system at Los Alamos. I read this paper the first week of class. I am very aware of the technology development cycle outlined in the early part and then the latter half of the paper. The more interesting part of this paper for me was the analysis of the "learner" and the analogy drawn with living systems. This approach to knowledge building influenced my thesis project at ITP.

Haertel, G.D., & Means, B. (Eds.) (2003). *Evaluating Educational Technology*. New York: Teachers College Press. [Introductions to Part I, II, III, Chapter 6, plus one additional chapter]