Meta-effectiveness Excerpts from *Cognitive Productivity: Using Knowledge to Become Profoundly Effective*

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I recently wrote a blog post containing some importants concepts for understanding adult development of competence (including "learning to learn"). The overarching concept of that topic, and *Cognitive Productivity*, is *meta-effectiveness*, i.e., the abilities and dispositions (or "mindware") to use knowledge to become more effective. *Effectance* is a component of meta-effectiveness.

The concepts of meta-effectiveness and effectance being both subtle and important, I am publishing in this document a few excerpts from my book (*Cognitive Productivity*) to elucidate them. You will notice that I am critical of the position espoused by Dennett (*e.g.*, in *Inside Jokes*) that the tendency to think is pleasure-seeking in disguise. Also, I've modernized White's concept of *effectance*, aligning it with Sloman's concept of *architecture-based motivation*. I have also updated David Perkins' concept of *mindware*.

Acknowledgements

Footnotes

Revision History

2015–05–31. First revision.

COGNITIVE PRODUCTIVITY

USING KNOWLEDGE TO BECOME PROFOUNDLY EFFECTIVE

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CogZest™

Cognitive Productivity

Using Knowledge to Become Profoundly Effective

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Only the ideas that we actually live are of any value.
Hermann Hesse

1. Introduction

> *The essence of knowledge is, having it, to apply it; not having it, to confess your ignorance.*
> **Confucius**

We live in an era of ineffable opportunities to use knowledge to become more effective. The information cornucopia is at our finger tips. We are served the latest knowledge in print, ebooks, audiobooks, web pages, podcasts, videos, screen casts, webinars, and other forms.

For example, books by relationship expert Dr. John Gottman can improve your marriage and other close relationships. The principles of rationality conveyed by cognitive scientists like Dr. Keith Stanovich can help you avoid costly mistakes. Agile product-development principles conveyed by the likes of Eric Ries can help you develop products customers will actually like and pay for. High caliber investment advice from writers like TSI Network's Pat McKeough can protect and grow your investments. Applying health and nutrition information from Center for Science in the Public Interest[1]'s *Nutrition Action*[2] newsletter might help you live a healthier and longer life. The open-access movement provides public access to information hitherto only available to select knowledge workers. Many universities are now even offering massive, open (free) online courses—MOOCs!

To be sure, there is more irrelevant information than text worth reading, let alone delving. But there is no denying the abundance of potent knowledge to help us solve problems and develop ourselves. This bodes well for the exercise of the seventh habit of highly effective people, which—according to the late Stephen R. Covey—is to "sharpen the saw"®. It is to improve ourselves—our productive capacity—through regular reading and related pro-active activity (Covey, 2004). If we properly conduct our research and apply ourselves, then we can develop personal effectiveness: understanding, skills, attitudes, habits and dispositions. I agree with Aristotle, who laid the foundations for Western ethics, that in the balanced pursuit of excellence lies the route to happiness.

Alas "the shallows", intellectual defeatism, naive optimism and cognitive miserliness each in their own way threaten our knowledge-based and technology-enabled pursuit of effectiveness. In his best selling book, *The Shallows,* Nicolas Carr laments the effects he supposes the Internet has on our brains, minds and behavior. He suggests that our usage of information technology causes us to have shorter "attention spans" and more difficulty learning. He claims that the distractions, hyperlinks and other features of technology (and our way of using it) not only interfere with our productive use of technology, they alter our brains and minds. "The tools of the mind amplify and in turn numb the most intimate, the most human, of our natural capacities—those for reason, perception, memory, emotion." From the neuroplasticity bandwagon, Carr professes that our new technological vices "rewire our brains". We are, he seems to believe, becoming inextricably stuck in the shallows.

However, Carr's apparent defeatism overshadow his legitimate concerns. Let us "consider the opposite", a reasoning strategy discussed below. If plasticity (i.e., modifiability) is as important a

[1] http://www.cspinet.org
[2] http://www.nutritionaction.com

observations and data from phenomena-based researchers.[33] Ideally, they subject the concepts of their requirements analyses to conceptual analysis. (b) They produce detailed designs of systems to meet these requirements. These designs specify an overall architecture and component mechanisms. (c) They implement as much of their designs as they can in computer simulations and possibly robotic systems. (d) They analyze the extent to which their designs and implementations meet (and fail to meet) their requirements. (e) They explore and study the space of possible designs that might satisfy these requirements. This leads to the gradual re-interpretation, pruning and replacement of folk psychological concepts and the creation of new concepts.

Phenomena-based researchers test conjectures produced from the designer stance, folk psychology, and various cognitive science research programs. This book leverages pertinent empirical research.

The second part of this book describes mechanisms of mind and their development from a designer-stance. Here are some of the concepts described there that are particularly important to personal development.

- Monitors that help us recognize potentially pertinent information (for example, a child develops monitors to recognize when her name is spoken);
- Inner motivators that generate new goals and evaluations (for example, a goal to slow down the vehicle as one approaches a red light);
- Long-term working memory, a form of secondary memory that people develop as they gain expertise in a domain. It has some of the properties of normal long-term memory and some of the properties of working memory (rapid access).
- Deliberate practice, a form of practice in which people engage in order to develop expertise. We are all intuitively familiar with this concept. However, outside of public performance disciplines, people tend to forget its importance. They also don't necessarily understand how it relates to long-term working memory. **Productive practice** is a form of deliberate practice designed specifically for knowledge workers.

The first three of these concepts are forms of mindware, whereas productive practice is a way to develop effectiveness, which hinges on mindware.

1.2.2 Mindware

Information-processing is not simply a metaphor we use to understand the mind. It is what the mind does that is functionally important. It is what needs to be understood and modeled in order for us to make sense of mental phenomena and explain overt behavior. If we are to describe, in information-processing terms, the structures that the mind develops as people learn, we will need a

[33]Phenomena-based research is by far the most commonly used family of research methods in psychology. It consists of various methods to test hypotheses produced through ad hoc theory development or, alternatively, through the designer stance. Undergraduate textbooks on research methods in psychology, for example Shaughnessy, Zechmeister & Zechmeister (2009), occasionally briefly describe theory construction. But they do not provide guidance on how to develop theories. Nor do they, to my knowledge, even mention designer-based research. I was accepted in the Ph.D. programme in the department of Psychology at McGill University in 1990. My prospective advisor, Prof. Thomas Shultz, accepted that I intended to do computational research. I asked him whether anyone had ever defended a theoretical Ph.D. thesis in his department. He said no! So, I turned down their offer and accepted a Commonwealth Scholarship to study in the Cognitive Science programme at Sussex University, which had an established tradition of theoretical research. Rigorous empirical research is required for progress in psychology; but it is not sufficient.

concise expression to refer to them abstractly. The folk psychological term "memory" has culturally loaded connotations that disqualify it. We need a term for the active processors we develop, such as our monitors, motive generators, long-term working memory, and reactive processes (as described in Part 2). The generic term must not commit us to a specific type of component. Yet it must be more compact than "information-processing mechanism". It must also be more theoretically neutral than the "agents" described in one of Marvin Minsky's contributions to the canon of cognitive science, *The Society of Mind*.

I opt for the expression "mindware", which was coined by David Perkins and elaborated by Keith Stanovich. Mindware is the brain's analog to a computer's software. Like software, it comes in very different forms. It includes information processed in the mind, mechanisms to process information, mental representations, and even information architectures. Of course, mindware is only metaphorically related to software. Please do not assume I am (or that any serious AI researcher is) drawing a naive analogy between computers and minds.

Mindware is cognitive science's analog to matter in physics. Some physicists indicate that they are not really sure what matter is. Their models of matter change. But (so far as I know) they do not give up on there being matter. Cognitive science (as an information processing science) is a much younger science than physics. It seeks to explain higher-level phenomena. And so the concept of mindware, understandably, is still quite nebulous. It can, however, already benefit from the work of tens of thousands of cognitive scientists in addition to computer scientists and software developers outside of AI. The latter have studied countless types of information-processing systems that may be relevant to understanding mindware.

I find it strange that the term "mindware" has not yet been widely adopted in cognitive science. However, I suppose it is just a matter of time before it or some other candidate for the concept takes off. For it is very convenient to have a term to refer to this important concept.

1.2.3 Adult mental development

> *adult intellect is expected to grow over early and middle adulthood*
> **Phillip L. Ackerman**

This book describes a way of thinking about the development of competence. This usually falls under the umbrella term "learning". However, Carl Bereiter has convincingly argued that the term "learning" is over-used and misleading (Bereiter, 2002a). There is such a variety of changes called learning that the expression is meaningless. A unicellular organism can learn in some sense. The most important distinction the term blurs is between the creation of objective knowledge and changes in mindware.[34] The distinction between objective knowledge and mental representations is not that knowledge is unbiased—knowledge can even be false. Rather, it's that objective knowledge is potentially public. In some cases, objective knowledge is also negotiable. For example, one can buy, sell and license patents and copyright material. You can't do that with your mental states, processes and mechanisms. While this may seem like an esoteric distinction, Bereiter has shown that blurring it is the source of much confusion.

[34] See Popper (1979). I elaborate on these distinctions in chapter 5. They relate to Bereiter's distinctions between learning and knowledge building.

People often behave as if processing information guarantees they will be able to use it later. Yet new competencies do not often develop from knowledge resources as quickly or as passively as is common under associative learning paradigms such as classical (Pavlovian) conditioning and (Skinnerian) operant conditioning. (See the section Illusions of Meta-effectiveness.) Whether we are developing skills, understanding, habits, or simply an ability to recall information, a large number of mental changes must occur. Thinking about this as some kind of amorphous learning, or merely using the behavioral concepts of skills and habits, draws our attention away from the mechanisms that change as we learn.

Thinking of learning in terms of mental (i.e., mindware) development draws us back inside. We don't know exactly what happens mentally, let alone neurally, as we learn. But I suggest that we can benefit from using a broad and deepening theory of what happens when we grasp knowledge. This theory will draw our attention to the varied constituents of our mental development. It will involve hypothesized mental components such as monitors, inner motivators and long-term working memory. This way of thinking is also meant to help us choose ways of processing information that are more likely to deliver desired "learning outcomes".

Whatever theory of mind we espouse, many of us are accustomed to thinking of *child* development. People are much less apt to speak of *adult* mental development. We think of child development as a genetically unfolding program. However, developmental cognitive psychologist Annett Karmiloff-Smith has shown that epigenetic factors are very important in child development (Karmiloff-Smith, 2012). In a knowledge society, variability in adult development is largely a function of people's interactions with knowledge. The minds of effectant people develop significantly over their lifetime, as a function of the knowledge resources they delve and master. The differences in mental functioning and performance between an expert and a novice (at least with respect to their domains of expertise) are as remarkable as the most striking differences between a young and older child. Effectant people's mindware is programmed, and their mental architecture developed, with the knowledge resources they master.

1.2.4 Effectance: motivation for competence

> *Sustein is one of the foremost legal scholars in the United States, and shares with other leaders of his profession the attribute of intellectual fearlessness. He knows he can master any body of knowledge quickly and thoroughly and he has mastered many, including both the psychology of judgment and choice and issues of regulation and risk policy.*
> **Daniel Kahneman**

As I mentioned above, Robert White (1959) coined the term "effectance" to make sense of the cognitive properties of children's play. He attempted to fill conceptual gaps of two schools of thought, behaviorism and psychodynamics, that continue to limit our thinking about cognition.

> There is a competence motivation as well as competence in its more familiar sense of achieved capacity (p. 318) […]
> Such activities in the ultimate service of competence must therefore be conceived to be

> motivated in their own right. It is proposed to designate this motivation by the term effectance, and to characterize the experience produced as a feeling of efficacy.

Expounding the concept of *effectance*, White emphasized the child's need to learn to systematically influence the environment. He drew attention to the interest and curiosity displayed by children.

The concept of effectance is of tremendous importance to knowledge work and personal development. White's term never made its way into dictionaries and is only infrequently cited in the psychology literature. Waytz et al. (2010) are an exception. They defined effectance as "the motivation to attain control, predictability, and understanding, and to reduce uncertainty, unpredictability, and randomness." (p. 424). They noted that the concept is important to make sense of much research, including on: sense-making, need for closure, desire for control, locus of control and, I would add, thinking dispositions and perceived self-efficacy. Absent a term for effectance, however, we are prone to overlook some of the major reasons why some people progress more than others (and more at some times than they did previously.)

While White's concept of effectance is a useful starting point for understanding the factors that drive people to improve themselves, it has a weakness. In chapter 3, I put forward a more subtle, parsimonious and powerful concept of effectance.

1.2.5 Meta-effectiveness

> *Human language, and human culture, are not instincts— but they* are *instincts to learn*
> **W. Tecumseh Fitch**

With these concepts in place, we can revisit meta-effectiveness. Meta-effectiveness refers to the skills, dispositions and manifold underlying information-processing mechanisms that enable and drive people to improve themselves. It includes both fluid expertise and effectance. Fluid expertise is the ability to develop expertise (Bereiter & Scardamalia, 1993); it includes learning skills as distinct from one's inclination to apply them. The concept of meta-effectiveness exemplifies a key tenet of this book: the folk psychological distinction between motivation and abilities fades when we adopt the designer-stance. This will become clearer when we take a closer look at information processing in Part 2.

Many knowledge workers have easy access to useful high caliber knowledge. The major bottleneck in the development of personal excellence, for them and many others, is converting this knowledge into mindware. Meta-effectiveness is the width of this bottleneck. It enables and motivates individuals to release the potential of objective knowledge in themselves. It involves mindware that *potentiates* objective knowledge, further generating and developing mindware.

The most potent ways in which knowledge workers improve themselves are through delving knowledge, progressive problem-solving, knowledge building, reflecting-in-action, deliberate practice, deliberate performance.

- Delving refers to attentive, deliberate processing of knowledge resources (e.g., reading, attending seminars meetings, lectures and workshops, listening to podcasts, watching videos).

- Progressive problem-solving refers to addressing and attempting to resolve increasingly difficult problems (Bereiter & Scardamalia, 1993). It entails working at the edge of one's competence, as opposed to simply trying to reduce effort, be efficient, and "get things done" in the short run.
- Knowledge building refers to creating, improving and assessing objective knowledge in response to problems of understanding (Scardamalia & Bereiter, 2006).
- Deliberate performance refers to deliberately practicing skills on the job, i.e., while accomplishing things.
- Deliberate practice involves purposefully practicing, offline.
- Reflecting-in-action involves thinking about one's work, and improving it, while one is doing it (Schön, 1983).
- Productive practice is a form of deliberate practice in which one uses (and potentially builds) knowledge to develop personally (to become more effective).

These activities are not completely orthogonal. For example, productive practice and progressive problem solving often involve knowledge building. Schön also described multiple types of practice (Schön, 1982). More importantly, the mental processes involving these activities overlap in ways that can be analyzed. (For example, the process of representational redescription (Karmiloff-Smith, 1995) can be invoked in all of these activities to develop mindware and improve one's effectiveness.) Of these activities, this book focuses mainly on delving and deliberate practice (in the form of productive practice).

1.3 Example knowledge resources referenced in this book

As we will see in chapter 7, meta-effective people like to use examples to drive their learning. They also process them more carefully (VanLehn, 1996). Therefore, I've loaded this book with examples. In particular, I refer to four sets of knowledge resources that are likely to be pertinent to my readers. They illustrate a wide variety of types of effectiveness you might seek. They are the following:

- Some concepts expressed in two of John Gottman's books: With N. Silver (1999). *The Seven Principles for Making Marriage Work.*[35] With J. DeClaire (2001). *The Relationship Cure: A Five-Step Guide For Building Better Connections with Family, Friends, and Lovers*[36].
- Some concepts expressed in Keith Stanovich's (2009) book, *What Intelligence Tests Miss: The Psychology of Rational Thought*[37].
- Concepts developed in Eric Ries's (2011) book: *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*[38].
- Various works by Aaron Sloman and myself (including this book).

[35] http://www.gottman.com/shop/7-principles-for-making-marriage-work-2/
[36] http://www.gottman.com/shop/the-relationship-cure/
[37] http://www.keithstanovich.com/Site/Books.html
[38] http://theleanstartup.com/book

Several pages omitted

One reason we sometimes fail to benefit from what we have learned is that we don't always meaningfully abstract the structure of the problem and and its solution. In other words, it's not that we fail to apply what we know, but that we don't learn properly in the first place. We often fail to analyze (and name) the type of problem and solution we are facing. I referred to the Ray and General problems as calling for a "divide-and-conquer in parallel strategy", which is a type of divide-and-conquer strategy. If you've already dealt with many similar problems in abstract terms, you might quickly apply such a label yourself. Otherwise, it might take some time and effort to detect and label the pattern. When you perform this kind of cognitive task in preparing for future problem solving, you are engaging in "forward-reaching transfer" (Perkins & Solomon, 1987). Here, you are trying to construct personal knowledge that you can apply ("transfer") to future similar cases. Forward-reaching transfer is something we strive for with all kinds of information that we learn. (It requires a rational processing mindset.) To deeply process this information, I recommend you identify a book or document that you had carefully read that might have helped you with a recent problem but didn't. Why did you fail to use the knowledge?

The backward- and forward-reaching characterization of transfer are examples of the structure-matching approach. Structure matching goes like this: discover the structure of a prior problem (i.e., the structure of both the initial and goal conditions, and the mapping between them); discover a solution and express it in abstract terms (e.g., divide-and-conquer in parallel strategy). Then notice, in the future, when a given situation matches the prior problem's structure; when it does, consider applying the prior solution in its abstract form. Structure matching calls for some heavy thinking up front, and sophisticated pattern-matching at "run time".

Alas, this approach does not capture all failures to apply what we know. A problem with this rather schematic characterization of transfer is that it under-emphasizes some of the most important mindware we develop as we become more effective. That is a web of fine-grained mental mechanisms, many of which are perceptual. The perception is not so much of the external environment as it is of the mind. Often, the reason we fail to apply knowledge is that we fail to detect that it is pertinent. It's as if all we need is a hint, like the students who were prompted to consider the story, "The General". But we must provide the hint ourselves! Asking ourselves "what relevant prior knowledge can I bring to bear on this problem?" won't necessarily be enough (though it may help). Something has to happen to our internal perception in between forward-reaching and backward-reaching processing.

To understand transfer failures (and the breakdowns in rationality they entail), we need to refer to a blue-print of the mind, one that starts to make sense of successes and failures of learning. This will enable us to pinpoint some of the mental mechanisms that fail to develop in cases where we systematically fail to apply the knowledge we "acquired." We also need a relational concept of understanding. For there is more to "transfer" and knowledge-based rationality than applying concepts and skills. We will turn our attention to these matters in Part 2. Chapter 14 describes ways of practicing that increase the likelihood that we will apply what we know.

3.3.3 Cognitive miserliness and its antagonists

> *I'm sorry Darling you are disappointed at the sale of the Book [The Arms and the Covenant]. I'm sure it's the price—The sort of people who want to hear that the*

> *Government is all wrong are not the rich ones —The Tories don't want to be made to think.*
> **Clementine Churchill to Winston Churchill**

Even with the ideas and tips in this book, using knowledge to become a more effective person requires a lot of effort. Meta-effectiveness makes personal development easier, not easy. One must fight the temptation to passively process information. Rather, we must actively seek the best information, process it carefully, think about and with it, and practice it, whether deliberately or implicitly. This requires thinking dispositions that most people lack, propensities that are at odds with what Keith Stanovich refers to as "cognitive miserliness", a concept he introduces as follows:

> Consider the following problem, taken from the work of Hector Levesque and studied by my research group. Try to answer before reading on:
>
> Jack is looking at Anne but Anne is looking at George. Jack is married but George is not. Is a married person looking at an unmarried person?
>
> A) Yes
> B) No
> C) Cannot be determined
>
> Answer A, B, or C before you look ahead. (Stanovich, 2009[a])

[a] http://www.keithstanovich.com/Site/Books.html

I've tucked the answer to this question and a brief explanation of the data in this footnote[47] to prevent you from accidentally reading it. While solving this problem does require a certain level of fluid intelligence, IQ does not explain the fact that 80% of participants get this wrong. They were all smart enough to answer the question correctly; but the cognitive misers amongst them eye-balled the problem and then quickly selected an incorrect answer. This shows that smart people shouldn't expect to be able to coast through life based on their high IQ. Fluid intelligence is of little use if one can't be bothered to think.[48]

[47] Most people, at first blush, don't see a way of proving "yes" or "no". A way to answer this question is to consider that Anne may be married or unmarried. Most people then seem to suppose that because Anne's marital status is not given, the problem cannot be solved. And so they answer "C". This is the easy way out. For one could instead wonder and logically investigate the implications of Anne being married. If she is married, then a married person (Anne) is looking at an unmarried person (George). One could then continue to wonder what follows in the case where she is not married. One may then conclude that a married person (Jack) is looking at an unmarried person (this time, Anne). To solve this problem in this way requires that one consider hypothetical possibilities, store them in memory, draw inferences, and reason about them. That's cognitively demanding. In Part 3, I give an example of how the concept of cognitive miserliness can be learned with productive practice.

[48] Many factors can affect the answer one gives to this question; one must therefore not read too much into a wrong result on one question. Stanovich (2011) calls for the creation of psychometrically valid tests to measure one's "rationality quotient (RQ)" (p. 246).

What does this mean for developing personal effectiveness from knowledge? Think back to Janet of Water Flop. Her high IQ will certainly help her to solve problems when she applies herself. She might even tend to process reams of information. However, she also tends to shoot from the hip. She does not seek out the best knowledge resources nor does she effortfully try to apply them in her day-to-day problem-solving. Many of her former classmates who invest more effort in developing themselves, even those with lower IQs, have long since become more effective than she is. As a result, their teams also perform better and they are more often consulted for their expertise.

On the one hand, it is helpful to keep in mind the dangerous allure of cognitive miserliness; but on the other, one ought not to depend too heavily on negative self-talk and duty (to avoid cognitive miserliness). Besides, conservation of mental resources is important. It is difficult to nurture the dispositions required to do the necessary demanding, sometimes dry, cognitive work if we cannot even name and describe them. We need *positive* language to express the affective underpinnings of our cognitive pursuits. *Effectance, perceived self-efficacy* and thinking disposition are helpful concepts for our pursuit of knowledge-based excellence.

3.3.3.1 Effectance as a propensity to develop competence

> *Helen [Keller] did not come by her knowledge easily. Everything she did was so difficult that most people would have given up early in the learning process. But she worked furiously at mastering all she encountered.*
> **Merlin Donald**

In chapter 1, I introduced White's concept of effectance: the motivation to develop competence. However, I use the term in a subtly different way than is normally used, namely as the often tacit propensity to develop competence. The key difference is that this propensity does not necessarily involve explicit (let alone conscious) motivation for competence. I also emphasize the role of objective knowledge in adult effectance. This new concept of effectance is more subtle and more powerful. It is based on an architectural concept of motivation, which comes from "designer-based" Artificial Intelligence.

White always qualified the term "effectance" with "motivation" or "urge"[49], as in "effectance motivation". In so doing, he vitiated his own neologism. I suspect this is why it is not in common currency. There is no use for the term so qualified; one might as well use the phrase "competence motivation".[50] Moreover, as I argue below, the compound use of "effectance" betrays a folk-psychological notion of motivation which, though it is for all intents and purposes the only one used in psychology, needs to be superceded with an architectural, designer concept (cf. Part 2). So, I use the term "effectance" by itself and in adjectival form, "effectant".

Concepts similar to effectance have shown up many times in cognitive science—but without an adequate label.[51] Carl Bereiter and Maria Scardamalia provided an insightful analysis of the

[49]For example, "In infants and young children it seems to me sensible to conceive of effectance motivation as undifferentiated." White (1959, p. 323).

[50]That is in fact how White defined effectance. However, to be fair, White emphasized the ability to affect the environment, which is slightly different from competence. Such hair-splitting distinctions cannot be expected to have moved the pens of White's contemporaries (but cf. Allport, 1961, p. 251). Moreover, "effectiveness" and "efficacy" would do just as well.

[51]Bruner (1966, chapter 6, "The Will to Learn"), who also refers to White, comes closer than White and Bereiter to the concept of effectance described here.

processes of expertise (Bereiter & Scardamalia, 1993). They did not merely focus on differences between experts and novices. They sought to explain how people acquire and lose expertise. They drew attention to critical similarities between "expert-like novices" and experts. At every level of competence, there are some people who have more fluid expertise than others. Fluid expertise is a major component of meta-effectiveness. It is distinct from effectance.

As people gain *crystallized* expertise, they become more efficient. Fluid experts reinvest the temporal gains of these efficiencies in learning and progressive problem-solving. Thus, they further develop their expertise. Bereiter & Scardamalia stressed the importance of the underlying propensity to develop. However, they did not name their motivational concept. The concept of effectance, as I have adapted it, designates the underlying motivational processes. We can attribute effectance to people using the intentional stance and explain it with the designer stance (i.e., an architecture-based theory of motivation). Effectance is the propensity to develop competence. One need not be an expert to be effectant. But without effectance one cannot indefinitely sustain the development of expertise. The motivational processes underlying what Bereiter and Scardamalia called "reinvestment" deserves its own name (effectance) and further characterization.

Gopnik, in her paper "Explanation as orgasm", reinvented White's evolutionary explanation for effectance (Gopnik, 1998) without referencing White or using the term "effectance". She posited a theory drive, "a motivational system that impels us to interpret new evidence in terms of existing theories and change our theories in the light of new evidence". (p. 101) This is not identical to White's effectance. For parsimony, rather than introduce a brand new concept, I extend White's concept of effectance to accommodate Gopnik's data and other manifestations of effectance described in this book. I want the meta-effectiveness framework to avoid the fate of instinct theory (e.g., William McDougall's proliferating list of instincts[52]).

There is also a vast literature on thinking dispositions that is relevant to effectance. Stanovich and his colleagues have developed a taxonomy of rationality involving thinking dispositions (Stanovich, 2011; Stanovich, et al, 2011; Toplak, West, & Stanovich, 2012). The "need for cognition" is particularly relevant to effectance as are various factors related to curiosity (Aubé, 2005).

The concept of *motivation for increased competence* shows up in the psychology literature in different forms. The term "effectance", however, is only rarely used. Moreover, it has never previously been used with the specific meaning I develop here, i.e., one that is grounded in designer-based cognitive science research (Beaudoin, 1994; Sloman, 2010c). In fact, the general concept of motivation described here is not widely known in the psychology literature or elsewhere. Yet it's impossible to understand and promote the pursuit of excellence without such a concept.

It has become customary in attempts to account for competence-motivation (effectance) to invoke Csikszentmihalyi's concept of "flow".[53] "The concept describes a particular kind of experience that is so engrossing and enjoyable that it becomes autotelic, that is, worth doing for its own sake even though it may have no consequence outside itself." (Csikszentmihalyi, 1999, p. 824.) Csikszentmihalyi provides as an example of the state of flow a composer's account of writing music

> You are in an ecstatic state to such a point that you feel as though you almost don't

[52]Bernard (1924) painstakingly identified over 14,000 alleged instincts in the social science literature. The doctrine of instincts is not particularly parsimonious.

[53]For example, Bereiter and Scardamalia appeal to flow in their explanation of "fluid expertise".

> exist. I've experienced this time and time again. My hand seems devoid of myself, and I have nothing to do with what is happening. I just sit there watching in a state of awe and wonderment. And the music just flows out by itself. (Csikszentmihalyi, 1975, p. 44)

Work becomes as Stuart Brown concisely describes play[54] (Brown & Vaughan, 2009):

> A "Goldi Locks" state of peak performance, wherein one addresses a difficult but not insurmountable challenge and feels a sense of timelessness and selflessness, as if the activity was done for its own sake.[55]

Alas, the fact that a concept is commonly invoked to explain a phenomenon does not entail that it is productive. While, as I described elsewhere (Beaudoin, 2014b), I do not doubt that most knowledge workers can relate to and enjoy the experience of flow, the theory of flow betrays a nearly universal yet false assumption in colloquial and scientific accounts of behavior. It is essentially hedonism, that people do things because they enjoy either the *feelings* the behavior elicits or some other aspect of the state of performance.[56] More generally, that we are driven by the "law of effect" (reinforcement and punishment). I don't believe knowledge workers are seeking a fix ("flow").[57] Moreover, even if flow had the powerful motivational effects that Csikszentmihalyi claims, it would not be of great use to promote it—pleasure seeking tends to take care of itself. Thus, the explanation of effectance is not flow and the concept of flow has very little explanatory power.

The explanation for effectance, like the drive to mate, is instead evolutionary, as White alluded to with respect to children's play. That is to say that the motivation for competence in humans throughout our evolutionary history provided a reproductive advantage.[58]

However, here lies a rarely noted subtlety. Effectance ought not to be understood as a single, top-level drive, goal or motivator.[59] Nor do our inclinations towards behaviors that increase our competence necessarily involve explicit and conscious representations of competence (e.g., goals to become more competent). Instead, it is reasonable to assume that people have mechanisms that

[54]The psychological properties of play are described in a concise, informal book (Stuart Brown & Vaughan, 2009). For a development perspective on play see Pellegrini (2013). For ways to use play (and implicitly, flow) to decrease sleep-onset latency, see Beaudoin (2013, 2014a). The latter paper applies the theory of mind described in Part 2.

[55]Compare Campbell's (2008) interview of Stuart Brown.

[56]Gilbert Ryle criticizes the notion that people do things for the feelings those things give them (Ryle, 1949). Csikszentmihalyi implicitly applies Ryle's argument (without referencing Ryle) when he states "Being happy would be a distraction, an interruption of the flow" (Csikszentmihalyi, 1999, p. 825). Csikszentmihalyi acknowledges that flow is not the only motive for behaviors that elicit flow. However, he assumes that flow is an intrinsic motive, without distinguishing between two dimensions of intrinsic motivation: internal vs. external to the agent, and derivative vs. intrinsic value goals. Compare the discussion of functional autonomy in Beaudoin (1994) and Allport (1937, 1961). See also Sloman (2009b).

[57]Hedonism is still alive and kicking in cognitive science: "Higher cognition in its many forms—what it means to think like a human—is simply the chasing of the pleasures and the avoidance of the pains that are supplied by this eclectic group of cognitive, but of course ultimately neurobiological, emotions." (Hurley et al., 2011) I believe this is false. Moreover, it is incompatible with the architectural view of motivation. See Erber & Erber (2001) and chapter 5 of Frijda (2007) for related arguments against hedonism.

[58]The thoughtful theory of humor recently proposed by Hurley, Dennett and Adams also implicitly hinges on the concept of effectance (Hurley et al., 2011). (In particular, see their sixth chapter). They expatiate about evolutionary bases for thinking dispositions comprising fluid rationality (Stanovich, 2011). However, they do not use the terms effectance, fluid rationality or thinking disposition. (They do not refer to White's work or that of Stanovich.) I believe their theory would have been easier to communicate with the concept of effectance and thinking dispositions. They further fail to draw necessary distinctions between motivational and emotional states, distinctions which become apparent when one explores the architectural basis for motivation, as described below. I make some of these distinctions in chapter 5 and 6. See also Sloman (2003) and discussions of the work of Andrew Ortony below.

[59]However, a person *can*, of course, form explicit goals to increase competence. And this can lead them (unconsciously) to create motive generators that when acted upon increase their competence.

lead them to produce goals the pursuit of which will *or may* directly or as a side-effect improve their competence.[60] One normally delves a paper to better understand it and to use it for building knowledge or solving a problem. One does not necessarily engage in this behavior for the explicit or otherwise unconsciously operating motive of improving one's competence. Yet delving can develop one's effectiveness and so it reflects our *implicit* effectance.[61] More generally, the human mind can generate top-level goals as a reflex without deriving them from means-ends analysis, planning or other deliberate processes. I call these "reactive, intrinsic motives".[62] A motive whose pursuit improves one's effectiveness is not necessarily seen, felt or otherwise represented in the mind as a means towards effectiveness.

Thus, effectant motives are not simply aimed at flow.[63] Nor are they normally aimed (even unconsciously) at improving effectiveness. For one to be effectant is to have mechanisms that produce top-level goals (i.e., goals that are treated as good in themselves) the pursuit of which leads (or tends to lead) to the development of competence. Effectant people implicitly inherently value competence.

Having dealt with this special case, I acknowledge that people can become more effectant by becoming conscious of their effectance and by valuing effectance. From a practical perspective, effectance, while natural, can and ought to be nurtured. It can lead to the intrinsic benefits cataloged in the previous chapter. They, in turn, tend to lead to the external consequences and reward of competence that do not need to be explicitly cataloged here.[64]

Effectance, considered this way, calls for a characterization of motivation in terms of the architecture of the human mind. That is to seek the explanation of effectance not in terms of its consequences (rewards or pleasure) or functions but in terms of the mechanisms that give rise to our ascriptions of it. The designer-based concept of effectance can lead us to inquire into the information processing substrate of motivation. In addition to any overarching, explicit drive for effectiveness, there are myriad mechanisms that generate all kinds of motives to behave in ways which increase effectiveness, even though the agent is not explicitly or even unconsciously seeking to become more effective. The architectural basis of motivation and other affective states is briefly described in chapter 5.

Thus, while the concept of flow is of some value, the concept of effectance is of greater theoretical and practical significance with respect to motivation for competence. Its theoretical

[60]This is a special case of the argument for architecture-based motivation (Sloman, 2009b). Evolution cannot guarantee that a motive generator will necessarily create motives that provide a selective advantage. Motive generators evolve because they tend to produce an advantage often enough, which might be very rarely. "The main point [of architecture-based motivation] is that the individual concerned has no information about [the benefit provided by this type of motive], not even implicit information (unless the individual is a biologist who starts asking 'Why do I have these motives?')" (Sloman, 2013b).

[61]"Implicit" does not mean "unconscious".

[62]In Part 2, I refer to deliberation processes as *management processes*. There, we will see that "reactive motives" stem from asynchronous motive generators —reactive mechanisms.

[63]White's paper could also be criticized for emphasizing the *feeling* of competence, though the emphasis there is not as strong. It can also be criticized, along with much literature on affect, for characterizing affect as a matter of feelings. The architectural model described below does not emphasize (or deny a role for) feelings of competence or flow, and yet it does not depend on the rather unparsimonious assumption of the pursuit of pleasure. See also chapter 6 of Beaudoin (1994); Sloman (1987, 2009b).

[64]Peter Brems (personal communication, February 21, 2015) distinguished two types of effectance: propensity to increase a specific competence and propensity to become better at improving oneself (such as by mastering new learning strategies). He suggested we call the latter "meta-effectance". Understandably, however, most readers are resistant to neologisms and even more to recursive concepts. Moreover, the concept of *architecture-based motivation* blurs the distinction between competence and motivation. I would be content were the terms "effectance" and "meta-effectiveness" to enter common parlance. So, in this book I stick to these overarching terms.

advantages are implicit in my criticism of the concept of flow. Having a term for this important construct (effectance) may promote both our understanding of meta-effectiveness and the practical development of effectance.

To summarize the admittedly complex and uncommon ideas presented in this section:

- Humans are capable of generating top-level motives that are not derived from other motives. These "reactive motives" do not necessarily serve any other motive, drive, or purpose. They are not necessarily driven by implicit considerations of reward, punishment, pain, pleasure or "flow". They may have intrinsic value.
- Effectance refers to a person's propensity to develop effectiveness.
- The concept of effectance applies both to cases where an agent engages in behaviors (a) for the deliberate goal of becoming more effective; (b) that viewed from the intentional stance promote effectiveness but that (i) were not explicitly spawned in pursuit of effectiveness and (ii) do not explicitly code for the pursuit of effectiveness (or its consequences).
- Effectance is not necessarily explicit motivation for competence; however, it is motivation that tends to develop one's competence.
- Effectance is thus the motivational underpinning of meta-effectiveness.

Deliberately nurturing one's effectance may help improve one's effectiveness.

3.3.3.2 Perceived self-efficacy

> *One must strike a balance between arrogance and underconfidence.*
> **Douglas Kennedy**

Effectance is predicated on perceived self-efficacy. Believing one inherently is unable to succeed in a domain has been shown to affect performance in a wide variety of areas: work performance, academic performance, health, etc. (Bandura, 1997). Perceived self-efficacy is one of the most researched phenomena in psychology. It ought not to be confused with self-esteem, self-concept or "locus of control". If a person believes she is inherently incompetent in one area (such as mathematics), it will directly affect that area without necessarily affecting another (e.g., writing). Consider, for an ironic example, the psychologist who sees herself as quite competent in helping children improve *their* perceived self-efficacy yet who sees herself as being inept with computers. She does not realize it, but her assumption that she is "simply not a computer person" makes it difficult for her to (want to) keep abreast of the literature.

I deliberately chose the example of perceived competence with technology because I believe it is one of the most wide-spread self-limiting attitudes people contend with, even young knowledge workers. By failing to become more proficient with technology, highly intelligent people also limit their meta-effectiveness.

The mechanisms by which perceived self-efficacy affect performance are easy to comprehend and compelling. Wood & Bandura (1991) report that perceived self-efficacy in a domain affects:

1. the activities and environments we choose (people tend to avoid activities at which they expect to perform miserably);

Several pages omitted

References

60-Minutes-Overtime-Staff. (2013, May 12). Bill Gates on Steve Jobs: We grew up together. *60 Minutes Overtime.* Retrieved May 13, 2013, from http://www.cbsnews.com/8301-504803_162-57584072-10391709/bill-gates-on-steve-jobs-we-grew-up-together/

Aarts, H., & Dijksterhuis, A. (2000). Habits as knowledge structures: Automaticity in goal-directed behavior. *Journal of Personality and Social Psychology, 78*(1), 53–63. doi:10.1037//0022-3514.78.1.53

Ackerman, P. L. (1996). A theory of adult intellectual development: Process, personality, interests, and knowledge. *Intelligence, 22*(2), 227–257.

Ackerman, P. L. (2008). Knowledge and cognitive aging. In F. I. M. Craik & T. A. Salthouse (Eds.), *The Handbook of Aging and Cognition.* New York, NY: Psychology Press.

Ackerman, P. L. (2013). Nonsense, common sense, and science of expert performance: Talent and individual differences, *Intelligence* doi:10.1016/j.intell.2013.04.009

Ackerman, P. L., Beier, M. E., & Boyle, M. O. (2005). Working memory and intelligence: The same or different constructs? *Psychological Bulletin, 131*(1), 30–60. doi:10.1037/0033-2909.131.1.30p

Adler, M., & Van Doren, C. (1972). *How to read a book* (2nd ed.). New York, NY: Simon & Schuster.

Al-Omar, M., & Cox, A. (2013). Finders, keepers, losers, seekers: A study of academics' research-related personal information collections. In *Human Interface and the Management of Information. Information and Interaction Design* (pp. 169-176). New York, NY: Springer.

Alberts, B. (2000). Some thoughts of a scientist on inquiry. In J. M. E. van Zee (Ed.), *Inquiring into inquiry learning and teaching in science* (pp. 3–13). American Association for the Advancement of Science.

Allen, D. (2001). *Getting things done: The art of stress-free productivity.* New York, N.Y.: The Penguin Group.

Allen, D. (2008). *Making it all work: Winning at the game of work and business of life.*

Allport, A. (1989). Visual attention. In M. I. Posner (Ed.), *Foundations of cognitive science* (pp. 631–682). Cambridge, MA: MIT Press.

Allport, D. A. (1980). Patterns and actions. In G. Claxton (Ed.), *Cognitive psychology: New directions* (pp. 26–64). London, England: Routledge & Kegan Paul.

Allport, Gordon W. (1937). The functional autonomy of motives. *American Journal of Psychology.* 50 141–56.

Allport, G. W. (1961). *Pattern and growth in personality.* Harcourt College Publishers.

American Diabetes Association. (2012). Standards of medical care in diabetes (Position statement). *Diabetes Care, 35.* doi:10.2337/dc12-s011

Anastasi, A. (1988). *Psychological testing.* New York, NY: Macmillan.

Anderson, J. R. (1990). *The adaptive character of thought.* Mahwah, NJ: Laurence Earlbaum Associates.

Anderson, J. R., & Lebiere, C. (1998). *The atomic components of thought.* Mahwah, NJ: Erlbaum Publishers.

Anonymous (2001). The in crowd: the seventh annual selection of the best and brightest among achievers on the rise. (2011, June 26). *Report on Business Magazine, 17*(11), 62–82.

Aristotle. (350 BCE, 2000). *Nicomachean Ethics.* (W. D. Ross, Trans.). MIT (Internet Classics Archive). Retrieved from http://classics.mit.edu/Aristotle/nicomachaen.html

Aubé, M. (2005). Curieuse curiosité… *Vie Pédagogique, 135*, 46–49.

Austin, J. L. (1956). A plea for excuses. *Proceedings of the Aristotelian Society,* 57.

Baars, B. J. (1988). *A cognitive theory of consciousness.* New York, NY: Cambridge University Press.

Baars, B. J. (1997). *In the theater of consciousness.* Oxford, England: Oxford University Press on Demand.

Baker, A. G., & Mercier, P. (1982). Extinction of the context and latent inhibition. *Learning and Motivation, 13*(4), 391–416. doi:10.1016/0023-9690(82)90001-7

Baker, A. G., Berbrier, M. W., & Vallee-Tourangeau, F. (1989). Judgements of a 2× 2 contingency table: Sequential processing and the learning curve. *The Quarterly Journal of Experimental Psychology. B, Comparative and Physiological Psychology, 41*(1), 65–97. doi:10.1080/14640748908401184

Baker, A. G., Murphy, R. A., & Mehta, R. (2003). Learned irrelevance and retrospective correlation learning. *The Quarterly Journal of Experimental Psychology. B, Comparative and Physiological Psychology, 56*(1), 90–101. doi:10.1080/02724990244000197

Bandura, A. (1997). *Self-efficacy: The exercise of self-control.* Gordonsville, VA: WH Freeman & Co. Chicago

Bahrick, H. P., & Phelphs, E. (1987). Retention of Spanish vocabulary over 8 years. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13*(2), 344.

Barnacle, R. E. S., & Abbott, D. A. (2009). The development and evaluation of a Gottman-Based premarital education program: A pilot study. *Journal of Couple & Relationship Therapy, 8*(1), 64–82. doi:10.1080/15332690802626734

Baron, Jonathan. (1994). Nonconsequentialist decisions. *Behavioral and Brain Sciences, 17*(01), 1–10. doi:10.1017/S0140525X0003301X

Baron, Joseph. (2008). *Thinking and deciding.* New York, NY: Cambridge University Press.

Bartlett, F. (1938). *Remembering.* Cambridge, England: Cambridge University Press.

Baumeister, R. F., & Twenge, J. M. (2003). The social self. In T. Millon, M. J. Lerner, & I. B. Weiner (Eds.), *Handbook of Psychology (Personality and Social Psychology)* (Vol. 5, pp. 327–352). Hoboken, NJ: John Wiley & Sons, Inc.

Beaudoin, L. P. (1990). *A computational investigation of the evolution of vision* (unpublished Honours thesis) University of Ottawa, Ottawa, Canada.

Beaudoin, L. P. (1994). *Goal processing in autonomous agents.* (Doctoral dissertation). University of Birmingham, Birmingham UK.

Beaudoin, L. P. (2002). *gStudy - Release Functional Specification (No. GST-RFS-01)* Learning Kit Project, Simon Fraser University, Burnaby, Canada.

Beaudoin, L. P. (2010a, Jan. 26). *Will the Apple tablet support or hinder users' cognitive fitness?* Retrieved from http://www.sharpbrains.com/blog/2010/01/26. Reprinted with corrections and additional commentary as Beaudoin (2011b). Retrieved from http://cogzest.com/2011/10/steve-jobs-and-the-topic-of-cognitive-productivity/

Beaudoin, L. P. (2010b, Feb. 11). *Apple iPad thumbs-up: brain fitness [sic] value, and limitations*

[should have read "cognitive fitness"]. Retrieved from http://www.sharpbrains.com/blog/2010/02/11/. Reprinted with corrections and additional commentary as Beaudoin (2011, Oct. 8) Retrieved from http://cogzest.com/2011/10/steve-jobs-and-the-topic-of-cognitive-productivity/

Beaudoin, L. P. (2011a). Experts' productive learning from formal knowledge: Motive generators and productive practice. In J. Wyatt (Ed.), *A symposium in honour of Aaron Sloman: From animals to robots and back: Reflections on hard problems in the study of cognition.* (pp. 139–172). Birmingham, UK: University of Birmingham. (See Beaudoin, 2014b)

Beaudoin, L. P. (2011b). *Steve Jobs and cognitive productivity.* Retrieved from http://cogzest.com/2011/10/steve-jobs-and-the-topic-of-cognitive-productivity/

Beaudoin, L. P. (2011c). The designer stance towards Shanahan's dynamic network theory of the 'conscious condition'. *International Journal of Machine Consciousness, 3*(2), 313–331. doi:10.1142/S1793843011000716

Beaudoin, L. P. (2013). *The possibility of super-somnolent mentation: A new information-processing approach to sleep-onset acceleration and insomnia exemplified by serial diverse imagining.* Simon Fraser University Summit repository. Retrieved from http://summit.sfu.ca/item/12143

Beaudoin, L. P. (2014a, July). *A design-based approach to sleep-onset and insomnia: super-somnolent mentation, the cognitive shuffle and serial diverse imagining.* Paper presented at the 2014 Cognitive Science Society Annual Conference's workshop on "Computational Modeling of Cognition-Emotion Interactions: Relevance to Mechanisms of Affective Disorders and Therapeutic Action", Québec, Canada.

Beaudoin, L. P. (2014b). Developing expertise with objective knowledge: Motive generators and productive practice. In J. Wyatt, D. Petters, & Hogg, D. (Eds.), *From robots to animals and back: Reflections on hard problems in the study of cognition* (pp. 161-190). Berlin, Germany: Springer.

Beaudoin, L. P., & Sloman, A. (1993). A study of motive processing and attention. In A. Sloman, D. Hogg, G. Humphreys, D. Partridge, & A. Ramsay (Eds.), (pp. 229–238). *Prospects for Artificial Intelligence* (Proceedings of AISB–93, Birmingham, England), Amsterdam, Netherlands: IOS Press.

Beaudoin, L. P., & Winne, P. (2009, June). *nStudy: An Internet tool to support learning, collaboration and researching learning strategies.* Paper presented at the Canadian E-learning Conference (CELC-2009). Vancouver, BC. Retrieved from http://blogs.sfu.ca/people/lpb/wp-content/uploads/2014/09/nStudy-2009-Luc_P_Beaudoin-Phil_Winne.pdf

Beaudoin, L. P. & Winne, P. (2010). Principles of psychology for designing software to improve recall performance in older adults. *Gereontechnology Conference Issue: Abstracts of the 7th World Conference, The Vancouver Conference Issue. 9*(2), 192.

Beavers, K. M., Brinkley, T. E., & Nicklas, B. J. (2010). Effect of exercise training on chronic inflammation. *Clinica Chimica Acta, 411*(11–12), 785–793. doi:10.1016/j.cca.2010.02.069

Bélanger, M.-E. (2010). *The annotative practices of graduate students: Tensions & negotiations fostering an epistemic practice* (Master's thesis). University of Toronto, Toronto, ON, Canada.

Benjamin, A. S., Bjork, R. A., & Schwartz, B. L. (1998). The mismeasure of memory: when retrieval fluency is misleading as a metamnemonic index. *Journal of Experimental Psychology: General, 127*(1), 55.

Bereiter, C. (1991). Implications of connectionism for thinking about rules. *Educational Researcher,*

20(3), 10–16.

Bereiter, C. (1995). A dispositional view of transfer. In A. McKeough, J. Lupart, & A. Marini (Eds.), *Teaching for transfer: Fostering generalization in learning* (pp. 21–34). Mahwah, NJ: Laurence Earlbaum Associates.

Bereiter, C. (2002a). *Education and mind in the knowledge age.* Mahwah, NJ: Laurence Earlbaum Associates.

Bereiter, C. (2002b). Design research for sustained innovation. *Cognitive studies, Bulletin of the Japanese cognitive science society, 9*(3), 321–327.

Bereiter, C., & Scardamalia, M. (1993). *Surpassing ourselves: An inquiry into the nature and implications of expertise.* Chicago, IL: Open Court.

Bereiter, C., & Scardamalia, M. (2012). Theory building and the pursuit of understanding in history, social studies, and literature. In J. R. Kirby & M. J. Lawson (Eds.), *Enhancing the quality of learning: Dispositions, instruction, and learning processes* (pp. 160–177). Cambridge, England: Cambridge University Press.

Bernard, L. L. (1924). *Instinct: A study in social psychology.* New York, NY: Holt, Rinehart and Winston.

Bertsch, S., Pesta, B. J., Wiscott, R., & McDaniel, M. A. (2007). The generation effect: A meta-analytic review. *Memory & cognition, 35*(2), 201–210.

Bielaczyc, K., Hakkarainen, K., Ritella, G., Seitamaa-Hakkarainen, P., Stahl, G., Scardamalia, M., & Bereiter, C. (2011). Strengthening the conceptual foundations of Knowledge Building theory and pedagogy. In H. Spada, G. Stahl, N. Miyake, & N. Law (Eds.), *CSCL2011 Computer Supported Collaborative Learning: Connecting Research to Policy and Practice, Conference Proceedings*, Vol. III (pp. 1089-1094). Hong Kong: International Society of the Learning Sciences.

Bjork, E. L., & Bjork, R. A. (2003). Intentional forgetting can increase, not decrease, residual influences of to-be-forgotten information. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 29*(4), 524–531. doi:10.1037/0278-7393.29.4.524

Bjork, R. A., Laberge, D., & Legrand, R. (1968). The modification of short-term memory through instructions to forget. *Psychonomic Science, 10*(2), 55-56.

Blair, M. (2013). Real-time strategy video games: a new "drosophila" for the cognitive sciences. In N. Hedberg (Ed.). Presented at the *2013 Spring Defining Cognitive Science* talk series, Burnaby, Canada.

Bloch, J. (2001). *Effective Java: Programming language guide.* Sun Microsystems.

Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain.* (B. S. Bloom, Ed.). New York, NY: David McKay.

Bloom, B. S. (1984). The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring. *Educational Researcher, 13*(6), 4–16. doi:10.3102/0013189X013006004

Boden, M. A. (1977). *Artificial Intelligence and natural man.* London, England: MIT Press.

Boden, M. A. (1978). *Purposive explanation in psychology.* Cambridge, MA: Harvard University Press.

Boden, M. A. (1988). *Computer models of mind.* Cambridge, England: Cambridge University Press.

Boden, M. A. (1996). Commentary on "Towards a design-based analysis of emotional episodes." *Philosophy, Psychiatry & Psychology, 3*(2), 135–136.

Boden, M. A. (2004). *The creative mind: Myths and mechanisms* (2nd ed.). New York, NY: Routledge.
Boden, M. A. (2006). *Mind as machine: A history of cognitive science* (2 volumes).
Böhme, G. (2012). Invasive technification: Critical essays in the philosophy of technology (C. Shingleton, Trans.). London: Bloomsbury.
Bostic, K. (2013, October 4). Behind-the-scenes details revealed about Steve Jobs' first iPhone announcement. Retrieved from http://appleinsider.com/articles/13/10/04/behind-the-scenes-details-reveal-steve-jobs-first-iphone-announcement
Bratt, S. E. (2007). A framework for assessing the pedagogical utility of learning management systems (pp. 218–225). Presented at the *World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education (ELEARN),* Quebec, Canada.
Bratt, S. E. (2009). Development of an instrument to assess pedagogical utility in e-Learning systems. (Unpublished doctoral dissertation) Simon Fraser University, Burnaby, Canada.
Brel, J. (1977). Vieillir. Les Marquises.
Broadbent, D. E. (1958). *Perception and communication.* New York, NY: Oxford University Press.
Brooks JR, F. P. (1995). *The mythical man-month* (anniversary ed.). Boston, MA: Addison-Wesley Longman Publishing Co., Inc.
Brooks, R. A. (1991) Intelligence without representation. *Artificial Intelligence 47*(1-3), 139–159.
Brown, Stuart, & Vaughan, C. (2009). *Play: How it shapes the brain, opens the imagination, and invigorates the soul.* New York, NY: Penguin Books.
Bruner, J. S. (1966). *Toward a theory of instruction* (Vol. 59). Cambridge, MA: Harvard University Press.
Bruning, R. H., Schraw, G. J., & Norby, M. M. (2010). *Cognitive psychology and instruction* (5th Edition). Upper Saddle River, NJ: Prentice Hall.
Button, K. S., Ioannidis, J. P. A., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S. J., & Munafò, M. R. (2013). Power failure: why small sample size undermines the reliability of neuroscience. *Nature reviews: Neuroscience, 14*(365), 1–12. doi:10.1038/nrn3475
Caillies, S., & Denhière, G. (1999). The intermediate effect: Interaction between prior knowledge and text structure. In H. van Oostendorp & S. Goldman (Eds.), *The construction of mental representation during reading* (pp. 151–168). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
Campbell, G. (2008, December 9). Interview with Seth Grant. *Brain Science Podcast, 51.* Podcast retrieved from http://brainsciencepodcast.com
Campbell, G. (2012, May 10). Exploring Glial Cells with R. Douglas Fields. *Brain Science Podcast, 69.* Podcast retrieved from http://brainsciencepodcast.com
Campbell, G. (2010, February 10). Memory: Challenging current theories with Randy Gallistel. *Brain Science Podcast, 66.* Podcast retrieved from http://brainsciencepodcast.com
Campbell, G. (2013, November 22). Connectome Update with Olaf Sporn. *Brain Science Podcast, 103* Podcast retrieved from http://brainsciencepodcast.com
Carpenter, S. K. (2009). Cue strength as a moderator of the testing effect: The benefits of elaborative retrieval. *Journal of experimental psychology. Learning, memory, and cognition, 35*(6), 1563–1569. doi:10.1037/a0017021
Carpenter, S. K. (2012). Testing enhances the transfer of learning. *Current directions in psychological science, 21*(5), 279–283. doi:10.1177/0963721412452728

Carpenter, S. K., & DeLosh, E. L. (2006). Impoverished cue support enhances subsequent retention: Support for the elaborative retrieval explanation of the testing effect. *Memory & Cognition, 34*(2), 268–276.

Carr, N. (2011). *The shallows: What the Internet is doing to our brains (Kindle Edi.).* New York, NY: W. W. Norton & Company.

Cavallini, E., Pagnin, A., & Vecchi, T. (2003). Aging and everyday memory: The beneficial effect of memory training. *Archives of Gerontology and Geriatrics, 37*(3), 241–257. doi:10.1016/S0167-4943(03)00063-3

Cepeda, N. J., Coburn, N., Rohrer, D., Wixted, J. T., Mozer, M. C., & Pashler, H. (2009). Optimizing distributed practice: Theoretical analysis and practical implications. *Experimental Psychology.* doi:10.1027/1618-3169.56.4.236

Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin, 132*(3), 354–380. doi:10.1037/0033-2909.132.3.354

Cepeda, N. J., Vul, E., Rohrer, D., Wixted, J. T., & Pashler, H. (2008). Spacing effects in learning: A temporal ridgeline of optimal retention. *Psychological Science, 19*(11), 1095–1102. doi:10.1111/j.1467-9280.2008.02209.x

Chaffin, R. (2011). Thinking about performance: Memory, attention, and practice (pp. 1–11). Paper presented at the International Symposium on Performance Science.

Chaffin, R., Logan, T. R., & Begosh, K. T. (2008). Performing from memory. In S. Hallam, I. C. Thaut, & M. Thaut (Eds.), *The Oxford handbook of music psychology* (pp. 352–363). Oxford, England: Oxford University Press.

Changeux, J. P & McGinn, C. (2013). Neuroscience & Philosophy: An Exchange. *The New York Review of Books.* Retrieved from http://www.nybooks.com/articles/archives/2013/aug/15/neuroscience-philosophy-exchange/

Charette, R. N. (2005, September 1). Why software fails. *IEEE Spectrum.* Retrieved from http://spectrum.ieee.org/computing/software/why-software-fails/0

Charness, N., Tuffiash, M., Krampe, R., Reingold, E., & Vasyukova, E. (2005). The role of deliberate practice in chess expertise. *Applied Cognitive Psychology, 19*(2), 151–165. doi:10.1002/acp.1106

Chatterji, D., Massengill, B., Oslin, J., Carver, J. C., & Kraft, N. A. (2011). *Measuring the efficacy of code clone information: An empirical study.* Paper presented at the Empirical Software Engineering and Measurement Conference (ESEM, IEEE).

Chiew, K. S., & Braver, T. S. (2011). Positive affect versus reward: Emotional and motivational influences on cognitive control. *Frontiers in Psychology, 2,* 1–10. doi:10.3389/fpsyg.2011.00279

Chomistek, A. K., Manson, J. E., Stefanick, M. L. Lu, B., & Sands-Lincoln, M. and Going, S. B. ... & others (2013). The relationship of sedentary behavior and physical activity to incident cardiovascular disease: Results from the Women's Health Initiative. *Journal of the American College of Cardiology, 61*(23), 2346–2354. Retrieved from http://dx.doi.org/10.1016/j.jacc.2013.03.031

Christian, B. (2012, April 25). The A/B Test: Inside the technology that's changing the rules of business. *Wired.* Retrieved from http://www.wired.com/business/2012/04/ff_abtesting/

Chung, T. M., & Nation, P. (2003). Technical vocabulary in specialised texts. *Reading in a Foreign Language 15*(2), 103–116.

Churchill, W. S. (1949). *Great contemporaries.* London, England: Odhams Press Limited.

Clark, A. (1989). *Microcognition: Philosophy, cognitive science, and parallel distributed processing.* Cambridge, MA: MIT Press.

Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences, 36*(03), 181–204.

Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis, 58*(1), 7–19.

Cockburn, A. (2001). *Writing effective use cases.* Boston, MA: Addison-Wesley.

Cognitive science. (n.d.). In *Wikipedia.* Retrieved from http://en.wikipedia.org/ on November 27, 2012.

Conley, C. (2007). *Peak: How Great companies get their mojo from Maslow* San Francisco, CA: Jossey-Bass.

Conlin, L., Gupta, A., & Hammer, D. (2010). Where to find the mind: Identifying the scale of cognitive dynamics. In K. Gomez, L. Lyons, & J. Radinsky (Eds.), *Learning in the Disciplines: Proceedings of the 9th International Conference of the Learning Sciences* (Vol. 1, pp. 277-284). Chicago, IL: International Society of the Learning Sciences.

Cooke, N. J., Atlas, R. S., Lane, D. M., & Berger, R. C. (1993). Role of high-level knowledge in memory for chess positions. *American Journal of Psychology, 106*(3), 321-351.

Cooper, R. P. (2007). The role of falsification in the development of cognitive architectures: Insights from a Lakatosian analysis. *Cognitive Science, 31*, 509–533.

Cooper, R. P., & Shallice, T. (2000). Contention scheduling and the control of control of routine activities. *Cognitive Neuropsychology, 17*(4), 297–338. doi:10.1080/026432900380427

Cooper, R. P., & Shallice, T. (2006). Hierarchical schemas and goals in the control of sequential behavior. *Psychological Review, 113*(4), 887–931. doi:10.1037/0033-295X.113.4.887

Copi, I. M., & Cohen, C. (2005). *Introduction to Logic* (12 ed.). Upper Saddle River, NJ: Pearson.

Covey, S. R. (2004). *The 7 habits of highly effective people.* New York, NY: Free Press.

Cox, M. T. (2005). Metacognition in computation: A selected research review. *Artificial Intelligence, 169*(2), 104–141.

Coyle, D. (2009). *The talent code: Greatness isn't born. it's grown. Here's how.* New York, NY: Bantam.

Craik, F. I. M., & Salthouse, T. A. (2008). *The handbook of aging and cognition.* New York, NY: Psychology Press.

Craik, F. I., & McDowd, J. M. (1987). Age differences in recall and recognition. *Journal of Experimental Psychology, 13*(3), 474–479.

Critchley, S. (2011). *The book of dead philosophers.* London, England: Granta Books.

Csikszentmihalyi, M. (1975). Play and intrinsic rewards. *Journal of humanistic psychology. 15*(3), 41-63.

Csikszentmihalyi, M. (1999). If we are so rich, why aren't we happy? *The American Psychologist, 54*(10), 821–827. doi:10.1037//0003-066X.54.10.821

Cullen, B. (2010, November 25). *Nine tips for more effective study.* Retrieved from http://www.standinginspirit.com/nine-tips-for-more-effective-study/

Damasio, A. (1994). *Descartes' error: Emotion, reason and the human brain.* New York, NY: Avon Books.

Davenport, T. (2013, February 18). *Jonathan Ive on how Apple names its products.* Retrieved from http://tomdavenport.co.uk/post/43400664026/jonathan-ive-on-on-how-apple-names-its-products

Davenport, T. H. (2005). *Thinking for a living: How to get better performances and results from knowledge workers.* Boston, MA: Harvard Business Press.

David, P. (2013). Wedding the Gottman and Johnson Approaches into an Integrated Model of Couple Therapy. In *Pair Bonding & Repair: Essays on Intimacy & Couple Therapy* (Therapeutic models). Retrieved from http://pauldavidphd.com/wp-content/uploads/Davids-Integrated-Couple-Therapy-Model.pdf

Dawkins, R. (1976). *The selfish gene.* Oxford, England: Oxford University Press.

Dawkins, R. (1986). *The blind watchmaker.* New York, NY: W. W. Norton & Company.

Delaney, P. F., Verkoeijen, P. P. J. L., & Spirgel, A. (2010). Spacing and testing effects: A deeply critical, lengthy, and at times discursive review of the literature. *The Psychology of Learning and Motivation 53* , 63–148. doi:10.1016/S0079-7421(10)53003-2

Dennett, D. (1978). Why you can't make a machine that feels pain. *Synthese, 38*(3), 415–456.

Dennett, D. C. (1987). *The intentional stance.* Cambridge, MA: The MIT Press.

Dennett, D. C. (1991). *Consciousness explained.* Boston, MA: Back Bay Books.

Dias, M., & Harris, P. L. (1988). The effect of make-believe play on deductive reasoning. *British Journal Of Developmental Psychology, 6*, 207–221.

DiLullo, C., McGee, P., & Kriebel, R. M. (2011). Demystifying the Millennial student: A reassessment in measures of character and engagement in professional education. *Anatomical Sciences Education, 4*(4), 214–226. doi:10.1002/ase.240

DiSessa, A. A. (2001). *Changing minds.* Cambridge, MA: The MIT Press.

Dixon, T. (2012). "Emotion": The history of a keyword in crisis. *Emotion Review, 4*(4), 338–344. doi:10.1177/1754073912445814

Doctorow, C. (2009, June 22). *Some Kindle books have secret caps on the number of times you can download them.* Retrieved from http://boingboing.net/2009/06/22/some-kindle-books-ha.html

Doctorow, C. (2012, April 26). Is publishing looking at a DRM-free future? *CBC Podcast.* Podcast retrieved from http://www.cbc.ca/books/2012/04/is-publishing-looking-at-a-drm-free-future.html

Donald, M. (2001). A mind so rare: The evolution of human consciousness. New York, NY: W. W. Norton & Company.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, 14*(1), 4–58. doi:10.1177/1529100612453266

Edmondson, A. C., Roberto, M. A., Bohmer, R. M., Ferlins, E. M., & Feldman, L. R. (2004). *The recovery window: Organizational learning following ambiguous threats in high-risk organizations.* Division of Research, Harvard Business School. Harvard Business School Working Paper.

Egan, K. (1997). *The educated mind: How cognitive tools shape our understanding.* Chicago, IL: University of Chicago Press.

Egan, K. (2010). *Learning in depth: A simple innovation that can transform schooling.* Chicago, IL: University of Chicago Press.

Egan, K. & Madej, K. (2009). Learning in depth: students as experts. *Education Canada, 49*(2), 18–20.

Einstein, G. O., & McDaniel, M. A. (2004). *Memory fitness: A guide for successful aging.* New Haven, CT: Yale University Press.

Elgort, I. (2011). Deliberate learning and vocabulary acquisition in a second language. *Language Learning, 61*(2), 367–413. doi:10.1111/j.1467-9922.2010.00613.x

Elman, J. L., Bates, Johnson, M. H., Karmiloff-Smith, A., Parisi, D. & Plunkett, K. (Eds.). (1996). *Rethinking innateness: A connectionist perspective on development.* Cambridge MA: MIT Press.

Emerson, R. W. (1904). *Essays and Representative Men* (Vol. 1). London, England: George Bell and Sons.

Engelbart, D., & English, W. K. (1968). A research center for augmenting human intellect. *Proceedings of the AFIPS Fall Joint Computer Conference, 33,* 395–410. doi:10.1145/1476589.1476645

Engelbart, D., & Ruilifson, J. (1999). Bootstrapping our collective intelligence. *ACM Computing Surveys, 31*(4es). doi:10.1145/345966.346040

Erber, R., & Erber, M. W. (2001). Mood and processing: A view from a self-regulation perspective. In L. L. Martin & G. L. Clore, *Theories of mood and cognition: A users guidebook* (pp. 63–84). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Ergotron. (2013, April 9). *Ergotron 33-329-085 33-329-057 Neo-Flex Widescreen Monitor Stand.* Retrieved from http://www.ergotron.com/Products/tabid/65/PRDID/242/language/en-US/Default.aspx

Ericsson, K. A. (1998). The scientific study of expert levels of performance: General implications for optimal learning and creativity. *High Ability Studies, 9*(1), 75–100.

Ericsson, K. A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. In K. A. Ericsson, N. Charness, P. Feltovich & R. R. Hoffman (Eds.), *Cambridge handbook of expertise and expert performance* (pp. 685–706). Cambridge, UK: Cambridge University Press.

Ericsson, K. A., & Charness, N. (1995). Abilities: evidence for talent or characteristics acquired through engagement in relevant activities. *American Psychologist, 50*(9), 803-804.

Ericsson, K. A., Charness, N., Feltovich, P. J., & Hoffman, R. R. (2006). *The Cambridge handbook of expertise and expert performance.* Cambridge, England: Cambridge University Press.

Ericsson, K. A., & Kintsch, W. (1995). Long-term working memory. *Psychological Review, 102*(2), 211–245.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review. 100*(3), 363–406. doi:10.1037//0033-295X.100.3.363

Ericsson, K. A., Patel, V., & Kintsch, W. (2000). How experts' adaptations to representative task demands account for the expertise effect in memory recall: Comment on Vicente and Wang (1998). *Psychological Review, 107*(3), 578–592. doi:10.1037//0033-295X.107.3.578

Ericsson, K. A., & Staszewski, J. J. (1989). Skilled memory and expertise: Mechanisms of exceptional performance. In D. Klahr & K. Kotovsky (Eds.), *Complex information processing the impact of Herbert A. Simon*(pp. 235–267). Hillsdale, NJ: Erlbaum

Evans, J. A. (2008). Electronic Publication and the Narrowing of Science and Scholarship. *Science, 321* (5887), 395–399. doi:10.1126/science.ll57215

Fadde, P. J., & Klein, G. A. (2010). Deliberate performance: Accelerating expertise in natural settings.

Performance Improvement, 49(9), 5–14. doi:10.1002/pfi

Fayol, M., & Rouet, J.-F. (2008). Memory processes in text and multimedia comprehension: Some reflections and perspectives. In R. Lowe, J. R. Rouet & W Schnotz (Eds.), *Understanding multimedia documents* (pp. 267–280). Boston, MA: Springer US. doi:10.1007/978-0-387-73337-1_14

Fields, R. D. (2008a). White matter in learning, cognition and psychiatric disorders. *Trends in neurosciences, 31*(7), 361–370.

Fields, R. D. (2008b). White matter matters. *Scientific American, 298*(3), 54–61.

Finn, B., & Metcalfe, J. (2008). Judgments of learning are influenced by memory for past test. *Journal of Memory and Language, 58*(1), 19–34. doi:10.1016/j.jml.2007.03.006

http://pss.sagepub.com/content/22/6/781

Fischler, I. (1977). Associative facilitation without expectancy in a lexical decision task. *Journal of Experimental Psychology: Human perception and performance, 3*(1), 18–26.

Fisher, H. (2005). *Why we love: The nature and chemistry of romantic love.* (iBook version). Available from https://itunes.apple.com/ca/book/why-we-love/id569886738

Fitch, W. T. (2012). An instinct to learn. In J. Brockman *This will make you smarter: New scientific concepts to improve your thinking* (pp. 154-156). New York, NY: Harper Perennial.

Fitts, P. M. (1964). Perceptual-motor skill learning. In A. W. Melton (Ed.), *Categories of Human Learning* (pp. 243–285). New York, NY: Academic Press.

Fodor, J. A. (1975). *The language of thought.* Cambridge, MA: Harvard University Press.

Fodor, J. A. (1983). *The modularity of mind: An essay on faculty psychology.* MIT press.

Foer, J. (2011). *Moonwalking with Einstein: The art and science of remembering everything.* New York, NY: The Penguin Press.

Franklin, B. (1758) *The way to wealth.* Retrieved from http://www.swarthmore.edu/SocSci/bdorsey1/41docs/52-fra.html

Franklin, B. (1914). *Poor Richard's Almanack.* Waterloo, IA: U. S. C. Publishing. Retrieved from http://ia600200.us.archive.org/. Selections from material first published 1732-1758.

Freud, S. (1914). *The psychopathology of everyday life*, (A. A. Brill, Trans.). London, England: T. Fisher Unwin. (Original work published 1901).

Frijda, N. H. (1986). *The emotions.* Cambridge, England: Cambridge University Press.

Frijda, N. H. (2007). *The laws of emotion.* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Frijda, N. H. (2009). Emotion experience and its varieties. *Emotion Review, 1(3),* 264–271. doi:10.1177/1754073909103595

Frijda, N. H., & Parrott, W. G. (2011). Basic emotions or Ur-emotions? *Emotion Review, 3*(4), 406–415. doi:10.1177/1754073911410742

Fritz, C. O., Morris, P. E., Acton, M., Voelkel, A. R., & Etkind, R. (2007). Comparing and combining retrieval practice and the keyword mnemonic for foreign vocabulary learning. *Applied Cognitive Psychology, 21*(4), 499-526.

Fromm, E. (2013/1956). *The art of loving.* Available from http://www.openroadmedia.com/the-art-of-loving

Funt, B. V. (1980). Problem-solving with diagrammatic representations. *Artificial Intelligence, 13,* 201–230.

Gallimore, R., & Tharp, R. (2004). What a coach can teach a teacher, 1975–2004: Reflections and reanalysis of John Wooden's teaching practices. *Sport Psychologist, 18,* 119–137.

Gardner, H. E. (2010, June 3). Help! Paul McCartney admits to forgetting his own lyrics. *Mail Online.* Retrieved from http://www.dailymail.co.uk/tvshowbiz/article-1283542/Paul-McCartney-admits-forgetting-lyrics.html

Gardner, D. (1998). *Extraordinary minds: Portraits of 4 exceptional individuals and an examination of our own extraordinariness.* New York, NY: Basic Books.

Gardner, H. (1999). *The disciplined mind.* New York: Simon & Schuster.

Gawronski, B., Hofmann, W., & Wilbur, C. J. (2006). Are "implicit" attitudes unconscious? *Consciousness and Cognition, 15*(3), 485–499. doi:10.1016/j.concog.2005.11.007

Georgeff, M. P., & Lansky, A. L. (1986). Procedural knowledge. *Proceedings of the IEEE, 74*(10), 1383–1398.

Georgeff, M. P., & Lansky, A. L. (1987, July). Reactive reasoning and planning. In *Proceedings of AAAI* (Vol. 87, pp. 677-682).

Gerber, M. E. (1995). *The E-myth revisited: Why most small businesses still don't work and what you can do about yours.* New York, N.Y.: HarperBusiness.

Gibson, J. J. (1979). *The ecological approach to visual perception.* Boston, MA: Houghton Mifflin Company.

Gick, M. L., & Holyoak, K. J. (1980). Analogical problem solving. *Cognitive Psychology, 12,* 306–355.

Gick, M. L., & Holyoak, K. J. (1983). Schema induction and analogical transfer. *Cognitive Psychology, 15*(1), 1–38. doi:10.1016/0010-0285(83)90002-6

Gigerenzer, G., Todd, P. M., & The ABC Research Group. (1999). *Simple heuristics that make us smart.* New York, NY: Oxford University Press, USA.

Gladwell, M. (2008). *Outliers: The story of success.* New York, NY: Little, Brown and Company.

Gladwell, M. (2013). *David and Goliath.* (iBook version). Available from https://itunes.apple.com/us/book/david-and-goliath/id599651578?mt=11

Gobet, F. (2000). Some shortcomings of long-term working memory. *British Journal of Psychology, 91*(4), 551–570.

Gobet, F. (2001). Is experts' knowledge modular? In J. D. Moore, & K Stenning (Eds.), *Proceedings of the Twenty-Third Annual Conference of the Cognitive Science Society* (pp. 336–242). Mahwah, NJ: Erlbaum.

Gobet, F., & Charness, N. (2006). Expertise in chess. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 523–538). Cambridge, England: Cambridge University Press.

Gobet, F., & Chassy, P. (2008). Season of birth and chess expertise. *Journal of Biosocial Science, 40*(2), 313.

Gobet, F., & Simon, H. A. (1996a). Recall of rapidly presented random chess positions is a function of skill. *Psychonomic Bulletin & Review, 3*(2), 159–163.

Gobet, F., & Simon, H. A. (1996b). Templates in chess memory: a mechanism for recalling several boards. *Cognitive Psychology, 31*(1), 1–40. doi:10.1006/cogp.1996.0011

Gobet, F., Lane, P. C. R., Croker, S., Cheng, P. C. H., Jones, G., Oliver, I., & Pine, J. M. (2001). Chunking mechanisms in human learning. *Trends In Cognitive Sciences, 5*(6), 236–243.

Goldacre, B. (2014). *I think you'll find it's a bit more complicated than that.* London: Fourth Estate.

Goldberger, P. (2013, October 10). Apple's Jony Ive and designer Marc Newson on their shared "level of perfection": "It is actually very sick". Retrieved from http://www.vanityfair.com/business/2013/11/jony-ive-marc-newson-design-auction

Goleman, D. (2006). *Emotional Intelligence.* New York, NY: Bantam.

Good, I. J. (1971). Comments on Herman Rubin's "Occam's razor". In V. P. Godambe & D. A. Sprott (Eds.), *Foundations of statistical inference.* Toronto, Canada: Holt, Rinehart, and Winston.

Goodwin, P. (2010). Why hindsight can damage foresight. *Foresight: The International Journal of Applied Forecasting, 17,* 5–7.

Gopnik, A. (1998). Explanation as orgasm. *Minds and Machines, 8*(1), 101–118.

Gottman, J. M. (2002). A multidimensional approach to couples. In F. W. Kaslow & T. Patterson (Eds.), *Comprehensive handbook of psychotherapy: Cognitive behavioral approaches* (Vol. 2, pp. 355–372). New York, NY: John Wiley & Sons.

Gottman, J. M., & DeClaire, J. (2001). *The relationship cure: A five-step guide for building better connections with family, friends, and lovers.* New York, N.Y.: Crown Publishers.

Gottman, J. M., & Driver, J. L. (2005). Dysfunctional marital conflict and everyday marital interaction. *Journal of Divorce & Remarriage, 43*(3-4), 63–77. doi:10.1300/J087v43n03_04

Gottman, J. M., & Levenson, R. W. (2002). A two-factor model for predicting when a couple will divorce: exploratory analyses using 14-year longitudinal data. *Family Process, 41*(1), 83–96.

Gottman, J. M., & Silver, N. (1999). *The Seven Principles for Making Marriage Work.* New York, NY: Three Rivers Press.

Gottman, J. M., Murray, J. D., Swanson, C. C., Tyson, R., & Swanson, K. R. (2002). *The Mathematics of marriage: dynamic nonlinear models.* Cambridge, MA: MIT Press.

Goyvaerts, J., & Levithan, S. (2012). *Regular Expressions Cookbook.* Sebastopol, CA: O'Reilly Media.

Graesser, A. C., Jackson, G. T., Mathews, E. C., Mitchell, H. H., Olney, A., Ventura, M., … the Tutoring Research Group. (2003). Why/AutoTutor: A test of learning gains from a physics tutor with natural language dialog autotutor and Why/AutoTutor. In R. Alterman & D. Hirsh (Eds.), *Proceedings of the Twenty-Fifth Annual Conference of the Cognitive Science Society* (Vol. 1, pp. 1–6). Mahwah, NJ: Laurence Earlbaum Associates.

Grant, S. (2003). Systems biology in neuroscience: Bridging genes to cognition. *Current Opinion in Neurobiology, 13*(5), 577–582. doi:10.1016/j.conb.2003.09.016

Grant, S. G. N. (2007). Toward a molecular catalogue of synapses. *Brain Research Reviews, 55*(2), 445–449. doi:10.1016/j.brainresrev.2007.05.003

Grigorenko, E. L., & Sternberg, R. J. (1998). Dynamic testing. *Psychological Bulletin, 124*(1), 75–111. doi:10.1037/0033-2909.124.1.75

Guadagnoli, M. A. (2009). *Practice to learn, play to win.* Cornwall, UK: Ecademy Press.

Guadagnoli, M. A., & Lee, T. D. (2004). Challenge point: A framework for conceptualizing the effects of various practice conditions in motor learning. *Journal of Motor Behavior, 36*(2), 212–224.

Hardof-Jaffe, S., & Nachmias, R. (2013, June). Students Personal Information Management. In *World Conference on Educational Multimedia, Hypermedia and Telecommunications, 2013*(1), pp. 820-828).

Hadwin, A. F. & Tevaarwerk, K. L. (2011, unpublished). Are we teaching university students to

strategically self-regulate their learning? An analysis of contemporary study skills textbooks. (35 pp.).

Hambrick, D. Z., Oswald, F. L., Altmann, E. M., Meinz, E. J., Gobet, F., & Campitelli, G. (2014). Deliberate practice: Is that all it takes to become an expert?. *Intelligence, 45,* 34-45.

Hammer, D., Elby, A., & Scherr, R. E. (2005). Resources, framing, and transfer. In J. P. Mestre (Ed.), *Transfer of learning from a modern multidisciplinary perspective* (pp. 1–26). Greenwich, CT: Information Age Publishing.

Harris, R. (2007). *The happiness trap.* Auckland, New Zealand: Exisle Publishing.

Haskell, R. E. (2000). *Transfer of learning: Cognition and instruction.* San Francisco, CA: Academic Press.

Hatano, G. (1998). Might we adopt the learning-related account instead of the talent account? *Behavioral and Brain Sciences, 21*(03), 416–417. doi:10.1017/S0140525X98331234

Hawes, N. (2011). A survey of motivation frameworks for intelligent systems. *Artificial Intelligence, 175*(5-6), 1020–1036.

Hawkins, J., & Blakeslee, S. (2005). *On intelligence.* New York, NY: St. Martin's Griffin.

Hayes, J. R. (2002a). Three problems in teaching general skills. In D. J. Levitin (Ed.), *Foundations of cognitive psychology: Core readings* (pp. 551–564). Cambridge, MA: MIT Press.

Hayes, S. C. (2002b). Buddhism and acceptance and commitment therapy. *Cognitive and Behavioral Practice, 9*(1), 58–65.

Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (2011). *Acceptance and commitment therapy: The process and practice of mindful change.* New York, NY: Guilford Press.

Hayes-Roth, B. (1985). A blackboard architecture for control. *Artificial Intelligence, 26*(3), 251–321.

Hayes-Roth, B. (1990). Architectural foundations for real-time performance in intelligent agents. *Journal of Real-Time Systems, 2,* 99–125.

Hayes-Roth, B., & Perrault, F. H.-R. (1979). A cognitive model of planning. *Cognitive Science, 3*(4), 275–310. doi:10.1207/s15516709cog0304_1

Heathcote, A., Brown, S., & Mewhort, D. J. K. (2000). The power law repealed: The case for an exponential law of practice. *Psychonomic Bulletin & Review, 7*(2), 185–207.

Heckhausen, H., & Beckmann, J. (1990). Intentional action and action slips. *Psychological Review, 97*(1), 36-48.

Heng, C. S., Tan, B. C., & Wei, K. K. (2003). De-escalation of commitment in software projects: Who matters? what matters? *Information & Management, 41*(1), 99-110.

Herrin, T. C. (2009). *The analysis of an integrated model of therapy using structural and Gottman method approaches: A case study.* (Unpublished master's thesis). Utah University, Salt Lake City, UT. Retrieved from http://digitalcommons.usu.edu/etd/368

Hesse, H. (1965). *Demian.* (M. Roloff & M. Lebeck, Trans.). New York, NY: Harper & Row. (Original work published 1919)

Higbee, K. L. (1988). *Your memory—How it works and how to improve it.* New York, N.Y.: Marlowe & Company.

Hill, C. R. (2007). *Relationship Rhetoric: Representations of intimacy in contemporary self-help literature.* (Unpublished doctoral dissertation.) Simon Fraser University, Burnaby, Canada.

Hoffman, R. R. (2005). *The psychology of intelligence analysis revisited: An update from developments in cognitive science post-1980.* Pensacola, FL: Florida Institute for Human and Machine Cognition. http://www.ihmc.us/groups/rhoffman/

Hoffman, R. R., & Militello, L. G. (2012). *Perspectives on Cognitive Task Analysis.* New York, NY: Psychology Press.

Hoffman, R. R., Feltovich, P. J., Fiore, S. M., Klein, G., & Ziebell, D. (2009). Accelerated learning (?). *Intelligent Systems, IEEE, 24*(2), 18–22.

Hoffman, R. R., Marx, M., Amin, R., & McDermott, P. L. (2010). Measurement for evaluating the learnability and resilience of methods of cognitive work. *Theoretical Issues in Ergonomics Science, 11*(6), 561–575. doi:10.1080/14639220903386757

Horvitz, E. J., Breese, J. S., & Henrion, M. (1988). Decision theory in expert systems and artificial intelligence. *International Journal of Approximate Reasoning, 2*(3), 247–302.

Howe, M. J., Davidson, J. W., & Sloboda, J. A. (1998). Innate talents: Reality or myth? *Behavioral and Brain Sciences, 21*(3), 399–407; Discussion 407–442.

Howes, M. B. (2007). *Human memory.* Thousand Oaks, CA: SAGE Publications.

Huang, J. Y., & Bargh, J. A. (in press). The selfish goal: Autonomously operating motivational structures as the proximate cause of human judgment and behavior. *Behavioral and Brain Sciences.* http://journals.cambridge.org/BBSJournal/Call/Huang_preprint

Hurley, M. M., Dennett, D. C., & Adams, R. B. (2011). *Inside jokes: Using humor to reverse-engineer the mind.* Cambridge, MA: MIT Press.

Ingle, S., & Murray, S. (2002, March 28). My goal, your goal. *The Guardian.* Retrieved from http://www.theguardian.com/football/2002/mar/28/theknowledge.sport

Intensional definition. (n.d.). In *Wikipedia.* . Retrieved from http://en.wikipedia.org/ on May 30, 2011.

Isaacson, W. (2011). *Steve Jobs.* New York, NY: Simon & Schuster.

Izard, C. E. (2010). The many meanings/aspects of emotion: definitions, functions, activation, and regulation. *Emotion Review, 2*(4), 363–370. doi:10.1177/1754073910374661

Jabr, F. (2013, November 27). Why the brain prefers paper. *Scientific American, 309,* 48–53. Retrieved from http://www.nature.com/.

Jacobs, A. J. (2010). *My life as an experiment.* New York, NY: Simon & Schuster.

Jagger, M., & Richards, K. (1966). Mother's Little Helper. On *Aftermath* [CD]. London, England: London Records.

Jenkins, R. (2002). *Churchill: A biography.* New York, NY: Plume.

Jones, C. (2012). The new shape of the student. In R. Huang, Kinshuk & J. M. Spector (Eds.), *Reshaping Learning* (pp. 91–112). New York, NY: Springer. doi:10.1007/978-3-642-32301-0_4

Jones, D. (2005, December 28). Brain science is key to learning, specialist says. *The Globe and Mail,* p. S28. Toronto.

Johnson, J. (2007). *GUI Bloopers 2.0: Common user interface design don'ts and dos.* San Francisco: Morgan Kaufmann.

Junker, K. W. (2008). What is reading in the practices of law? *The Journal of Law Society of America, 9*(1), 111–162

Kagan, J. (1972). Motives and development. *Journal of Personality and Social Psychology, 22*(1), 51–66.

Kahneman, D. (2011). *Thinking, fast and slow.* New York, NY: Farrar, Straus and Giroux.
Kant, I. (1917) Answering the question: What is enlightenment? (M. C. Smith, Trans.) (Original work published 1784.) Retrieved from http://www.columbia.edu, September 23, 2014.
Kant, I. (2011). *Critique of pure reason.* (J. M. D. Meiklejohn, Trans.). Seattle, WA: Pacific Publishing Studio. (Original work published 1781.)
Karmiloff-Smith, A. (1995). *Beyond modularity: A developmental perspective on cognitive science.* Cambridge, MA: MIT Press.
Karmiloff-Smith, A. (2012). From constructivism to neuroconstructivism: The activity-dependent structuring of the human brain. In E. Marti & C. Rodriguez (Eds.), *After Piaget* (pp. 1–14). Piscataway, NJ: Transaction Publishers.
Karmiloff-Smith, A., & Clark, A. (1993). What's special about the development of the human mind/brain? *Mind & Language, 8,* 569–581.
Karmiloff-Smith, A., & Inhelder, B. (1975). If you want to get ahead, get a theory. *Cognition, 3*(3), 195–212.
Karpicke, J. D. (2009). Metacognitive control and strategy selection: deciding to practice retrieval during learning. *Journal of Experimental Psychology: General, 138*(4), 469–486. doi:10.1037/a0017341
Karpicke, J. D., & Bauernschmidt, A. (2011). Spaced retrieval: absolute spacing enhances learning regardless of relative spacing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37*(5), 1250–1257. doi:10.1037/a0023436
Karpicke, J. D., & Blunt, J. R. (2011a). Response to Comment on "Retrieval practice produces more learning than elaborative studying with concept mapping." *Science, 334*(6055), 772–775. doi:10.1126/science.1204035
Karpicke, J. D., & Blunt, J. R. (2011b). Retrieval practice produces more learning than elaborative studying with concept mapping. *Science, 331,* 772–775. doi:10.1126/science.1199327
Karpicke, J. D., & Roediger, H. L. (2007). Expanding retrieval practice promotes short-term retention, but equally spaced retrieval enhances long-term retention. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33*(4), 704–719. doi:10.1037/0278-7393.33.4.704
Karpicke, J. D., & Roediger, H. L. (2008). The critical importance of retrieval for learning. *Science, 319,* 966–968. doi:10.1126/science.1152408
Keegan, P. (2007, June 21). How David Allen mastered getting things done. *Business 2.0 Magazine.* Retrieved April 9, 2013, from http://money.cnn.com.
Kentgen, L., Allen, R., Kose, G., & Fong, R. (2011). The effects of rerepresentation on future performance. *British Journal of Developmental Psychology, 16*(4), 505–517.
Kern, R., Körner, C., & Strohmaier, M. (2010). Exploring the influence of tagging motivation on tagging behavior. In M. Lalmas, J. Jose, A. Rauber, R. Sebastiani, I. Frommholz (Eds.). *Research and Advanced Technology for Digital Libraries*, 461–465. Berlin, Germany: Springer Berlin-Heidelberg.
Keshav, S. (2013, August 2). How to read a paper. Retrieved November 11, 2013, from http://blizzard/cs/uwaterloo.ca.
Kintsch, W. (1998). *Comprehension.* Cambridge, UK: Cambridge University Press.
Kipling, R. (1895/1910). *If.* Retrieved from http://unix.cc.wmich.edu .

Kirby, J. R. & Lawson, M. J. (Eds.). (2012). *Enhancing the quality of learning: Dispositions, instruction, and learning processes.* Cambridge, MA: Cambridge University Press.

Klahr, D., Chase, W. G., & Lovelace, E. A. (1983). Structure and process in alphabetic retrieval. *Journal of experimental psychology: Learning, Memory, and Cognition, 9*(3), 462–477.

Koriat, A., & Bjork, R. A. (2005). Illusions of competence in monitoring one's knowledge during study. *Journal of experimental psychology: Learning, Memory, and Cognition, 31*(2), 187–194. doi:10.1037/0278-7393.31.2.187

Kruglanski, A. W., Bélanger, J. J., Chen, X., Köpetz, C., Pierro, A., & Mannetti, L. (2012). The energetics of motivated cognition: A force-field analysis. *Psychological Review,* 119(1), 1–20. doi:10.1037/a0025488

Kljun, M., Mariani, J., & Dix, A. (2013). Transference of PIM research prototype concepts to the mainstream: successes or failures. *Interacting with Computers,*. doi:10.1093/iwc/iwt059

Kuhl, J. (1992). A theory of self-regulation: Action versus state orientation, self-discrimination, and some applications. *Applied Psychology, 41*(2), 97–129

Kuhn, T. S. (1962/1996). *The structure of scientific revolutions.* Chicago, IL: University of Chicago Press.

Kwary, D. A. (2011). A hybrid method for determining technical vocabulary. *System, 39*(2), 175–185. doi:10.1016/j.system.2011.04.003

LaBossiere, M. C. (2013, November 25). E-reading & education. *The Philosophers' Magazine Blog.* Retrieved November 26, 2013, from http://talkingphilosophy.com.

Lachter, J., Forster, K. I., & Ruthruff, E. (2004). Forty-five years after Broadbent (1958): Still no identification without attention. *Psychological Review, 111*(4), 880–913. doi:10.1037/0033-295X.111.4.880

Lakatos, I. (1980). *The methodology of scientific research programmes: Philosophical papers.* (Vol. 1). Cambridge, UK: Cambridge University Press.

Lamontagne, C. (1973). A new experimental paradigm for the investigation of the secondary system of human visual motion perception. *Perception, 2,* 167–180.

Lamontagne, C. (1976). *Steps towards a computational theory of visual motion detection: Designing a working system.* (Doctoral dissertation). University of Edinburgh, Edinburgh, UK.

Lamontagne, C. (1987). Sensorymotor emergence: Proposing a computational "syntax." In W. Callebaut & R. Pinxten (Eds.), *Evolutionary epistemology: A multiparidigm program* (pp. 283–310). Boston, MA: Reidel Publishing.

Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes, 50*(2), 212–247. doi:10.1016/0749-5978(91)90021-K

Lather, P. (1999). To be of use: The work of reviewing. *Review of Educational Research, 69*(1), 2–7.

Laufer, B. (1981). A problem in vocabulary learning — Synophones. *ELT Journal, 35*(3), 294–300. doi:10.1093/elt/XXXV.3.294

Leahy, R. L. (2003). *Cognitive therapy techniques: A practitioner's guide.* New York: The Guilford Press.

Lee, D. N., & Lishman, J. R. (1975). Visual proprioceptive control of stance. *Journal of Human Movement Studies, 1*, 87–95.

Lehmann, A. C., K. A. Ericsson, N. Charness, P. Feltovich. (1997). Research on expert performance

and deliberate practice: implications for the education of amateur musicians and music students. *Psychomusicology, 16,* 40–58.

Lennon, J., & McCartney, P. (1995). A hard day's night. On Anthology 1 [Audio CD]. London, UK: Apple Records. (Original recording 1964.)

Lepage, G. A. (Host), & Brisebois, M. (Director). (2012, November 18). Auteur à temps plein (Douglas Kennedy). [Television series episode segment]. In G.A. Lepage (Producer), *Tout le monde en parle.* Montréal, QB: Retrieved from http://ici.radio-canada.ca/.

Lepage, G. A. (Host), & Brisebois, M. (Director). (2013, November 10). La face cachée de Louis-José Houde. [Television series episode segment] In G.A. Lepage (Producer), *Tout le monde en parle.* Montréal, QB: Radio-Canada. Retrieved from http://www.radio-canada.ca/.

Leveen, S. (2005). *The little guide to your well-read life.* Delray Beach, FL: Levenger Press.

Linehan, M. (1993). *Cognitive-behavioral treatment of borderline personality disorder.* New York, NY: Guilford Press.

Little, J. L., Bjork, E. L., Bjork, R. A., & Angello, G. (2012). Multiple-choice tests exonerated, at least of some charges: Fostering test-induced learning and avoiding test-induced forgetting. *Psychological Science, 23*(11), 1337–1344. doi:10.1177/0956797612443370

Littlejohn, A., Beetham, H., & McGill, L. (2012). Learning at the digital frontier: A review of digital literacies in theory and practice. *Journal of Computer Assisted Learning, 28*(6), 547–556. doi:10.1111/j.1365-2729.2011.00474.x

Livingstone, D. W. (2010). *Lifelong learning in paid and unpaid work: Survey and case study findings.* New York, NY: Routledge.

Lodge, D. (2011). Thinks… [Kindle version]. Retrieved from Amazon.com.

Lord, C. G., Lepper, M. R., & Preston, E. (1984). Considering the opposite: a corrective strategy for social judgment. *Journal of Personality and Social Psychology, 47*(6), 1231–1243.

Mäantylä, T. (1986). Optimizing cue effectiveness: Recall of 500 and 600 incidentally learned words. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 12*(1), 66–71. doi:10.1037/0278-7393.12.1.66

Macaulay, T. B. (1950). *Critical and historical essays.* London, UK: Longman, Brown, Green and Longmans.

MacNamara, J. (1976). Stomachs assimilate and accommodate, don't they? *Canadian Psychological Review/Psychologie canadienne, 17*(3), 167.

MacNamara, J. (1978). Another unaccommodating look at Piaget. *Canadian Psychological Review/Psychologie canadienne, 19*(1), 78–81.

Marano, H. E. (1997). Gottman and Gray: The two Johns. *Psychology Today, 30*(6), 28. Retrieved from http://www.u.arizona.edu/.

Marcus, G. (2012). Cognitive Humility. In J. Brockman, *This will make you smarter: New scientific concepts to improve your thinking* (pp. 39–40). New York, NY: Harper Perennial.

Marr, D. (1982). *Vision: a computational investigation into the human representation and processing of visual information.* San Francisco, CA: W.H. Freeman.

Martin, B. R., & Irvine, J. (1985). Evaluating the evaluators: A reply to our critics. *Social Studies of Science, 15*(3), 558–575.

Martin, J., & Hiebert, B. A. (1985). *Instructional counseling: A method for counselors.* Pittsburgh, PA: University of Pittsburgh Press.

Mastaglio, T. W., Jones, P., Bliss, J. P., & Newlon, E. (2007). An integrated theory for after action review. In *Proceedings of The Interservice/Industry Training, Simulation & Education Conference (I/ITSEC), 1.* Arlington, VA: National Training Systems Association.

McBurney, S. (Director). (2013). *Steve Jobs: Visionary entrepreneur* [Motion picture]. (Available from Silicon Valley Historical Association, Menlo Park, CA.)

McCarthy, J. (2008). The well-designed child. *Artificial Intelligence, 172*(18), 2003–2014. doi:10.1016/j.artint.2008.10.001

McCulloch, W. S. (1953). The past of a delusion. In W. S. McCulloch, *Embodiments of Mind* (1965). Cambridge, MA: MIT Press.

McCulloch, W. S. (1965). A heterarchy of values determined by the topology of nervous nets. In W.S. McCulloch, *Embodiments of Mind* (1965). Cambridge, MA: MIT Press.

McCulloch, W. S. (1965). *Embodiments of mind.* Cambridge, MA: MIT Press.

McCulloch, W. S. & Pitts, W. (1943). A logical calculus of the ideas imminent in neural activity, *Bulletin of Mathematical Biophysics,* Vol. 5, 115–133.

McCulloch, W. S., We, S., & Twain, M. (1964). What's in the brain that ink may character? In W.S. McCulloch, *Embodiments of Mind* (1965). Cambridge, MA: MIT Press.

McDaniel, M. A. (2007). Transfer: Rediscovering a central concept. In H. L. Roediger, Y. Dudai, & S. M. Fitzpatrick, *Science of memory: Concepts.*

McDaniel, M. A., & Bugg, J. M. (2012). Memory training interventions: What has been forgotten? *Journal of Applied Research in Memory and Cognition, 1*(1), 58–60. doi:10.1016/j.jarmac.2011.11.002

McDaniel, M. A., Einstein, G., & Jacoby, L. (2008). New considerations in aging and memory: The glass may be half full. In F. Craik & T. Salthouse (Eds.), *The handbook of aging and cognition* (3rd Ed., pp. 311–372). New York, NY: Psychology Press.

McDaniel, M. A., Roediger, H. L., & Mcdermott, K. B. (2007). Generalizing test-enhanced learning from the laboratory to the classroom. *Psychonomic Bulletin & Review, 14*(2), 200–206.

McGovern, K. (2007). Emotion. In B. J. Baars & N. M. Cage (Eds.), *Cognition, Brain, and Consciousness.* Waltham, MA: Academic Press.

McKinney, R. A. (2005). *Reading like a lawyer: Time-saving strategies for reading law like an expert.* Durham, NC: Carolina Academic Press.

Metcalfe, J. (2011). Desirable difficulties and studying in the region of proximal learning. In S. Benjamin (Ed.), *Successful remembering and successful forgetting: A festschrift in honor of Robert A. Bjork* (pp. 259–276). London, UK: Psychology Press.

Metcalfe, J., & Finn, B. (2008). Familiarity and retrieval processes in delayed judgments of learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34*(5), 1084–1097. doi:10.1037/a0012580

Minsky, M. L. (1986). *The society of mind.* New York, NY: Simon & Schuster.

Minsky, M. L. (2006). *The emotion machine: Commonsense thinking, artificial intelligence, and the future of the human mind.* Hew York, NY: Simon and Schuster.

Mogle, J. A., Lovett, B. J., Stawski, R. S., & Sliwinski, M. J. (2008). What's so special about working memory? An examination of the relationships among working memory, secondary memory, and

fluid intelligence. *Psychological Science, 19*(11), 1071–1077. doi:10.1111/j.1467-9280.2008.02202.x

Moltz, H. (1965). Contemporary instinct theory and the fixed action pattern. *Psychological Review, 72*(1), 27.

Moon, B. M., Hoffman, R. R., Eskridge, T. C., & Coffey, J. W. (2011). Skills in applied concept mapping. In B. M. Moon, R. R. Hoffman, J. D. Novak, A. J. Cañas (Eds.). *Applied Concept Mapping: Capturing, Analyzing, and Organizing Knowledge.* (pp. 23-46.) Boca Raton, FL: CRC Press.

Moore, G. (1999). *Crossing the chasm.* New York, NY: HarperCollins.

Morgan, N. (2009). The rule of threes. Retrieved from http://publicwords.com/.

Morris, P. E., Fritz, C. O., Jackson, L., Nichol, E., & Roberts, E. (2005). Strategies for learning proper names: Expanding retrieval practice, meaning and imagery. *Applied Cognitive Psychology, 19*(6), 779–798. doi:10.1002/acp.1115

Mozer, M. C., Pashler, H., Cepeda, N., Lindsey, R., & Vul, E. (2009). Predicting the optimal spacing of study: A multiscale context model of memory. In Y. Bengio, D. Schuurmans, J.D. Lafferty, C. K. I. Williams, & A. Culotta (Eds.), *Advances in neural information processing systems, 22* (pp. 1321–1329). La Jolla, CA: Neural Information Processing Systems Foundation.

Mulcahy-Ernt, P. I., & Caverly, D. C. (2009). Strategic study-reading. In R. F. Flippo & D. C. Caverly (Eds.), *Handbook of college reading and study strategy research* (pp. 177–198). Mahwah, NJ: Lawrence Earlbaum Associates.

Mullet, K., & Sano, D. (1995). *Designing visual interfaces: Communication oriented techniques.* Englewood Cliffs NJ: SunSoft Press.

Nadel, L. (2007). Consolidation: The demise of the fixed trace. In Y. Dudai, H. L. I. Roediger, E. Tulving, & S. M. Fitzpatrick (Eds.), *Science of Memory: Concepts.* New York: Oxford University Press.

Nation, I. S. P. (2011). Research into practice: Vocabulary. *Language Teaching, 44*(04), 529-539.

Naveh-Benjamin, M., & Old, S. R. (2008). Aging and Memory. In J. H. Byrne (Ed.), *Learning and memory: A comprehensive reference* (Vol. 2). Waltham, MA: Elsevier.

Naveh-Benjamin, M., Craik, F. I. M., & Ben-Shaul, L. (2002). Age-related differences in cued recall: Effects of support at encoding and retrieval. *Aging, Neuropsychology, and Cognition, 9*(4), 276–287. doi:10.1076/anec.9.4.276.8773

Neath, I., & Surprenant, A. (2005). Mechanisms of memory. In K. Lamberts & R. L. Goldstone (Eds.). *Handbook of cognition,* (pp. 221–238). New York: Sage Publishing.

Nesbit, J. C., & Adesope, O. O. (2006). Learning with concept and knowledge maps: A meta-analysis. *Review of Educational Research, 76*(3), 413–448.

Nesheim, J. L. (2000). *High tech start up, revised and updated: The complete handbook for creating successful new high tech companies.* New York, NY: Free Press.

Newell, A. (1990). *Unified theories of cognition.* Cambridge, MA: Harvard University Press.

Newton, L. (1990). *Overconfidence in the communication of intent: Heard and unheard melodies.* (Unpublished doctoral dissertation.) Stanford University, Stanford, CA.

Nilsson, N. J. (1994). Teleo-reactive programs for agent control. *Journal of Artificial Intelligence Research,* 1(1), 139–158.

Nilsson, N. J. (1998). *Artificial intelligence.* San Francisco: Morgan Kaufmann Publishers.

Nist-Olejnik, S., & Holschuh, J. P. (2013). *College success strategies.* New York, NY: Penguin Academics.

Norman, D. A. (1981). Categorization of action slips. *Psychological Review*, 88(1), 1–15.

Norman, D. A., & Shallice, T. (1986). Attention to action: willed and automatic control of behavior. In R. J. Davidson, G. E. Schwartz, & D. Shapiro, (Eds.) *Consciousness and self-regulation.* (Vol. 4, pp. 1–18). New York: Plenum.

Norman, D., & Bobrow, D. G. (1979). Descriptions: An intermediate stage in memory retrieval. *Cognitive Psychology, 11*(1), 107–123. doi:10.1016/0010-0285(79)90006-9

Oatley, K. (1992). *Best laid schemes: The psychology of the emotions.* Cambridge, UK: Cambridge University Press.

Oatley, K., & Johnson-Laird, P. N. (1987). Towards a cognitive theory of emotions. *Cognition & Emotion, 1*(1), 29–50. doi:10.1080/02699938708408362

Oatley, K., & Johnson-Laird, P. N. (2011). Basic emotions in social relationships, reasoning, and psychological illnesses. *Emotion Review, 3*(4), 424–433. doi:10.1177/1754073911410738

Oh, K. (2012). What happens once you categorize files into folders? *Proceedings of the 75th American Society for Information Science and Technology (ASIS&T) Annual Meeting, USA, 49*(1). doi:10.1002/meet.14504901253/full

Oh, K., & Belkin, N. (2014). Understanding what personal information items make categorization difficult. *Proceedings of the 77th American Society for Information Science and Technology (ASIS&T) Annual Meeting, USA, 51*(1).

Ordóñez, L. D., Schweitzer, M. E., Galinsky, A. D., & Bazerman, M. H. (2009). Goals gone wild: The systematic side effects of overprescribing goal setting. *The Academy of Management Perspectives, 23*(1), 6–16.

Ortony, A., & Turner, T. J. (1990). What's basic about basic emotions? *Psychological Review, 97*(3), 315–331.

Ortony, A., Clore, G. L., & Collins, A. (1988). *The cognitive structure of emotions.* Cambridge, UK Cambridge University Press.

Ortony, A., Clore, G. L., & Foss, M. A. (1987). The referential structure of the affective lexicon. *Cognitive Science: A Multidisciplinary Journal, 11*(3), 341–364.

Otani, H., & Stimson, M. J. (1994). A further attempt to demonstrate hypermnesia in recognition. *The Psychological Record, 44*(1), 25.

Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions.* New York, NY: Oxford University Press USA.

Panksepp, J., & Biven, L. (2012). *The archaeology of mind: Neuroevolutionary origins of human emotions.* [Kindle edition.] Retrieved from Amazon.com.

Papert, S. (1965). Introduction. *Embodiments of Mind.* Cambridge, MA: MIT Press.

Park, S. M. (1994). Reinterpreting Ryle: A nonbehavioristic analysis. *Journal of the History of Philosophy, 32*(2), 265–290.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker.* Cambridge, UK: Cambridge University Press.

Peirce, C. S. (1905). What pragmatism is. *The Monist, 5*(2), 161–181.

Pellegrini, A. D. (2013). Play. In P. D. Zelazo (Ed.), *Oxford Handbook of Developmental Psychology* (pp. 276-299). New York: Oxford University Press USA.

Perkins, D. N. (1986). *Knowledge as design.* Hillsdale, NJ: Lawrence Earlbaum Associates.

Perkins, D. N (1995). *Outsmarting IQ: The emerging science of learnable intelligence.* New York, NY: Free Press.

Salomon, G., & Perkins, D. N. (1987). Transfer of cognitive skills from programming: When and how?. *Journal of Educational Computing Research, 3*(2), 149-169.

Perlmutter, M. (1979). Age differences in adults' free recall, cued recall, and recognition. *Journal of Gerontology, 34*(4), 533–539. doi:10.1093/geronj/34.4.533

Pessoa, L. (2013). *The cognitive-emotional brain.* Cambridge, MA: MIT Press.

Petty, R. E., Wheeler, S. C., & Tormala, Z. L. (2003). Persuasion and attitude change. In I. B. Weiner (Ed.) *Handbook of psychology* (2nd ed.). New York, NY: John Wiley & Sons.

Piaget, J. (1967). *Biologie et connaissance.* Paris, France: Éditions Gallimard.

Piaget, J. (1977). Recherches sur l'abstraction réfléchissante. Paris: Presses Universitaires de France.

Pigliucci, M. (2010). *Nonsense on stilts: How to tell science from bunk.* Chicago, IL: University of Chicago Press.

Pigliucci, M., & Galef, J. (2012, November 7). Answers for Aristotle. *Rationally Speaking Podcast.* Podcast retrieved from http://rationallyspeaking.blogspot.ca/.

Pigliucci, M., & Galef, J. (2013, April 24). Samuel Arbesman on the half-life of facts. *Rationally Speaking Podcast.* Podcast retrieved from http://www.rationallyspeakingpodcast.org/.

Pinker, S. (1999). *How the mind works.* New York, NY: W.W. Norton.

Pinker, S. (2010, June 10). Mind over mass media. New York Times. Retrieved from http://www.nytimes.com/.

Pogue, D. (2013, July 17). 6 reasons smartphones won't replace our brains. *Scientific American, 309*(2). Retrieved from http://www.scientificamerican.com/.

Popper, K. R. (1959). *The logic of scientific discovery.* New York, NY: Basic Books.

Popper, K. R. (1979). *Objective knowledge.* Oxford, UK: Oxford University Press.

Popper, K. R. (1983). *Realism and the aim of science: From the postscript to the logic of scientific discovery.* (W. W. Bartley III, Ed.). Totowa, NJ: Rowman and Littlefield.

Post, L. A. (1932). Ancient memory systems. *The Classical Weekly, 25*(14), 105–110.

Power, R. (1979). The organisation of purposeful dialogues. *Linguistics, 17,* 107–152.

Pressley, M., & Gaskins, I. W. (2006). Metacognitively competent reading comprehension is constructively responsive reading: How can such reading be developed in students?. *Metacognition and Learning, 1*(1), 99-113.

Pressley, M., & Afflerbach, P. (1995). *Verbal protocols of reading.* London, UK: Routledge.

Pronin, E., Puccio, P., & Ross, L. (2002). Understanding misunderstanding: Social psychological perspectives. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases* (pp. 636–665). Cambridge, UK: Cambridge University Press.

Psotka, J., Massey, L. D., & Mutter, S. A. (Eds.). (1988). *Intelligent tutoring systems: Lessons learned.* Hillsdale, NJ: Routledge.

Pyc, M. A. (2010). Why is retrieval practice beneficial for memory? An evaluation of the mediator shift hypothesis. (Unpublished doctoral dissertation.) Kent State University, Kent, OH.

Pyc, M. A., & Rawson, K. A. (2009). Testing the retrieval effort hypothesis: Does greater difficulty correctly recalling information lead to higher levels of memory? *Journal of Memory and Language, 60*(4), 437–447. doi:10.1016/j.jml.2009.01.004

Pyc, M. A., & Rawson, K. A. (2012). Why is test–restudy practice beneficial for memory? An evaluation of the mediator shift hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 38*(3), 737-746.

Pyc, M. A., & Rawson, K. A. (2010). Why testing improves memory: mediator effectiveness hypothesis. *Science 330*(6002), 335. doi:10.1126/science.1191465

Quiller-Couch, A. T. (1920). *On the art of reading.* [E-book.] Gutenberg Project. Retrieved from http://www.gutenberg.org/.

Rawson, K. A., & Dunlosky, J. (2011). Optimizing schedules of retrieval practice for durable and efficient learning: How much is enough? *Journal of Experimental Psychology: General, 140*(3), 283–302. doi:10.1037/a0023956

Read, T., & Sloman, A. (1993). The terminological pitfalls of studying emotion. Paper presented at the Workshop on Architectures Underlying Motivation and Emotion - WAUME 93, Birmingham, UK. Retrieved from http://www.cs.bham.ac.uk/, 23 September 2014.

Redding, R. E., Herbert, J. D., Formann, E. M. & Guadiano, B. A. (2008). Popular self-help books for anxiety, depression, and trauma: How scientifically grounded and useful are they? *Professional Psychology: Research and Practice, 39, (5)*, 537-545. doi:10.1037/0735-7028.39.5.537

Richard K. Wagner, & Stanovich, K. (1996). Expertise in reading. In A. Ericsson (Ed.), *The road to excellence: The acquisition of expert performance in the arts and sciences, sports, and games* (pp. 189–225). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc. doi:10.1016/j.resuscitation.2011.10.011

Ries, E. (2011). *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses.* New York, NY: Viking Press

Rigney, D. (2010). *The Matthew effect: how advantage begets further advantage.* New York, NY: Columbia University Press

Robbins, A. (1991). *Awaken the giant within: How to take immediate control of your mental, emotional, physical and financial destiny!* Mahwah, NJ: Free Press.

Robertson, G., Czerwinski, M., Baudisch, P., Meyers, B., Robbins, D., Smith, G., & Tan, D. (2005). The large-display user experience. *Computer Graphics and Applications, IEEE, 25*(4), 44–51.

Robinson, J. P., Martin, S., Glorieux, I., & Minnen, J. (2011). The overestimated workweek revisited. *Monthly Labor Review Online, 134*(6), 43–53.

Roediger, H. L. (2008). Relativity of remembering: Why the laws of memory vanished. *Annual review of psychology, 59,* 225–254. doi:10.1146/annurev.psych.57.102904.190139

Roediger, H. L., & Karpicke, J. D. (2006). The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science, 1*(3), 181.

Roediger, H. L., & Karpicke, J. D. (2010). Intricacies of spaced retrieval: A resolution. In A. S. Benjamin (Ed.), *Successful Remembering and Successful Forgetting: Essays in Honor of Robert A. Bjork.* New York: Psychology Press.

Roediger, H. L., Marsh, E. J., & Lee, S. C. (2002). Varieties of memory. In D. Medin and H. Pashler

(Eds.). *Steven's handbook of experimental psychology, Vol. 2: Memory and cognitive processes*, (3rd ed.) (pp. 1–41). New York: John Wiley & Sons.
Rouet, J.-F. (2006). *The skills of document use: from text comprehension to web-based learning.* Mahwah, NJ: Lawrence Erlbaum Associates.
Russel, S., & Norvig, P. (1995). *Artificial intelligence.* Upper Saddle River, NJ: Prentice Hall.
Russell, S. (1995). Rationality and intelligence. *Artificial Intelligence, 94*(1-2), pp. 57–77.
Russell, S. J., & Wefald, E. H. (1991). *Do the right thing.* Cambridge, MA: MIT Press.
Ryle, G. (1949). *The concept of mind.* Chicago, IL: University of Chicago Press.
Ryle, G. (1954). *Dilemmas.* Cambridge University Press, Cambridge, England.
Sacks, O. (2007). *Musicophilia.* Toronto, ON: Alfred A. Knopf.
Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: Rethinking mechanism of a neglected phenomenon. *Educational psychologist, 24*(2), 113-142.
Samsonovich, A. (2012, June 18). Comparative table of cognitive architectures. Retrieved from http://bicasociety.org/, August 8, 2014.
Sandberg, J., & Alvesson, M. (2011). Ways of constructing research questions: gap-spotting or problematization? *Organization, 18*(1), 23–44. doi:10.1177/1350508410372151
Sartre, J. P. (1938). *Esquisse d'une théorie des émotions.* Paris, France: Hermann.
Satel, S., & Lilienfeld, S. O. (2013). *Brainwashed: The seductive appeal of mindless neuroscience.* New York, NY: Basic Books.
Saul, J. R. (2009). *A Fair Country.* Toronto, ON: Viking Canada.
Scardamalia, M., & Bereiter, C. (1991). Literate expertise. In K. A. Ericsson & J. Smith (Eds.), *Towards a general theory of expertise: Prospects and limits* (pp. 172–194). Cambridge, UK: Cambridge University Press.
Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (pp. 97–118). New York, NY: Cambridge University Press.
Schacter, D. L. (1999). The seven sins of memory. Insights from psychology and cognitive neuroscience. The *American Psychologist, 54*(3), 182–203.
Schacter, D. L. (2002). *The seven sins of memory: How the mind forgets and remembers.* Boston, MA: Houghton Mifflin Harcourt.
Schön, D. A. (1983). *The Reflective Practitioner.* New York, NY: Basic Books.
Schön, D. A. (1987). *Educating the reflective practitioner.* San Francisco, CA: Jossey-Bass.
Schonfield, D., & Robertson, B. A. (1966). Memory storage and aging. *Canadian Journal of Psychology, 20*(2), 228–236.
Schrank, F. A. Engels, D. E. (1981). Bibliotherapy as a counseling adjunct: Research findings. *Personnel and Guidance Journal 60*(3), 143-147.
Schwartz, D. L., Bransford, J. D., & Sears, D. (2005). Efficiency and innovation in transfer multidisciplinary perspective. In J. Mestre (Ed.), *Transfer of learning: Research and Perspectives* (pp. 1–51). Charlotte, NC: Information Age Publishing.
Seidenberg, M. S. (2013, October 28). The Gladwell pivot. Retrieved from http://languagelog.ldc.upenn.edu/, November 26, 2013.
Selfridge, O. (1959). *Pandemonium: A paradigm for learning.* London, UK: HM Stationery Office.

Seligman, M. E., & Yellen, A. (1987). What is a dream? *Behaviour research and therapy, 25*(1), 1–24.
Selye, H. (1964). *From dream to discovery: On being a scientist.* New York, NY: McGraw Hill.
Sereno, J. (2013, April 7). Form and meaning regulation in language. In S. DiPaola (Director), *Defining Cognitive Science Talks,* Simon Fraser University, Burnaby, BC. Retrieved from http://www.sfu.ca/.
Sereno, J. A., & Jongman, A. (1990). Phonological and form class relations in the lexicon. *Journal of Psycholinguistic Research 19*(6), 387–402.
Sereno, J.A. (1994). Phonosyntactics. In L. Hinton, J. Nichols, and J. Ohala (Eds.), *Sound Symbolism* (pp.263-275), Cambridge, UK: Cambridge University Press.
Shallice, T., & Burgess, P. (1996). The domain of supervisory processes and temporal organization of behaviour. *Philosophical Transactions of the Royal Society of London: Series B, Biological Sciences, 351*(1346), 1405–1412. doi:10.1098/rstb.1996.0124
Shanahan, M. (2010). *Embodiment and the inner life: Cognition and consciousness in the space of possible minds.* New York, NY: Oxford University Press USA.
Shanahan, M. (2012). The brain's connective core and its role in animal cognition. *Philosophical Transactions of the Royal Society B: Biological Sciences, 367*(1603), 2704–2714. doi:10.1098/rstb.2012.0217
SharpBrains. (2013). *The digital brain health market 2012-2020: Web-based, mobile and biometrics-based technology to assess, monitor and enhance cognition and brain functioning.* (A. Fernandez, Ed.). San Francisco, CA: SharpBrains.
Shultz, T. R. (1982). Rules of causal attribution. *Monographs of the Society for Research in Child Development, 47(1)* 1–51.
Shultz, T. R., Fisher, G. W., Pratt, C. C., & Rulf, S. (1986). Selection of causal rules. *Child Development, 57*(1), 143. doi:10.2307/1130646
Simon, H. A. (1967). Motivational and emotional controls of cognition. *Psychological Review, 74*(1), 29–39.
Simon, H. A. (1971), Designing organizations for an information-rich world. In M. Greenberger (Ed), *Computers, Communication, and the Public Interest.* Baltimore, MD: The Johns Hopkins Press.
Simon, D. A., & Bjork, R. A. (2001). Metacognition in motor learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27*(4), 907.
Simon, H. A. & Kaplan, C. A. (1989). Foundations of cognitive science. In M. I. Posner (Ed.), *Foundations of cognitive science* (pp. 1–47). Cambridge, MA: MIT Press.
Simpson, J. (Ed.). (2013). *Oxford English Dictionary.* Oxford, UK: Oxford University Press. Retrieved from [http://www.oed.com].
Sinclair, N. (2004). The roles of the aesthetic in mathematical inquiry. *Mathematical Thinking and Learning, 6*(3), 261–284. doi:10.1207/s15327833mtl0603_1
Sinclair, N. (2006). *Mathematics and beauty: aesthetic approaches to teaching children.* New York, NY: Teachers College Press.
Slamecka, N. J., & Graf, P. (1978). The generation effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning and Memory, 4*(6), 592–604.
Slaney, K. L., & Racine, T. P. (2011). On the ambiguity of concept use in psychology: Is the concept "concept" a useful concept? *Journal of Theoretical and Philosophical Psychology, 31*(2), 73–89.

doi:10.1037/a0022077
Sloman, A. (1975). Afterthoughts on analogical representations. In B. L. Nash-Webber & R. C. Schank (Eds.), *Proceedings of the 1975 Workshop on Theoretical Issues in Natural Language Processing (TINLAP '75)* (pp. 431–439). Stroudsburg, PA: Association for Computational Linguistics.
Sloman, A. (1978). *The computer revolution in philosophy: Philosophy, science and models of mind.* New York, NY: Harvester Press. Retrieved from http://www.cs.bham.ac.uk
Sloman, A. (1979). The primacy of non-communicative language. In M. MacCafferty & K. Gray (Eds.), *The analysis of meaning: Informatics 5, Proceedings ASLIB/BCS Conference* (pp. 1-18). Retrieved from http://www.cs.bham.ac.uk/.
Sloman, A., (1983), Image interpretation: The way ahead. In O. J. Braddick & A. C. Sleigh (Eds), *Physical and Biological Processing of Images* (pp. 380-401). Berlin, Germany: Springer-Verlag.
Sloman, A. (1984). The structure of the space of possible minds. In S. Torrance (Ed.), *The mind and the machine: Philosophical aspects of artificial intelligence* (pp. 35–42). Chichester: Ellis Horwood.
Sloman, A. (1985a). Real-time multiple-motive expert systems. In M. Merry (Ed.), *Proceedings of the fifth technical conference of the British Computer Society specialist group on expert systems* (pp. 1-13). Cambridge, UK: Cambridge University Press.
Sloman, A. (1985c). What enables a machine to understand? In A. Joshi (Ed.), *Proceedings of the 9th international joint conference on artificial intelligence* (pp. 995–1001). San Francisco, CA: Morgan Kaufmann Publishers.
Sloman, A. (1987). Motives, mechanisms, and emotions. *Cognition & Emotion, 1*(3), 217–233. doi:10.1080/02699938708408049
Sloman, A. (1988). TEACH AITHEMES: A personal view of artificial intelligence. In M. Sharples, D. Hobb, C. Hutchinson, S. Torrancce, & D. Young, 1989, *Computers and thought: A practical introduction to artificial intelligence* (preface). Cambridge, MA: MIT Press.
Sloman, A. (1989). On designing a visual system. *Journal of Experimental and Theoretical Artificial Intelligence, 1*(4), 1–54.
Sloman, A. (1993a). Prospects for AI as the general science of intelligence. In A. Sloman, D. Hogg, G. Humphreys, D. Partridge, & A. Ramsay (Eds.). *Prospects for Artificial Intelligence,* (pp. 1–10). Amsterdam, Netherlands: IOS Press.
Sloman, A. (1993b). The mind as a control system. In C. Hookway & D. Peterson (Eds.), *Philosophy and the Cognitive Sciences* (pp. 69–110). Cambridge, UK: Cambridge University Press.
Sloman, A. (1996). Actual possibilities. In L. C. Aiello, J. Doyle, & S. C. Shapiro (Eds.) *Proceedings of the fifth international conference on principles of knowledge representation and reasoning (KR'96)* (pp. 441–448). Burlington, MA: Morgan Kaufmann.
Sloman, A. (1998). The "semantics" of evolution: Trajectories and trade-offs in design space and niche space. In H. Coelho (Ed.), *Progress in artificial intelligence - IBERAMIA 98, 6th Ibero-American conference on AI* (pp. 27–38). New York, NY: Springer.
Sloman, A. (2000a). Models of models of mind. In J. Barnden & M. Lee (Eds.), *Proceedings of the AISB'00 symposium on how to design a functioning mind.* (pp. 1-13). Hove, UK: Society for the Study of Artificial Intelligence and the Simulation of Behavior.
Sloman, A. (2000b). Interacting trajectories in design space and niche space: A philosopher speculates about evolution. In M. Schonauer, K. Deb, G. Rudolph, X. Yao, E. Lutton, J. J. Merelo, & H.-P.

Schwefel (Eds.), *Parallel Problem Solving from Nature - PPSN VI* (pp. 3–16). Berlin, Germany: Springer Berlin-Heidelberg.

Sloman, A. (2001). Beyond shallow models of emotion. *Cognitive Processing, 2*(1), 177-198.

Sloman, A. (2002). Architecture-based conceptions of mind. In P. Gärdenfors, J. Wolenski, and K. Kijania-Placek (Eds.), *In the scope of logic, methodology, and philosophy of science* (Vol. 2), (pp. 403–427). Dordrecht, Netherlands: Kluwer Academic Publishers.

Sloman, A. (2002b). Getting meaning off the ground: symbol grounding vs symbol attachment/tethering. Lecture conducted from MIT Media Lab, Cambridge, MA. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2003). How many separately evolved emotional beasties live within us? In R. Trappl, P. Petta, & S. Payr (Eds.), *Emotions in humans and artifacts* (pp. 35–114). Cambridge, MA: MIT Press.

Sloman, A. (2004). Do machines, natural or artificial, really need emotions? Lecture conducted from Birmingham Café Scientifique, Birmingham, UK. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2005). The design-based approach to the study of mind (in humans, other animals, and machines), including the study of behaviour involving mental processes. Aaron Sloman. Retrieved November 17, 2012, from http://cs.bham.ac.uk/research/projects/cogaff/sloman-aiib10.pdf

Sloman, A. (2008a/2011). Varieties of meta-cognition in natural and artificial systems. In M. T. Cox and A. Raja (Eds.), *Metareasoning: Thinking about thinking* (pp. 12-20). Cambridge, MA: MIT Press.

Sloman, A. (2008b). What evolved first and develops first in children: Languages for communicating, or languages for thinking. *Mind as machine weekend course*. Lecture conducted from Oxford University, Oxford, UK. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2009a). What cognitive scientists need to know about virtual machines. In N. A. Taatgen, H. van Rijn, L. Schomaker, and J. Nerbonne (Eds.) *Proceedings of the 31st annual conference of the Cognitive Science Society* (pp. 1210–1215). Retrieved from http://csjarchive.cogsci.rpi.edu/.

Sloman, A. (2009b). Architecture-based motivation vs reward-based motivation. Retrieved from: http://www.cs.bham.ac.uk/.

Sloman, A. (2009c). Understanding causation in robots, animals and children: Hume's way and Kant's way. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2010a). Two notions contrasted: 'Logical geography' and 'logical topography'. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2010b). How virtual machinery can bridge the "explanatory gap", in natural and artificial systems. In S. Doncieux, B. Girard, A. Guillot, J. Hallam, J.-A. Meyer, J.-B. Mouret (Eds.), *Natural and artificial systems. From Animals to Animats 11* (pp. 13–24). Berlin, Germany: Springer-Verlag.

Sloman, A. (2010c). Phenomenal and access consciousness and the "hard" problem: A view from the designer stance. *International Journal of Machine Consciousness, 2*(1), 117. doi:10.1142/S1793843010000424

Sloman, A. (2011a). What's information, for an organism or intelligent machine? How can a machine

or organism mean? In G. Dodig-Crnkovic & M. Burgin (Eds.), *Information and Computation* (pp. 393–438). Hackensack, NJ: World Scientific.

Sloman, A. (2011b). Supervenience and causation in virtual machinery. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2011c/2013a). Comments on Annette Karmiloff-Smith's (1992) book: *Beyond Modularity: A Developmental Perspective on Cognitive Science*. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2011d, March 10). The self–A bogus concept. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2012a). The meta-morphogenesis (MM) project (or meta-project?). Retrieved from: http://www.cs.bham.ac.uk/.

Sloman, A. (2012b, November 1). Meta-morphogenesis and toddler theorems: Case studies. Retrieved from http://www.cs.bham.ac.uk/.

Sloman, A. (2013). Meta-morphogenesis theory as background to cognitive robotics and developmental cognitive science. In J. Fagard, R. A. Grupen, F. Guerin, & N. Krüger (Organizers), *Mechanisms of ongoing development in cognitive robotics*, Schloss Dagstuhl, Wadern, Germany.

Sloman, A., & R. L. Chrisley, (2003). Virtual machines and consciousness. *Journal of Consciousness Studies, 10*(4-5), 133–172.

Sloman, A. and Croucher, M. (1981) Why robots will have emotions. In P. J. Hayes (Ed.), *Proceedings of the 7th international joint conference on artificial intelligence* (pp. 197-202). San Francisco, CA: Wiliam Kaufmann

Small, T. (2008, May 20). Brain bulletin #38 - 8 simple strategies to boost your brain power. Retrieved from http://www.terrysmall.com/.

Smolin, L. (2006). *The trouble with physics: The rise of string theory, the fall of a science, and what comes next* Boston, MA: Houghton Mifflin Harcourt.

Sonnentag, S., & Kleine, B. M. (2000). Deliberate practice at work: A study with insurance agents. *Journal of Occupational and Organizational Psychology, 73*(1), 87–102.

Sparks, D. (2012). *Paperless*. [E-book.] Available at http://macsparky/com/.

Speelman, C. P., & Kirsner, K. (2005). *Beyond the learning curve: The construction of mind*. New York, NY: Oxford University Press.

Spencer, C. (2006). Research on learners' preferences for reading from a printed text or from a computer screen. *Journal of Distance Education, 22*(1), 33–50.

Spitzer, H. F. (1939). Studies in retention. *Journal of Educational Psychology, 30*(9), 641.

Stanovich, K. E. (2009). *What intelligence tests miss: The psychology of rational thought*. New Haven, CT: Yale University Press.

Stanovich, K. E. (2011). *Rationality and the reflective mind*. New York, NY: Oxford University Press.

Stanovich, K. E. (2010). *How to think straight about psychology* (9th ed.). Upper Saddle River, NJ: Pearson Education.

Stanovich, K. E., West, R. F., & Toplak, M. E. (2011). Intelligence and rationality. In R. J. Sternberg & S. B. Kaufman (Eds.), *The Cambridge handbook of intelligence* (pp. 784–826). Cambridge, UK: Cambridge University Press.

Starbuck, W. H. (1992). Learning by knowledge-intensive firms. *Journal of Management Studies, 29*(6), 713–739.

Starbuck, W. H. (2010). What makes a paper influential and frequently cited? *Journal of Management Studies, 47*(7), 1394–1404. doi:10.1111/j.1467-6486.2009.00903.x

Staw, B. M. (1981). The escalation of commitment to a course of action. *Academy of Management Review, 6*(4), 577-587.

Sternberg, R. J. (1981). Intelligence and nonentrenchment. *Journal of Educational Psychology 73*(1), 1–16.

Sternberg, S. (1969). Memory-scanning: Mental processes revealed by reaction-time experiments. *American Scientist, 57*(4), 421–457.

Sternberg, S. (1975). Memory scanning: New findings and current controversies. *The Quarterly Journal of Experimental Psychology, 27*(1), 1–32.

Sterner, T. M. (2006). *The practicing mind.* Wilmington, DE: Mountain Sage Publishing.

Stich, S. (1992). What is a theory of mental representation? *Mind, 101*(402), 243–261.

Stix, G. (2013) New study: Neuroscience research gets an "F" for reliability. Retrieved from http://blogs.scientificamerican.com/.

Strohmaier, M. (2008). Purpose tagging: Capturing user intent to assist goal-oriented social search. In I. Soboroff, E. Agichtein, & R. Kumar (Eds.), *Proceeding of the 2008 ACM workshop on search in social media, SSM 2008* (pp. 35–42). Napa Valley, CA: Association for Computing Machinery.

Strohmaier, M., Körner, C, & Kern, R. (2010). Why do users tag? Detecting users' motivation in social tagging systems. In M. Hearst, W. Cohen, & S. Gosling (Eds.), *Proceedings of the fourth international conference on weblogs and social media* (pp. 339-342). Palo Alto, CA: Association for the Advancement of Artificial Intelligence.

Surprenant, A., & Neath, I. (2009). *Principles of memory.* New York, NY: Psychology Press.

Sziraki, M. (1978). Mental and biological assimilation and accommodation. *Canadian Psychological Review/Psychologie Canadienne 19*(1), 67–73.

Tavris, C., & Aronson, E. (2008). *Mistakes were made (but not by me): Why we justify foolish beliefs, bad decisions, and hurtful acts.* Boston, MA: Mariner Books.

Templar, R. (2006). *The rules of life.* Harlow, UK: Pearson Education Limited.

Thagard, P. (2007, April 30). Cognitive science. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy.* Retrieved from http://plato.stanford.edu/, on November 27, 2012.

Thagard, P. (2012). *The cognitive science of science: Explanation, discovery, and conceptual change.* Cambridge, MA: MIT Press.

Thayer, R. E. (2001). *Calm energy.* Toronto, ON: Oxford University Press.

Thompson, J. J., Blair, M. R., Chen, L., & Henrey, A. J. (2013). Video game telemetry as a critical tool in the study of complex skill learning. *PLoS ONE, 8*(9), e75129. doi:10.1371/journal.pone.0075129

Toplak, M. E., West, R. F., & Stanovich, K. E. (2012). Education for rational thought. In J. R. Kirby & M. J. Lawson (Eds.), *Enhancing the quality of learning: Dispositions, instruction, and learning processes* (pp. 51–92). Cambridge, UK: Cambridge University Press.

Torneke, N. (2010). *Learning RFT: An introduction to relational frame theory and its clinical application.* Oakland, CA: New Harbinger Publications.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of Memory* (pp. 381–403). New York, NY: Academic Press.

Tulving, E. (2007). Are there 256 different kinds of memory? In J. S. Nairne (Ed.), *Foundations of remembering: Essays in honor of Henry L. Roediger, III* (pp. 39–52). New York, NY: Psychological Press.

Tulving, E., & Schacter, D. L. (1990). Priming and human memory systems. *Science, 247*(4940), 301–306.

Turing, A. M. (1937). On computable numbers, with an application to the Entscheidungsproblem. *Proceedings of the London Mathematical Society, 42*(2), 230–265.

Tversky, A. (1969). Intransitivity of preferences. *Psychological Review, 76*(1), 31–48.

United States Department of Labor, Occupational Safety and Health Administration. (2013, April 9). Computer workstation evaluation checklist. Retrieved from http://www.osha.gov/.

Unsworth, N., & Engle, R. W. (2005). Simple and complex memory spans and their relation to fluid abilities: Evidence from list-length effects. *Journal of Memory and Language, 54*(1), 68–80. doi:10.1016/j.jml.2005.06.003

Unsworth, N., & Engle, R. W. (2007). The nature of individual differences in working memory capacity: active maintenance in primary memory and controlled search from secondary memory. *Psychological Review, 114*(1), 104–132. doi:10.1037/0033-295X.114.1.104

van der Vlist, E. (2002). *XML Schema.* Sebastopol, CA: O'Reilly.

van Merriënboer, J. J. G. (1997). *Training complex cognitive skills: A four-component instructional design model for technical training.* Englewoods Cliffs, NJ: Educational Technology Publications.

VanLehn, K. (1989). Problem solving and cognitive skill acquisition. In M. I. Posner (Ed.), *Foundations of Cognitive Science* (pp. 526–579). Cambridge, MA: Bradford Books.

VanLehn, K. (1996). Cognitive skill acquisition. *Annual review of psychology, 47*(1), 513–539. doi:10.1146/annurev.psych.47.1.513

VanLehn, K. (1999). Rule learning events in the acquisition of a complex skill: An evaluation of Cascade. *Journal of the Learning Sciences, 8*(1), 71–125.

VanLehn, K., Arbor, A., & Jones, R. M. (1993). Better learners use analogical problem solving sparingly. In P. E. Utgoff (Ed.), *Proceedings of the tenth international conference on machine learning* (pp. 338–345). San Francisco, CA: Morgan Kaufmann

Visser, C. (2009, November). Interview with Keith Stanovich. Retrieved from http://articlescoertvisser.blogspot.ca/.

Vygotsky, L. S. (1978). *Mind in society.* Cambridge, MA: Harvard University Press.

Wagner, J. F. (2006). Transfer in pieces. *Cognition and Instruction, 24*(1), 1–71.

Wagner, R. K., & Stanovich, K. (1996). Expertise in reading. In A. Ericsson (Ed.), *The road to excellence: The acquisition of expert performance in the arts and sciences, sports, and games* (pp. 189–225). Hillsdale, NJ: Lawrence Erlbaum Associates.

Wallace, M., & Wray, A. (2006). *Critical reading and writing for postgraduates.* London, UK: Sage Publications.

Wallace, M., & Wray, A. (2011). *Critical reading and writing for postgraduates,* 2nd Ed. London, UK: Sage Publications.

Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological Review, 20*(2), 158–277.

Waytz, A., Morewedge, C. K., Epley, N., Monteleone, G., Gao, J.-H., & Cacioppo, J. T. (2010). Making sense by making sentient: Effectance motivation increases anthropomorphism. *Journal of Personality and Social Psychology, 99*(3), 410–435. doi:10.1037/a0020240

Wechsler, D. (1925). What constitutes an emotion? *Psychological Review, 32*(3), 235–240. doi:10.1037/h0074516

Wells, A. (2005). Detached mindfulness in cognitive therapy: A metacognitive analysis and ten techniques. *Journal of Rational-Emotive and Cognitive-Behavior Therapy, 23*(4), 337–355. doi:10.1007/s10942-005-0018-6

Wells, A. (2008). Metacognitive therapy: Cognition applied to regulating cognition. *Behavioural and Cognitive Psychotherapy, 36*(06), 651. doi:10.1017/S1352465808004803

Wells, A., & Mathews, G. (1994). *Attention and emotion: A clinical perspective.* Hillsdale, NJ: Lawrence Erlbaum Associates Publishers.

Wertheimer, M. (1959). *Productive thinking,* Enlarged Ed. New York, NY: Harper & Brothers.

Weststar, J. (2011). Staying current in computer programming: The importance of informal learning and task discretion in maintaining job competence. In D. W. Livingstone (Ed.), *Education & jobs: Exploring the gaps* (pp. 185–209). Toronto, ON: University of Toronto Press.

White, A. R. (1975). Conceptual analysis. In C. J. Bontempor & S. J. Odell (Eds.), *The owl of Minerva* (pp. 103–117). New York, NY: McGraw Hill.

White, R. W. (1959). Motivation reconsidered: the concept of competence. *Psychological Review, 66*(5), 297–333.

Whittaker, S. (2011). Personal information management: from information consumption to curation. *Annual Review of Information Science and Technology, 45,* 3–62.

Whittaker, S., Kalnikaité, V., & Ehlen, P. (2012). Markup as you talk: Establishing effective memory cues while still contributing to a meeting. *CSCW'12* (pp. 349–358). New York: ACM Press.

Wile, D. (1993). *After the fight.* New York: Guilford.

Wiley, J., & Voss, J. F. (1999). Constructing arguments from multiple sources: Tasks that promote understanding and not just memory for text. *Journal of Educational Psychology, 91*(2), 301–311. doi:10.1037//0022-0663.91.2.301

Winne, P. H. (2006). How software technologies can improve research on learning and bolster school reform. *Educational Psychologist, 41*(1), 5–17.

Winne, P. H. (2012). Should we expect experiments to advance cognitive science? Four criticisms and a remedy. In S. DiPaola (Director), *Defining Cognitive Science Talks,* Simon Fraser University, Burnaby, BC. Retrieved from http://www.sfu.ca/.

Winne, P. H. (2014). Issues in researching self-regulated learning as patterns of events. *Metacognition and Learning, 9*(2), 229-237. doi:10.1007/s11409-014-9113-3

Winne, P. H., & Baker, R. S. (2013). The potentials of educational data mining for researching metacognition, motivation and self-regulated learning. *Journal of Educational Data Mining, 5*(1), 1-8.

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 279–306). Hillsdale, NJ: Lawrence Erlbaum Associates.

Wissman, K. T., Rawson, K. A., & Pyc, M. A. (2012). How and when do students use flashcards?

Memory, 20(6), 568–579. doi:10.1080/09658211.2012.687052

Wolfe, J. L. (2000). Effects of annotations on student readers and writers. In *Proceedings of the Fifth ACM Conference on Digital Libraries* (pp. 19-26). New York: ACM Press.

Wolfe, J. L. (2001). *Pedagogical uses of annotations and annotation technologies* (Doctoral dissertation). The University of Texas at Austin.

Wolfe, J. L. (2002). Annotation technologies: A software and research review. *Computers and Composition, 19*(4), 471–497.

Wood, R., & Bandura, A. (1991). Social cognitive theory of organizational management. In R. M. Steers & L. W. Porter (Eds.), *Motivation and work behavior*, 5th Ed. (pp. 179–191). New York, NY: McGraw Hill.

WorkEZ Light. (n.d.). Retrieved from Uncaged Ergonomics: https://www.uncagedergonomics.com/, on April 9, 2013.

Worthen, J. B., & Hunt, R. R. (2008). Mnemonics: Underlying processes and practical applications. In H. L. Roediger (Ed.), *Cognitive psychology of memory*, Vol. 2 (pp. 145–156). Oxford, UK: Elsevier.

Wozniak, P. A., & Gorzelanczyk, E. J. (1994). Optimization of repetition spacing in the practice of learning. *Acta Neurobiologiae Experimentalis, 54*(1), 59–62.

Wright, I., Sloman, A., & Beaudoin, L. P. (1996). Towards a design-based analysis of emotional episodes. *Philosophy, Psychiatry, & Psychology, 3*(2), 101–126. doi:10.1353/ppp.1996.0022

Yamamoto, S. (Ed). (2013). *Human interface and the management of information (Proceedings of the 15th International Conference, HCI International 2013)*. New York, NY: Springer.

Yates, T., Khunti, K., Wilmot, E. G., Brady, E., Webb, D., Srinivasan, B., et al. (2012). Self-reported sitting time and markers of inflammation, insulin resistance, and adiposity. *American Journal of Preventive Medicine, 42*(1), 1–7. doi:10.1016/j.amepre.2011.09.022

Young, M. N., & Gibson, W. B. (1976). *How to develop an exceptional memory.* Chatsworth, CA: Wilshire Book Company.

Zhang, Y., Huang, S. C., & Broniarczyk, S. M. (2010). Counteractive construal in consumer goal pursuit. *Journal of Consumer Research, 37*(1), 129–142. doi:10.1086/649912

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25*(1), 82-91.

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