TOWARD A THEORY OF WEB-MEDIATED KNOWLEDGE SYNTHESIS: HOW ADVANCED LEARNERS USED THE WEB TO CONSTRUCT KNOWLEDGE ABOUT CLIMATE CHANGE BEHAVIOR

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ABSTRACT

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This dissertation utilized a multiple case study design to explore how advanced learners synthesize information about ill-structured topics when reading-to-learn and reading-to-do on the Web. Eight graduate students provided data in the form of think-alouds, interviews, screen video, digital trails, and task artifacts. Data analysis was based on abductive coding, first examining synthesis through the theoretical lenses of reading comprehension, Cognitive Flexibility Theory on the Web, and creativity, followed by a constant comparative exploration of emergent phenomenon in the data. The empirical findings from this study provided the foundation for a Theory of Web-mediated Synthesis comprised of interdependent elements - divergent keyword search phrases, synthesis for meaning, in-the-moment insights, repurposing, reinforcement and note-taking - which together lead to creative syntheses. Illustration and elaboration of these elements are provided in the context of two in-depth case studies. In doing so, this dissertation provides a post-comprehension lens through which to better explore and understand generative reading and learning activities on the Web.

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INTRODUCTION

This project demonstrates how eight advanced learners used the Web as they explored and applied ideas about an ill-structured topic. A *post-comprehension* perspective guided the inquiry, focusing on the generative reading experiences of participants. That is, the study examined how these advanced learners constructed knowledge that was neither explicit nor implied in the texts they visited, through a multifaceted process of Web-mediated synthesis.

The study provides five key contributions to the understanding of knowledge synthesis on the Web. First, based on a thorough review of existing literature, it re-conceptualizes the notion of synthesis by identifying and differentiating a distinction that to date has not been made clear in the literature, that of *synthesis for meaning* versus *generative synthesis*. Second, based on this re-conceptualization, the data provided across eight participants, and in-depth case studies of two of these participants, it proposes a theory for Web-mediated knowledge synthesis. This theory accounts for isolated incidents of knowledge synthesis in online environments and also explains how elaborate, iterative, and layered activities may ultimately lead readers to creatively synthesize knowledge that results in solutions to complex and ill-structured problems. Third, this study demonstrates that Web-mediated synthesis is itself complex, multiplicitous, unpredictable, and ill structured. Fourth, it explores the role of background knowledge in the synthesis process, differentiating it from idea-play and insight. Finally, this study presents how note-taking is integral to the process of Web-mediated synthesis, serving important functions that support all its various elements.

Several trends motivated this study. The first was the ongoing rapid technological change all around us, particularly as it relates to the Web. Given the ubiquity of the Web in modern culture, it is now a mainstay for educational, professional, and personal learning. At school, 90% of undergraduates use the Internet to look for information about their studies (Selwyn, 2008) easily preferring the Web to library resources (Griffiths & Brophy, 2005; Van Scoyoc, 2006). At work, 75% of professionals, executives, managers, and government workers use the Internet several times a day to complete job-related activities (Madden & Jones, 2008). And, at home, the Internet is used more commonly to explore common problems than advice from professionals, family, friends, newspapers, magazines, television or the library (Estabrook, Witt, & Rainie, 2007). This environment provides the foundation for a new ecology of information, of reading, of knowledge, of teaching, of learning, and of thinking.

This trend has far-reaching implications. Web users can take advantage of its ubiquity, the well directedness of search, and the "ambient findability" (Morville, 2005) of a seemingly unlimited scope of information, to harness an unprecedented adjunct to human memory. They can devote less time and cognitive energy to remembering what the texts they encounter say and revisit the meaning of those texts at any given moment. This can happen through the original online text itself, inline annotations or markups, or online database collections of user selected text segments. As such, use of the Web may allow for more time to engage in higher order thinking, such as creativity, analysis, integration, and problem solving (Anderson & Rainie, 2010).

The second trend motivating this study was school related. Technology "integration" initiatives still largely result in the widespread perception that technology is merely a "tool" (e.g., Schrum, 2005; Thieman, 2008) or an "information resource" (Kuiper & Volman,

Handbook, 2008) to supplement the traditional learning process. In fact, Edyburn (2003) suggested that many educators have a bias for the knowledge contained in one's head over that which can be facilitated with external devices, indicting a preference for educational performance through "naked independence." This has resulted in a disconnect between how these tools are used in schools and in the workforce. For instance, while students do not have access to the Web during high-stakes testing in the United States, they will have access to such technology resources in nearly every professional context for the rest of their lives. Policy makers in Denmark are starting to realize these issues and have made accommodations. Pilot initiatives in Denmark include laptops connected to the Web during high-stakes testing and the test questions do not ask students to regurgitate facts and figures (Hobson, 2009). Consequently, the present study was designed to begin to inform educators in the United States, and elsewhere, as to the foundational and potentially revolutionary implications this new ecology is effecting on thinking, reading, and learning, opening up more forward thinking educational environments like those in Denmark.

The third trend was also cultural. We live at a time in history of unprecedented complexity, which increasingly values integrated decision-making and creative solutions. From nutritional choices (Gunther, 2010), to health care options (Thaler & Sunstein, 2008), to retirement savings decision-making (Blaufus & Ortlieb, 2009), to prescription drug plan choices (Hanoch, Wood, Barnes, Liu, & Rice, 2011); individuals need to know how to harness the power of Web-based content to make informed choices in their lives. At work, fields from accounting (Friedman, 2004) to genetic engineering (Hollander, 2004) to teaching with technology (Mishra & Koehler, 2007) require creative solutions to complex, ill-structured, or "wicked," problems. A number of these issues are facing our citizens today on a broad scale, such as multi-party

regional water issues (Adams, 2001); genetic engineering (Hollander, 2004); cyber-terrorism (Mitroff, Alpasian & Green, 2004) and international economics (Schwab, 2001). Just knowing how to find or even understand information on the Web will not help develop solutions to any of this. We no longer live in an "information economy" but in an "age of complexity" (Schwab, 2011) for which new ways of thinking about thinking are required.

The fourth motivating trend emanated from the field of literacy. A variety of perspectives within this field explore the *new*, *multi,* or *informational* literacies of online reading and learning (e.g., see Hartman, 2000; Leu, Kinzer, Coiro, & Cammack, 2004; Moje, 2009; New London Group, 1996), many of which focus on the skills and strategies needed to *understand* and *make meaning* of the multiple texts provided on the Web (Afflerbach & Cho, 2009; Warshcauer & Ware, Handbook, 2008). Several of these perspectives also focus on the literacy skills and strategies needed to *produce* a variety of media elements (text, video, audio, multimedia) based on the near instant read/write capabilities of the Web. Literature on both media understanding and media production often incorporate the idea of synthesis, as defined by bringing elements together from various and often disparate resources. However, little attention is given to the potential for generative thinking (e.g., DeSchryver & Spiro, 2008; Coiro, 2009; Spiro, 2006a, b, c, d, e, f) when learners "act with the meaning" (Cho, 2011). Such Web-mediated generative thinking may bridge online media comprehension and media production by supporting the construction and flow of new ideas, resulting in a broader conception of synthesis, where synthesis becomes a creative activity.

The purpose of this study is to provide a theory from which to explore Web-mediated synthesis in greater depth, using the following broad question as a starting point: How do advanced learners synthesize new ideas in a Web-mediated learning environment? In this first

chapter, I explore the four theoretical lenses that guided my original understanding of synthesis on the Web. I then integrate these four perspectives and operationalize the term "synthesis" as starting point for the study, and conclude with the specific research questions that emerged from this literature review. Thereafter, Chapter 2 outlines the method utilized in this study, by describing the design, the tasks, and data collection and analysis procedures. Chapter 3 presents general findings across all eight participants. Chapters 4 and 5 report additional findings based on in-depth case studies of two individual participants. Finally, Chapter 6 summarizes and discusses the implications of these findings.

CHAPTER 1

THEORETICAL FRAMEWORK

Synthesis is a term used widely in both education and educational research. This means it has also been defined in a variety of ways. Therefore, at the outset of this study, I explored four separate theoretical perspectives to provide a foundation from which to operationalize synthesis: (1) reading comprehension research (2) hypertext and Web-based reading research, (3) Cognitive Flexibility Theory, and (4) creativity.

Reading Comprehension Research

Given that online reading utilizes many of the processes that are critical to offline reading (Leu, et al., 2008), I first explored the general literature on reading comprehension. Theories explaining offline reading indicate that extraction and construction of meaning from text (i.e. comprehension) is the result of the myriad possible transactions among various reader characteristics, text attributes, purpose/task, and context (Pearson, 2009; Rand, 2002). The phrases "reading-to-learn" (Sticht, 1979) and "reading-to-comprehend" (Kintsch, 1988; Mosenthal & Kirsch, 1991) describe reading activity where the primary purpose is to understand the text. However, once the meaning is understood, readers may also establish a "deep understanding of the subject matter, so that information acquired can be used productively in novel environments" (Kintsch, 1994, p. 294), or for a particular purpose or situational need (*National*, 2008). This latter conception of reading is often considered "reading-to-do" (e.g., Mikulecky & Drew, 1991; Sticht, 1975).

For the purposes of this study, the reading environment comprised of advanced learners reading multiple informational texts in both "reading-to-learn" and "reading-to-do" contexts. The most important contributions from offline reading comprehension research to the development of

this study derived from five areas: (1) prior knowledge; (2) informational text comprehension; (3) inferencing; (4) summarizing; (5) and, multiple text comprehension.

Prior knowledge. One of the primary activities documented by proficient readers is the ability to access their prior knowledge and connect or relate it to the text they are reading (Afflerbach, 1990; Anderson & Pearson, 1984; Clymer, 1968; Kintsch, 1998; Kintsch & Rawson, 2005). Prior knowledge includes general world knowledge, subject matter knowledge, knowledge of text structure (Coiro, 2007), and epistemic knowledge (Kardash & Howell, 2000). All contribute to successful understanding of text (Afflerbach, 1986; Weaver & Kintsch, 1991). Kintsch (1994) described this interaction between the text and the reader's background knowledge and experience as a construction-integration model whereby the information provided in a text (the internal meaning of the text, or text base) must be elaborated from the prior knowledge and then integrated with it to form the readers interpretation of the text (i.e., the situation model). Prior knowledge facilitates inferencing (Graesser, Singer & Trbass, 1984; Kintsch, 1990; Tarchi 2010), the process of determining the main idea when it's not explicitly stated (Afflerbach, 1990), text search success (Symons & Pressley, 1993), prediction strategy usage (Afflerbach, 1990), and the ability to link across texts (Strums & Braden, 2002). It is important to note, however, that prior knowledge can be both accurate and inaccurate (e.g., Kendeou & van den Broek, 2005).

Informational text comprehension. Significant differences appear in the literature when considering narrative versus informational text, including structure and purpose. While narrative texts primarily communicate a story, informational texts communicate information about the natural or social world, persuade people to think or do something, give directions, or tell a true story (Duke, 2010). Traditionally, informational texts include difficult and complex

topics, specific organizational structures (Chambliss, 1995), and specialized vocabulary, which make the text more difficult to understand and use (Coiro, 2007). The purpose of informational text is often to get the gist of, locate, or remember particular information (Brown, 2003; Dreher, 1993; Guthrie & Kirsch, 1987).

There are four categories of informational texts: (1) exposition, (e.g., textbooks, news stories and trade books); (2) argumentation and persuasive text (e.g., speeches, editorials, advertisements); (3) procedural text and documents (e.g., manuals, directions) (*National*, 2008); and, (4) nonfiction narrative (Duke, 2010). The arrangement of these varies, but they commonly follow one of five structures. A descriptive text provides attributes, specifics or setting information on a topic. A sequential text provides ideas grouped in order or time. A causal text provides cause-and-effect relationships between different ideas. A problem/solution text is divided into two parts of question and answer. Finally, a comparison text presents similarities and differences in a way that facilitates comparison, through contrasting or alternative perspectives. Successful readers of informational texts are able to make inferences about these different text structures to aid in their comprehension. They are able to identify connections between the text context and their background knowledge, and summarize text to express important ideas (Coiro, 2007; Kintsch & Kintsch, 2005; Weaver & Kintsch, 1981). Background knowledge of these structures and how to use them for comprehension is presumed to come from school-based training (Pearson & Fieldsing, 1991); however, school children typically get very little training in how to successfully read informational text (Duke, 2000).

In order to comprehend informational text, the reader must be able to seek and locate text information effectively. Several components have been noted to comprise this ability: (1) formulating a goal; (2) category inspection; (3) information extraction; (4) integration with

previous knowledge; and, (5) recycling until the goal is achieved (Guthrie & Kirsch, 1987; Guthrie and Mosenthal, 1987). In many cases, informational text comprehension is supported by the use of key search terms. Readers find information more easily when given these terms (Dreher, 1992), and single terms are easier to use than complex multi-word terms (Brown, 2001). This sort of information extraction is strategic and selective and is not considered reading to learn (Brown, 2003). Text characteristics in traditional offline texts that aid in information seeking behavior include: navigational tools (e.g., glossary, table of contents), titles, headings, typographic schemes (e.g. bolding, color, or punctuation), and graphic design (Brown, 2003).

Inferencing. Making inferences about text content is one of the nine basic reading skills (Davis, 1944) and is at the heart of the comprehension process (Dole, Duffy, Roehler & Pearson, 1991). It is a higher order activity (Cho, 2011; Greasser & Kreuz, 1993; Greasser, Mill, & Zwaan, 1997) based on the interactions among the text and the previous knowledge of the reader. Inferencing fills in details that are not explicitly stated in the text and allows the reader to elaborate on what is read (Dole, et al., 1991). Inferences can occur in the moment or when prompted after reading and are often a conscious act. Knowledge-based inferences result from activating generic and specific prior knowledge, the latter typically taking longer than the former (Graesser, Swamer, Baggett & Sell, 1996). Novel knowledge-based inferences build up a referential situation model of understanding (i.e. mental model) only after iterative interactions between prior knowledge and accumulating knowledge from multiple text sources (Just & Carpenter, 1992; Graesser & Britton, 1996). The result of inferencing is coherence at both local and global levels of the text.

Kintsch (1998) indicated that some inferences come from simple retrieval, while others result from active memory processes generating new information (Rouet, 2006). Automatic

retrieval inferences result from topic-specific associations between information in working memory and prior knowledge. Controlled retrieval inferences require a more conscious and extended search of memory for specific links based on cues in short term memory. Automatic generative inferences result from general world knowledge about the evolving mental representation of source material. Additionally, controlled generative inferences occur when deductive reasoning and logic help to fill in gaps in the text, which relies heavily on prior knowledge (Kintsch, 1998; Rouet, 2006). Together, these devices allow readers to "properly understand a text" (Kintsch, 1998, p. 189).

Summarizing. The ability to summarize text is also important to successful reading comprehension (Dole, Duffy, Roehler & Pearson, 1991). Good readers "sift through large units of text, differentiate important from unimportant ideas, and then synthesize those ideas and create a new coherent text that stands for, by substantive criteria, the original" (p. 244). These summaries can be "writer-based" or "reader-based." Writer-based summaries typically occur from text that is largely unfamiliar, and they are best written when the text is being read. The summary writer is not accountable for the amount of material summarized or the quality and mechanics of the summary. Writer-based summaries are, in essence, summary notes taken by the reader. Reader-based summaries are typically assigned tasks summarizing longer sections of text (e.g., an entire book or article) with more strict parameters on the length, grammar, and cohesiveness. As such, reader-based summaries change the goal of the task from comprehension of text to composition. Research suggests that the process of making of either type may facilitate learning (Brown, Campione & Day, 1981).

Hidi and Anderson (1986) described the process of text summarization in great detail, which includes comprehension, evaluation, condensation, and transformation of ideas in the

original text. During summarization, some sections of the text are deleted, while others are purposefully included in the summary. Condensation occurs by substituting higher level, more general concepts for lower level concepts with more detail. Finally, integration, combination, and transformation of text occur to provide the most accurate representation of the original text. According to Hidi and Anderson, "the major concerns of the summary writer, therefore, *are not how to plan and generate new content*…" (p. 472, emphasis added), but how to understand and encapsulate meaning that already exists within the text.

Multiple text comprehension. The comprehension of multiple texts is a complex task based on comparing, contrasting, relating, and differentiating information across various texts (Afflerbach and Cho, 2009). This can involve building intertextual links (Afflerbach & VanSledright, 2001; Hartman, 1995; Stromso, Braten, & Samuelstuen, 2003; Wolfe & Goldman, 2005), and requires constant revision of one's own understanding of and reaction to previous text (Hartman, 2000). Cho (2011) describes this process succinctly

> readers learn the content conveyed across different texts, relating the currently read text to previous texts, cross-referencing and extracting related information, assembling different ideas into globally coherent meaning, and continuously elaborating a cross-textual mental model—*synthesis strategies* are highly required in the construction of cross-textual meaning (p. 64, emphasis added)

Not only does comprehension occur for each document, readers must integrate the information across sources, and remember the source for new information (Rouet, 2006). There are three differences from single text comprehension. First multiple text comprehension focuses on source information. Second, readers of multiple texts must make distinctions between and corroborate information across documents. In doing so, multiple text comprehension may lead to

the updating of previous knowledge or beliefs (Johnson & Seifert, 1999). Finally, the multiple documents may complement each other and "fill in the gaps" of other documents by confirming or disconfirming inferences the reader may have made about them. Because each document typically only contributes to the overall understanding of the topic or situation, the reader is responsible for recognizing global relationships that can be integrated into a coherent whole.

These relationships manifest in several different ways and are understood through various strategies. The Theory of Documents Representation describes how these relationships emerge between and among sources. Based on this theory, content from multiple sources may include links that (1) support/oppose one another; (2) agree/disagree with one another; (3) show how texts are based on each other; (4) indicate a temporal relationship; (5) demonstrate the spirit of one another; and, (6) show how they may be relevant to each other (Braten, Stromso & Britt, 2009; Perfetti, Rouet & Britt, 1999). Hartman (1995) demonstrated that these connections may result from linking the same text (primary endogenous), another text in the current context (secondary endogenous), or texts outside of the current context (exogenous). Afflerbach and Cho (2009) identified a variety of multi-text linking strategies, including recursive reading and theme identification across texts, prediction of text content based on understanding of previous texts, identification of tentative meanings using other sources to reduce ambiguities, and building understanding through re-reading two or more texts to find links regarded previously as unrelated. These strategies are used to both deconstruct and reconstruct the linkages among texts (Hartman, 1994), and are critical to understanding across the landscape of texts available (Afflerbach & Cho, 2009).

Stromso, Braten, and Samuelstuen (2003) suggested that these relationships facilitate memorization, organization, elaboration, and monitoring, all of which can lead to greater textual

understanding. Memorization involves the selection and rehearsal of text information without moving beyond the content, whereas elaboration requires the reader to make intertextual links that make the content more meaningful, such as by offering analogies, providing examples, or describing personal experiences. Organization is when readers relate, group or order ideas from the texts, and monitoring is when readers assess or regulate their comprehension of the text. Integrating this information within the developing situation model results in a document model of coherent understanding that reflects not just one situation but a range of situations reflected by the documents considered together (Braten, Stromso & Britt, 2009; Perfetti, Rouet &Britt, 1999). Given the possibility of an "intertextual loop" (Hartman, 1994, p. 618) as readers revisit documents multiple times and create a mental web of meaning (Stromso & Braten, 2002), the reader's comprehension of the text can be continually updated.

Hypertext and Web-based Reading Research

Hypertext reading. The advent of hypertext systems for reading and learning brought about new considerations for reading comprehension (Bolter, 1998; Landow, 2006; Reinking, McKenna, Labbo, & Keiffer, 1998). Landow described hypertext as "an information medium that links verbal and non-verbal information…thereby creat[ing] text that is experienced as non-linear, or more properly, as multilinear or multisequential" (p. 3). This information includes text, video, sounds, animations, images, maps, and diagrams and there is not a specific beginning or endpoint. Bolter (1998) indicated that the primary feature of hypertext is its fluidity; each hypertext experience is a "set of different potential texts awaiting realization" (p. 5), which leads to an unstable and unpredictable environment. Activating links among the pages controls movement from page to page and readers determine their experience both by their own decisions and by the author's placement of embedded connections (Bolter, Burbules, & Callister, 2000;

Rouet & Levonen, 1996). Finally, readers of hypertext tend to focus on the macro-level of processing information, as compared to a micro-level for those with linear offline text (Alexander, Kilikowich, & Jetton, 1994).

Hypertext provides complications and requires skills and abilities beyond traditional offline text (*RAND*, 2002). Coiro & Dobler (2004) outlined the four primary differences between offline text and hypertext. First, because of the non-linear and multi-sequential nature of hypertext, readers must take a more active role in quality and coherence building. Second, because of the "hidden" navigations elements of hypertext, and the lack of semantic clarity and surrounding cues with hyperlinks, inference demands are higher. Third, the addition of hyperlinked images and icons requires readers to be able to decode and interpret more visual elements. Finally, the explicit intertextual representations create a more highly complex reading environment, both mentally and physically (e.g., as it relates to orientation within the texts).

Similar to offline text, the reader's experience with hypertext is primarily one of meaning construction (Bolter, 1998). However, while offline meaning construction is primarily invisible and internal, hypertext reading demonstrates more external manifestations of meaning making through the choices of links followed. Because of the increased complexity provided by the hyperlinking structure, certain skills identified for successful offline comprehension may be even more important when reading hypertext. For instance, "abstract link labels and incoherent transitions" (Coiro, 2007, p. 34) require increased use of inferential reasoning (Wenger & Payne, 1996). Based on such inferencing, Kim and Kamil (1999) demonstrated how successful hypertext readers were able to make effective predictions about what information specific links might provide.

The role of prior knowledge in hypertext comprehension is less clear than with offline

text. Some hypertext readers with low prior knowledge comprehension seem to have benefitted from highly organized and coherent hypertext (e.g. see Balyctiene, 1999; McNamara & Kintsch 1996; McNamara et al, 1996; Potelle & Rouet, 2003; Salermon, et al, 2005). Others demonstrated no benefits from structured overviews (Brinkerhoff, Klein, & Koroghlanian, 2001; De Jong & van der Hulst, 2002; Hofman & van Oostendorp, 1999; Mueller-Kalthoff & Moeller, 2003; Puntambekar, Stylianou, & Hübscher, 2003). This suggests that the "unstable" structure of hypertext may have an interaction with prior knowledge levels.

Finally, the, multiplicity of hypertext is important to comprehension. Salermon, et al., 2005) demonstrated that the more different texts read by a reader, the better textbase comprehension that emerged, especially for low prior knowledge readers. Salermon further suggested that this finding might indicate that high prior knowledge readers can fill in gaps from unread resources. Alternatively this may also suggest that the multiplicity and sheer scope of hypertext systems may allow for low prior knowledge readers to fill in their own gaps through well-directed and rapid movement around the knowledge landscape (e.g., see DeSchryver & Spiro, 2008).

Web-based reading. When readers move from more "closed" hypertext systems to an open online environment (i.e., the Web), the reading environment increases in complexity yet again (Coiro & Dobler, 2004; Eagleton & Dobler, 2007; Hartman, et al., 2010; Zhang & Duke, 2008). The scope of the information available on the Web as compared to closed systems provides qualitative differences in the effects of information multiplicity. The structure, form and context can change from day-to-day. Advertisements are common distractors to the reader's purpose. Web texts are more likely reflect hidden social, economic, and political goals (Coiro & Dobler, 2004). Modern Web-based search tools (e.g., Google) provide a wider range of services

and options than closed system searches, utilize sophisticated artificial intelligence algorithms, are "traceable," and can produce results in various different forms (e.g., visual, timeline). The rapid evolution of computing speed, server space, compression algorithms, and Web page design technology has facilitated increased multi-modal integration of more polished elements with greater attention to layout, visual, and graphic design. These modes of information delivery include newly available elements such as video with text comments embedded and "mash-ups" of multiple modes of data (e.g., maps with text, image and video data embedded). The Web is also a more interactive read-write medium employing a variety of technologies to incorporate "soft" resources (e.g. blogs) and real-time reader feedback on both soft and hard resources, such as through comments.

Several frameworks for successful reading on the Web explain these complexities in detail. The two that informed the development of this study were: (1) the new literacies of online reading comprehension (Leu et al., 2004; Leu, Zawilinski, et al., 2007) and, (2) Constructive Responsive Reading on the Internet (Afflerbach & Cho, 2009).

The new literacies of online reading comprehension. Support for the idea that new information and communication technologies (ICTs, including the Web) require New Literacies is strong and ever growing (e.g., Bruce, 2003; Coiro, Knobel, Lankshear & Leu, 2008; Gee, 2003; Karchmer, 2001; Leu, Kinzer, Coiro, & Cammack, 2004; Kuiper, Volman & Terwel, 2009; McKenna, Labbo, Keiffer, & Reinking, 2006). The notion of New Literacies applies to multiple fields of inquiry, from computer-mediated communication to media literacy to educational technology (Coiro, Knobel, Lankshear & Leu, 2008). A recent review of scholarship in this area proposed a set of shared characteristics across the various ways of operationalizing New Literacies. The broader New Literacies perspective is therefore identified by the following

assumptions: (1) the Web and other new digital technologies require new skills, strategies, social practices and dispositions for effective use; (2) new literacies are critical to taking part in the global ecology of digital information; (3) new literacies are rapidly changing; and, (4) new literacies are underscored by multiplicity (i.e., multimodal, multifaceted, multiperspectival) and may call for analysis from multiple disciplinary perspectives (Coiro, Knobel, Lankshear & Leu, 2008).

One of the most detailed frameworks available in this area is from the University of Connecticut *New Literacies Research Team,* specific to online reading comprehension (e.g., see Coiro & Dobler, 2007; Leu, Reinking, et al., 2007). It defines and delineates online reading comprehension "as a problem-based inquiry process involving new skills, strategies, and dispositions on the Internet to generate important questions, and then locate, critically evaluate, synthesize, and communicate possible solutions to those problems online" (Leu, Coiro, Castek, Hartman, Henry & Reinking, 2008, p. 323). Castek et al. (2011) provided further details on this approach. Their perspective assumes that Internet reading almost always starts with a question, and has the purpose of solving problems. Within that environment, generating effective keyword search strategies, inferring website usefulness from search engine results, and scanning for relevant material comprise the primary locational skills and strategies. These are referred to as the "circuit breaker" for online reading comprehension (Leu, Mcverry et al. 2009). That is, if you cannot locate information, you cannot read it. Critical evaluation of resources is considered more important than with offline texts, given the scope and diversity of resources encountered. Similarly, due to the multiplicity of resources, synthesis is crucial, since the reader must integrate separate and unique ideas. Another unique feature of the online environment is the close connection between reading and writing skills. For instance, online reading comprehension

includes using email, text messaging, chats, blogs, wikis, and discussion boards or video conferencing to solve problems.

Reading online utilizes some of the traditional elements of reading comprehension, such as locating main ideas, summarizing, inferencing, and evaluating (Coiro, 2003). However, this process is not considered isomorphic with offline comprehension (Coiro & Dobler, 2007; Educational Testing Services, 2005; International Reading Association, 2009; Leu, et al., 2005; *RAND*, 2002; Sutherland-Smith, 2002). For example, it involves self-directed construction of text and knowledge (Coiro & Dobler, 2007), while "readers navigate their own paths through an infinite informational space to construct their own versions of the online texts they will read" (Leu, et al., 2008, p. 323). Online reading comprehension also manifests as a collaborative and social practice, whereby the unique affordances of the media lead to gains in depth of understanding (Leu, et al, 2011). Some of the new skills needed to do this successfully include using a search engine, reading search engine results, scanning Web pages for relevant links, and knowing how to determine who authored information posted on a Web site. The *Taxonomy of Internet Comprehension Skills and Strategies* (*Taxonomy*) ("Taxonomy," n.d.) is a detailed outline of these skills derived mostly from the study of skilled K-12 students (Leu, Reinking, et al., 2007).

Constructive responsive reading on the Internet. Constructive Responsive Reading (Pressley & Afflerbach, 1995) explained basic offline reading comprehension through identifying content, content evaluation, and monitoring. Afflerbach and Cho (2008) extended this theory to explore fundamental changes in the architecture of reading fostered by the Internet. As they suggest, readers must address "novel or hybrid strategies that new reading situations create" (p. 85). These include a group of strategies considered unique to online reading that

address the various unknowns of online reading (e.g., possible links, texts, decisions, and interactions). They describe a process in which the reader is constantly "managing a shifting problem space" (Afflerbach & Cho, 2009, p. 212), which they claim does not have a counterpart in traditional reading, either in practice or theory. Specifically, readers must locate, identify and select appropriate texts and determine the order by which they are read.

Within this framework, Afflerbach and Cho (2008) outlined the constructive reading strategies found across multiple studies of Internet reading. These strategies are used in a "dynamic, recursive interplay" with those identified for traditional reading. In order to realize and construct potential texts, the reader must: (1) search for relevant Web sites; (2) focus searches by generating keyword phrases; (3) conduct complementary searches with revised keywords; and, (4) scrutinize, predict, and make inferences about the relevance and utility of hyperlinks. There are many skills required to identify and learn important Web-based information, including the ability to use search engines to construct meaning, search for information related to already established meaning, link to related sites beyond the original goal, use multilayer inferences across the three-dimensional space of the Web, revisit pages to revise constructed meaning, and combine disparate forms of information to construct meaning. Taking into consideration these "new or hybrid" strategies, several key points emerged. First, the role of inferencing expands compared to traditional texts and includes the need to make educated guesses about these unknowns. Inferences are now about the path as well as the content. Second, there is an increased emphasis on intertextual reading strategies for meaning construction, such that they become the "central aspects of the activities for constructing meaning" (Cho, 2011, p. 86). Third, search and keyword construction are central to the process of Web-based reading. Fourth, the goal of these strategies is to help the reader construct

meaning for the multiple Web texts explored. It is worth noting that while Afflerbach and Cho did not explicitly list synthesis in their framework, their description of the act of combining disparate forms of information from multiple websites and resources to construct meaning would represent a synthesis-like activity.

Other considerations for Web-based reading. Many consider the role of *prior knowledge* in Web-based reading environments to be equally central to the offline comprehension process (e.g. Calisir & Gruel, 2003; Potelle & Rouet, 2003). However, this is not always clear. For instance, Desjarlais and Willoughby (2007) found that access to the Web facilitated learning as measured in essay writing in similar ways for both high and low domain knowledge participants. In addition, Coiro (2011) noted, "prior knowledge of the topic may be somehow less important when reading on the Internet" (p. 360). This may be a result of the "new forms" of background knowledge available on the Web for in-the-moment schema construction. In particular, this may be due to the nearly unlimited scope of resources, speed of access, and increasingly well-directed searches available on the Web (Spiro & DeSchryver, 2010, LRA poster). At the same time, while the value of prior knowledge of the topic may be less important, the importance of prior knowledge of online text structure, website organization, and search engines may be even greater, increasing the complexity of Web-based reading (Eagleton & Dobler, 2007).

Another consideration in Web-based reading context is the role that *note taking* plays. Offline note taking enjoys an abundance of research. Kiewra (1989) outlined both the encoding and storage benefits of student note-taking in lectures. When reading, though the intention and function of note taking can be quite different than during a lecture, both the processing and review of notes also serves to deepen mental representation and comprehension (Slotte & Lonka,

1999). In several studies, processing notes alone was enough to increase comprehension. This was most often attributed to the depth of processing (Craik & Lockhart, 1972) attained. Learning gains from offline notes are also based in large part on the quality of the notes taken. For instance, summary notes enabled deep learning better than those taken verbatim, and organization, restructuring, storage, and integration of notes were key features for successful note-taking (Makany, Kemp & Dror, 2009). Verbatim notes helped the learner remember what the text said, but summary notes better facilitated understanding the connections between the new information and analogous situations (Kintsch & Kintsch, 1996). Makany, Kemp and Dror (2009) also found that non-linear note-takers significantly outperformed linear note-takes in both quantity and quality of learning. Most studies in this area assumed a model whereby learners take notes during a lecture or while reading, review those notes prior to a test or transfer task, and then undertake a test or transfer task without their notes. However, Slotte and Lonka (1999) demonstrated that the availability of notes during a transfer task resulted in better performance.

Though well researched in offline contexts, attention to the use of either traditional notes or new forms of note-taking available on the Web is minimal (e.g., see Stanford Faculty Senate, n.d.). For instance, although the *Taxonomy* ("Taxonomy," n.d.), identified note taking as an aspect of online reading comprehension, it did so as a component of communication, with very little detail. Though note taking on the Web does support similar intentions and functions to those taken offline, it also offers additional affordances. Online clipping systems facilitate both verbatim and summary notes. The availability of tags and keyword searching enhances the learner's ability to organize, recall, and integrate notes taken on the Web. Annotations are easily accommodated at the time notes are taken, or during revisitation and review. And, notes taken

online are also available in a variety of contexts and representations, including on the original Web page resource itself.

Equally important to how online notes can be taken or revisited is when they can be used. The ubiquitous nature of the Web underscores learning environments where both the Web itself and the personal Web one creates with notes and annotations are available while learning *and* during transfer tasks related to that learning. Government officials in Denmark piloted a program where its college students had access to the Web during their final year exams (Hobson, 2009). This is indicative of the new information ecology the Web is producing. The role of online note taking and the adjunct systems to support it in this new ecology is, at present, unclear and unstudied. As such, this study sought to identify whether note taking has a greater role in the online reading process, in particular whether it is an important component of knowledge synthesis for advanced learners on the Web.

Another important consideration is the potential significance of *keyword selection* and the *search process* to Web-based reading (e.g., Eagleton & Guinee, 2002; Eagleton, Guinee & Langalis, 2003; Guinee, Eagleton & Hall, 2003; Kuiper, Volman & Terwel, 2009). One of the key differences between offline reading/hypertext systems and the Web is the dependence and value of using keyword search phrases. For instance, Google is the dominant search engine on the Web, and keyword search is the "default standard" for Web based information retrieval (Wilson, 2009). Consequently, using a keyword search phrase is often the entry point for reading on the Web. Henry (2006) indicated that searching may be the most important new literacy skill for reading comprehension on the Internet, given that "all other decisions and reading functions on the Internet emanate from the decisions that are made during the search process" (p. 616). The results of Nachmias & Gilad's work prompted them to claim, "Web

searching is a nontrivial complex skill" (2002, p. 481). Similarly, Moraveji et al. (2011) wrote, "Formulating queries is a particularly complex task due to its reliance upon abstraction, vocabulary, domain knowledge, and grammar. Despite this complexity, query formulation is often the focus of explicit instruction because it is so central to Web search practice" (p. 2). Likewise, the International ICT Literacy Panel (ETS, 2002) indicated that access and retrieval of information is a key to ICT literacy. However, unlike those above who consider it a complex skill, this panel listed the ability to access information (which includes searching) as requiring the lowest cognitive complexity of the literacy process.

While the importance of this process is well documented, and both the Taxonomy and Constructive Responsive Reading on the Internet frameworks include the use of searching and keyword construction, neither is explicit about how this is done well. Research based on the construction of keywords in closed systems, such as online catalogs, provides some insight into this phenomenon. For instance, Bates (1979) outlined the use of "term tactics" in selecting and revising terms for search formulation in manual and on-line systems; Fidel identified 18 different "moves" in query formation for online searching; and Chen and Dhar (1990) explored query refinement and the role of subject and system knowledge for an online catalog. However, several considerations differentiate modern Web-based keyword search phrase development and use from these older systems. First, in Web-based reading tasks, search phrase use is fully integrated into the reading and learning process. Keyword search phrases guide Web-based readers from one resource to another *while* they are reading them. In comparison, library catalog search phrases used in the past were typically employed *prior* to the reading process. Second, modern search engines are highly sophisticated in their interactions with users. For example, keyword search phrase suggestions are now common in search engines like Google. Third, the

immediacy of results in Web searches allows for the results of one search to inform the next iteration of search. This dynamic changes the cognitive process of keyword search development (DeSchryver & Spiro, 2008, Spiro, 2006a, 2006b). Finally, the availability of "histories" on keyword search phrase use provides the potential for more review and study of metacognitive approaches to keyword search development.

Most Web searches are very simple. For example, Beitzel (2004) demonstrated that the average query length is 2.2 terms, and that 81% of users view only one page. Nachmias and Gilad (2002) also found that most of their undergraduate participants used trivial strategies for keyword development (i.e., single keyword search). Unfortunately, Britt and Gabrys (2001) demonstrated that many of these searches are unsuccessful. Studies comparing novice and expert Web searching demonstrated that experts have more complex information seeking strategies. Experts used more unique search terms, persisted longer, used varied strategies, visited more diverse resources, integrated more synonyms, and changed their search terms when searches were unsuccessful (Hembrooke, et al, 2005; Hsieh-Yee, 1993; Warwick, Rommer, Blandford, Gow, & Buchanan, 2009; Vakkari, 2001). "Double experts" (i.e., experts in both search and domain) selected search terms that produce better results in size and quality (Holscher and Strube, 2000), and some experts used more Boolean phrases (Holscher & Strube) while others did not (Aula, 2005). Collectively, this evidence may indicate that "expert" keyword phrases use Boolean logic, and/or that experts select the correct terms and do not need Boolean functions to be successful. Finally, many researchers have noted that prior conceptual knowledge influenced the ability of experts to select appropriate search terms (Hembrooke, Granka, Gay, & Liddy, 2003; Vakkari, 2002; Vakkari, Pennanen, & Serola, 2003).

The process of developing keyword search phrases has many necessary features. Lau and

Horvitx (1999) outlined several of these activities, including: generalization, specialization, reformulation, and interruption. Additionally, Rieh & Xie (2001) proposed that searchers must make parallel, dynamic, and alternative reformulations of searches all in the context of content, format and resources. Nachmias and Gilad (2002) further identified the use of general knowledge in keyword phrase formulation, specifically describing the value of the search words that were *not* mentioned in the search task bar.

The complexity of search terms is also linked to the type of task. When using a search engine on the Web the difference between navigation and exploration purposes is particularly important. White and Drucker (2007) found that "navigators" demonstrated few deviations in their search paths, tacked problems sequentially, and were more likely to revisit domains. On the other hand, the search paths of "explorers" branched frequently. Explorers submitted many different keyword queries, and visited many new domains. The authors suggested that these approaches to searching were related to both cognitive style and task. That is, navigators exhibited a "serialist" cognitive style (Pask, 1976), using local learning strategies, examining one idea at a time, and focusing on separate topics and the sequences that connect them together. However, explorers reflected a "holist" style, which was cognitively complex, applied a global approach to learning, and focused on the relationships between multiple ideas during the learning process. In this way, navigation was more appropriate for fact-finding tasks, and the variable behavior of exploration was more relevant to sense-making tasks.

Finally, it is possible that keyword selection requires expanding the role of inferencing and prediction in similar, but even more complex ways than do hyperlinks. Just as selecting a hyperlink involves inferencing about its relevance or utility (Afflerbach & Cho, 2008) and predicting what information it will provide (Eagleton & Dobler, 2007), readers may apply the

same processes to keyword search phrase development and selection. However, since the reader develops the keyword search phrases, the additional effort required may either represent additional extraneous cognitive load (e.g., Sweller, van Merrienboer & Paas, 1998) or be germane cognitive load. In the latter case, keyword development is an integral part of the meaning making process, as it helps the reader create implicit interconnections among the multiple resources encountered both before and after selecting that specific phrase (DeSchryver & Spiro, 2008).

Cognitive Flexibility Theory

When considering the parameters of Web-mediated synthesis for this study, both Cognitive Flexibility Theory (CFT) (Spiro, Coulson, Feltovich & Anderson, 2004) and Cognitive Flexibility Theory on the Web (CFT-W) (Spiro & DeSchryver, 2010) provided useful insights. CFT describes how to promote advanced knowledge acquisition of ill-structured topics, where learners "attain a deeper understanding of content material, reason with it, and apply it flexibility in diverse contexts" (Spiro, et al, 2004, p. 641). The foundation of this theory was based on seven features: (1) avoidance of oversimplification and overregularization; (2) the importance of multiple representations; (3) the necessity of cases; (4) the use of knowledge in practice rather than the abstract; (5) the employment of in-the-moment schema assembly; (6) the importance of multiple interconnectedness; and, (7) active participation and adjunct support for the management of complexity. CFT is a constructivist, or generative, theory in which each application of knowledge in use is different. It devalues storage or fixed knowledge and instead promotes the "mobilization of potential knowledge" (p. 649). This is accomplished through the flexible use of preexisting knowledge and through the acquisition of new knowledge in ways amenable to flexible application (Spiro, Feltovich, Jacobson, & Coulson, 1992). This flexible

use of prior knowledge is not based on the recall of intact schematic representations, but the re-assembly of multiple pieces of prior knowledge into a new "schema-of-the-moment."

In its early applications, CFT utilized the affordances of closed hypertext systems to promote these experiences. Using thematic coding systems, these hypertexts allowed for virtually limitless text configurations, non-linear multiple criss-crossings of the knowledge landscape, and conceptual combination and re-combination in a minimally guided exploration environment. In these systems, multiple juxtapositions of content were provided in rearranged instructional sequences, through revisiting the same materials at different times, in various contexts, with different purposes, and from different conceptual perspectives (Spiro et al, 1992). The time that it took to move from one resource to another was important in this environment. That is, the speed with which conceptual variability could be demonstrated across cases was essential to avoiding the long periods of time typical to more traditional linear learning environments. Use of these systems also inculcated an epistemological belief structure that was appropriate for learning about ill-structured ideas - a mindset that appreciated complexity and irregularity.

CFT-W is a revisitation and extension of CFT for the open hypertext-learning environment afforded by the Web (Spiro & DeSchryver, 2010). Several enabling affordances of the Web were identified through CFT-W, which support its fundamental cognitive and meta-cognitive processes. These enabling affordances include: a virtually unlimited scope of resources, near instant speed of access, extended opportunities for serendipity, availability of multiple in-line adjunct cognitive aids, non-linear random access, and the well directedness of search. Together, these affordances support several outcomes, including learner-initiated, complex, reciprocally-adaptive searching techniques; open mindsets for learning; new forms of

background knowledge for in-the-moment schema construction; virtual conceptual simultaneity; noticing unexpected connections; and transdisciplinary, interconnected boundary crossing. CFT-W is presented in much greater detail with illustrative examples in DeSchryver & Spiro (in preparation). Below, I highlight the primary extensions from CFT that guided and informed this study.

One of the key differences between CFT and CFT-W was the emphasis on searching. CFT-W also provided insights into the genesis of keyword search phrases. Spiro (2006e) wrote of this process:

> As you are going through this *ongoing process* (dynamic and unceasing), what it is that you are "studying" changes, evolves. Your searches are changing partly because 'what' you are searching for changes. The Web *teaches you* what the 'subject' is that you are trying to learn about. So you search differently, taking off from where you end up at a given time to next places that are at conceptually-oblique angles from the point of departure. Learners develop an *organic* relationship with the material they are learning from: in rapid turnover time, what they are trying to learn is affected by what they are finding, and that in turn affects what they are looking for (and how they look for it), until an *equilibrium* is reached – an accommodation between *you* (including what you already know and what you are coming to know), your *task*, and the *world*, as dynamically mediated by the Web (Spiro, 2006e, p. 5)

In doing so, the reader creates his or her own non-linear path through the Web. However, the links established between and among information resources are "externally oriented" as opposed to the internal guidance provided by the author-determined precompiled links.

The second feature of CFT-W that extended beyond the theoretical claims of CFT was the enabling cognitive affordance of virtual conceptual simultaneity. This process involves many ideas simultaneously being considered in the context of each other, across multiple resources, from which "*conceptual wholes greater than the sum of the parts* can form" (Spiro, 2006e, p. 2). Based on the enabling affordances of speed, scope, and non-linear random access on the Web and the associative cognitive process of spreading activation, ideas encountered by the learner from multiple sources appear "simultaneously" in functioning cognitive space. Experiencing the often-heterogeneous resources in this way may lead to the recognition of loose interconnections among them (i.e., connections that might otherwise not appear to the reader), including those not implied in the texts. In this way, virtual conceptual simultaneity may lead to generative thinking of the kind targeted in this study.

CFT-W also provided new insights into the role of prior knowledge on the Web (DeSchryver & Spiro, in preparation). As noted above, this role is more nuanced and less clear in hypertext in Web-based environments than with traditional offline text. First, it outlines how, when lacking adequate prior knowledge, a Web-based reader can use the virtually unlimited scope of resources available, well-directedness of search, speed of access, and non-linear access to fill in prior knowledge gaps that assist in assimilating and understanding the current text(s). Filling in knowledge gaps in this way may also minimize the misuse of prior knowledge, such as by helping to avoid the possible inaccurate recall of memories (Spiro, 1980). Second, given the ability to fill in these gaps in previous knowledge, low previous knowledge readers may also be able to make more inferences than they would otherwise offline (i.e., because inferences are often based on prior knowledge). Third, any inferences made on the Web can be instantly tested for accuracy and applicability to the task. Given the importance of inferences to understanding,

this ability to maximize the use of correct inferences and minimize the use of incorrect inferences may lead to greater understanding. CFT-W also demonstrates how prior knowledge, either traditional formats or that accumulated by filling in gaps in the moment, is used to construct keyword search phrases and decide which links to follow in search results.

Another key difference between CFT and CFT-W was how revisitation is achieved. In the closed hypertext CFT system, revisitation most often meant a reviewing of the same text. However, while revisitation of the same text on the Web is accommodated, so is the revisitation of the same idea, but from a different resource. In the latter case, an added dimension of multiplicity allows for even greater appreciation for the irregularity and complexity of ill-structured topics. As with CFT systems, however, this will likely only be accomplished once the appropriate scaffolds for learning on the Web in this way are established, since this added multiplicity may also lead to disorientation or cursory reading (Kuiper, Volman, & Terwel, 2005; Hannafin, Hannafin & Gabbitas, 2009).

Finally, CFT-W indicated how the combination of an open mindset and the ability to notice unexpected connections among the resources visited on the Web can lead to productive, serendipitous stumbling. When reading about an ill-structured topic, the multiplicity of resources available helps readers to understand that *"it's not that simple"* by demonstrating the irregularity of application. This can reduce temptations to over-generalize about ill-structured ideas and lead the reader to be more open to recognizing the value of accidental, unexpected, and otherwise ignored information. In generative reading-to-learn and reading-to-do tasks such as those utilized in this study, these sorts of experiences may also have the important outcome of facilitating synthesis of information.

Creativity

Of the higher order thought processes commonly associated with generative thinking, creativity is arguably the most popular of late. In popular media, the likes of Friedman (2005), Pink (2006), and Florida (2002) have all highlighted the importance of creative thinking in our schools and for long-term economic success. The International Society of Technology in Education has highlighted creativity in its first standard for both students and teachers (ISTE 2008 & 2009). As a result, promoting classroom creativity is often supported at the national level, in both developed and developing countries (e.g., Gunseli, 2006; Loveless, Burton, & Turvey, 2005; Park, Lee, Oliver, & Cramond, 2006; QCA, 2004; Williams, 2002).

Though creativity may be defined in a variety of ways, for the purposes of this study, it will be explained by a composite of definitions from: (1) Plucker, Beghetto, and Dow (2004) who defined creativity based on a survey of 90 creativity research articles; (2) O'Quin and Besemer (2006) who designed the Creative Product Semantic Scale (CPSS) and, (3) Mishra & Koehler (2008) who adapted the CPSS subset for elaboration and synthesis. For the purposes of this study, creativity was defined as:

> the interaction among *aptitude, process, and environment* by which an individual or group produces a *perceptible product or idea* that is *novel, useful, and whole* within a *social context*

The primary reason to examine creativity in the context of this study was to explore and emphasize the processes that resulted in new or novel ideas when reading on the Web, which aligns with the goals of generative thinking. However it is important to highlight the importance of utility and value; that is, in order to avoid the misconception that creativity is unbounded, creative ideas must be useful. Equally important is the proposal that creative ideas must be "whole," a term used by Mishra & Koehler to encapsulate the various subscales of the CPSS that

are intended to measure how organic, elegant, complex, understandable, and well-crafted something is. Finally, this definition makes clear that creativity is not typically a rapid in-the-head insight, but a complex process mediated not only by cognitive ability but process and environment (which in this study, refers to the Web).

Literature on the process of creativity provides insights into the generative thinking of interest in this study. Wallas (1926) first proposed that creativity is based on preparation, incubation, illumination, and verification. Osborn (1953) expanded these ideas to include orientation, ideation, and synthesis. The latter two are of particular interest in this study, defined as "piling up alternatives by way of ideas" and "putting the pieces together," respectively. The creative cognition explanation of creativity provides even more detail about how the generation, exploration, and integration of ideas occurs (Ward, Smith, & Finke, 1999). Creative cognition describes idea generation as a retrieval of existing ideas from memory, followed by associating or combining those ideas to form new, synthesized forms. Individuals may also use analogical transfer of ideas from one domain to another, and categorical reduction of ideas. During the exploratory phase, individuals may search for novel or desirable attributes, metaphorical implications, or functionality in an idea. They will evaluate the idea from different perspectives or within different contexts, interpret the idea as a possible solution to a problem, and identify practical or conceptual limitations to the idea.

The attention given to exploration and association in all theories of creativity makes clear the importance of both. Einstein referred to this as combinatorial play that helps to connect ideas and concepts that have rarely, if ever, been combined. Amabile, Hadley and Kramer (2002) described this as "throwing a bunch of balls into cognitive space, [and] juggling them around until they collide in interesting ways" (p. 52). Creativity of this type often requires that

this play occurs among disparate ideas for a long enough period of time to generate new idea spaces (McWilliam, 2009) or move ideas from one state to another (Jackson, 2006). As such, these descriptions comprise a perspective on creativity that values what will henceforth be referred to as "idea-play."

(Re)Defining Synthesis

As is apparent above, the concept of synthesis is introduced widely across fields of scholarship, from reading research to the creative process. However, the meaning of this term varies equally as widely. This complexity can be demonstrated by exploring one of the most common manifestations of synthesis for learning, Bloom's *Taxonomy of Educational Objectives* for the cognitive domain (1956). Though conceptualized as a creative activity leading to new and original wholes "with emphasis on creating new meaning or structure," words such as combine, compile, organize, rearrange, and summarize have all too often displaced the creative aspect of synthesis. It is clear from Bloom's original intent that combining, rearranging, and summarizing were *parts* of the process that could help lead to synthesis of new and original wholes, but this nuance is often difficult to parse. A reclassification of this *Taxonomy* (Bloom, 2001) helped to alleviate this issue, when Bloom re-named synthesis as creativity. Another common use of the term synthesis stems from the Big6 approach to ICT Literacy, which first describes synthesis using lower-order terms (e.g., organize and communicate), and then uses some examples that connote higher order thinking (e.g., create and generate), while using other examples that are associated with lower-order words (e.g., classify and group) (Eisenberg, Johnson & Berkowitz, 2010).

This level of complexity is also noted in the reading literature. As described above, the primary goal associated with synthesis in reading comprehension is to understand the *meaning* of

one or multiple texts. Cho (2011) described how synthesis strategies are required to achieve cross-textual meaning. Dole et al. (1991) use the word "synthesis" to describe summarizing, where readers synthesize ideas to create a new coherent text that *stands for the original*. Other theories of reading discuss "moving beyond the text," but stop short of describing how this leads to new ideas or knowledge. Instead, "beyond the text" in these cases connotes inferencing, which is tied to the author's implied meaning (Dole, et al; Kintsch, 1994; Scharere, Pinnell, Lyons & Fountas, 2005), to the reader's interpretation of content, to the author's intent in relation to the reading context (VanSledright & Kelly, 1998; Wineburg, 1991a, 1991b; Wolfe & Goldman, 2005), or to using ideas from the text in new settings (Clymer, 1968). For online reading comprehension, synthesis has been defined by the ability to sort relevant information from irrelevant information, organize and understand the texts available ("Taxonomy," n.d.) and assimilate multiple sources across multiple modes to construct meaning (Glister, 2000). In this way, the *Taxonomy* ("Taxonomy," n.d.), defines synthesis as "integrating information from multiple resources" across multiple texts and media types. Furthermore, the theory of Constructed Response Reading on the Internet accounts for this through a process of "combining disparate forms of information to construct meaning." None of these interpretations of synthesis connotes a generative process that moves the reader substantially beyond what is explicit or implicit in the text.

Cho (2011) extends the concept of meaning making from text in a quasi-generative way. Based on the Programme for International Student Assessment (PISA) 2009 Framework (Organisation for Economic Co-operation and Development, 2009; International Association for the Evaluation of Educational Achievement, 2009), he notes that the meaning making online "is most often a midpoint in the act of reading, where the meaning construction is followed by the

use of the meaning that is constructed from a variety of print and digital texts" (p. 39). He does so while emphasizing the situated nature of reading and comprehension. That is, "people read to *use and act with the meaning* they construct through the reading of the wide range of texts in different situations" (p. 39, emphasis added). However, acting with meaning in this way, may or may not lead to generative knowledge constructions.

One way to interpret the complexity of synthesis is to think of it in different levels. Low-level synthesis may involve combining, organizing, and summarizing that leads the reader to better understand and make meaning of text. Whereas, high-level synthesis results in creativity and knowledge generation on the part of the reader. Consistent with this idea, Eagleton and Dobler (2007) describe how strong readers synthesize ideas to understand what is being read by using inferencing and summarizing as they bridge ideas together from separate locations on the Web. This is considered low-level synthesis. They further assert that:

> At the highest level, synthesizing goes beyond determining meaning and moves into the development of a *new perspective or viewpoint*, also known as transformation. A reader's thinking changes based on her transaction with texts, as she comes to "own" her new ideas. (p. 38, emphasis added)

They go on to point out the complexity of the various elements of synthesis, for example, that "a synthesis takes a summary one step further by including the reader's personal response to the text in the form of connections to herself, other texts, and the world" (p. 201). Jenkins similarly described this concept of high-level synthesis as a process by which "multiple resources are combined to produce *new knowledge*" (2006, p. 94, emphasis added). It is this sort of high-level new knowledge synthesis that creativity describes, as well. Osborn's (1956) notion of synthesis included "putting the pieces together." However, as opposed the goal of meaning making in

reading comprehension theories, Osborn conceived of putting pieces together as part of a process to create novel and useful products or ideas. Ward et al. (1999) similarly described synthesis as the process that results in new ideas.

Given the importance of higher-order thinking and deeper learning on the Web (e.g., Kuiper, Volman & Terwel, 2005) the field is in need of greater attention to how learners integrate and understand resources being visited across multiple texts (Hartman, 1995, 2000; Leu, Zawilinski, et al., 2007) (i.e., how they engage in low-level synthesis), and then, how they solve problems with the Web by moving beyond information consumption to knowledge generation (i.e., how they engage in high-level synthesis). Coiro (2009) summed this up by stating that we need more research that explores "how to synthesize information (e.g. isolated data) with unique personal experiences and perspectives to *generate new knowledge* that can be acted upon in ways that help others" (p. 2, emphasis added). The focus on new knowledge that moves beyond meaning construction and understanding is why the current study proposes that high-level synthesis should be considered a "post-comprehension" perspective of reading online.

Based on these ideas, prior to meeting with participants, I operationalized the term synthesis in ways that were specific to the online learning environment. Since low-level synthesis resulted in meaning making, I defined this as "synthesis for meaning." High-level synthesis resulted in new knowledge construction, so I referred to this as "generative synthesis."

Synthesis for meaning. Synthesis for meaning occurs when readers on the Web organize, combine, compose, rearrange, rewrite, compile, and structure information in a way that facilitates their understanding of the multiple text(s) encountered (Duke & Pearson, 2002; Dole et al, 1991; Glister, 2000; Hartman, 1995; Leu, Zawilinski, et al., 2007; Mayer, 2000; Rouet, 2006; Stromso & Braten, 2002). Key components involve sorting relevant from irrelevant

information and organizing it effectively ("Taxonomy," n.d.), summarizing information (Dole et al, 1991; Hidi & Anderson, 1986), making inferences about the implied author meaning or intent (Dole, et al; Kintsch, 1994; Scharere, Pinnell, Lyons, and Fountas, 2005), and relating the text to background knowledge (Dole, et al., 1991). Skills that support synthesis for meaning include note taking, bookmarking, clipping, highlighting, and other forms of offline and online text management. The texts to be synthesized are available in multiple media formats (e.g., written text, audio, images, video, table, graphs), thus online readers must be proficient at summarizing information from multiple sources. They engage in a low-level synthesis by "…actively construct[ing] the text that they read through the choices they make about which sites to visit" and "putting together an understanding of what they have read" (Leu, Zawilinski, et al., 2007, p. 48). The result of synthesizing in this way is to make meaning of the text.

Generative synthesis. Two forms of generative synthesis were defined for the purposes of this study, Virtual Conceptual Simultaneity Synthesis and Creativity Synthesis.

Virtual conceptual simultaneity (VCS) synthesis. The first form of generative synthesis is called VCS synthesis, based on Spiro's enabling cognitive affordance of virtual conceptual simultaneity (VCS). It is a form of creative synthesis that happens "in-the-moment." While learning on the Web, multiple, heterogeneous resources are simultaneously "being considered in the context of each other" from which "*conceptual wholes greater than the sum of the parts* can form" (Spiro, 2006e, p. 2). This latter form of synthesis is more prevalent on the Web than with traditional offline resources given the possibility of the *virtual conceptual simultaneity* of resources. Because the online reader can rapidly click from one resource or idea to another, they may experience the associated cognitive process of spreading activation. Ideas accessed from multiple sources may be subject to "simultaneous" processing within the same functioning

cognitive space, and this can lead to conceptual breakthroughs. VCS synthesis is also likely to be task agnostic, whereby the conceptual whole that emerges will be related to the resources recently visited more so than the primary task or purpose for reading on the Web.

Creative synthesis. The second form of generative synthesis is called creative synthesis. In combination with the methods of synthesis described above and several other critical processes theorized to undergird creativity, such as incubation and iteration (Bruner, 1962; Csikszentmihalyi, 1997; Osborn, 1953; Sternberg & Lubart, 1999; Ward, Smith, & Finke, 1999), ideas may occur that serve as novel, effective, and holistic solutions (Mishra & DeSchryver, 2009) to a task. The creative cognition approach (Ward, Smith, & Finke, 1999) is particularly well suited to exploring and identifying Web-mediated reading and thought processes given how well most of these processes can be performed using keyword searches and other affordances of the Web. For instance, retrieval of ideas and associating or combining those ideas is supported by keyword search phrase use, especially when using compound keyword phrases. The Web also easily accommodates transformation of ideas to new forms, where readers can search for phrases in the main Google page and then switch to a Google Image search. And there are myriad opportunities for serendipitous encounters with information on the Web (DeSchryver & Spiro, 2008). Given the longer periods of time often associated with creative solutions, the results of this form of synthesis are typically task specific; the solutions that emerge will be more likely to be related to the primary task or purpose for reading on the Web than the resources just recently visited.

It is important to note two things about these three definitions of synthesis. First, they are not meant to imply that a synthesis activity is necessarily defined by any one of these processes. For this study, synthesis is considered a complex phenomenon, more appropriately represented

by a multiplicity of activities. Any single instance of synthesis could be represented by a combination of keyword construction, prior knowledge, summary, inference, and note taking. At the same time, creative synthesis might manifest as a combination of VCS and synthesis for meaning. Second, given the amorphous nature of synthesis, this study was also designed to allow for emergent forms of synthesis to occur that were not described by the definitions above. In this way, the study might provide some insight into this complex process.

Research that focuses on synthesis for learning on the Web has, to date, been primarily framed through the synthesis for meaning lens noted above, and has proven difficult to observe (e.g., Leu, Zawilinski, et al., 2007). This study expanded beyond that framework, and sought to provide evidence of all three types of synthesis in advanced learners. In doing so, it addressed the challenges of studying synthesis in four ways. First, by working with advanced learners, it was expected that synthesis of all types would occur more often than with K-12 learners and that advanced learners would be better able to articulate their synthesis experiences through think-alouds and interviews. Second, the tasks provided to participants in this study were specifically designed to promote synthesis, especially during the second, reading-to-do task. Third, the coding system for data analysis allowed for multiple codes to be assigned to any given reading activity, which provided a level of appreciation for the complexity of online reading. Finally, this study used an expanded the definition of synthesis which allowed new forms of synthesis to emerge. This provided both a wider and more specific net with which to categorize related online activity.

Chapter Summary

This chapter reviewed the essential components of four different theoretical frameworks that informed a reconceptualization of synthesis when reading online. The reading

comprehension literature contributed important ideas about prior knowledge, informational text, inferencing, summarizing, and multiple text comprehension. The hypertext and Web-based reading literature highlighted how readers are required to take more active roles in complex, non-linear, multi-modal environments and the specific skills and strategies required for successful comprehension therein. The CFT and CFT-W literature offered further support for the importance of searching, virtual conceptual simultaneity, and prior knowledge on the Web. Finally, the creativity literature contributed specific processes that undergird generative thinking.

Collectively, these four areas of scholarship helped re-define synthesis. First, the reading comprehension, hypertext, and Web-based reading literatures offered traditional conceptions of synthesis. In these traditions, synthesis leads to understanding both explicit and implied ideas in the texts being read. I categorized all synthesis activity related to this as *synthesis for meaning*. The CFT, CFT-W, and creativity literatures helped extend this notion of synthesis with two forms of *generative synthesis*. CFT-W offered the idea that virtual conceptual simultaneity on the Web can lead to "new" ideas on the part of the reader, and creativity scholarship helped outline the idea the creative synthesis is an integrated reading activity leading to novel, useful, and whole solutions.

Based on this re-conceptualization of synthesis, I conducted a qualitative study of the synthesis skills and strategies used by advanced learners on the Web to answer the following research questions:

1. How do synthesis for meaning, VCS synthesis, and creative synthesis manifest for advanced learners in Web-mediated reading-to-learn and reading-to-do environments?
2. What other forms of generative synthesis emerge from the data, and how do they

manifest, for advanced learners in Web-mediated reading-to-learn and reading-to-do environments?

3. How do synthesis for meaning activities and generative synthesis activities interact for advanced learners in Web-mediated reading-to-learn and reading-to-do environments?
4. What role does background knowledge play to support the knowledge synthesis of advanced learners in Web-mediated reading-to-learn and reading-to-do environments?
5. What role does note taking play to support the knowledge synthesis of advanced learners in Web-mediated reading-to-learn and reading-to-do environments?

CHAPTER 2

METHOD

Chapter Introduction

This chapter presents the qualitative methodologies used in this study. It details the design, participant selection procedures, task development, data collection, research session details, and data analysis procedures used to investigate the five main research questions.

Design

This study utilized a multiple-case study design and multiple methods of data collection and analysis to triangulate findings.

Participant Selection Procedures

This study utilized purposive sampling (Patton, 1990) to identify eight highly literate advanced learners (i.e. doctoral, graduate business, and law students), who demonstrated using the Web in sophisticated ways for learning, indicated a comfort with thinking out loud, and represented a diversity of backgrounds and experiences. Several factors guided the choice to explore advanced learners. First, studying experts has historically provided important contributions to the learning sciences (e.g., Berliner, 1986; Chi, Feltovich & Glaser, 2005; Ertmer & Newby, 1996; Pressley & Afflerbach, 1995; Wyatt, Pressley, El-Dinary, 1993). Second, the advanced learners utilized in this study all successfully passed validated measures of high offline reading in their entrance to a nationally recognized graduate school (GRE, GMAT or LSAT). Third, the use of advanced learners increased the likelihood of synthesis interactions on the Web as compared to the K-12 students most often used in studies of Web-based reading (e.g.,

Coiro & Dobler, 2007; Leu et at, 2004), where synthesis has been very difficulty to identify. Finally, recent work by DeSchryver & Spiro (2008; in preparation) provided illustrations of several skills that may be unique to advanced learners on the Web. For instance, they indicated that advanced learners may use sophisticated methods for locating information on the Web that involve an organic and reciprocal relationship between the learner and the knowledge landscape of the Web. They also proposed that advanced learners rely on an integrated method of "triangulation" for resource evaluation that becomes part of the text comprehension and learning process (DeSchryver & Spiro, 2008). Finally, they suggested that advanced learners often benefit from utilizing Web learning skills and cognitive processes in concert, and not in isolation.

Ensuring a diversity of experiences and backgrounds in the final sample was important to maximize exposure to different ways of thinking. That is, as Zerubavel (1995) noted, university learning can create mental "walls" and "moats" that lead to mental rigidity within disciplines. In addition, Coiro & Dobler (2007) noted how different types of readers might demonstrate different strategic knowledge and ability to describe this knowledge. A diversity of participants thus maximized the potential for this study to document a variety of different synthesis skills and strategies in advanced learners.

The selection process started with an online survey, administered to identify advanced learners who demonstrated the potential to use the Web in sophisticated ways for learning. The survey was largely researcher generated based on the researchers knowledge of these constructs, a strategy described by Netemeyer, Bearden & Dharma (2003). It also used questions adapted from the *Survey of Internet Usage and Online Reading* ("Survey", 2003). Three experts in the field of Web-based reading and learning established content validity by judging how well the survey reflected the intended constructs (Netemeyer, Bearden & Dharma, 2003). Based on their

feedback, I modified the survey, and then re-administered it to ten education graduate students and practitioners to elicit feedback on its clarity, presentation, form and length (Litwin, 1995). The survey contained questions about general Web use, Web use for learning, knowledge of the Web, use of Web-based tools for learning, and advanced Web use for learning. Within these categories, the participant's ability to use keywords, comprehend multiple Web texts, make inferences about those texts, and make unique insights about those texts was measured. The survey also asked each respondent to rate the comfort level with thinking out loud in a face-to-face research session. As used it was 45 minutes long. More than 500 doctoral, graduate business and law students received an invitation to the final survey via email. Eighty-one completed the survey. From these eighty-one surveys, I identified the top eight responses based on the criteria above. Three experts in the field of Web-based reading and learning verified these eight respondents as advanced learners who demonstrated the potential to use the Web in sophisticated ways for learning. All eight respondents agreed to participate in the study. Each collected a stipend for their time.

The eight participants who participated in this study were Beth, Janet, Jim, Jeff, Karen, Molly, Olivia, and Troy (all names are pseudonyms). Five females and three males participated. Their backgrounds were as follows: one law student and seven doctoral students from the fields of education, philosophy, criminal justice, computer science, food science, economics, and zoology. The average age of the participants was 32 years old. They reported averaging more that 4 hours of Web use on a typical day, including an average of between 3 and 4 hours of Web use for learning. The average self-assessment score on a scale from 1-5 (beginner-expert) for a series of five questions related to finding, organizing, and evaluating information on Web sites

was 3.9. The average self-assessment score for a series of three questions related to synthesizing information and using the Web for creative solutions and conceptual breakthroughs was 3.4.

Tasks

The specific task prompts chosen for this study reflected the following characteristics: (1) highly ill-structured; (2) of general interest to the participants, but not topics so common that participants would likely know a lot about them; (3) not too broad, not too narrow; (4) two clear sides to explore and extensive resources available for both; and, (5) "Wikipedia unfriendly" - results based on the initial expected keywords did not include Wikipedia on the first page. After two separate pilot tests with five doctoral students in education, feedback from them about the clarity or questions, and analysis of the results provided, the following tasks emerged:

> Reading-to-Learn Task: *Please use the next hour to learn about why some people make decisions to change their behavior in ways that may lessen the effects of climate change and why some people do not choose to change their behavior in ways that may lessen the effects of climate change. Please use the learning time you have to prepare as if you are going to be part of a public panel on this topic that will represent a diversity of perspectives*.
>
> Reading-to-Do Task: *After such a good showing in the public panel about individual choices related to climate change, you have been hired by an environmental non-profit.*
>
> *Your first day on the job, the Director of the non-profit asks you to come up with some new, creative ideas about how persuade three specific groups of people to voluntarily change their behavior in ways that will help lessen the effects of climate change: (1) college students; (2) high SES professionals; and (3)*

individuals with strong religious affiliations. The Director would like to hear any thoughts you have about targeting these three groups at the afternoon staff meeting 45 minutes from now. Though the Director was clear that your ideas should be new and creative, he also indicated that they should be back up with some evidence of their potential to be successful strategies.

The first task replicated the sort of open-ended reading and learning on the Web that is common in schools, at work, and at home. The second task was intended to elicit a creative synthesis of the type outlined above; that is, it requested a perceptible idea that was both novel and useful within a situated social context.

Two arguments guided the choice to focus this study on ill-structured topics. First, there is an increasing need for learners of all ages, both in schools and out, to better understand complex, ill-structured problems. This includes myriad fields of knowledge such as accounting (Friedman, 2004); multi-party regional water issues (Adams, 2001); genetic engineering (Hollander, 2004); cyberterrorism and changing weather patterns (Mitroff, Alpasian & Green, 2004); and, teaching with technology (Mishra & Koehler, 2007). Second, the learning affordances on the Web appear to match very well with the unique needs of learning about ill-structured topics (DeSchryver and Spiro, 2008; in preparation). That is, among other things, learning ill-structured topics requires multiple open representations; real-world cases with naturally occurring and ecologically based integration and interconnectedness; an open-mindset (which learning on the Web may actually facilitate); and the ability to criss-cross the knowledge landscape from multiple directions (DeSchryver & Spiro, 2008; Spiro & DeSchryver, 2008). As a precursor to Web-based learning, closed hypertext learning systems (e.g., Cognitive Flexibility Systems) demonstrated these characteristics (Mishra, Spiro & Feltovich, 1996) and provided

learning benefits in ill-structured domains (Jacobson & Spiro, 1995). The Web provides similar learning affordances.

Data Collection

Each participant met with me for approximately 2.5 hours. During the first five minutes, I recorded each participant explaining his or her background and experiences with the topic of climate change. Then, they practiced thinking aloud for 10 minutes while using the Web to learn about Thomas Malthus' main ideas about population growth and using any techniques or strategies for saving and organizing information that they might need to prepare for a test, presentation, paper, or important discussion about this subject. Each participant had a pad of legal paper, pens, and access to any digital resources (software or Web tools) they requested to do the tasks. Their computers had the Firefox browser with an empty Google search page open, one page on each of two monitors. Thereafter, I gave each participant a printout of the first reading-to-learn task spelled out above and the following instructional text:

> *Explore what you can discover that you don't already know. Be open to new ideas. Try not to get stuck in ruts; that is, don't allow your learning and searching to close down on any one Web site or particular idea. This is a complex topic that necessitates sophisticated and open learning strategies to even begin to fully appreciate it. Also, continue to use any techniques or strategies for saving and organizing information that you think you might need to prepare for this panel.*

I reminded them to think aloud constantly and told them that they would be reminded to do so if they remained silent for any period of time.

Once the participants began this task, verbal protocols, screen video, and digital trails gathered data. The software system Morae collected video of their screen and the audio of their

think aloud comments, as well as metrics on the Web browsing conducted. I watched the video of each session from a remote computer in real time, and coded the video stream based on a preliminary coding scheme derived from the theoretical framework above.

After each reading-learn task, I interviewed and audio taped each participant for approximately 15 minutes about the task. The protocol for this interview reflected informal conversational interview and interview guide approaches to interview research (Patton, 2002). That is, I designed the protocol based on the theoretical framework above to guide the process (i.e. as an interview guide), including questions about locating information, evaluating information, synthesizing information, and note taking. However, I conducted the interviews as informal conversations, since such an environment offered the "maximum flexibility to pursue information in whatever direction appears to be appropriate, depending on what emerges from observing a particular setting…" (p. 342).

Upon completion of the first interview, I gave each participant a printout of the reading-to-do task. I provided similar directions about goals, mindset, techniques and strategies, as noted above. The data collection procedures reflected those carried out in the first task, and one final retrospective interview finished the session in a similar fashion to the first.

The Research Sessions

I carried out the research sessions in campus meeting rooms one participant at a time. Participants varied in their ways of reacting to the environment provided and completing the tasks outlined. All of them demonstrated an acceptable comfort level with thinking out loud in a short amount of time (i.e., I asked all of them to stop "practicing" earlier than the 10 minutes allocated for this in the design plan). Everyone revisited the task instruction right away, re-reading it to him or herself, annotating it (e.g., underlining key words or writing short notes on

the task paper) or highlighting important ideas in it (e.g., emphasizing out loud that the task was specifically interested in the "why" people do or don't change behavior). The choices about what to do first varied across participants and tasks. In the reading-to-learn tasks, many started immediately with open ended Google searches - [green living tips], [opinions on climate change], [climate change] (twice), and [why aren't people more concerned about climate change]. Both participants who used the generic (and somewhat unexpected) [climate change] search phrase navigated to Wikipedia right away to refresh their memories about climate change. Others took some time to note their own thoughts about the question. One took a short time to make a bullet list of reasons in her notes – fear, guilt, compassion, change is difficult, don't care about environment or other people, not hearing messages, don't know what to do, overwhelmed, burying head in sand – followed soon thereafter by a search of [behavior change related to climate change]. Two others took extend time to think out loud about what they already knew and take some notes. For example, Janet started right away by saying the following:

> "I would just write down a couple assumptions on what I think they might be doing. You know…so climate change is real…so then some people I would think one of their questions is going to be yes, but what can I do at an individual level that really makes an impact? And, is there any proof that if I do alter behavior it does make an impact? Because I think that' ultimately, from what I already know about this, it seems a lot of people just figure that what they do doesn't really matter…whether they use paper bags or plastic bags, they don't seen the impact on climate...and getting back to the original idea that they don't believe its really occurring, or is it really occurring at a rate that is relevant to them. And that's

> probably the biggest problem. Reminds me of when my parents, for years I was talking to them about the importance of well heads, and they totally ignored it until the people across the street starting having well problems because a new development, and suddenly, it became pertinent to them, and they suddenly became all conservative about – gee we have to protect out well heads – and I'm thinking yeah we saw that before, but you weren't interested until it actually directly impacted you. And, unfortunately, it seems like that's human behavior in a nutshell. So, what we're going to do now it to find out what specifically has been looked at in terms of why people change behavior or don't change behavior so that I can be educated here for this public panel."

After planning to find out what the average person finds on the Web (misinformation and otherwise), and then looking for the actual facts about climate change, she then searched for [attitudes toward climate change] five minutes after the task started.

During the reading-to-do tasks several participants again started right away with quick searches - [how to lessen effect of climate change] [how to change behavior climate change], [college students and climate change], and [how to convince Christian right wing people to be concerned about climate change]. The others spent anywhere from two minutes to seven minutes listing out how they thought the three groups identified might be convinced to change their behavior related to climate change, then commenced with searching. Several made reference to articles or ideas from the first session, but only two specifically visited any sites initially from that first session.

From there, the skills and strategies for completing the tasks varied. Most used the primary search option (Web) on Google. A few used Google scholar. One searched extensively on Amazon for books related to this topic. Another used the online library catalog at her university quite a bit. The keyword search phrases used were almost entirely different from participant to participant. Several participants used PDF files available from the Web. A few used bookmarks, but otherwise, no adjunct aids were used to organize information. Most used multiple tabs in the browser, and three did this extensively, as shown in Figure 1.

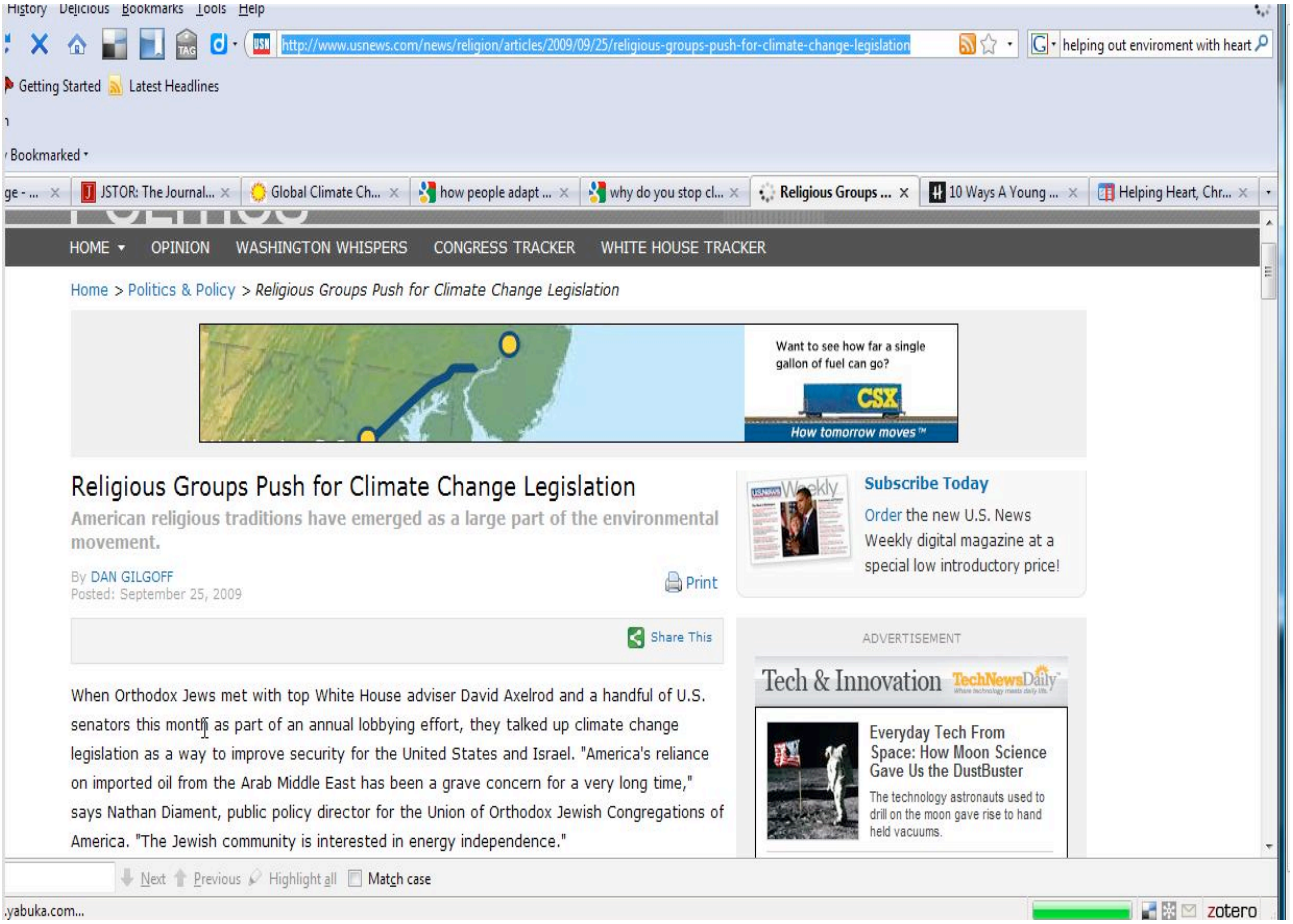
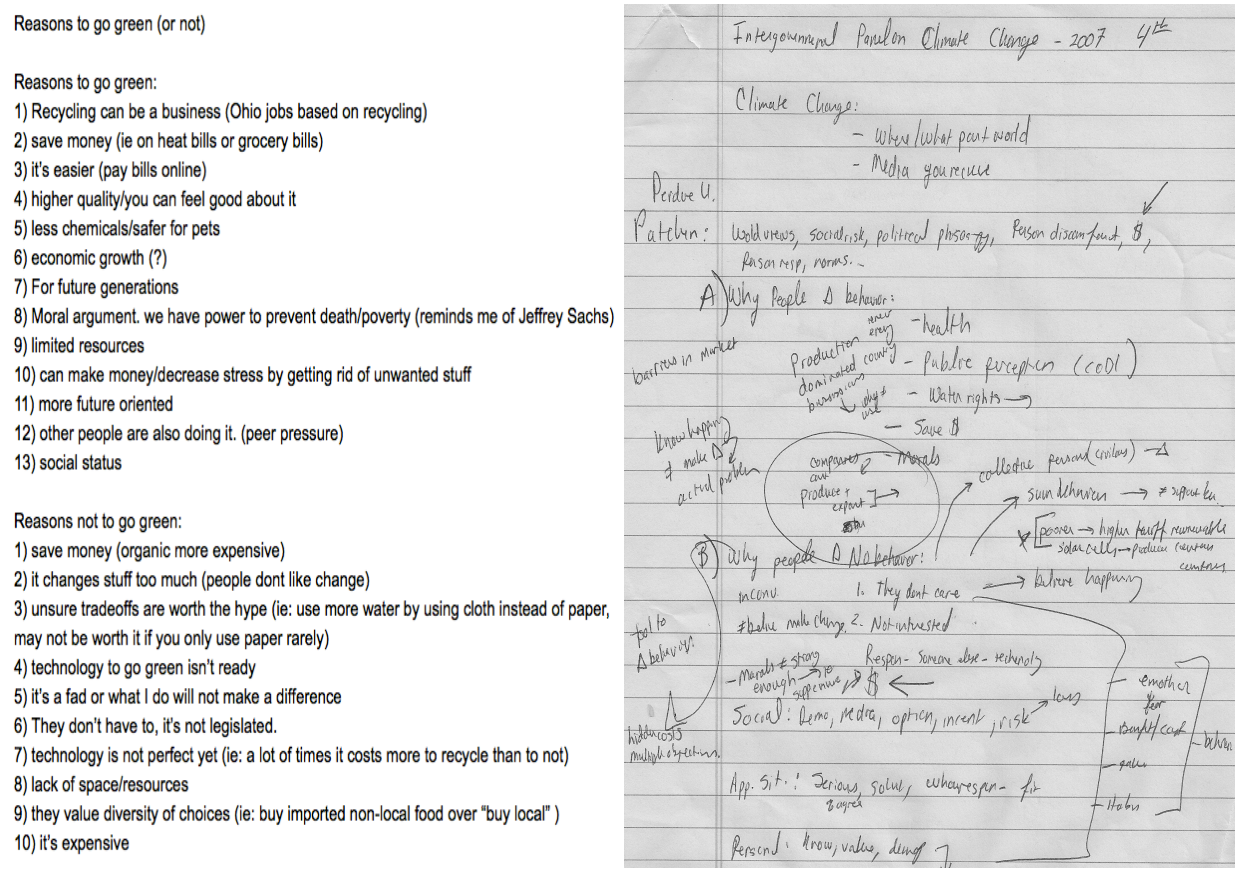


Figure 1. Use of multiple tabs in the browser. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation. The text in this figure is not meant to be readable. The figure is meant to demonstrate the use of multiple tabs, regardless of their content.

Everyone took some notes; three used only the legal pad provided, one started on the pad and extended her notes in Microsoft Word, one used Google Docs exclusively, two used Microsoft Word with a few additional offline notes, and one took a very few notes on the legal pad. Among those taking notes on the computer, bullet points, lists, and outlines were common; offline notes also included lists, but they were more freeform in their structures (e.g., see Figure 2). Among the seven taking extensive notes, between two and five pages of notes were completed. Each participant had access to two monitors during the tasks (a laptop and an external monitor). Only two participants made use of the external monitor in any significant way, mostly to take notes while Web browsing on the main laptop monitor.



Reasons to go green (or not)

Reasons to go green:
1) Recycling can be a business (Ohio jobs based on recycling)
2) save money (ie on heat bills or grocery bills)
3) it's easier (pay bills online)
4) higher quality/you can feel good about it
5) less chemicals/safer for pets
6) economic growth (?)
7) For future generations
8) Moral argument. we have power to prevent death/poverty (reminds me of Jeffrey Sachs)
9) limited resources
10) can make money/decrease stress by getting rid of unwanted stuff
11) more future oriented
12) other people are also doing it. (peer pressure)
13) social status

Reasons not to go green:
1) save money (organic more expensive)
2) it changes stuff too much (people dont like change)
3) unsure tradeoffs are worth the hype (ie: use more water by using cloth instead of paper, may not be worth it if you only use paper rarely)
4) technology to go green isn't ready
5) it's a fad or what I do will not make a difference
6) They don't have to, it's not legislated.
7) technology is not perfect yet (ie: a lot of times it costs more to recycle than to not)
8) lack of space/resources
9) they value diversity of choices (ie: buy imported non-local food over "buy local")
10) it's expensive

Figure 2. Computer based versus written notes. The text in this figure is not meant to be readable. The figure is simply intended to demonstrate linear vs. non-linear note-taking.

Only three times did I ask a participant to continue speaking out loud, and once I asked someone to speak louder. The participants asked very few questions of me, primarily about things like where to take notes, if they should bookmark or just say they would bookmark, and other logistical issues. There were no technical issues with the equipment being used in the research sessions, either by the participants for their tasks or with data collection, save for one instance of a slow Internet connection which lasted about one minute.

Data Analysis

The think aloud data and screen video captures served as primary data sources for this study. My analysis of this data used abductive (Morgan, 2007) coding that started deductively and then inductively added new codes that emerged from the data. I first listened to the think aloud audio and watched the concurrent screen video several times in order to gain a general sense of the data (Tesch, 1990). Then, the coding was conducted.

The first coding pass on the data focused entirely on synthesis moments, using codes for (1) synthesis for meaning, (2) VCS; and (3) creative synthesis. In approaching the data, the notion of propositional clusters (van dijk & Kintsch, 1983), whereby the unit of analysis comprises a "cluster of propositions focused on the same idea" (Coiro & Dobler, 2007, p. 227), provided the initial parsing lens. I soon adapted it to identify the data as "synthesis clusters" comprised of propositions that defined an instance of at least one element of synthesis, given the complexity and multiplicity of the clustering found to frame the synthesis taking place.

During this first coding pass, several instances of synthesis type experiences emerged that were not explained by the preliminary coding system. As such, I followed an iterative process of modifying the existing codes and generating and applying new codes, as outlined by the constant comparative process (Bogdan & Biklen, 2003; Dye, Schatz, Rosenberg, & Coleman, 2000;

Merriam, 1988). Once I identified a new set of codes, I utilized experts in the field of online reading to evaluate them. I first asked these experts to provide a critique of the final coding schemes used and developed over the course of this analysis. Then, I showed them multiple samples of each synthesis element. As was the case with Hartman (1995), the primarily purpose of this exercise was to confirm or disconfirm the "perceptions, hypotheses, and interpretations" made during the construction of these elements. There was 100% agreement (with minor tweaks in descriptive language) regarding the elements discussed with these experts. Based on their feedback, I finalized codes for six elements of Web mediated synthesis - divergent keyword searches, synthesis for meaning, in-the-moment insights, repurposing, reinforcement, and creative synthesis. I then conducted one more pass through the data to re-code synthesis experiences (i.e., based on the final code definitions, some forms of synthesis were changed to others).

Thereafter, I performed one additional coding on two of the participant's data (Beth and Olivia) to inform the in-depth case studies provided below. This pass provided information about the conditions for synthesis that appeared in the data. That is, consistent with the allowance for multiple codes in this study, each synthesis proposition was revisited and codes related to note-taking and background knowledge were applied to the data stream just prior to, during, and just after the synthesis proposition. Two expert raters determined interrater reliability of the application of these codes. These raters were shown 10% of the synthesis moments coded in each category applied in Olivia and Beth's data (the case study text in chapters four and five includes most of the examples). The initial interrater agreement for these examples was 50%. After discussion, we agreed on 90% of the examples. We also agreed that the final 10% on

which we disagreed were complex interactions that could accurately be coded several ways or with multiple codes.

As it relates to reliability, it important to note that I concentrated the bulk of my efforts to establishing reliability in two specific areas. First and most importantly, I wanted to have full agreement based on the synthesis elements that were initially proposed (and subsequently revised) and those that emerged during the study. Once reliable corroboration of these categories emerged, they did not change and there is high confidence and agreement associated with them. Secondly, given the thickness of the descriptions provided below in the case studies, I wanted a high level of reliability of the application of theses coded based on the examples provided therein. This was achieved as well. As this paper evolves, however, it will become clear that even with high levels of reliability, there are many vagaries when applying codes with a concept as indeterminate and irregular as synthesis. As such, the total numbers reported below for the seven elements of synthesis discussed represent accurate and reliable interpretations based on the multiple coding passes noted above. As such they can be used confidently to make broad claims about the data. However, the impact of the important results reported below is not dependent on a pinpoint accuracy of these numbers. The findings of most interest are based on the final operationalization of these synthesis elements and the thick descriptions of them that emerged from the case studies. That is, none of the important findings below depend on whether there were 40 insights across the participants or 45.

Based on the results of the above analyses, I performed two additional analyses of the think aloud and screen capture video, specific to the use of keyword search phrases. First, I coded every keyword search phrase as either “consistent” or “divergent,” based on whether any words in the search phrases used were included in the task prompts provided to the participants,

or not. Second, I used data from audio data of participants talking about their background knowledge about climate change and their interviews to corroborate (triangulate) and extend ideas that emerged from the above analysis.

Subjectivity in Qualitative Research

Peshkin (2005) wrote of researchers "It is no more useful to acknowledge simply that subjectivity is an invariable component of their research than it is for them to assert that their ideal is to achieve objectivity" (p. 17). Though Peshkin indicated that this comment applied not only to observational investigations, but all research, it is clear that a qualitative study such as that conducted here is more subject to investigator persuasions that may affect the results of the observation and analysis.

As such, the following techniques were employed throughout this study to reduce investigator subjectivity to the extent that it was possible. First and foremost, at several times during the study, the use of experts was used to examine my perceptions, inferences, and interpretations. This is a common practice when employing think-aloud data (e.g., Hartman, 1995). When designing a survey to help determine the most advanced users of the Web for this study, experts in the field of online reading established content validity based on the intended constructs. Later in the participant selection process, the same experts verified that the individuals selected to be invited to participate in the study demonstrated the potential the use the Web in sophisticated ways for reading and learning.

Similarly, during the constant comparative analysis of think-aloud data, experts were used to critique both the initial coding categories and the new coding categories that emerged from the data. Experts were shown both the specific operationalization of these codes and several examples of the concepts assigned these codes during their evaluations. Given that the

final codes themselves would end up as the foundation for a Theory of Web-mediated Knowledge Synthesis (detailed in Chapter 6), the negotiation about these ideas was lengthy. Though the experts confirmed all of these codes with 100% agreement, they contributed more than three hours of feedback and dialogue, providing insight into the evolution of these codes and the language used to describe them. This proved invaluable. During this process, the subjectivity of my assumptions and interpretations was directly challenged, and the resulting constructs were inherently more objective that before the expert insights.

Experts were employed at one additional step in the investigation to further ameliorate subjective analysis on my part. After the coding scheme had been modified and finalized based on expert feedback, I reviewed and re-coded the case study data for Beth and Olivia, the two participants from which a majority of the discussions below are derived. After this final coding analysis, experts once again evaluated the assignment of codes. This time, they reviewed 10% of the examples to which each code applied. Though initial inter-rater reliability on these examples was only 50%, further dialogue and debate resulted in 90% agreement. For the final 10% disagreement, the experts and I concluded that the disagreement was important evidence as to the complexity of the very nature of Web-mediated synthesis. That is, we came to agreement that the examples should be coded in multiple ways. This conclusion corroborated one of the assumptions identified in Chapter 1 to frame the study from the outset: synthesis is often too complex to reduce to singular interpretations.

In all, the use of experts to evaluate the coding schemes and their application was more beneficial to the evaluation of ideas in this study than providing percentage agreement statistics to report here. This is consistent with Barbour's (2001) assertion that in qualitative research

> the degree of concordance between researchers is not really important; what is ultimately of value is the content of disagreements and the insights that discussion can provide for refining coding frames. The greatest potential of multiple coding lies in its capacity to furnish alternative interpretations and thereby to act as the "devil's advocate" implied in many of the checklists in alerting researchers to all potentially competing explanations. Such exercises encourage thoroughness, both in interrogating the data at hand and in providing an account of how an analysis was developed. Whether this is carried out by a conscientious lone researcher, by a team, or by involving independent experts is immaterial: what matters is that a systematic process is followed and that this is rendered transparent in the written research project (p. 1116)

In addition to the use of experts, a literature review conducted after the data analysis provided a form of scholarly triangulation to the theoretical findings reported. That is, when detailing the Theory of Web-Mediated Knowledge Synthesis below, references to both the original literature used to frame this study and to a literature that was explored *after* the emergence of new phenomenon are discussed. For instance, the emergence of repurposing as a component of Web-mediated synthesis was not predicted or framed by the initial literature review. However, after its emergence, evaluation by experts, and further analysis, I explored literature in related areas. Typically, one of the primary contributions of this sort of literary analysis would be that it provides a frame for readers to better understand the phenomenon and how it emerged in the context of Web-mediated synthesis. However, this review of related literature also provided additional insight into the foundations of the new phenomenon and served to question my interpretations by providing alternative interpretations and competing explanations, albeit from ideas that are largely ancestral to repurposing in the context of Web-

mediated synthesis. That is, examining the roots of repurposing through lenses of learning, creativity, and design, provided one final way to increase conceptual objectivity.

Finally, it is also important to address the role of objectivity and subjectivity in theory development. Given the lack of scholarly work that directly addresses synthesis in a Web-mediated environment, the subjective insights that I had prior to embarking on this study regarding learning on the Web and creativity (e.g., DeSchryver & Mishra, 2008; DeSchryver & Spiro, 2008; Mishra & DeSchryver, 2009; Spiro & DeSchryver, 2008; DeSchryver & Spiro, in preparation;) were valuable in order to determine what to look for and what I was seeing when evaluating related data. With that in mind, the study was designed with the most appropriate design to maximize the utility of that specific researcher experience and expertise, balanced with objective analysis of the conceptual insights that evolved from that experience and expertise. The result is an exploratory case study. As specific evidence of the contributions my prior expertise balanced with objective analysis, pay particular attention below to the treatment of VCS, virtual conceptual simultaneity. As should be clear from above, at the outset of the study I operationalized VCS as one of the three primary forms of synthesis to look for in advanced learners using the Web. However, VCS did not emerge as an independent construct in the data. The idea evolved, through a transparent process of data collection, initial analysis, expert insight, secondary analysis, and final expert insight to a more broadly defined category of generative synthesis with several possible manifestations, one of which is VCS. Like any scholarly study, the literature framed the idea of VCS, but it was my work with Dr. Rand Spiro that provided that literature. As such, the subjective insights and relative expertise that I had about VCS could not be discounted before the study, or during the observation and analysis, nor should they have been.

Chapter Summary

This chapter described the design, participant selection procedures, task development, data collection, research session details, and data analysis procedures used in this study. In particular, it highlighted the use of abductive coding, constant comparative analysis, and experts in the data analysis. These experts helped in several areas: (1) establishing content validity in the survey used to assist in participant selection; (2) selecting final participants who demonstrated the ability to use the Web in sophisticated ways for leaning; (3) creating clearly worded tasks that fit the characteristics desired for studying synthesis; (4) authenticating the modification to existing synthesis elements and the conceptualization of emergent synthesis elements; and, (5) providing reliable interrater evaluations of these synthesis elements for the two in-depth case studies.

CHAPTER 3

FINDINGS ACROSS ALL EIGHT PARTICIPANTS

Chapter Introduction

This chapter presents the results of data analysis across all eight participants. These data provided insights into the process of Web-mediated synthesis from two levels. First, the data indicated that the process is more complicated than that outlined by the theoretical framework above, resulting in the expansion and elaboration of my theoretical operationalization of the elements of Web-mediated knowledge synthesis. In doing so, the data corroborate the existence of *synthesis for meaning* and *creative syntheses*, contribute to an expanded and recategorized notion of VCS as *in-the-moment insight*, and substantiate three new synthesis elements that emerged from the qualitative analysis. Second, the data provide detailed statistics about how these elements manifested across all eight participants.

In doing so, this chapter primarily addresses RQs 1, 2, 4, and 5. That is, with regard to RQ 1, this chapter demonstrates how synthesis for meaning and creative synthesis show up in the data mostly as expected, and how VCS did not appear as expected. It also describes the "other forms of generative synthesis" that emerged from the data to address RQ 2. The role of background knowledge is discussed in broad strokes and differentiated from the idea-play activities of the participants, targeting RQ 4. And, the use of notes across the eight participants is detailed to address RQ 5.

Overview

The theoretical framework constructed above operationalizes Web-mediated synthesis as three separate processes that work independently or in concert to produce synthesis experiences. However, this lens was too narrow to explain the phenomenon fully during data analysis. A more complex explanation of both synthesis for meaning and generative synthesis developed whereby the initial elements evolved and new elements emerged. Table 1 highlights the descriptive statistics gathered for the final six elements that more fully explained Web-mediated synthesis as it appeared in this study, including (1) divergent keyword search phrases; (2) synthesis for meaning; (3) in-the-moment insights; (4) repurposing; (5) reinforcement; and, (6) creative synthesis. Thereafter, I provide more details for each.

Table 1

Descriptive Data of Synthesis Elements, All Participants

	Reading-to-Learn	Reading-to-Do	Totals
Divergent Keyword Search Phrases	52	70	122
Synthesis for Meaning	71	41	113
In the Moment Insights	40	28	68
Repurposing	17	24	41
Reinforcement	19	10	29
Creative Synthesis	3	13	16

Divergent keyword search phrases. As noted above, the use of keyword search phrases is one of the primary reading strategies that differentiates Web-based reading from its offline and

hypertext ancestors. This data in this study confirmed this literature. The eight participants conducted 158 keyword search phrases and utilized 242 unique keywords.

Table 2 indicates that the eight participants used 158 unique keyword search phrases during both tasks. They used 67 during the eight hours of reading-to-learn tasks and 91 during the six hours of reading-to-do tasks. Of the phrases used, 36 were consistent (i.e., using words that were provided in the task prompts), and 122 divergent (i.e., using words not provided in the tasks prompts). Of the consistent phrases, 15 were used during the reading-to-learn tasks and 21 during the reading-to-do tasks. Of the divergent phrases, 52 were used during reading-to-learn tasks and 70 during reading-to-do tasks.

For example, based on the tasks provided above, the following keyword search phrases were considered consistent: [how to lessen the effects of climate change], [why people don't change behavior climate change], [college students and climate change], and [climate change and people's behavior]. However, the following keyword search phrases were considered divergent: [does God care about climate change], [economic reasons for behavior change], [how people assess risk and their behavior regarding climate change], and [theory of planned development].

Table 2

Descriptive Data from Keyword Search Phrases Used, All Participants

	Consistent	Divergent	Totals
Reading-to-Learn	15	52	67
Reading-to-Do	21	70	91
Totals	36	122	158

Across all participants, 242 unique keywords comprised the phrases used. During the reading-to-learn task, 133 unique keywords were used, and 153 during the reading-to-do task. When keyword search phrases were consistent, 53 unique keywords were used, and when they were divergent, 222 unique keywords were used. As shown in Table 3, the average keywords used per search phrase were 5.87 across all participants and tasks, 5.52 in the reading-to-learn task, 6.11 in the reading-to-to task, 5.77 in consistent phrases, and 5.9 in divergent phrases. Across all participants and tasks, only once did the exact search phrase get used - [college students and climate change] - two different participants used it.

Table 3

Average Length of Keyword Search Phrases, All Participants

	Consistent	Divergent	Totals
Reading-to-Learn	6.13	5.38	5.52
Reading-to-Do	5.52	6.28	6.11
Totals	5.77	5.90	5.87

Synthesis for meaning. Above, both reader intent and outcomes described synthesis across the literature for reading comprehension, multiple text comprehension, and Web-based reading. That is, most prior conceptions of synthesis in these areas focused on how readers organize, combine, compose, rearrange, rewrite, compile, and structure text(s) when synthesizing information with the explicit goal to make meaning and understand of the text(s) being read (Duke & Pearson, 2002; Dole et al, 1991; Glister, 2000; Hartman, 1995; Leu, Zawilinski, et al., 2007; Mayer, 2000; Rouet, 2006; Stromso & Braten, 2002). This active construction involved

sorting relevant from irrelevant information and organizing it effectively (TICA Basic Skills, n.d.) and common reading comprehension strategies such as summarizing (Dole et al, 1991; Hidi & Anderson, 1986), inferencing implied author meaning or intent (Dole, et al; Kintsch, 1994; Scharere, Pinnell, Lyons, and Fountas, 2005), and relating to background knowledge (Dole, et al). The data in this study confirmed extensive use of this process to make meaning of the Web text(s) encountered with 113 instances of synthesis for meaning across all eight participants and both tasks.

In-the-moment insights. In the theoretical framework for this study, Spiro's (2006e) enabling cognitive affordance of virtual conceptual simultaneity (VCS) underscored the first form of generative synthesis – which I called VCS synthesis. The data from this study confirmed several instances of VCS based synthesis, but many more were demonstrated based on a broader category of *in-the-moment insights*. That is, the participants in this study frequently demonstrated insights based either on: (1) a single Web resource; (2) multiple Web resources (e.g., as explained by VCS); (3) activity unconnected to the Web (e.g., based on background knowledge or idea play); or, (4) a combination of the prior three possibilities. The process of *selective combination* (Sternberg, 1985), whereby the reader combines "what might originally seem to be isolated pieces of information into a unified whole that may or may not resemble its parts," appeared in play within a single resource, from background knowledge, or through idea-play. VCS synthesis as I operationalized it extended that notion based on the speed of the Web to allow for conceptual simultaneity across multiple resources. And, the enabling affordances of virtual conceptual simultaneity underscored the instances demonstrated. In-the-moment insights were primarily task agnostic, where the conceptual/unified whole that emerged was more often related to the resource(s) recently visited than the primary task or purpose for reading on the

Web. The data demonstrated multiple instances of this process with 68 instances across the participants and tasks.

Repurposing synthesis. Several instances of synthesis that were not explained by the preliminary framework appeared in the data. Among them, a group based on the idea of repurposing ideas emerged. That is, many times, the readers recast, reused, or otherwise tweaked ideas they encountered in the text(s) to fit a new context. These instances demonstrated generative experiences given that the value-added to the idea originated with the reader. They actively transformed a singular idea much in the way that Kress (2000) described how transformation, remaking, editing, and juxtaposition of texts create new and alternative meanings. In these cases, the relationship between the original and repurposed idea was one-to-one (as opposed to many-to-one) with a parallelism of meaning remaining intact from the first occurrence to the repurposing. The data demonstrated multiple instances of this process with 41 instances across the participants and tasks.

For example, after reading about the idea of "going green for lent" one participant wrote about how "finding a day in religion where they can give up something…maybe a common thread between religious…religions can join together in interfaith." The commonality between Lent and his idea is clear, but he transformed this idea to include the ecumenical component and the importance of interfaith. Similarly, after reading through a PowerPoint on the Web about persuasion and specifically how expert opinions are used in advertising, another participant noted how business leaders in high SES situations might be less inclined to listen to experts, and asked himself whether they might be more willing to "listen to one of their own." He continued writing, "expert opinion might fit here, with an industry leader or expert giving testimony." Again, this notion of "one of their own" as an expert is a transformed idea based on the use of

experts in advertising, and reshaped what an expert is for the context of high SES business leaders.

Reinforcement synthesis. Another form of synthesis that emerged from the data involves the reinforcement of other synthesis experiences. That is, when the participants encountered ideas that had previously been synthesized in different resources, a reinforcement of that idea occurred, often from a different perspective or in a different context. Given the scope of resources available on the Web and speed of access to them, the potential for such interactions is much greater than in offline texts or even hypertext systems. In the data from this study, these experiences provided confirmation to the readers regarding their own ideas and interpretations, and often presented with increased affect. It is important to note that these interactions were not revisitations of the same text-based information, as outlined in CFT (e.g., Spiro, Coulson, Feltovich & Anderson, 2004). Nor were they just occurrences the same idea, but just in a different resource as accommodated by CFT-W (DeSchryver & Spiro, in preparation; Spiro & DeSchryver, 2010). They were new instances of *synthesized* knowledge such as that provided by in the moment insights or repurposing. In some cases, the reinforcement of those ideas led to even further elaboration with even more generative ideas. The data demonstrated multiple instances of this process with 29 instances across the participants and tasks.

For example, the same participant noted above suggesting the importance of interfaith cooperation on the topic of climate change, later read "Earth Keepers, a coalition of 10 faiths and 150 congregations across Michigan's Upper Peninsula [who have] joined together to protect the regional environment." He then noted, "If they are already doing this…contact the ones who are doing this well and work with them. Don't have to reinvent the wheel." This text confirmed his earlier thoughts about the value of interfaith collaborations, and provided him with an

elaborative element in his emerging solution to contact interfaith agencies that are doing this well with college students through their faith.

Creative synthesis. The data confirmed the existence of a task/problem based creative synthesis as outlined in the preliminary framework. It presented as a variety of combinations of the other forms of synthesis, especially in the reading-to-do tasks. It appeared iterative, including as part of this process text(s) from the Web, background knowledge, and idea-play. Note taking was also a crucial part of creative syntheses. In several cases, the participants started the process of creative synthesis by brainstorming without the Web, and then used the Web to explore, confirm, and elaborate on those ideas. Many participants also discovered new ideas thereafter directly on the Web and added them to the evolving creative synthesis. Across all eight participants, the reading-to-do tasks included at least one extended interaction that demonstrated creative synthesis. Given the detail and space required to properly address how this happens, I present examples of creative syntheses in the detailed illustrative case studies for Olivia and Beth, below (Chapters 4 and 5).

Data from the case studies provided three additional considerations to the environment of Web-mediated synthesis, the role of background knowledge, the use of "soft" resources, and the process of note taking.

Background knowledge. Background knowledge played a key role in many of the instances of synthesis demonstrated in this study. This is not surprising, since background knowledge is foundational to successful reading comprehension (Afflerbach, 1990; Anderson & Pearson, 1984; Clymer, 1968; Kintsch, 1998; Kintsch & Rawson, 2005). However, though at various times it played a role in each of the component processes of Web-mediated knowledge synthesis, **the role was rarely explicit**. In an attempt to deconstruct its contributions to the

processes to the extent that it was possible, the in-depth case analyses below operationalize background knowledge considered **in the context of how it informed each of the synthesis elements**. For instance, **i**f Olivia integrated background knowledge to understand the text(s) she read, I report it as part of the synthesis for meaning process. However, background knowledge also contributed to the various generative processes Olivia experienced. That is, background knowledge at different times informed the choice of divergent keywords search phrases she selected and at others contributed to her in-the-moment insights. Still in others, insights were based entirely on background knowledge. She also repurposed and reinforced ideas that were themselves informed by background knowledge. Across all of these cases, the extent to which background knowledge informed her syntheses represents a continuum. However, in most cases, it is difficult to determine the level of contribution background knowledge provided. As such, where possible, I identify and detail these instances of background knowledge used, but do not speculate as to the strength of the contribution that it makes.

There are also times that I differentiate background knowledge from "idea-play." This notion of idea-play is based on the conceptions of play underlying creativity identified above in the creativity literature. For instance, Einstein discussed how combinatorial play helps to connect ideas and concepts that have rarely, if ever, been combined. Amabile, Hadley and Kramer (2002) described this as "throwing a bunch of balls into cognitive space, [and] juggling them around until they collide in interesting ways" (p. 52). And, McWilliam (2009) described how creativity of this type often required that this idea play occur among disparate ideas for a long enough period of time to generate new idea spaces or, as Jackson (2006) phrased it, move ideas from one state to another. As such, this juggling of ideas over a period of time as identified below represents idea-play. It manifests differently from a recall of background knowledge or an

insight based on background knowledge in that recall or insight is typically apparent in a relatively quick time frame and is often singular in nature. Conversely, idea-play as a juggling of multiple ideas from background knowledge, multiple ideas from the Web texts(s), multiple ideas from the participants' notes, or various combinations thereof, all occurring over a longer period of time than is apparent for recall of background knowledge or an insight based on background knowledge.

Soft resources. The following descriptive data regarding Web sites visited and keyword search phrases used was collected from all eight participants, differentiated by the reading-to-learn and reading-to-do tasks, and then aggregated across the study. Table 4 indicates that the eight participants visited 233 unique Web sites during both tasks. They visited 137 during reading-to-learn tasks and 96 during reading-to-do tasks. Of the sites visited, 103 were hard resources (e.g., books, NASA, universities, national and international newspapers/magazines, governmental agencies), and 130 soft resources (e.g., blogs, aggregators, individuals Web sites, institutes, sites based on a cause). Of the hard resources, 67 were used during the reading-to-learn tasks and 36 during the reading-to-do tasks. Of the soft resources, 70 were used during reading-to-learn tasks and 60 during reading-to-do tasks.

Table 4

Descriptive Data from Web Sites Visited, All Participants

	Hard Resources	Soft Resources	Totals
Reading-to-Learn	67	70	137
Reading-to-Do	36	60	96
Totals	103	130	233

Participants visited the same Web sites only seven times. Two participants visited three of these sites (a blog entry about persuasion techniques and propaganda, the global climate change and health page on the World Health Organization site, and Greenbiz.org). At least two different participants visited the other four of these sites, but always to different articles or resources on the site (The Guardian newspaper, by five participants; the Washington Post, Huffington Post, and Nature.org by three participants, but always to different articles; the Climate Progress and Green Facts Web sites two different participants; and, Wikipedia which was visited 12 times, by four different participants, but always to different entries).

Note-taking. Seven of the eight participants took extensive notes, at least two pages and as many as five. One participant took only about one-quarter of a page of notes. Three participants used all offline notes, two used Microsoft Word and some offline notes, one used only Google Docs, and one started offline and finished in Microsoft Word. Six of these seven started separate notes for the reading-to-do task.

The notes varied from verbatim to summary. All notes taken on the computer were linear in nature, and often took bullet, list, or outline form. The offline notes were largely linear, but non-linear affordances were utilized (e.g., arrows, circles, brackets, sectioning). Additional mark-ups identified important elements (e.g., asterisks, stars, underlining). Two participants used bookmarks. Two others pasted URLs into their computer-based notes. Four participants revisited their notes during the reading-to-do tasks, but only minimally. More importantly, nearly all of the synthesis elements reported above resulted in or from note taking.

Chapter Summary

This chapter addressed issues relates to RQs 1 and 5, by corroborating several ideas about synthesis based on the theoretical framework for this study - synthesis for meaning, creative synthesis, and the importance of note-taking. With additional attention to RQ 1, it recategorized the generative concept of VCS to be described as in-the-moment insights, which better explains what is seen the data (that is, insights are less constrained by the expectation of multiple sources, and the updated definition allows for insight to occur in a under a variety of simpler conditions). With regard to RQ 2, the chapter also discussed how the definitions of synthesis provided by the theoretical framework were not sufficient to account for the phenomenon that emerged in this study and described three new ways to conceptualize Web-mediated synthesis - divergent keyword search phrases, repurposing, and reinforcement. Data regarding keyword search construction and soft resources used was presented to address how the synthesis elements from RQ1 and RQ2 manifest on the Web. To address the role of background knowledge in Web-mediated synthesis examples from the data are utilized to differentiate how background knowledge and idea-play activities differed across participants, targeting RQ 4. The chapter also highlighted the extensive use of soft resources in both the reading-to-learn and reading-to-do tasks. And, finally, the chapter reported statistical data on how often each of these elements occurred.

CHAPTER 4

IN-DEPTH CASE STUDY #1 - OLIVIA

Chapter Introduction

This chapter provides detailed illustrations and discussion of the broad themes about Web-mediated synthesis elements outlined in Chapter 3, based on an in-depth case study of one individual participant, Olivia. The chapter explores each synthesis element individually and then demonstrates how they worked in concert to comprise creative syntheses. The chapter finishes with conclusions drawn from the case study about specific patterns of use, interactions, and relationships among the synthesis elements.

In doing so, the chapter provides specific examples of the broad themes that emerged from analysis of all eight participants. However, the focus of this chapter is on *how* synthesis for meaning, insight, repurposing, reinforcement, and creative synthesis manifested for Olivia, by providing detailed examples and illustrations that further explore RQs 1 and 2. Variation and nuance in the application of these themes is demonstrated across specific examples in this one case study (e.g., by highlighting the uniqueness of the various ways Olivia synthesized for meaning). This chapter also emphasizes the multiplicity of these ideas and how they interact and work in concert, the primary concern of RQ 3. The specific roles of background knowledge and idea-play are highlighted in several examples with respect to RQ 4. And finally, to explore RQ 5, most examples emphasize the substantive contributions note-taking provides to Olivia's synthesis processes.

Olivia

Olivia was a 25-year-old food science and integrative toxicology doctoral student. I selected Olivia's data for closer examination based on data indicating that she demonstrated the most extensive use of synthesis in her reading processes of any participant (120 instances). She also demonstrated a diversity of synthesis experiences and the ability to think-aloud in great detail. A detailed profile of Olivia is provided in Appendix A, including a reporting of her background knowledge and experiences on the topic of climate change collected at the beginning of her research session.

Olivia demonstrated 120 instances of synthesis during her sessions. Table 5 outlines the descriptive statistics gathered.

Table 5

Descriptive Data for Olivia By Task

	Reading-to-Learn	Reading-to-Do	Totals
Consistent Keyword Search Phrases	2	3	5
Divergent Keyword Search Phrases	10	8	18
Hard Web Sites	7	4	11
Soft Web Sites	16	3	19
Synthesis for Meaning	25	15	40
In the Moment Insights	6	8	14
Repurposing	8	15	23
Reinforcement	12	9	21
Creative Synthesis	0	4	4

In addition to these statistics, several other characteristics described her session. First, she took a lot of notes; all by hand on the legal pad provided. Second, she revisited and referenced the task instructions multiple times during each session. Third, she was largely non-technical in her approach to reading online. That is, she rarely used multiple tabs, did not bookmark or clip resources, did not save any URL's during the sessions, and rarely used any of the additional services provided by Google beyond the basic Google Web search. Olivia integrated well with the think-aloud protocol and never had to be prompted.

The data collected during Olivia's sessions provided multiple illustrations of each element of synthesis noted above. Just below, several illustrations are provided, and then conclusions about the specific patterns of use, interactions and relationships among these elements are explored.

Divergent keyword search phrases. Olivia balanced her use of divergent keyword search phrases between the reading-to-learn and reading-to-do tasks. Table 6 lists all of the phrases used in the first session.

Table 6

Keyword Search Phrases
Olivia, Reading-to-Learn

Time	Keyword Search Phrase	Type	Origin
:38	opinions on climate change	D	BG knowledge
3:23	people's opinions on climate change	D	iteration
7:03	why people change behavior on climate change	C	task
19:35	Why not to change my behavior on climate change	C	task

Table 6 (cont'd)			
28:44	Barriers in market for climate change	D	Web text
34:30	why people don't care about climate change	D	review of notes & Web text
38:04	why climate change beneficial to government	D	insight
38:57	mitigation	D	Web text
42:39	why climate change mitigation beneficial to government	D	iteration & Web text
43:53	benefits of climate change	D	iteration
49:53	religious views on climate change	D	Web text, BG knowledge & task
57:02	different countries perspectives on climate change	D	Web text, BG knowledge & task

Several key findings emerged from this data. First, consistent with the participants as a whole, **Olivia used many more divergent search phrases than consistent**. Second, her **keyword searches originated from a variety of sources**. This included the Web text, background knowledge, the task (for consistent searches) and iteration. She also often **relied on more than one source for keyword development**. For instance, just before switching her direction to search about [religious views on climate change], Olivia said "So, and when I just read about the science, part of this topic says to open up to others, I'm wonder if any…if religion affects your view on climate change." When interviewed, Olivia further described her decision to use the [religious views on climate change] search phrase as follows:

> I was reading about the government citing all these scientific articles, and in my mind when I think scientific articles, we try to search for the truth, I'm not a particularly religious person, but in religion they try to do the same thing through

> different means. So I was like that can give me perspective, people tend to follow their religion, people tend to do their behaviors, based on their religion. Think about how the government can cite all of these articles, but if people aren't listening to the science, and listening to something, and something else that can be viewed kind of opposite, or kind of go against science would be religion, so I wanted to get the opinions of that.

In this case, **a combination of the Web text, the task instructions, and her background knowledge together guided her choice** of the next direction to go and the keywords to select. Specifically, as she re-read the task, the instructions to "be open to new ideas" impacted her at this point.

In addition to **the notes Olivia took also informed and guided her decisions about keyword search phrases**. At one point, she stopped reading the Web, and just took time to review her notes "And now I'm just looking over what I've done thus far…Why people change behavior…why people don't change behavior…so I've gotten in to…but why would…I guess…something that would boggle my mind, is to why people knowing there is a problem, not choose to care…" Thereafter, she searched for [why don't people care about climate change]. This demonstrates how the notes served as a one of the sources of her idea-play about constructing keywords. However, it is also indicates that Web text played a role in the process, given that "they don't care" was listed as the first reason under her "people don't change behavior" section, which was based on repurposed ideas from an article read 25 minutes earlier. In this way, notes provided "downstream" access to ideas that the reader synthesized earlier, which can then be used to inform keyword choices.

Finally, one of Olivia's k**eyword search phrases was constructed by what was best represented by an in-the-moment insight**, with no direct connection to background knowledge, the Web text, the notes, or the task, but. That is, at one point, after reading *Five Reasons Why We don't Care About Climate Change* and taking several notes, the last of which is "not enough time to make a big difference," Olivia immediately said "And I wonder why then, uh, for some reason in my head I just got thinking…I wonder why it's beneficial for countries to make climate change a problem. So I'm actually going to go back and type in…" then following the search phrase [why climate change beneficial to government]. The Web text just prior was completely unrelated. Just before that she read about production, tariffs, exports and international trade in renewable energy products, which may have provided a seed for this search, but was not a clearly direct influence. In this case, the idea to move in this particular direction is best described as an insight, in that her phrasing was generative of the text.

Table 7 lists all of the phrases Olivia used in her reading-to-do session. The development and use of searching in this task was quite similar to her first session. She utilized various origins, used almost the same number of phrases over the course of the task, and relied primarily on divergent phrasing. A few differences emerged. First, the phrases used in the learning-to-do tasks were equally divergent at the keyword level, but less divergent at the topical level. That is, Olivia used about the same number of divergent keyword search phrases in each task, but those used in the second only diverged within the task parameters. As such, **the nature of the keyword phrases constructed was very highly connected to the type of task provided** (i.e., during the learning task she expanded her

searches beyond the specific topic, where as during the reading-to-do she was more "narrowly divergent").

Second, through the task provided specifically listed three groups to focus her ideas on, Olivia only searched for phrases related to high SES, college student, or religious groups three times. The rest of her phrases were comparatively group agnostic. In doing so, Olivia also almost doubled (from 8 to 15) the times she repurposed information and reduced her number of syntheses for meaning (from 25 to 10). In this way, she evidenced **a possible relationship between task, keyword search phrases, and synthesis type**.

Table 7

Keyword Search Phrases
Olivia, Reading-to-Do

Time	Keyword Search Phrase	Type	
5:06	Rich people change behavior global warming	D	task + BG knowledge
14:31	How to change a behavior voluntarily	C	Web text & task
18:46	How to change climate change behavior voluntarily	C	task
25:05	Improving efficacy of voluntary behavior change	D	Web text
26:31	Improving voluntary behavior change	D	Web text
31:55	Fun projects for climate change	D	BG knowledge
33:41	Fun things for people to do to prevent climate change	D	iteration
39:21	How to make people want to change behavior about climate change	C	task
41:24	Effective way to reduce climate change college	D	task +notes
42:07	Recycling program Michigan State University	D	BG knowledge
43:39	High socioeconomic status professionals and recycling	D	task & BG knowledge

Synthesis for meaning. Olivia compiled and recombined information across texts and from her background knowledge extensively during both tasks. She did this 25 times during the reading-to-learn task and 15 times during the reading-to-do task, synthesizing information for meaning at various times based on her background knowledge, a single Web resource, and/or multiple Web resources. She also incorporated skills consistent with high achieving offline readers, including summarizing and inferencing.

One of the simplest examples of Olivia's activities that represented synthesis for meaning is when **she would read something out loud from a text and then take verbatim (or mildly condensed) notes** on that text. For instance, as she read a PDF of a research article from Purdue about *Public Attitude and Behavior About Climate Change*, she encountered a list of factors affecting pro-environmental behavior. She read "worldviews, perception of personal and social risks, political philosophy, personal discomfort, personal responsibility, and social norms" and took verbatim notes of these ideas. Multiple incidents similar to this comprise her construction of an intertext (Afflerbach & VanSledright, 2001; Hartman, 1995; Stromso, Braten, & Samuelstuen, 2003; Wolfe & Goldman, 2005) that aids in developing a global coherence and meaning of the multiple texts she reads with respect to the topic she is learning about.

Similarly, after reading a Web page about the public opinion on climate change, and then an article about the impact of climate change in Bangladesh, Olivia paused to reflect on what she had learned thus far and **synthesized for meaning based on inference and summary** (see Appendix B for details). During her comments and notes Olivia made an inference (Dole, Duffy, Roehler & Pearson, 1991) about an idea implied by the author, but not explicitly stated in the text (i.e. he did not directly say the type of media received impacts public opinion on climate change, but the text insinuated this), and then summarized the authors perceived intentions in her

own words (i.e., through comprehension, condensation, and transformation of the ideas (Hidi & Anderson (1986)). In this sense, her comments and notes made up a single entry into an evolving "synthesis for meaning" of the texts she was reading on the Web, based primarily on the text from a single page (though their is likely some influence of background knowledge given its general contributions to inferencing).

In another case, Olivia synthesized meaning through a **single soft resource that provided multiple perspectives to her understanding**. This occurred when reading a comment page on Reddit (a "social news" site that is user generated and allows comments on the stories) about the environment. The details of her interactions on this page are provided in Appendix C. Based on her reading of comments from several different users, she synthesized meaning about the role of inconvenience, beliefs, industrial/corporate influence and externalities, the sum of individual behavior, being affected personally, and morals through both verbatim and summary notes. The extensive multiplicity of ideas she synthesized from just one resource was a direct result of the structure of the page - that of a discussion based on comments about a single article. As such, it demonstrated the potential importance of soft resources to the Web-mediated synthesis process.

Finally, Olivia also **synthesized information for meaning from multiple sources at the same time for meaning**. While skimming a long PDF, she read, "A recent survey found that, among Americans who believe there is solid evidence of global warming, only a minority…think that we will have to make major sacrifices…" and then commented "Oh, so people know that its happening, but they don't know…so they know it is happening, but they don't know…sacrifices…but they don't care to make a change because they don't actually believe it is a big problem." She wrote in her notes "know happening ≠ make **Δ** → actual problem." Her

comments and notes synthesized ideas from the current page, the idea that people just are not concerned or don't care from a different article she read 10 minutes earlier (and took notes about), and the idea that about of individual perceptions of the seriousness of the problem from a resource five minutes earlier.

In addition, a deeper examination of the conditions surrounding the various processes demonstrated to synthesize meaning indicates how **Olivia's path to synthesis for meaning was a complex interaction among various elements**. For example, the very first synthesis for meaning example above demonstrates how various decisions and precursor events contributed to its manifestation (see Appendix D for a detailed accounting). Though this appears to be a simple interaction, the resulting information copied is central to her developing understanding of the topic, and her path to finding it is important to consider. This path shows how Olivia's background knowledge about the text structure (i.e., the value of Google scholar vs. Google search), her ability to evaluate the relevancy of an article (both the fact that she recognized the first article was not about global warming, and that the Purdue article looked good), her skimming proficiency, and her ability to separate relevant from irrelevant information within a relevant text all contributed to the synthesis for meaning she experienced.

In-the-moment insights. Insight comprised or contributed to many of the ideas that Olivia synthesized during both of her tasks, and the conditions for insight varied across her activity. Some insights were isolated incidents unrelated to the text(s), others based on providing generative value-added ideas based on the text, and still others in the midst of synthesizing information for meaning. For instance, after reading about technology, personal sacrifices, and making related comments and notes, she read the text "most people are willing to make some financial sacrifices." She then commented "Yeah, that can be it, too, so not change

behavior…money…" making notes about money. Without hesitating, she added, "also probably public perception, I'd say…of why people would change their behavior…because…it's…probably because it's like cool…it's cool to recycle…" During these comments she wrote "public perception (cool)" in her why people **Δ** behavior section.

It is impossible to know exactly where the idea of public perception came from based on the data collected. However, the context of her reading provides several clues. First, this idea was not explicitly stated nor implied in the then current or any previous text(s) she had read thus far in the session. In that way, it did not represent a synthesis for meaning as defined in this study. It is also not background knowledge used to help her understand the meaning of the current or previous text, since public perception or a related idea is not in the text. Second, in the 18 minutes of online reading prior to this insight, Olivia read about various topics, including: climate change around the world, media, personal interest, world views, social risk, political philosophy, personal discomfort, money, demographics, incentives, social norms, values, responsibility, fear, risk, health, technology, and sacrifice. The density of ideas available to her and the rapid successful with which she moved from one to another created an infinite number of possibilities for combination and recombination of ideas, a *creative stew* of potential for insight. As such, it is viewed as a generative form of synthesis - an insight. That is, it may represent a *selective combination* (Sternberg, 1985), enabled by the cognitive affordance of virtual conceptual simultaneity (Spiro, 2006e) of the above ideas, and likely some background knowledge, that once amalgamated represented a "conceptual whole great than the sum of the parts" (Spiro) "that may or may not resemble its parts" (Sternberg).

Olivia made several other **insights explicitly related to the text(s)** she read, when she provided value-added ideas to those text(s). Four of these examples are detailed in Appendix E.

Of these four examples, the conditions for a generative insight about the text(s) vary. In the first example, Olivia skimmed text from a hard resource very quickly, reading only text segments and titles as she moved through several pages of text in less than a minute, which presented many of the ideas from the extensive subset of topics similar to those listed for the public perception example above. That is, *the rapid successful of ideas in the text* may have contributed most to her insight. In the second case, Olivia read a soft resource with a much greater attention to the text, reading at least part of, if not the entirety of, five different paragraphs before reading a sixth and providing her own value-added to the text. That is, *her attention to detail and a deeper reading of the text* may have contributed most to her insight. In the third example, there was very little text on the page and the previous five minutes had been spent exploring only articles about religion and climate change. Olivia read the title and just one paragraph of two sentences from this page. In this case, given the isolated context of her activity, *background knowledge* may have contributed most to the insight. In the final example, Olivia read only a few ideas in a hard resource, but conducted a deep read of one paragraph where she repeated several sentence fragments in her think-aloud. The pausing and repetition of ideas demonstrated by Olivia is consistent with the notion of *idea-play*, which may have provided the foundation for this particular insight.

Another example from Olivia's sessions demonstrated how an **insight occurred in the middle of a synthesis for meaning**. As noted above, while she read the Purdue research, she synthesized a list of factors affecting individual behavior, worldviews, perception of personal, and so one. While writing down these ideas, she read "political philosophy, knowledge, personal discomfort" from the text, and then said "yeah, that's a big one…personal discomfort, I never thought of that…um…probably money, as well. I'm just going to write that in there, but I'm

going to make a note that he didn't actually say that, yet." She then continued synthesizing the rest of the list into her notes, mostly verbatim. The notion of money as a contributor to behavioral decision-making had not, to this point, presented itself in the text(s). It is worth noting that her insight also occurred after making a few comments about the list of ideas she was synthesizing. That is, **stepping away from the text for just a spilt second to reflect in a meta-cognitive manner may have provided the opportunity for her to have this insight**, in the same way that incubation supports creativity.

Repurposing synthesis. Olivia repurposed information from multiple texts and her background knowledge during both tasks. She did this eight times during the reading-to-learn task and 15 times during the reading-to-do tasks. The examples provided in Appendix F illustrate how repurposing occurred in several ways, from one context to another, by using an idea in the opposite way it was intended, by reorienting the ideas to a different scale, by repurposing an idea in two different ways, and by combining a repurposed idea with an insight.

Taken as a whole, these examples demonstrate several key ideas about repurposing. First, it can happen with both **task specific resources** (e.g., the Purdue PDF on behavior change) **and resources that are somewhat far afield from the task** (e.g., social justice, & trade barriers for renewable energy). Second, r**epurposing happens in both soft and hard resources**. Third, an **open mindset**, such as that proposed by CFT-W (Spiro and DeSchryver, 2010) may be **important to finding information that is amenable to repurposing**. Finally, the **keyword search phrases that directly preceded each repurposing may in fact provide the lens** that facilitates it. For instance, the fact that Olivia was specifically searching for [rich people change behavior global warming] may have prefigured her ability to adapt the carbon tax to a tax benefit, where as, if she had been searching for information about college students and climate

change, the potential relevance of carbon taxes may not have occurred to her. Similarly, in this way, the keyword search process serves to reconnect the reader to their task in important ways that may in fact facilitate different types of synthesis.

Reinforcement synthesis. Olivia reinforced her knowledge synthesis experiences several times during each task. These included reinforcement of ideas synthesized for meaning, as well as her own insights, including insights that were reinforced multiple times about the same idea. Examples are provided in Appendix G.

Across these instances, several important benefits of reinforcement to generative synthesis emerged. First, **each reinforcing activity offers a different context to related ideas**. This provides the sort of loose-associations among ideas that are key to developing cognitive flexibility and may make these ideas more flexibly adaptable for future application (Spiro, et al 2004). Many of the different resources provide **different perspectives**, as well, which helps to ameliorate the danger of relying on the biases of just one or two resources. The **reliability of the different resources also compliment each other**. That is, soft resources and hard resources may serve to fill in the gaps that the other inherently demonstrate. For instance, opinions are often more difficult to find in hard resources, and data may be more difficult to find in soft resources. When one reinforces the other, the effect of the triangulation of the idea is that much more powerful. Finally, reinforcement also occurs through resources from **different time and dates, lending a sense of stability** to the idea.

Synthesis in multiples. At various times, Olivia demonstrated the ability to utilize several elements of synthesis while reading the same text, as evidenced by how several of the examples above overlap in some way. One example was particularly revealing of this point. When reading the HuffingtonPost article entitled *Five Reasons Why We Don't Care About*

Climate Change, Olivia utilized three different synthesis techniques in processing the text in Figure 3.

> First, from an evolutionary perspective, we are not programmed to take future threats as seriously as immediate one; and though ice caps are melting and storms worldwide are intensifying, for most of us, this is still going on somewhere out there. It's not yet happening where we can feel it and see it…
>
> Second, it costs money to do some of the right green things. Much to my children's embarrassment, for example, I still drive and SUV. I bought it 130,000 miles ago when we lived where snow could fall four feet in a weekend…Now that I live in a place where it never snows (to my children's chagrin) I have no reason to drive it, except the fact that I can't afford a hybrid.
>
> Third, we have become so distance from nature, after centuries of trying to wield our power over it and generations of relegating our children to spending more time indoors…
>
> Fourth, many of us no longer believe we can make a difference in the world. During the past 50 years, America's population has doubled and industries from banking to cat food have been supersized….
>
> Finally, we think we never have enough time—and, in some ways, we're right. In recent decades, the rise of families composed of two working parents (or a single working parent) has created a lifestyle that ill-equips us to address issues outside our own personal, immediate concerns…

Figure 3. Text from *Five Reasons Why We Don't Care About Climate Change*

She synthesized information for meaning by summarizing the first point in the article when she read

> we are not programmed to take future threats seriously," then said, "we are not programmed to take future threats seriously" says "evolutionarily…to takes threats seriously…as immediate ones…though ice caps are melting…still going on somewhere out there…it's not yet happening..we can't feel it or see it...so we worry about more immediate things

and then noted "evolu: take threats seriously...worry about immediate."

She used the text in the second paragraph to reinforce and clarify the idea of how money might be a reason for people not to change behavior. The third paragraph resulted in an insight on her part about valuing nature. The fourth paragraph reinforced and simplified the her idea about collective vs. civilian considerations and how many people feel one person cannot make a difference. And, she synthesized not having enough time to make a difference in the fifth paragraph for meaning.

All of this occurred in a short editorial about climate change behavior. Her interactions with the text in that article provided only a glimpse, however, of the level of sophistication and complexity the data later demonstrated. Now, I explore how these elements worked in rapid sequence, such as that shown with this example, and also worked in relative simultaneity, providing the foundation for creative synthesis.

Creative synthesis. The above examples and those provided in related appendices of Olivia's synthesis for meaning, insights, repurposing, and reinforcements derive solely from Olivia's reading-to-learn sessions. There are two reasons for this. First, in her reading-to-do (second) task, Olivia made reference to knowledge she had synthesized during the reading-to-learn (first) task. This provided more complexity to the notion of synthesis that is best understood after discussing the "simpler," mostly isolated and independent, examples above from each element. In her second session, "downstream" synthesis (or synthesis of syntheses) occurred. For instance, when Olivia copied or summarized a segment of her own notes from the reading-to-learn session (either from memory or by looking) into the notes from the reading-to-do session, it represented a synthesis for meaning, with no value added from the reading-to-learn notes text. However, when she used text from her reading-to-learn notes, regardless of where it came from (synthesis for meaning or generative synthesis), in a way that provided a value-added

to it, it was a form of generative synthesis. For example, if she had an insight based on something from her reading-to-learn notes that originally had been synthesized for meaning, then integrated that insight into the reading-to-do notes, it represented a generative use of her own notes from the reading-to-learn sessions. Conversely, if an insight from the reading-to-learn session was copied or summarized in the reading-to-do notes, that was considered a synthesis for meaning in the reading-to-do session.

The second reason that most of the examples above are from the reading-to-learn session is that a majority of the synthesis experiences in the reading-to-learn task were relatively isolated in their manifestation, simpler to identify, and interacted only minimally. However, in the reading-to-do task, many of the synthesis activities were either multiple in nature (e.g., synthesis for meaning and insight occurring at the same time), or in the context of broader creative synthesis chunks. These are best considered in groups based on how they interacted. Though more difficult to parse, it is this multiplicity and complexity that defines creative synthesis.

Three examples of Olivia's creative syntheses are detailed in Appendices H, I, and J (creative synthesis #1, #2, and #3, respectively). Several important ideas about creative synthesis are demonstrated in these examples.

In the first example (see Appendix H), Olivia largely synthesized knowledge that had itself been synthesized during the first session. She commented and took notes about increasing the value of Mother Nature as related to the bible, which was **a synthesis of as many as three ideas**, from three different resources, in the reading-to-learn task. That is, in Olivia's reading-to-learn task the concept of valuing nature emerged from an insight based on Web text about how people were too distanced from nature; the concept of religion possibly leading to passion about climate change was an insight based on Web text about "environmentally minded clerics,"

"greens with a spiritual bent," and "acquaintances that transcend ethnic, ideological and theological obstacles;" and, the concept of religion possibly helping people be more invested in mother nature emerged was repurposed from text indicating how radical environmentalists have many parallels with Judeo-Christian traditions. In the first note during her reading-to-do task, she synthesized all three of these ideas for meaning as she summarized them in her notes. Her second comment and note about hymns demonstrates how Olivia **synthesized this same idea for meaning a second time** (i.e., the idea was synthesized for meaning in her reading-to-learn task directly from the Web text, and it was synthesized for meaning from her reading-to-learn notes into her reading-to-do notes). The third comment and note about the community aspect of religion demonstrates how Olivia again **synthesized several ideas from across different resources in the reading-to-learn task**, in particular repurposing the notions of collective action and groups. That is, in session one, Olivia used the ideas of collective versus individual action to explain why people might not change their behavior. Similarly, in the context of religion, she proposed that a way to bring people together would be to do environmental things. In the reading-to-do task, Olivia repurposed those ideas by reversing the relationship, so instead of the environmental activity bringing people together, it was the established community of religious people that might encourage people to clean up the environment or recycle. The seeds for this repurposing were from a variety of synthesis interactions in her reading-to-learn session. She synthesized the idea of collective vs. individual behavior for meaning from Reddit comments, and later reinforced it with a HuffingtonPost article; recycling was an insight based on background knowledge along with the importance of public perception; and, she synthesized the idea of linking faith and greenery together for meaning from an Economist article.

Olivia's second example (see Appendix I) comprises a creative synthesis with several features worth highlighting. First, **almost all of the syntheses that occurred in this example were generative**. Olivia oriented herself for searching based on **repurposing** the idea of caring from the first task (which was in the context of climate change in her reading-to-learn task) to whether rich people care about spending their money. She then **repurposed** carbon taxes on an international scale to tax credits for rich individuals. An **insight** that rich people might care about their families followed, just before she **repurposed** the idea of the wealthy transferring resources to the poor from the context of distributive justice to the individual behavior of caring and giving rich individuals. She paused and thought aloud about what she had been reading, resulting in an **insight** about the importance of considering investment. Thereafter, she had an **insight** about fame, recognition, and incentives. She then **repurposed** the idea of incentives to college students and again to the religious group. This lead to the **insight** that college students want to learn, followed by related **insights** about classes on global warming, integration of these ideas across the curriculum, and a specific project related to exercise equipment producing energy.

Second, these interactions demonstrate the **complexity and layering of synthesis elements between the reading-to-learn and reading-to-do tasks and among various synthesis elements within the reading-to-do task**. For instance, when Olivia repurposed the idea of incentives from rich people to college students and then to religious people, she incorporated and repurposed ideas from several different sources and times. Her proposal that "we could reduce the cost of meals, for example, if they learn to recycle...I would definitely say incentives" repurposed incentives from the discussion of rich people/fame/recognition, and was connected to insights about recycling in the reading-to-learn session. The implied casual

relationship between lower cost meals (saving money) and pro-environmental behavior may also have been repurposed from her ideas from about 10 minutes earlier in the reading-to-do session when she repurposed carbon taxes and said about rich people "if they do this voluntarily...they get a tax benefit." When talking about the religious implications of incentives, she noted that the incentive (itself repurposed from both rich people and college students) would be to do it for God, the latter of which may be a repurposing of the notion of "creation care" in the reading-to-learn task, or an insight based on her background knowledge about religion. "Doing it for your community" reinforced her repurposed ideas about community and religion from 10 minutes earlier in the reading-to-do task. She also said "more of a moral obligation for those reasons" which represented a repurposing of the ideal of morals being a reason for people to both change and not change in the reading-to-learn task (i.e., it is repurposed for the religious context here, given the absence of religion in the moral argument the first time around).

Third, though it would be easy to look at this series of events that make up the creative synthesis and come to **the conclusion that many of her ideas were a result of background knowledge** alone, this **would be overly reductive**. The data provide evidence of the impact of the current and former Web text(s) on her interactions. First, the idea of "caring" emerged in Olivia's initial comments about rich people. When she said "if they care about spending their money or if they don't care..." Olivia repurposed the idea of caring about climate change from the reading-to-learn to the high SES task. The importance of caring emerged even more during the ensuing creative synthesis in her reading-to-do task. First, Olivia had an insight that rich might care about their families. Then, she talked about how caring rich people might give to future generations. Furthermore, after reading a paragraph about preferences/beneficiaries/benefits and reviewing her notes about what rich people might care

about, she had an insight about determining what people are invested in. This concept of investment undergirded her subsequent insights about fame, recognition, and the importance of incentives. It is this switch in terminology from caring to investment that kept the momentum of this particular creative synthesis moving forward, and the switch came just after reading a long paragraph in the Web text. Though it is unclear what, if any, specific text in that paragraph made Olivia switch from caring to incentives, the paragraph contained several words and phrases that are financial in nature (poor, resources, benefits, cash, money, beneficiaries, wealthy, productivity), and the word incentive connotes a more financial relationship that caring. Given this relationship, and the timing that occurred (i.e., the switch to incentives came right after reading this paragraph), it is arguable that this text informed her switch from caring to investment. In this way, Web text potentially provided seeds to the two ideas that permeated nearly all of the generative elements in this creative synthesis.

Fourth, this example also demonstrates how **notes can be important to a creative synthesis**. This was especially evidenced in the final two synthesis elements. Just before having an insight about how college students want to learn, Olivia reviewed her notes. Her comments "they want to be cool, save money, have fun" were a summary of the first four lines of her notes about college students. This idea-play directly preceded her insight about students wanting to learn, which then evolved to her ideas about classes on global warming and cross-curricular integration. She then went back to her notes, reading "So they can take a class…reduce cost of meals…they can go someplace…" then said, "actions that they can do that would be fun…" and continued reading her notes, "fun other countries…travel in other countries…groups, fun, meet people…feel good about yourself…reduce cost…" before having the idea about the exercise project.

Fifth, the assertion that **these activities comprise a single creative synthesis** represented by one long series of related interactions is largely **based on what Csikszentmihalyi (1990) called flow**. Among other things, flow states are based on complete immersion, focus, and engagement. Very little, if any, time elapsed between even the most divergent of ideas in this sequence. For example, when transitioning from incentives that might influence religious people and her insight about college students wanting to learn, there was no break between the last word related to religion and the first words about college students. In fact, Olivia took a breath just after saying "moral" at the end of the religious arguments, and did not take another until after saying "college students" to begin the next thought. All of the transitions in this sequence were similarly paced. Where as, at the end of this series of syntheses, Olivia finally took a break from this flow experience (actually pausing for three seconds) before saying "Let's go back here, though, and look at um, look at how, so, I'm actually going go back here and I'm going to look at, let's see here, what was I just thinking...I want to go back, I had read something earlier that talked about how to get people to change behavior..." and then finally searched for [how to change a behavior voluntarily].

Finally, is it important to highlight **the integrated nature of all of the different elements** discussed just above for her second creative synthesis. In this example, the Web text, her background knowledge, incidents of idea-play, and her notes all lead to several different synthesis elements that comprised the creative synthesis she experienced. Given the organic way in which these various components interacted, it is impossible to parse which was most important. They all contributed to the ideas she constructed and were part of the flow of creative synthesis she experienced.

In the third example of creative synthesis (see Appendix J), there are several more things worth noting. First and foremost, it demonstrates the **near-simultaneous occurrence of syntheses elements**. When reading the short one paragraph abstract, Olivia synthesized text for meaning, had an insight, and reinforced two ideas. In addition, the Web text about "reducing gas and reducing energy" was itself used three different times leading to various generative synthesis experiences. The first time she read this information from the abstract of a *Journal of Preventative Medicine* article, she had an insight about how these represent the easy things to change in behavior. Then, she viewed this same information through the religious lens saying "reduction in gas, reduction in..." before reinforcing the idea of creation care. Finally, she said, in the context of rich people "how to get them to save...reduce energy...reduce gas..." which lead to her repurposing the idea of hybrid cars and the eventual insight about the value of unattainability and uniqueness with this group. Given that this text was encountered in the context of an abstract (i.e. a Web page with one paragraph of text) this example provides an argument for the potential value of short snippets of text when the task requires creative synthesis. Similarly, early text about government regulations and subsides facilitated both repurposing and reinforcement and later it supported insight, repurposing and reinforcement at nearly the same time.

Creative synthesis #3 also demonstrates how both of **the important articles selected**, *Public Perception of Climate Change: Voluntary Mitigation* and *Voluntary versus Mandatory Approaches to Climate Change Mitigation* **were based on ideas from the first, reading-to-learn task**. That is, during the first session, Olivia encountered the word mitigation in her Google results, but did not know what it meant. She opened up a new tab, searched for mitigation, and explored several different definitions before finding one that fit the context of

climate change (i.e., to lessen). At that point, she also rephrased her search to include mitigation as a term. The notion of mitigation, which she did not previously understand, became an important part of her ongoing synthesis of ideas in her reading-to-learn task. Similarly, the phrase "public perception" was an idea about which she had an insight in the reading-to-learn task regarding its importance to individual behavior decision-making. As such, she may have been primed to select these ideas in the different titles above, especially as they appeared together in her reading-to-do task. This phenomenon did not apply to just Google results, either. While browsing through a 17 page PDF, Olivia skipped many sections, but stopped at *Clinton, the Carbon Tax, and the Climate Change Action Plan,* possibly because carbon taxes were discussed in Web text earlier in her reading-to-do session (at the time leading to her repurposing an idea about tax breaks for the rich).

Two of the instances of keyword use across the series of events in this creative synthesis demonstrate how **search phrase development itself can be more than just a gateway to synthesis**, but synthesis-like itself. The first time, as Olivia switched gears from the creative synthesis #2 sequence, she said the following

> ...so let's see...I'm going to go back here though and look at...um...look at...how...um...so I'm actually going to go back here [to Google search box]...and look at how...let's see what was I just thinking...I want to go back, I had read something earlier that talked about how to get people to change behavior...and this thing says that my ideas need to be backed up...so I guess I'm going to consult the literature...

and then typed [how to change a behavior voluntarily] for her search phrase. This process took her about 45 seconds to complete, and though it is not a generative synthesis, it is very much a

synthesis for meaning of her own disparate ideas, bringing together ideas from the task and from articles she had read earlier, in an idea-play like environment that resulted in her preferred phrasing.

Similarly, after determining that she was "going to be done with" a PDF article about climate change policy, Olivia returned to the Google search window, and said,

> so, let's see here...um...so let's see here...I'm going to look up efficacy (as she typed the word in the search box)...or improving efficacy (as she deleted efficacy and then typed improving efficacy)...um...of...of...voluntarily behavior change

resulting in the search phrase [improving efficacy of voluntary behavior change]. This search phrase was based on an insight she had made about enhancing the efficacy of the weak voluntary programs she encountered in the previous article. In this sense, it is a form of generative synthesis designed to open up her knowledge to a new area. After a quick review (less that one minute) of one article about the "RP model" of behavior change, she returned to her results and immediately revisited the search phrase, and said, "improving...maybe take out efficacy and put in climate change" which resulted in the search phrase that netted several syntheses based on the PowerPoint outlined above. That is, her visit to one site and then right back to the search box indicated that looking at one result and determining it was not what she wanted was itself part of the search phrase development. In this way, her total search phrase development time was over two minutes, but the resultant phrase provided several generative syntheses based on the water stewardship PowerPoint she found. Finally, to the extent that her successful search phrase development was guided by the one result she browsed after the preliminary search, this form of development is something that cannot be explained by keyword search literature grounded in online catalogs of offline resources. This is because the time it would take to access each offline

resource would be excessive and essentially undermine the idea-play activity afforded by the immediacy of the Web.

Conclusions - Case Study #1

Several key findings emerge from an analysis of Olivia's overall synthesis experiences. First, **the complexity of synthesizing information in Web-mediated environment is demonstrated across the examples and elements**. Her interactions showed how keyword search phrases can be constructed in a variety of ways: (1) through a combination of Web text, task instructions and background knowledge; (2) from interactions between notes and Web text; and, (3) based on in-the-moment insights. In a synthesis for meaning, arguably the simplest element of synthesis proposed, the data demonstrated how Olivia's background knowledge about the text structure, ability to evaluate the relevancy of an article, text skimming proficiency, and ability to separate relevant from irrelevant information within a relevant text interacted as precursors to synthesis for meaning events. The data also showed how a variety of conditions may lead to in-the-moment insights, including the rapid succession through a multiplicity and density of ideas in multiple texts, attention to detail and deeper reading of specific text, background knowledge, and idea-play, across a myriad of text structures and types, including both hard and soft resources. Repurposing manifested several ways, from one context to another, using ideas in opposite ways, reorienting ideas based on scale, repurposing the same idea in two different ways, and combining a repurposed ideas with an insight; from task specific, divergent, hard, and soft resources. Examples of reinforcement indicated how information resulting from synthesis for meaning and insights were reinforced, often multiple times across multiple texts. The data also indicated how in a single text, several of these elements could be utilized in rapid sequence.

The concept of creative synthesis was explored, providing even greater evidence of the complexity and layering of synthesis elements in a Web-mediated environment. The implications for "downstream" syntheses of ones own previous syntheses were explored. The various elements of synthesis that can appear elsewhere in insolation can also interact, work in concert, and comprise a larger unit of knowledge construction that makes up a creative synthesis. For example, one sequence from the reading-to-do session demonstrated how a series of generative syntheses (repurposing, repurposing, insight, repurposing, insight, insight, repurposing, insight, insight), scaffolded by the Web, but also informed by Olivia's syntheses from the reading-to-learn session, comprised Olivia's foundational creative synthesis during her reading-to-do task. This example also indicated that flow (Csikszentmihalyi, 1990) is a consideration when examining the process of creative synthesis. In another creative synthesis example, the simultaneous occurrence of synthesis elements working in concert was explored; for instance, how the same text and ideas lead to insight, repurposing, and reinforcement. Together, these illustrations indicate one thing about synthesis in a Web-mediated environment quite clearly - it is anything but predictable or regular in its manifestation. In this way, the notion of Web-mediated synthesis is itself an ill-structured concept.

Second, Table 7 indicates the average times each element occurred per minute during each task. Olivia synthesized for meaning .42 times per minute during her reading-to-learn session and .33 times per minutes during her reading-to-do. She had insights .10 and .18 times per minute, respectively; repurposed .13 and .33 times per minute, respectively; and, reinforced at the same rate during both. These data are not surprising in that the reading-to-do task was essentially a creative task, where as the reading-to-learn task was exploratory. That is, **synthesis for meaning helped Olivia make sense of the text(s) she encountered in an exploratory task,**

but when more generative reading was required, she relied more heavily on insights and repurposing. She also relied more heavily on repurposing during the reading-to-do task than insights, which may be an indication of the relative difficulty of having an insight when compared to repurposing other information, and the significant value of repurposing to a creative synthesis.

Table 8				
Descriptive Data for Olivia Synthesis elements per Minute				
	Reading-to-Learn		Reading-to-Do	
Synthesis for Meaning	0.42		0.33	
In the Moment Insights	0.1		0.18	
Repurposing	0.13		0.33	
Reinforcement	0.2		0.2	

Third, **soft resources were a valuable part of both Olivia's reading-to-learn and reading-to-do syntheses**. As shown in Table 5, Olivia used more than twice as many soft resources (16) as hard (7) during her reading-to-learn task, and about the same number of each during the reading-to-do task (three to four, respectively). These soft resources were used in a variety of ways. A blog named *Old man in a cave* helped her synthesize the importance of media for meaning. A *Reddit* comments page provided her with ideas about inconvenience, sum of behavior, money, collective vs. individual behavior, how people are affected personally, and moral behavior. These ideas facilitated several synthesis activities, including synthesis for meaning, repurposing, and reinforcement. An editorial on the *HuffingtonPost* helped Olivia synthesize ideas about how humans deal with threat from an evolutionary perspective, a new perspective on money, human relationships to nature, our ability to make change alone, and the

implications of time; again with a variety of synthesis techniques. The idea that religion could make individuals more invested in nature came from repurposing a commentary on *WorldNetDaily*, a site often considered a right-wing media outlet. Similarly, an insight about the relationship between opposition to environmental protection and some individuals desire for less government was spurred by a commentary on an equally biased, but left-learning site, *Grist.org*. Finally, Olivia repurposed multiple ideas from a PowerPoint hosted at the *Empowerment Institute*, a consulting and training organization.

When asked about these soft resources, Olivia said they were "extremely" helpful, further commenting,

> I really feel that even though they are softer, in the sense that I wouldn't really want to necessarily publish a paper and cite a blog, it gives me background knowledge that I didn't even know, and so I can begin to read credible sources on this opposite to what I believe, I need to figure out what is opposite, I guess, basic bullet points under this category, before I can begin to go look at more of the credible resources...

With respect to the *Reddit* comments, she added

> So the bulletin board, um, I felt like I could relate more to the people who are writing. You know, it's actually them, and they're stating their opinion. It's that one opinion, and I know it's that one opinion, but it's interesting to then see two people go back and forth, because that show me, yeah that's right, yeah OK, I can see that too, even though I don't agree with it, I can totally see that...and, if it's a scientific article or the news, it's some sort of, they want you to think *this* way and they write the article for that. But, the blog [discussion board], you can see the

back and forth, back and forth, and I really...that really helped me get some basic ideas down

Her comments emphasize a fourth key idea about Web-mediated synthesis that is highlighted by many of the examples outlined above: **the topics and the task contribute greatly to the types of Web resources that will be useful addressing them**. In this case, given the ill-structured nature of the topic and the exploratory and creative focus in the tasks, Olivia was interested in ideas. She found ideas that she could borrow, repurpose, and that gave her the foundation to make her own insights. These kinds of ideas can come from anywhere, and sometimes the best came from sources that might not be considered reliable based on library research rubrics (e.g., "Evaluating") or Web reading guidelines (e.g., "TICA").

Fifth, **the relationship between keyword search phrases and the synthesis elements that followed soon thereafter was inconsistent**. Table 9 demonstrates the variability in the types of syntheses the resulted from consistent and divergent keyword search phrases that themselves preceded multiple instance of synthesis. No clear relationship emerged between the type of keyword search phrase and resulting types of synthesis. However, given that the phrases that lead to the most generative search elements were both consistent and took place during the reading-to-do task, in may be that the task has more to do with the emergence of generative syntheses than the type of keyword search phrase.

Table 9					
Selected Keyword Search Phrases Olivia					
Keyword Search Phrase		Type	Session	Generative Syntheses	Syntheses for Meaning
why people change behavior on climate change		C	RTL	8	6

Table 9 (cont'd)				
why not change my behavior on climate change	C	RTL	4	8
religious views on climate change	D	RTL	5	3
benefits of climate change	D	RTL	2	2
rich people change behavior global warming	C	RTD	9	2
how to change a behavior voluntarily & how to change climate change behavior voluntarily	C	RTD	12	3
improving of voluntary behavior climate change	D	RTD	5	0

Sixth, synthesis for meaning provided additional value to Olivia beyond just helping her understand text(s). **As ideas were synthesized for meaning, they also contributed to the idea-play that undergirded insights and creative syntheses**. For example, as discussed above, Olivia synthesized the idea of reducing energy and gas use in the context of ways to change behavior for meaning from an abstract in the *Journal of Preventative Medicine*. However, by repeating the phrases she had synthesized for meaning when considering several different lenses of behavior, these simple ideas contributed to several instances of insight, reinforcement, and repurposing thereafter.

Seventh, **Olivia visited the task and supporting instructions extensively while both reading-to-learn and reading-to-do, often directly supporting her synthesis experiences**. During the reading-to-learn task, and while reading about *How the science of behavior change can help with sustainability*, she looked back to her task instructions several times which helped her realize "I'm not interested in the theory of behavioral change, necessarily." This sort of filtering relevant from irrelevant is critical to synthesis for meaning. At about that same time, re-reading the task out loud directly preceded her repurposing the idea of caring from sustainability to climate change. About five minutes later, she re-read the instructions again in the midst of

starting on a 48 page PDF, after which she was again able to separate relevant from irrelevant, this time within a specific document. About eleven minutes later, re-reading the task and emphasizing to herself the instructions to "discover what you don't already know" she said, "well I know a lot of reasons why people make decisions to change behavior in many ways, but why people may not..." which contributed to the development of her next search phrase. Another 15 minutes later, she re-read the entire task, soon thereafter she read about the science of climate change, and said to herself "when I just read about the science...part of this topic (task) says to open up to others...I wonder if religion affects your view on climate change." This quick change in direction was directly facilitated by the task instruction, lead to her divergent searching and several related syntheses. Similarly, just a few minutes later, she read the task one last time, specifically the instructions to "not close down and be open to new ideas." After reviewing the current results from religions, she switched abruptly again in her direction and searched for [different country perspectives on climate change].

In her reading-to-do task, about 15 minutes after starting, Olivia read from the task that she should be focusing on "creative ideas how to persuade. " She then commented on the "actions we can take," reviewed her notes, and had an insight about projects for college students to do. Just thereafter, she reviewed her notes and said "this thing [the task instructions] says I need to have my ideas backed up, so I'm going to consult the literature on how to change a behavior voluntarily, which guided her next search phrase. Later, she read again from the task "persuade three different groups...lessen the effects of climate change...college students...socioeconomic" and immediately said "so I'm going to type in 'fun project for climate change.'" Only a few minutes later, she read the task again, "...creative ideas to persuade three

different groups, so show them what it would be like, go back and go through my list...” which led to the following insight

> Well…we can I guess we can make for college students we could give them an example of what the world would be like in so many years…make them…have them enter this new world…a day…and hour in the life of someone so many years from now…from global warming…this would also be fun, too, for people…like a church group could do this…everybody could do that together…

Olivia summed up her use of the task instructions in her interview by saying “I just needed to continuously go back and clarify, because for me it’s easy sometimes to get distracted.” However, the examples above indicate that the task served several more purposes in the Web-mediated synthesis environment. That is, re-visiting the task helped her change course and construct new search phrases five times, three of which were divergent. Re-reading the task instructions also directly preceded four of her synthesis moments.

Eighth, **Olivia used many more Web resources during the reading-to-learn task than the reading-to-do task** (23 to seven, respectively), which she described as task related. After her reading-to-learn task, during an interview, Olivia mentioned several times that her strategy was to search for opinions and information, “I was searching...I had kind of like a preconceived, I guess, I tried to get rid of that, but I kind of knew the type of information that I wanted.” That is, her mindset was to search, and Google was used as a search tool. Where as, in the second session

> I just sat and I thought about my ideas first..before I went to Google. Like what do I know, what are the ways that I know that could achieve this goal…and then I used Google to basically verify those ideas and to gain more ideas for each

> separate group. But then, as I was going through the groups, I realized the fundamental thing between all of them is this fundamental behavior change. And, then I wanted to get some background information on how to effectively change behavior. So I went back and I did that…in Google, and then I came up with some more ideas...

That is, when the task was more creative, her mindset was more about thinking, and Google became part of her creative process as more of a thinking tool.

Ninth, Olivia's examples demonstrate how **both background knowledge and idea-play contributed to her synthesis activity**. Background knowledge both contributed to and fully comprised synthesis elements related to keywords, synthesis for meaning, insights, repurposing, and creative syntheses. At the same time, several examples demonstrated how assigning background knowledge as the source for a several ideas that emerged would be overly reductive. The multiplicity Web text(s) and use of idea-play explained or partially explained several instance of synthesis that may have otherwise been contributed to background knowledge alone. Similarly, idea-play interacted with keyword construction, insights, repurposing, and creative syntheses. There are also times that both background knowledge and idea play worked in concert with synthesis elements. However, while these examples provide ample demonstration of the importance of both background knowledge an idea-play, the extent to which either contributed to any given synthesis element is unclear from Olivia's examples.

Finally, **Olivia's use of notes was extensive and supported all of her synthesis processes**. Synthesis for meaning was supported by both verbatim and summary notes in almost every case. Insights were prompted by reviews of her notes in several instances. Review of her notes even informed the development of her keyword search phrases at times. Adding ideas to

her notes (either for meaning for in a generative way) also facilitated the repurposing of that same idea to another section of the notes. For instance, as she synthesized morals as a reason people might change their behavior for meaning, she also realized that the same idea might apply to why people *don't* change their behavior, and added a note repurposing the idea of morals to that section. During the reading-to-do task, her reading-to-learn notes served as a new standalone text from which Olivia was able to synthesize several ideas for meaning into her reading-to-do notes. The discussions of the creative syntheses in her reading-to-do sessions above outline several of such instances. In addition, just stopping to synthesize ideas for meaning into her notes sometimes led to other insights. For instance, as presented above, she synthesized several ideas that might affect individual behavior from the Purdue study. In the middle of writing them down, she had an insight about money. Similarly, after making note of a different insight about how money might be a reason people do not change their behavior; she immediately had another insight about public perception. It is possible, therefore, that the act of stopping to take notes provides either idea-play among the ideas in the notes, or a small opportunity for internal incubation (i.e., a letting up of her focus on the Web text(s) allowing for subconscious idea-play), both of which may facilitate generative syntheses.

Chapter Summary

This chapter provided detailed illustrations and discussion of the broad themes about synthesis elements outlined in Chapter 3, based on an in-depth case study of one individual participant, Olivia. The chapter explored each element individually and then demonstrated how they worked in concert to comprise creative syntheses. The chapter finished with conclusions drawn from this case study about broader patterns of use, interactions, and relationships among the synthesis elements that directly address the research questions for this study.

Conclusions that contributed to a better understanding of RQs 1 and 2 included (1) Web-mediated knowledge synthesis is complex, multiplicitous, unpredictable, and ill-structured; (2) synthesis for meaning was used more during the exploratory task, while insights and repurposing were used more during the creative task; (3) soft resources were a valuable part of both Olivia's reading-to-learn and reading-to-do syntheses; (4) the topics and the task contributed greatly to the types of Web resources that Olivia used to address them; and, (5) Olivia utilized the task and supporting instructions extensively while both reading-to-learn and reading-to-do, often directly supporting her synthesis experiences.

Conclusions that contributed to a better understanding of RQ 3 included (6) the relationship between keyword search phrases and the synthesis elements that followed soon thereafter was inconsistent; (7) in additional to aiding understanding of text, synthesis for meaning also contributed to the idea-play that undergirded insights and creative syntheses; and, (8) Olivia used many more Web resources during the reading-to-learn task than the reading-to-do task, based on the type of task.

Conclusions that contributed to a better understanding of RQ 4 included (9) background knowledge and idea-play contributed to all of the other synthesis elements, though the extent to which either contributes is unclear.

Conclusions that contributed to a better understanding of RQ 5 included (10) Olivia's use of notes was extensive and directly supported her synthesis processes a majority of the time.

CHAPTER 5

IN-DEPTH CASE STUDY #2 - BETH

Chapter Introduction

This chapter provides detailed illustrations and discussion of the broad themes about synthesis elements outlined in Chapter 3, based on an in-depth case study of one individual participant, Beth. The chapter explores each synthesis element individually and then demonstrates how they worked in concert to comprise creative syntheses, primarily by comparing and contrasting these findings with the data provided in Chapter 4 regarding case study #1. In so doing, this chapter highlights further nuances in the application of the broad themes of Chapter 3. It finishes with conclusions drawn from the case study about specific patterns of use, interactions, and relationships among the synthesis elements that are unique to Beth.

The chapter focuses on *how* synthesis for meaning, insight, repurposing, reinforcement, and creative synthesis manifested for Beth by providing detailed examples and illustrations. Specific to RQs 1 and 2, variation in the application of these themes is demonstrated both across specific examples in this case study (e.g., by highlighting the uniqueness of the various ways Beth synthesized for meaning) and by highlighting differences between the two cases studies (i.e., between Beth and Olivia). The chapter also emphasizes the multiplicity of these ideas and how they interact and work in concert, the primary concern of RQ 3. The specific roles of background knowledge and idea-play are highlighted in several examples with respect to RQ 4. And finally, to explore RQ 5, most examples emphasize the substantive contributions note-taking provides to the participants' synthesis processes.

Beth

The second participant selected for an in-depth case study was Beth, a 23-year-old economics doctoral student. Her selection was also primarily based on her extensive demonstration of synthesis activity in both reading-to-learn and reading to do tasks (she had the second highest total after Olivia, 72 instances). Like Olivia, she also demonstrated a diversity of synthesis experiences and the ability to think-aloud in great detail. However, three additional factors contributed selecting Beth for the second in-depth case study, all related to the initial goal of diversity in participant selection. First, her background in economics was far enough afield from Olivia's in food toxicology to provide a significantly different perspective and learning background (e.g., hard science vs. social science). Second, her reading style for the Web-based texts generally involved less deep reading than Olivia. Finally, she took all her notes online (unlike Olivia who took notes offline). A detailed profile of Beth is provided in Appendix K including a reporting of her background knowledge and experiences on the topic of climate change collected at the beginning of her research session.

Beth demonstrated 72 instances of synthesis during her sessions. Table 10 outlines descriptive statistics gathered.

Table 10

Descriptive Data for Beth By Task

	Reading-to-Learn	Reading-to-Do	Totals
Consistent Keyword Search Phrases	2	1	3
Divergent Keyword Search Phrases	7	6	13
Hard Web Site	6	3	9

Table 10 (cont'd)			
Soft Web Sites	20	9	29
Synthesis for Meaning	7	10	17
In the Moment Insights	12	12	24
Repurposing	4	7	14
Reinforcement	12	2	14
Creative Synthesis	0	3	3

In addition to these statistics, several other characteristics describe her session. First, she took a lot of notes, all on the computer in Google Docs. Second, she revisited and referenced the task instructions multiple times during each session. Third, a vast majority of the resources she read were short articles on soft Web sites. Within these texts, she did not deep read much of the text, mostly skimming and skipping around. Finally, in both sessions, Beth "slowed down" a bit toward the end of the allotted time. In both cases she asked when the session would be over, and the number of synthesis experiences declined toward the end of the task.

The data collected during Beth's sessions provide further illustrations of the various synthesis elements. Similar to Olivia, several of these are explored in detail below, and conclusions about the patterns of use, interactions and relationships are discussed.

Divergent keyword search phrases. Beth's use of divergent keyword search phrases was relatively balanced between the reading-to-learn and reading-to-do tasks. Table 11 lists all of the phrases used in the first session.

Table 11					
Keyword Search Phrases Beth, Reading-to-Learn					
Time	Keyword Search Phrase		Type		
1:20	green living style (tips)		D	BG knowledge + Google	
2:59	why recycle		D	Web text	
4:30	how to lower energy consumption		D	Web text	
6:29	how to lessen the effects of climate change		C	task	
14:00	why not go green		D	BG knowledge + task	
25:11	reasons to go green		D	iteration	
35:18	why I don't recycle		D	iteration	
42:50	can I lessen climate change		C	iteration	
54:06	why I won't go green		D	iteration	

Several key ideas emerged from this data. First, Beth's keyword development was grounded by a single keyword - "green." It was the first phrase she used [green living tips], and resurfaced three more times during the session. Before using it the first time, she was reading the task instructions, and finished with "explore what you can discover that you don't already know." After which she commented

> all right, I'm aware of a lot of things, but I don't know a lot of things, if that makes sense. It's like, I kind of know that people drive hybrid cars and use cloth diapers and stuff, but that's...I don't know. All right, so let's get going...

She navigated to Google and typed in [green living style], as she said "green living style...tips, tips, I like tips better, thank you Google." She switched to "tips" based on the recommended

search phrases that Google presented below the search box as she typed the words "green living."

In this case, both Beth's **background knowledge and Google informed the final search phrase she selected**. Her interview comments provided an indication of the origins of her "green" orientation to the task. When asked what guided her searching throughout the reading-to-learn session, she replied

> it was pretty much what I underlined on the paper [task instructions], which is what I thought were the main topics...and basically, why do people...the words I underlined were why behavior lessen the effects of climate change and not change behavior...are the exact words I underlined

She continued "yeah, so that was what kind of guided my search was the word like behavior, green, why to go green, why not to go green." When asked where green came from, she said

> I think it's because I associate being green with like environmentally friendly decision making, people call it like the green movement, or people buy green products...I also had a friend who worked for, I don't remember exactly who, but like the green movement in Washington, D.C. and she helped organize the green festival out in California...so I think that's why I associate green with environmentally friendly. She is a Prius driving person...I didn't even notice it wasn't on there [on the task instructions]. I swear it was on there.

As such, the influence of her background knowledge and experience was significant, enough so that she assumed her "green" lens on climate change was in the instructions.

•Equally important to consider was the impact of Google's suggestion to her. That she was open to the recommendation from Google and switched to it without hesitation is indicative of

the confidence users may place in their technology. Though it cannot be determined whether [green living style], Beth's first choice at this moment in the session, would have resulted in better resources (i.e., she only spent less than two minutes on the [green living tips] results), it is important to consider the implication of using Google recommended keyword phrases. If, as discussed above, keyword selection is an important part of the overall synthesis of ideas for a creative task, it is arguable that using too many Google recommended search phrases would effectively "close down" the breadth of the learner's exploration since the Google recommended phrases are likely based on popular combinations of words based on the first few words entered by the learner.

The second characteristic of Beth's keyword searches was their **commonality across her reading-to-learn task**. Though she used nine different search phrases, they represented only four different general areas of search: (1) being green (or not); (2) recycling; (3) lessening climate change; and (4) lowering energy consumption. Compare this to Olivia's use of keyword search phrases (Table 6). Though Olivia only used three more phrases (12) than Beth, topically she explored many more areas: (1) opinions on climate change; (2) climate change behavior; (3) barriers; (4) caring about climate change; (5) benefits of climate change; (6) mitigation; (7) religious views; and (8) different countries. This may be related to Beth's waning motivation toward the end of her reading-to-learn session. That is, during the 60 minutes task she said "all of these Web sites say the same thing" at 47:55, said she felt "stuck in a rut" at 53:30, asked how much longer the session had at 53:42, and seemed to be out of ideas for keyword search phrases when she used [why I won't go green] at 54:06 and said "Have I already done that? I might have already done that..." Beth also demonstrated only five synthesis moment in her final 20 minutes of the reading-to-learn task, using two search phrases that were only mild changes to phrases

used earlier in the session ([how to lessen the effect of climate change] was used at 6:29 and [can I lessen climate change] at 42:50; [why not go green] was used at 14:00 and [why I won't go green] at 54:06). Whereas, Olivia demonstrated 13 synthesis moment in the final 20 minutes of her reading-to-learn task, using four largely different phrases that did not have similar antecedents ([why climate change mitigation beneficial to government], [benefits of climate change], [religious views on climate change], and [different countries perspectives on climate change]).

Together, these ideas illustrate the potential pitfalls of ignoring Web text(s) when developing keywords. Beth lifted only the ideas of recycle and energy consumption from the text to expand her exploration, even though in the interview, she commented that she commonly does this. That is, when exploring ill-structured topics, **the combination of task, background knowledge, and Web text** demonstrated by Olivia **may lead to more effective development of divergent keyword search phrases**.

Finally, though both Olivia and Beth used several soft resources in their reading-to-learn sessions, more than hard resources in both cases, the soft resources visited by Olivia were more serious. While individual choice of the resources to visit is the primary factor in determining what resources were visited, it is possible that the **different keyword choices made contributed to the quality of soft resources by impacting what was available**. That is, while Olivia generally used the term "climate change" to frame her searches, Beth used the variants on "going green," a more colloquial term. Of the soft resources visited by Olivia, most had more serious titles like "global governmental organization," "the 'public opinion' on climate change," "environmental economics," "social behavior and public policy," "behavioral economics," "the climate change religion," "Christian right-wing views are swaying politicians and threatening the

environment," and "how governments can creative incentives for mitigation." Where as, the soft resources visited by Beth included titles like "8 ways not to get tricked going green," "how to stop unwanted mail," "Ultimate way to go green? Don't have kids," "composting worms," "Convince me to go green! Eco Friendly Motivation," "reusable paper towels," "the four-day week," and "create jobs, don't go green."

Table 12 lists all of the phrases Beth used in her reading-to-do task. When compared to Olivia's reading-to-do search phrases, the data provide further argument for the importance of consistent and continued use of divergent search phrase. That is, Olivia used four topically dissimilar keyword search phrases in the final 10 minutes of her reading-to-do session and experienced five synthesis elements during that time, while the five search phrases Beth used during the final 10 minutes covered only two general topics and she only had one synthesis moment.

Table 12

Keyword Search Phrases
Beth, Reading-to-Do

Time	Keyword Search Phrase	Type	
1:36	how to lessen effect of climate change	C	task
10:23	marketing green products to upper class	D	task + BG knowledge
35:09	how to convince other to make environmentally friendly decisions	D	task + BG knowledge
39:50	convince others to make green decisions	D	task + BG knowledge
40:44	convince friends green choice	D	iteration
41:44	inspiring lifestyle change in others	D	BG knowledge
44:00	posh green products	D	idea-play

Synthesis for meaning. While Beth compiled and recombined information across texts and from background knowledge across tasks, she did so less often than Olivia. Olivia synthesized information for meaning 25 times during her reading-to-learn task; Beth did so only seven times. Several issues may have contributed to this difference. First, as noted above, Beth visited **less varied resources**. As she began to see the same information over and over, though it was reinforced for her (see below), it did not required a new synthesis for meaning to be useful. Second, as noted above, the **resources Beth visited were also sometimes less serious** in the topics they discussed, and **may not have provided information in substantive enough ways to be worth synthesizing for meaning**. Third, Beth made several more insights than Olivia during the reading-to-learn task, indicating that the **less serious resources visited may have been more amenable to insight**.

Of the times Beth synthesized information for meaning, she did so in its simplest form. That is, while Olivia demonstrated several different ways to synthesize meaning (i.e., based on her background knowledge, from a single Web resource, and/or from multiple Web resources), in every case, Beth primarily copied short phrases from the text(s) when synthesizing for meaning. Appendix L provides several examples of this.

In-the-moment insights. One of the things that differentiated Beth from Olivia was her extensive use of insights during both the reading-to-learn and reading-to-do sessions. While Olivia had six and eight insights during the first and second tasks, respectively, Beth relied more heavily on this process, having 12 insights during her reading-to-learn task and 12 during her reading-to-do sessions. Of these 24 experiences, she demonstrated insight under a variety of contexts and conditions.

At one point, Beth had several insights quickly in a row while **reading through a list** of ways for individuals to reduce climate change (see Appendix M, examples 1 and 2). Beth's rapid movement though this list and corresponding generative insights was similar insights Olivia experienced as a results of the rapid succession of ideas, but differed in two important ways. First, in this case the **rapid sequence of ideas is from one Web site**. That is, just this list of ideas seemed to create an environment similar to that which promoted insight over the course of several articles for Olivia. Second, while many of the ideas in Olivia's case were substantive in nature, the page Beth explored was very soft, even including what she considered some **silly or unrealistic** examples. However, given the lack of traditional reliability or accuracy, the text on this page still established something similar to the *creative stew* of ideas Olivia experienced. As such, Beth had insights based directly on the text (text about paying bills online resulted in an insight about people doing things that are easier; the vinegar text lead to an insight about chemicals and safety) and based on background knowledge (change stuff too much and you can feel good about it were both identified as specifically not from the Web, but a "personal opinion" and "from my brain") while reading the list. In the case of the third list item, Web text about purchasing local food, **two different insights were facilitated**, the importance of higher quality and the notion of feeling good. Finally, it is important to recognize that the articles Beth visited in the first two examples in Appendix M were not about *why* people make the decision they do, but actions people can take to reduce the effects of climate change. Part of the reason Beth was able to (or had to) make insights about these resources was just that **slight difference from the task she was assigned**. So, it is possible that a keyword search phrase that included keywords like "choices" or "behavior" would not have required or facilitated as much insight on her part when compared to resources that resulted from the more general [how to lessen the effects of

climate change] that led her to this site. Both examples of Beth using lists on the Web and the resulting insights indicate that **reading through bulleted material may provide smaller segments of text amenable to idea-play**. That is, the reading process of lists itself may again allow for small breaks in thought, fostering internal incubation (subconscious idea-play), which may facilitate generative syntheses.

In another case (third example in Appendix M), Beth made an insight that appeared to be based on a VCS synthesis of ideas across several articles. The build up of ideas in this example is different than the creative stew identified just above and in Olivia's data. All of the ideas in the texts Beth encountered had the notion of "tradeoffs" in common (though not explicitly stated), where as the creative stew is a number of relatively unrelated ideas.

In the final example, Beth's use of the text comprehension strategy of prediction (Brown, Pressley, Van Meter & Schuder, 2004) provided a generative insight. And, like Olivia's experience with the Purdue research, her insight occurred after stepping away from the text to take notes on a synthesis for meaning, which may have provided just enough **letting-up of ideas or incubation to promote insight**.

Repurposing synthesis. Beth repurposed only four times during the reading-to-learn tasks, but these instances reflected similar ways of doing so as Olivia. For instance, after searching for [how to lower energy consumption] she repurposed ideas from one context to another when reading about "13 Simple Ways to Lower Your Electric Bill." As she quickly scrolled through this article, she read

> keep it clean...clean air filters...program the thermostat...seal up the house (saying I should do this in my apartment, my heating bills are obscene)...um..let's

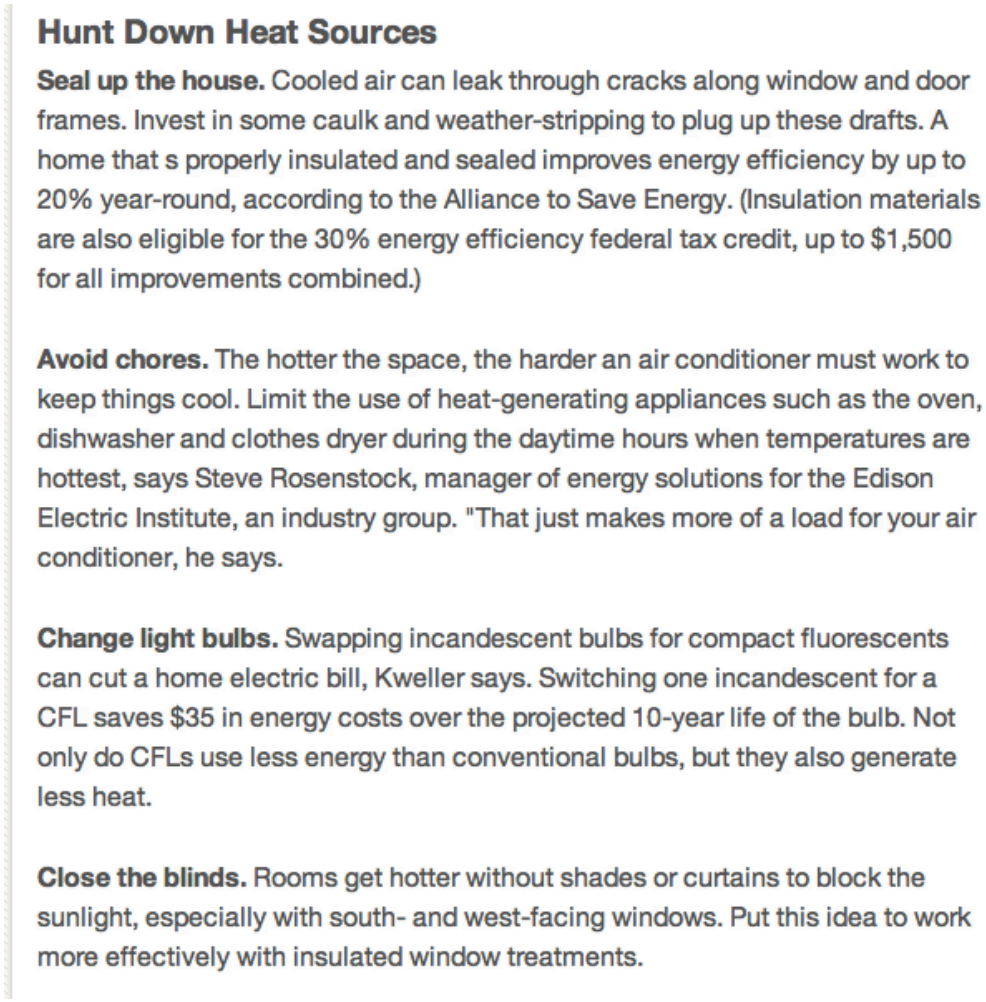
see...avoid chores...limit the use of heat generating appliances such as the oven...change light bulb to the compact fluorescent ones...

and then said, "another reason people might go green is to save money...like on heat bills or on grocery bills...go back to gardening thing," while she noted "save money (i.e. on heat bills or grocery bills)." In this case, the idea of saving money was repurposed from the context of lowering electric bills to climate change behavior. After returning to the same article, she read further "consider time-of-use plans...fix the bill..." then returned to her notes and said, "so, saving money is a reason...but then I guess it could kind of be a reason not to go green...because things that are like organic and stuff are more expensive," noting, "save money (organic more expensive).". In this latter case, Beth **repurposed her own repurposing** of saving money in a way opposite to how she herself intended it.

Beth repurposed another idea in the opposite way it was used in text *and* reoriented it to a new scale while reading the *Washington Post* article referenced above. After synthesizing morals for meaning from the article, she returned to the text and quickly read, "he's trying to say that we should look at the history of civil rights...uuum...should they [carbon emissions] be mandated by law..." and returned to her notes saying "another reason people choose not to go green, they don't have to, it's not legislated," as she noted the latter text. In this case, the idea of mandating behavior by law was reversed from a way to promote behavior to a reason people do not behave a certain way. It is also an example of **"double" repurposing**, given that Beth reoriented the same idea to a different scale, that is, from carbon emissions at the corporate/industrial level to individual behavioral mandates.

Reinforcement synthesis. Similar to Olivia, Beth encountered several opportunities for reinforcement of both Web text(s) and her own ideas during the reading-to-learn task. However,

many of the reinforcing instances for Beth did very little to enhance her knowledge in generative ways. Where as Olivia's examples often provided new context, perspective, reliability, and temporal stability, many of Beth's opportunities for reinforcement were reduced to mere repetition. Several of these examples were based on bullet points with limited text, such as that provided in Figures 4 and 5 (See Appendix N for detailed examples). In the first example, Beth read through this list, but did not read the supporting text. In the second example, she read through a list of hyperlinked ideas in a similar fashion. Though in both cases supporting text did provide new perspective on an issue she had read prior, her thin reading strategies did not allow for this. Whereas, in the second example, her deeper reading of a text structure similar to that provided in Figure 4, did lead to reinforcement. As such, both **the depth of reading on the part of the reader and the structure of the text may enhance or diminish the generative potential of reinforcement opportunities**.



Hunt Down Heat Sources

Seal up the house. Cooled air can leak through cracks along window and door frames. Invest in some caulk and weather-stripping to plug up these drafts. A home that s properly insulated and sealed improves energy efficiency by up to 20% year-round, according to the Alliance to Save Energy. (Insulation materials are also eligible for the 30% energy efficiency federal tax credit, up to $1,500 for all improvements combined.)

Avoid chores. The hotter the space, the harder an air conditioner must work to keep things cool. Limit the use of heat-generating appliances such as the oven, dishwasher and clothes dryer during the daytime hours when temperatures are hottest, says Steve Rosenstock, manager of energy solutions for the Edison Electric Institute, an industry group. "That just makes more of a load for your air conditioner, he says.

Change light bulbs. Swapping incandescent bulbs for compact fluorescents can cut a home electric bill, Kweller says. Switching one incandescent for a CFL saves $35 in energy costs over the projected 10-year life of the bulb. Not only do CFLs use less energy than conventional bulbs, but they also generate less heat.

Close the blinds. Rooms get hotter without shades or curtains to block the sunlight, especially with south- and west-facing windows. Put this idea to work more effectively with insulated window treatments.

Figure 4. Bulleted Paragraphs in Web Text. The text in this figure is not meant to be readable. The figure is simply meant to demonstrate the structure of the text.

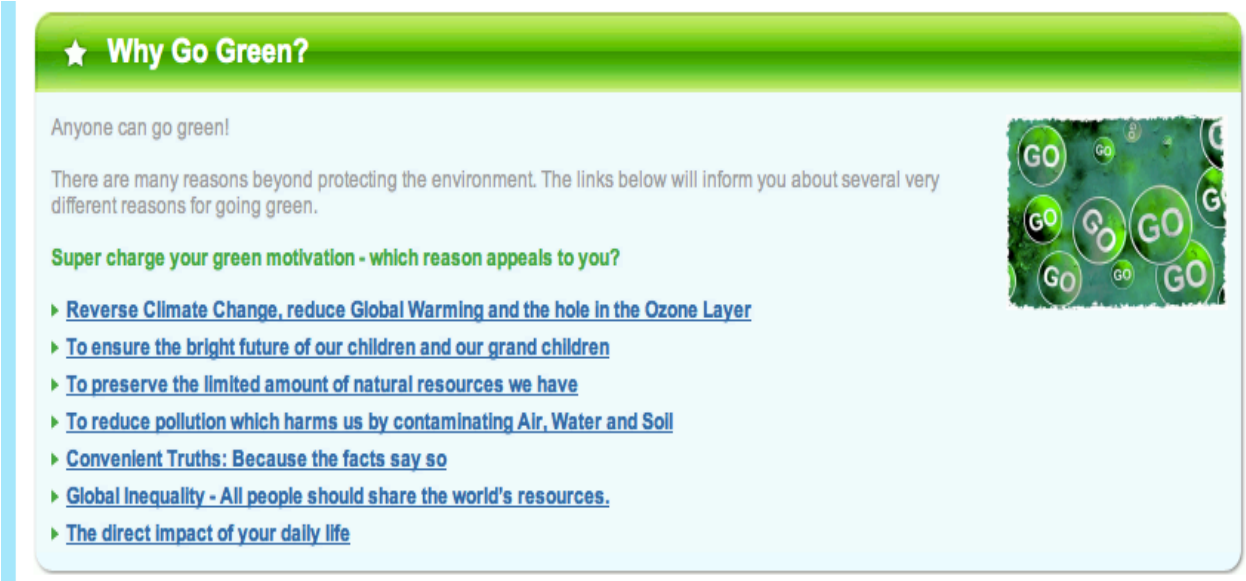


Figure 5. Bulleted Lists in Web Text. The text in this figure is not meant to be readable. The figure is simply meant to demonstrate the bulleted structure of the text.

Beth also demonstrated how reinforcement is not always directly from the Web text but can be more circuitous. For instance, she skimmed some comments from an article about "5 reasons why people don't recycle,"

> Ah, here we go...reasons recycling is bad for the environment...we are not running out of landfill space...recycling actually harms the amount of trees we have..it's not good for the environment because there is a lot of pollution to recycle.

She then said/wrote in her notes "reasons people aren't going green...technology is not perfect yet, i.e. it costs more to recycle than to not." In this case, the text itself did not reinforce anything, but it helped her think about technology again (i.e., reminded her of something she read earlier), which reinforced the idea that she noted earlier about the technology to go green not being ready yet. Reinforcing that idea here lead to an elaboration about recycling costs, and this elaboration was based on the text she had just read.

Finally, as mentioned above, Beth's use of keyword search phrases did not provide as many paths to new information as did Olivia's. One direct result of this was that near the end of her reading-to-learn task, when faced with information that might serve to reinforce earlier text(s) or insights, Beth's reaction was exasperation. As she pulled up a Web site entitled "Reduce Global Warming - Slow Down Climate Change with These Easy Green Tips!" she read "eat less meat" and then lamented "all of these Web sites say the same things" while laughing. In this way, the relationships between keyword development and the potential to experience generative reinforcement was highlighted. That is, the tendency for many of Beth's resources to have the same information may indicate the potential for decreasing returns on the utility of reinforcement after a certain point.

Creative synthesis. As with Olivia, the illustrations used above for Beth were culled from just her reading-to-learn task. As such, multiples of synthesis elements are now examined in the context of the creative syntheses they comprised during her reading-to-do task. Two examples of creative synthesis are detailed in Appendices O and P (creative synthesis #1 and #2, respectively). Several important ideas about creative synthesis are demonstrated in these examples.

The activity in Beth's first creative synthesis (Appendix O) comprised the first creative synthesis during Beth's reading-to-do task, and was quite different from Olivia's. While Olivia synthesized ideas from her first session for meaning, repurposed ideas from the first session, and had insights during her initial creative synthesis, she did so by working only from her notes. She did not use the computer at all in doing so. Where as, the activity from **Beth's initial creative synthesis integrated multiple sources**: (1) her reading-to-do notes; (2) her reading-to-learn notes; (3) the task; (4) the browser history text; (5) four articles from session one; and, (6)

background knowledge. Together, these resulted in ideas synthesized for meaning, insights, and repurposing.

For instance, the very first idea Beth proposed "it doesn't have to be expensive" was based on three separate ideas from the first session, "it's good for you" (a rephrasing of "you can feel good about it"), "saving money," and "accidentally doing it." In this way, she **synthesized several ideas together for meaning from memory**. That is, even though both "feeling good about it" and "accidentally going green" were insights in her first session, they were synthesized for meaning at this point, given that taken together with the idea of saving money, their combined meaning comprised "it doesn't have to be expensive" without further value-added. The next idea that she discussed was "God's kingdom" representing her **background knowledge** about religious groups and soon thereafter, the idea of "future generations" was **synthesized for meaning from notes**. (As a point of clarification, her reading-to-learn notes now represent a new text resource available in the universe of texts on the Web.)

Just considering future generations prompted Beth's memory of altruism in one of the reading-to-learn articles, which, even though she did not take notes on altruism, was available for her to access. The availability of the idea of altruism as a consideration and her ability to access the details of it quickly during the second task is indicative the complex environment for synthesis that ubiquitous Web access facilitates. You only need to remember core ideas and key markers on the Web. That is, Beth needed only a basic **familiarity** with the content she read and then the Web was available as a near-instant adjunct to her long-term memory. In Beth's case, she used the browser history to help her find this article, but, if she had Googled the phrase [US news world report altruism green] (i.e., all she really needed to remember was the publication, and two keywords), it would have likely been immediately available, as well (in May 2012, more

than one year after her research session, that search still listed the target article second in Google results). As this sequence of events related to her synthesis of information, though Beth could have just added altruism to her notes without revisiting the original article, actually finding it again accomplished two things. First, it allowed her to check the article for any explicit connections between religion and altruism (as she searched the page text for "relig" and "Christian"). Second, it facilitated elaborative and evaluative comments on her part before synthesizing for meaning the concept of altruism, as she wondered if it was too much of a generalization to assume religious people are altruistic before eventually synthesizing the idea into her notes.

Thereafter, returning to her notes prompted several more synthesis moments. While reviewing what she had already written, she had an *insight* about Christianity vs. religion and how the Bible fits (or doesn't) with this task. Given the lack of any supporting Web text(s) on this topic, her ideas here were largely *based on background knowledge*. She *synthesized future generations again for meaning* in the college student section. She had an *insight* about making a difference, which, though could be entirely based on background knowledge, may well have been informed by several of the ideas synthesized in the reading-to-learn task. That is, given that she just used the idea of future generations again, it, along with the idea of a moral argument that "we have the power to prevent death/poverty," both from the reading-to-learn task, may have contributed to the development of "making a difference." Beth was clear where "could be this generation's social movement" came from, which she *synthesized for meaning* from a *Washington Post* discussion about the parallels between civil rights and climate change action.

At this point, she still was starting to lose some of the momentum from this particular creative synthesis. She had been trying to find the *Washington Post* article, but when she did, it

replaced her notes in the browser tab. Once she got her notes back, the article was lost, and she kept trying to find it again in another tab. However, the sequence of reading some text from another article about peer pressure and greenwashing, re-reading part of the task, re-reading her reading-to-do notes, and then returning to her reading-to-learn notes prompted *two final insights* about trendsetting and responsibility. It would be easy to just assume both of these ideas were a result of background knowledge alone. However, given the multiplicity of resources and quick switching that occur adjust prior to having these insights, it is arguable that attesting these insights to background knowledge alone would be overly reductive. Beth read information from four different sources in the 40 seconds prior to the insights. As such, in this case, Web text, task instructions, current notes, session one notes, and background knowledge appeared to work in concert to facilitate the two final insights.

Beth's second creative synthesis (see Appendix P for details) is unique from those already discussed in that it was completed entirely without Beth ever doing a Google search or visiting a Web text directly. And, though it might be easy to attribute all of her insights during this time to background knowledge, close analysis of the interactions provides a more complex scenario. Indeed, Beth's vision of a product for religious people is largely based on ideas that did not appear in Web text(s), and were either new insights (the aesthetic of a beautiful landscape), or synthesizing for meaning her own previous insights that were originally based on background knowledge (e.g., God's planet, the bible verses from an insight earlier in this session and "feeling good about yourself" from an insight in the reading-to-learn task). But, a close examination of the other activity indicates how much **she synthesized information from her reading-to-learn notes**, which at this point represented its own Web text of her construction, based in large part on original Web text(s) and insights/repurposing she contributed based on these Web text(s). Her

vision for college students repurposed "everyone is doing it" (originally synthesized for meaning from Web text in the reading-to-learn task) in the opposite way - "personal decision" for college students. The economic aspects mentioned here were synthesized for meaning and reinforced from Web text(s) in the reading-to-learn task.

Finally, Beth's vision for high SES individuals in this example was **equal parts background knowledge and ideas based on Web text(s)**. The poverty issue was synthesized for meaning from the reading-to-learn session. However, her insights about the importance of charity and visibility derive, by her own admission, from her biases (background knowledge). Similarly, the idea of emphasizing small changes can be traced to an insight in the reading-to-learn task that was based on background knowledge. But, not moving into a smaller house was synthesized for meaning from a Web text in the first session. And, though the specific idea of health benefits had not appeared to this point anywhere in Web text(s) to this point, she did read about walking and biking instead of driving, had an insight about the higher quality of local foods, and discussed the higher prices or organic foods in session one. A such, the idea of health benefits could be based on her own background knowledge about health and climate change, but it may well be an insight based on her previous interactions in the reading-to-learn task, or a combination of the two.

Next, Beth read her session one notes with the explicit reason to "counteract" the reasons people don't go green. That is, when she read from her notes (now representing its own Web text), she repurposed the idea of "changing stuff too much" in the opposite way to emphasize small changes to the high SES groups. She then had an insight about the lack of certainty about the tradeoffs that using data would be helpful for the high SES group. Soon thereafter, when reviewing her session two notes, she synthesized turning off lights, insulation, and eating less

meat for meaning, which were originally synthesized for meaning in the first session. And, finally, biking and walking was repurposed from the context of transportation in her reading-to-learn task to health benefits in the reading-to-do task.

Conclusions - Case Study #2.

Beth's synthesis experience was for the most part "thinner" than Olivia's. That is, she visited resources with less text, didn't read them as closely, used more colloquial keyword search phrases with less topical breadth, and the notes she created were less detailed. At the same time, while Olivia experienced several synthesis moments that were "multiple" in the sense that they reflected two or more elements of synthesis (especially during her reading-to-do creative syntheses), Beth's were largely independent of each other. However, Beth still produced almost 50 interactions of generative synthesis. In fact, Beth experienced several more in-the-moment insights than Olivia (24-14). And, though Beth's insights were often based on bulleted or listed Web text and Olivia's were often based a paragraph or more of text from longer and richer sources, Beth's insights were no less meaningful. For instance, while Olivia made an insight about how religion can be a way for people to become more passionate about climate change based on the following, rather complex, text from a long research based PDF -

> …and greens with a spiritual bent, confer in increasing numbers, in particular over climate change, acquaintances are being struck that transcend many ethnic, ideological, a theological obstacles….And such encounters are not just a curiosity. The might make all the difference to the planet's future…

- Olivia made an insight about how technology to go green might not be ready based on a blog rant about how the author blew out a "10 year light bulb" in five minutes. As such, the data from

these case studies provide evidence that **synthesis can be facilitated in both complex and simple online reading environments, from both hard and soft resources**.

Similar to Olivia, Beth also made **extensive use of soft resources**. She used 20 soft resources (as compared to six hard resources) in the reading-to-learn task, and nine (as compared to three) in the reading-to-do task. Like Olivia, Beth used these resources to synthesize for meaning, spur insight, and repurpose information. When asked about her use of these soft resources, Beth commented,

> I think it depends on what I'm doing, if I'm writing a paper, I don't do that...but, if I'm just trying to get a feel for the various opinions out there...and just trying to like, even if I'm writing a research paper, a lot of times depending on the topic, I'll start with the Washington Post and BBC and things like that or even blogs, cause its just, to me, it helps give me context...like what are the opinions on this issue, what is the space I'm trying to navigate...

Beth's experiences also indicate that **different soft resources may be more amenable to certain forms of synthesis**. For example, when reading soft resources with less serious content, Beth had more insights than she synthesized for meaning. As such, Beth's experience **corroborated a possible interaction between task, resources, and synthesis type** for Web-mediated knowledge synthesis.

Beth's case study provided several examples where insight occurred in the context of idea-play resulting from bulleted lists. There were also times in both Beth and Olivia's sessions where they "let-up" from the text to revisit or take notes and insights occurred while doing so. Both of these situations indicate **how important the role of the creative process might be when considering Web-mediated synthesis**. That is, both idea-play and letting-up (or

incubation) are central to theories of creativity (see Bruner, 1962; Csikszentmihalyi, 1997; Osborn, 1953; Sternberg & Lubart, 1999; Wallas, 1926); Ward, Smith, & Finke, 1999) and should be considered when further exploring insight as part of the process of Web-mediated synthesis.

Beth and Olivia also differed greatly in their tendency to repurpose (14 to 23, respectively), especially in the reading-to-do task. This highlights the role of Web text and searching in the reading-to-do task. Neither participant used the Web extensively in this task, however, all of the sites Olivia visited were new, while Beth went back to several sites she had visited in the reading-to-learn task. Olivia used specific keywords ([rich people change behavior global warming]) that guided her to texts with enough similarity to her task that repurposing was afforded (e.g., carbon taxes for industrial customers repurposed to tax breaks for private individuals). However, when using the Web text(s) from her reading-to-learn task during the reading-to-do task, Beth either visited them to look for a specific idea (e.g., remembering the specific idea of altruism led Beth to revisit the article that originally presented that idea and synthesize it for meaning), or revisited the article because the title appeared in her history list while looking for something else (e.g., when she was looking for information on social movements and pulled up one on peer pressure from her history, which itself led to an insight about first adopters and trendsetters). In this way, **keyword development may prefigure the cognitive lens through which readers view their text(s) and the types of synthesis that result**. That is, Olivia repurposed her text to fit the constraints of her keyword search phrase. Where as, Beth's specificity of intent at times lead to a synthesis for meaning, and her lack of focus at others (e.g. when selecting the peer pressure article essentially because it was there), facilitated insight.

Though some of the differences above were rather stark, Olivia and Beth were quite similar in other areas. First and foremost, when faced with resources of extended text, **both were very capable at combining the reading comprehension skills of skimming and closer reading, and switching between them while reading Web text**. Both demonstrated several times where she would read several section headers or the first sentence or a short phrase from several paragraphs before finding something particularly interesting and focusing in on that. After reading more closely (and/or re-reading), and often having a synthesis experience, they would continue skimming until another closer read or the end of their article (or the end of their interest). (It should be noted that, in general, Olivia read more deeply that Beth, but both demonstrated this strategy of skimming to closer reading). This ability to vacillate between skimming and closer reading is different than that documented for skilled K-12 online readers. That is, the Taxonomy (n.d.) indicates how skilled K-12 online readers skim prior to a deep reading of an article (i.e., a text walk prior to a close reading (Taxonomy, n.d.)), but does not make reference to changing between these skills as quickly and efficiently at Olivia and Beth did. In this study, Olivia and Beth likely demonstrated this skill given that the extended length of some of their resources (not many in Beth's case). These resources were also likely longer than those used by K-12 readers in similar research settings. With shorter resources, a reader might not need to switch back and forth, a quick skim is enough to determine whether and entire short article is worth reading. However, for advanced online readers of ill-structured topics, the need to sort relevant from irrelevant ideas (Taxonomy, n.d.) within long texts may be especially useful as it relates to synthesizing for meaning online.

Both Olivia and Beth **revisited the task instructions several times during both tasks, as well**. This may be task specific (i.e., the ill-structured and complex nature of these tasks may

have required that they remind themselves of their goals extensively). However, given the emphasis on meta-cognitive skills for advanced readers offline (e.g., Baker & Brown, 1984), it is not surprising that doctoral students did this. However, another explanation is that the many and varied texts of the Web provide even more topical uncertainty on the part of the reader than offline texts that are pre-selected for a topic. For instance, Beth revisited her task 10 times during the two tasks. This included doing so after reading about ways to lower you electric bills, climate change and poverty, reusable shopping bags/laundry/cloth napkins, greenwashing, and earth friendly clothes washing. Olivia similarly checked her task instructions after reading about such varied topics as behavior change theory, a carbon footprint calculator, some outlandish advantages of global warming (e.g., mountains get higher as ice melts and boundary disputes between nations over low-lying island disappear), the social justice of global warming, and water stewardship, and while reviewing the results of a search for [fun things for people to do to prevent climate change].

Beth's use of background knowledge was similar to Olivia's in that she used background knowledge to facilitate various elements of the synthesis process. That is, background knowledge contributed to her keyword search phrase development, synthesis for meaning, insights. For instance, the use of "green" to guide most of her keyword search phrases in the reading-to-learn session was, by her own comments, entirely based on her background experiences. Beth's data also demonstrated how background knowledge contributes at times when multiple resources inform the knowledge synthesis. For example, at the beginning of her first creative synthesis Beth relied on (1) her reading-to-do notes; (2) her reading-to-learn notes; (3) the task; (4) the browser history text; (5) four articles from session one; and, (6) background knowledge when synthesizing. Such level of complexity further complicate any attempts to

determine the exact level of contribution from background knowledge and corroborate the findings from Beth's data **that the extent to which background knowledge contributes to any individual element of Web-mediated knowledge synthesis is unclear**.

One of the other most significant differences between Beth and Olivia was Beth's extensive use of notes during the second session. Like Olivia, **Beth made extensive use of note-taking during both tasks**. The included the same elements of note-taking, verbatim notes and summary notes, which supported Beth's syntheses for meaning. Insight and repurposing were also both promoted by revisiting her reading-to-learn and reading-to-do tasks. However, Beth differed in how she used her reading-to-learn notes during her reading-to-do task. Though there were times that Olivia used ideas that were in her notes, she never actually looked at them during her reading-to-do task. Where as, Beth's reading-to-learn notes were open in a tab through the entirety of her reading-to-do task, and she used them as if they were one additional stand-alone text in the universe of available texts on the Web. Many of the ideas that she synthesized into her reading-to-do notes were either directly from her reading-to-learn notes, insights based on those notes, or repurposed from them. This contrast highlights how **one of the primary advantages of online notes is that they integrate well into the Web-mediated synthesis environment**.

Chapter Summary

This chapter provided illustrations and discussion of the synthesis elements detailed in Chapter Three, based on an in-depth case study of one individual participant, Beth. The chapter explored each element individually and then demonstrated how they worked in concert to comprise creative syntheses. It also compared and contrasted these findings with the findings from Chapter 4 about Case Study #1. The chapter finished with conclusions drawn from this case

study about broader patterns of use, interactions, and relationships among the synthesis elements.

Conclusions that contributed to a better understanding of RQs 1 and 2 include: (1) synthesis can be facilitated in both complex and simple online reading environments, from both hard and soft resources; (2) like Olivia, Beth made extensive use of soft resources in various forms of synthesis and indicated her use of soft resources was largely based on the task; (3) elements of the creative process (e.g., idea-play and incubation) informed the environment for Web-mediated insight; and, (4) like Olivia, Beth revisited the task instructions several times during both tasks.

Conclusions that contribute to a better understanding of RQ 3 include: (5) keyword development may prefigure the cognitive lens through which readers view their text(s) and the types of synthesis that result; and, (6) both Olivia and Beth were very capable at combining the reading comprehension skills of skimming and closer reading, and switching between them while reading Web text.

Conclusions that contribute to a better understanding go RQ4 include: (7) Beth's experiences corroborated Olivia's with regard to background knowledge in that it contributed to several elements of the synthesis process. However, findings from Beth's data further complicate any attempts to ascertain the extent to which background knowledge contributes given its role in concert with as many as five other resources that contributed to her creative synthesis.

Conclusions that contribute to a better understanding of RQ 5 include: (8) one of the primary advantages of online notes is that they integrate well into the Web-mediated synthesis environment.

CHAPTER 6

TOWARD A THEORY OF WEB-MEDIATED KNOWLEDGE SYNTHESIS

Chapter Introduction

This chapter utilizes the data and findings provided above, integrating them with related literature to propose a Theory of Web-Mediated Knowledge Synthesis.

Background

To date, scholarship regarding both online and offline reading comprehension has largely approached the concept of synthesis from the perspective of understanding the text(s) being read (Duke & Pearson, 2002; Dole et al, 1991; Glister, 2000; Hartman, 1995; Leu, Zawilinski, et al., 2007; Mayer, 2000; Rouet, 2006; Stromso & Braten, 2002). This study endeavors to expand this perspective in two ways. First, above, it proposes a reconceptualization of synthesis to expand beyond *synthesis for meaning* to include *generative synthesis*. Synthesis for meaning facilitates understanding of what is explicit or implied in text(s). However, generative synthesis is based on a post-comprehension stance that emphasizes the value-added readers provide or experience when constructing knowledge beyond what is explicitly or implied in the text. Second, also above, this study provides data from advanced learners that demonstrate how synthesis for meaning and generative forms of synthesis manifest in reading-to-learn and reading-to-do tasks about an ill-structured topic in a Web-mediated environment. Together, these contributions provide a new lens with which to view reading and learning online. That is, they provide the foundation for a Theory of Web-Mediated Knowledge Synthesis.

Before presenting the details of this theory, it is important to first revisit the value of theory in general. The value of theory stems from its role as a "conceptual system, that is, a system of concepts with four properties" (Olson, 2005, p. 6). These properties of these concepts are as follows. First, the concepts identify entities that can be "pointed out and referred to" (Olson), further highlighting relevant entities and ignoring irrelevant ones (Mishra & Koehler, 2005) In so doing, theory provides a common language with which to examine them. Second, the concepts are linked logically to one another in a way that allows for some entities to be defined in terms of others (Olson). Third, theories provide the basis for "causal laws" that link concepts to one another, allowing for inference, prediction and explanation of the phenomenon. Finally, a theory based on such conceptual systems is open to elaboration and refinement over time. As such, a good theory balances the disaggregation of complex phenomenon into its essential components, without being overly reductive, and makes the phenomenon more amenable to rigorous investigation. At the same time, theory identifies and respects the interdependence among these components.

Another way of looking at the value of theories is that they "abstract from the complexity of everyday events and practices" (Olson, 2003, p. 6). In this way, theories succinctly describe the various essences that make up the whole of any complex phenomenon. These abstractions are important to moving our understanding forward in that they guide observation. That is, when observing complex phenomenon, "simply looking, even patiently, is not sufficient. Part of seeing...is know what to look at or for," and abstractions provide a framework for what to look for (Root-Bernstein & Root-Bernstein, 1999, p. 36). In this way, theory provides the "prerequisite" framework for "precise observation statements" (Chalmers, 1976).

Finally, Mishra & Koehler (2005) identified how educational theories need to provide information about how the concepts described can be applied in the real world. That is, theories of education need to help guide the design for better ways of learning, by providing "the right level of analysis in order to bridge the gap between description and design" (p. 29). In this way, theories of complex educational phenomenon that respect its complexity can facilitate the critique of more simplistic approaches to the same phenomenon. Good educational theories can also provide a mirror that educators "can hold up to their own practices to see the ways that their problems are both similar and different from those facing teachers in other settings" (Bulterman-Bos, 2008, p. 413) and provide a "normalizing lens" to educators, broadening their scope of understanding about issues for which they have significant local (or narrowly focused) experience and understanding.

In these ways, the Theory of Web-Mediated Knowledge Synthesis offered below makes contributions to the descriptive, inferential, and applied understanding of synthesizing knowledge online. Below, I propose this theory in detail by outlining seven interacting elements that emerged from this study: (1) divergent keyword search phrases; (2) synthesis for meaning; (3) in-the-moment insights; (4) repurposing; (5) reinforcement; (6) note-taking; and (7) creative synthesis.

Divergent Keyword Search Phrases

Henry (2006) noted how "all other decisions and reading functions on the Internet emanate from the decisions that are made during the search process" (p. 616). In particular, this study demonstrates the extensive use of *divergent* keyword search phrases in a Web-mediated synthesis environment - keyword search phrases that integrate words and phrases not provided in task instructions - to guide the reader's searching and ongoing construction of a personal text.

In should be noted that divergent keywords search phrases as operationalized here differ from previous conceptions of sophisticated keyword search development. For instance, LICRA searching (learner-initiated, complex, reciprocally adaptive searching (DeSchryver & Spiro, 2008; Spiro & DeSchryver, 2010), is a cognitive perspective on keyword search development. It describes where the keywords come from (i.e., mostly externally oriented), and emphasizes the critical role of iteration and adaptation. As defined herein, the use of divergent keyword search phrases is much simpler. The only requirement for a keyword search phrase to be divergent is that one or more words are not consistent with the task at hand. Two arguments for the importance of divergent keyword search phrase use in the process of Web-mediated knowledge synthesis are proposed here.

First, across all eight participants in this study, the use of divergent keyword search phrases outnumbered consistent search phrases more than three to one. That is, the advanced learners in this study demonstrated activity consistent with what White and Drucker (2007) called "explorers," where their search paths, guided by divergent keyword phrases, branched frequently, included many different keyword queries, and visited new domains of information. Additionally, in the case studies, a comparison of Olivia and Beth's experiences demonstrated that divergent does not just apply to the total number of different phrases. For instance, though Beth used nine different search phrases in her reading-to-learn task, they only represented four different domains of search, while Olivia used twelve phrases representing eight domains. These data suggested that Beth's waning motivation and decrease in synthesis experiences toward the end of her reading-to-learn task might have been related to her lack of divergence across domains. In this way, the sequential iteration of search phrases based only on synonyms for the same word(s) is divergent within a domain, but divergence across domains may also be

beneficial to successful Web-mediated knowledge synthesis. Finally, in this study, divergence was partially achieved through the use of multiple keywords per search phrase. For example, unlike the participants in Nachmias and Gilad's (2002) study of search behavior, for whom the use of single keywords was the most common search strategy, Olivia and Beth averaged 5.9 and 4.8 keywords per search phrase, respectively.

Second, the actual selection of divergent words for inclusion in a search phrase may itself be a form of generative synthesis. That is, the choices of divergent words to include in any given phrase may represent an active integration of entirely new categories, subjects, or fields of information by the reader. For example, when Olivia decided to use the divergent search phrase [religious view on climate change] in her reading-to-learn task, she said "So, when I just read about the science, part of this topic [in the task instructions] says to open up to others, I wonder if any…if religion affects your view on climate change." When interviewed, she elaborated on how this phrase developed in her mind:

> I was reading about the government citing all these scientific articles, and in my mind when I think scientific articles, we try to search for the truth...I'm not a particularly religious person, but in religion they try to do the same thing through different means. So I was like, that can give me perspective, people tend to follow their religion, people tend to do their behaviors, based on their religion. Think about how the government can cite all of these articles, but if people aren't listening to the science, and listening to something, and something else that can be viewed kind of opposite, or kind of go against science would be religion, so I wanted to get the opinions of that.

Her decision to chose that particular keyword search phrase was based on her synthesis of meaning across the Web text, task instructions, and generative insights based on her background knowledge. This is also consistent with White and Drucker's (2007) conception of the Web explorer that is cognitively complex, applies a global approach to learning, and focuses on the relationships between multiple ideas during the learning process. The data from this study suggest that not only does the variable behavior of an explorer directly support the sense-making White and Drucker proposed (in this study considered synthesis for meaning), but also generative syntheses beyond the text(s).

Synthesis for Meaning

Though the primary emphasis of this project was to investigate post-comprehension synthesis (i.e., generative synthesis), the data demonstrated that *synthesis for meaning,* both within a single Web resource and across the multiple sites visited, was a critical element in the overall consideration of Web-mediated synthesis. It was the most common form of synthesis across all eight candidates, and knowledge that was synthesized for meaning was at various times: (1) a direct antecedent to generative synthesis; (2) later repurposed in a generative way; (3) the content and context for combinatorial idea-play leading to insight; or (4) integrated directly with generative syntheses to comprise a creative synthesis. Synthesis for meaning was often from the current resource, but at other times combined as many as three ideas from recent articles when combined and rearranged in the participants' notes.

When first operationalized above, synthesis for meaning included a variety of activities. Each of these was apparent in the data. Organizing, combining, rearranging, rewriting, and compiling were integral to the process (Duke & Pearson, 2002; Dole et al, 1991; Glister, 2000; Hartman, 1995; Leu, Zawilinski, et al., 2007; Mayer, 2000; Rouet, 2006; Stromso & Braten,

2002). Several instances of synthesis for meaning resulted from common reading comprehension strategies such as summary, inference, and relating to prior knowledge (Dole et al, 1991; Hidi & Anderson, 1986; Kintsch, 1994; Scharere, Pinnell, Lyons, and Fountas, 2005). When synthesizing for meaning, the participants were by the very act sorting the relevant Web information from the irrelevant (Taxonomy, n.d.). And, the participants' notes during their tasks represented well the active construction of their own personal text (Leu, Zawilinski, et al., 2007).

However, though it was expected that several different "technical" activities would support synthesis for meaning (e.g., note-taking, bookmarking, clipping, highlighting), the vast majority of synthesis for meaning was demonstrated by rather traditional note-taking, both offline and online. In this way, note-taking was particularly important when synthesizing for meaning online. The act of combining ideas across the text(s) visited into one text is crucial and may be qualitatively different from merely highlighting in context or making a bookmark. That is, seeing the relevant text clips together may foster the global understanding that emerges from synthesis for meaning.

It is also not unexpected that synthesizing for meaning appears to be so important in the overall environment supporting the generative synthesis processes. Generative syntheses, such as insight and repurposing discussed below, are inherently creative activities, and many theories of creativity propose that domain knowledge is fundamental to the creative process (e.g., see Csikszentmihalyi, 1997; Lubart & Sternberg, 1995). In the absence of significant prior knowledge in a domain (such as that of climate change behavior for the participants in this study), synthesizing meaning in the moment may serve to fill in gaps in this domain knowledge and allow for more generative syntheses to emerge. For instance, though Olivia admitted she did not know there were any perceived benefits to climate change, after synthesizing a list of those

possible benefits directly from an article for their meaning, she soon thereafter repurposed the idea of longer growing seasons to explain why certain farmers might not want to change their own behavior in ways that would lessen the effects of climate change, if the longer growing seasons were more advantageous to their crops. She also had an insight based on these ideas that, in general, "even though you know there are many bad things going on with global warming, it just may be good for you." Sternberg (1988) summed up how important synthesizing meaning may be in the absence of domain knowledge when he said "It is impossible to have novel ideas about something if one knows nothing about it" (p. 137). As such, synthesis for meaning may be the foundation that facilitates generative syntheses.

In-the-Moment Insights

If divergent keywords are the gateway to Web-mediated insight, and synthesis for meaning is the foundation, then insight and repurposing provide the bricks with which to build up. A combination of Spiro's (2006e) cognitive affordance of VCS and Sternberg's ideas on insight (1985) comprise in-the-moment insights based on: (1) a single Web resource; (2) multiple Web resources; (3) activity unconnected to the Web (e.g., based on background knowledge or idea play); or, (4) a combination of the prior three possibilities. The generative connotation of insights requires that they provide value-added information neither explicit nor implied in the text(s). And, they are primarily task agnostic. That is, insights are not necessarily connected directly to the general task or purpose for reading the Web, but related specifically to the current context of reading.

The data in this study demonstrated the complexity of insight behavior by the fact that it occurred under the most varied and unpredictable conditions and contexts of any synthesis element. Insights occurred based on bulleted lists of text in a single article, after the succession

of as many as 18 different topics across several articles, when skimming text, when reading text at a deeper level, with significant contributions from background knowledge, and based on idea-play. They were at different times based on both soft and hard resources, and also occurred as a result of one-to-one (i.e., one idea in the text facilitated an insight) and many-to-one (i.e., several ideas in the text considered in VCS lead to a single insight) relationships. They occurred during both reading-to-learn and reading-to-do tasks. Insights also occurred in various multiples of synthesis. That is, they occurred in the midst of several syntheses for meaning, and were at other times reinforced themselves by background knowledge or Web text. Finally, insights comprised a large portion of the creative syntheses by both Beth and Olivia.

As such, Web-mediated insight is a relatively unpredictable phenomenon, with the exception of two common themes. First, in most cases, insight occurred in the context of the reader being concerned about ideas, as opposed to remembering. Given the creative aspects of insight, this is not surprising. Most theories of creativity emphasize the importance of "piling up alternatives" (Osborn, 1953) and "associating or combining those ideas" (Ward, Smith, & Fink, 1999). In this way, the *mindset* of the reader may be most important to promoting insights. Second, that focus on ideas often lead Beth and Olivia to skim and skip around the text (including their own notes). Given the emphasis on incubation in creativity literature (e.g., Wallas, 1926), the cognitive pauses when skimming and skipping around may provide just enough time for subconscious combination and recombination of ideas to promote insight.

Finally, it is important to differentiate how insight is conceived in this theory from its common use in psychological and creative literature. As used here, insight is not a "solution" as it is often described when insight is studied in the context of "insight problems" (e.g., Weisberg, 1985; Weisberg & Alba, 1981). As used in this theory, it is described as any idea or knowledge

that emerges as a value-added to the text that was neither explicit nor implied in the text. It does not have to be a "light bulb" moment that happens suddenly and unexpectedly, as is commonly associated with insight. In this way, the insight described in this study should be considered "little-i" or "everyday" insight, just as creativity itself has been differentiated as little-c and big-C creativity (e.g., Beghetto & Kaufman, 2007; Sawyer, 2012).

Repurposing Synthesis

While insights essentially provide "new" information to the reader, the act of repurposing allows readers to modify existing ideas in substantive and generative ways by recasting, reusing, or otherwise tweaking them. A repurposed idea retains one or more of the important qualities of the original idea (i.e., there is a clear parallelism between the original and the repurposed idea), while changing or adding other qualities. Olivia's case study demonstrated the generative implications for repurposing particularly well. During the course of both her reading-to-learn and reading-to-do tasks, she repurposed ideas from one context to another, by using ideas in the opposite way they were presented in the text, by reorienting ideas to a different scale than that explicit or implied in the text, by repurposing ideas in two different ways, and by combining repurposed ideas with an insights. She did so from both soft and hard resources, and focused especially on repurposing during the reading-to-do task. Repurposing occurred in both task relevant resources and those that were more far afield. However, viewed together with Beth's experiences, it is likely that resources that are very close in content area to the task may be less amenable to repurposing, given the topical consistency of Beth's resources and her limited use of repurposing. Finally, the keywords that preceded repurposing in Olivia's case may have helped to prefigure her orientation and lens toward repurposing and provide resources most amenable to it.

The roots of repurposing can be found in learning, creativity and design scholarship. The notion of transfer in learning is a broad concept that explores how learners apply or generalize what they have learned in similar or dissimilar contexts (e.g., Barnett & Cici, 2002). It is best considered across nine different dimensions - learned skill, performance change, memory demands, knowledge domain, physical context, temporal context, functional context, social context, and modality - and applies equally to skills and knowledge. Given the emphasis of repurposing on ideas, the most relevant dimension of transfer is knowledge domain. However, the difference between transfer among knowledge domains and repurposing in the context of this theory is that transfer is typically the application of already learned knowledge, where as repurposing is a component of the learning process. That is, a repurposed idea is integrated into an ongoing knowledge construction, while transfer takes the results of a knowledge construction and applies it.

Though these differences exist, both the conditions and the mechanisms of transfer can inform how repurposing manifests. In particular, the idea of abstraction is helpful to understanding how readers may repurpose ideas. That is, transfer may depend on (1) the level of abstraction of the phenomenon to be transferred (i.e., highly abstract ideas may be more transferrable), and (2) whether learners have actually abstracted the critical attributes of that phenomenon (Perkins & Salomon, 1992). As such, given that any situation, process, skills, or idea can have multiple abstractions (or essences) that together explain it fully (Root-Bernstein & Root-Bernstein, 1999), the more abstractions that exist for a given phenomenon, and the extent to which the learner understands all of those essences will impact how well transfer is accomplished. As such, transferred knowledge is typically not considered "generative" in the sense that all of it essences remain intact and are just applied elsewhere. In contrast, a

repurposed idea often keeps intact one or more of the abstractions while changing one or more others to comprise the generative and value-added component.

Creativity literature often explains the process of creativity through similar lenses of adaptation, reuse, and repurposing. For instance, Hofstadter (1985) describes creativity as "variations on a theme." The common tests for creative ability utilize "divergent thinking" tasks, which are often a measure the ability to "list the different ways to use" an object (e.g., Guilford, 1967), or how it can be repurposed. Ward, Fink and Smith (1999), in describing their Geneplore model of creativity (i.e., generate ideas and then explore them), propose that three of the processes for idea generation are (1) transformation of ideas into new forms; (2) analogical transfer of ideas from one domain to another; and, (3) categorical reduction of ideas. Each of these processes describes how one of the abstracted essences of an idea (form, content, scope) can be modified during the creative cognition process. As such, the application of these conceptions of creativity to the reading process demonstrated online in this study provide a foundation for the generative component of repurposing in Web-mediated knowledge synthesis.

Design literature also contributes to the concept of repurposing. Kress (2000) described how "(re-)shaping of the potentials of existing resources" leads to transformation of ideas. Similarly, Bereiter and Scardamalia (2003) proposed the concept of a "design mode" for learning, whereby the goals of learning, are, among others, the improvability and developmental potential of ideas. These ideas of transformation, improvement, and development provide further evidence of the generative capability of repurposing existing ideas. In this way, the design perspective emphasizes that repurposing starts with an existing idea and facilitates it evolution.

Reinforcement Synthesis

The data in this study also made apparent the value of reinforcement as an element of Web-mediated synthesis. Reinforcement is not just seeing ideas again in Web text(s). It is when the affordance of multiplicity of the Web facilitates a strengthening of the reader's emerging knowledge construction. This may happen once, or many times to the same idea. It applies to both information that has been synthesized for meaning and that which was a result of generative synthesis (i.e., insight or repurposing). In this way, reinforcement can at different times facilitate meaning and understanding of the Web text(s) or be generative. This depends on whether the reinforcement applies to knowledge that was originally synthesized for meaning or a result of generative synthesis. It also depends on the level of value-added during the reinforcement.

Reinforcement of ideas that were originally synthesized for meaning can strengthen them ideas in several ways. First, it can cement ideas in the reader's knowledge construction that might otherwise be questionable or unclear. For instance, hard resources can reinforce ideas synthesized from soft resources. Originally ambiguous ideas can also be reinforced by a simpler and more easily understood representation. Conversely, additional details can reinforce ideas that were too simplistic in their original state. All of these ways help to facilitate how well the reader understands what they have synthesized for meaning. However, if, while reinforcing ideas that were originally synthesized for meaning, the reinforcement prompts elaboration on the original idea, the reinforcement becomes generative. These elaborations can often be based on differences in context, perspective, and time that appear in the reinforcement Web text environment.

Reinforcement of ideas that resulted from generative synthesis can be similarly strengthened, in additional ways to ideas originally synthesized for meaning. When the reader

questions or disagrees with the text (representing a generative insight), their disagreement can be later reinforced and strengthened in the knowledge construction. Insights that were originally based on background knowledge or idea-play can also be reinforced by later Web text. Finally, reinforcement of ideas that were originally generative that includes elaboration on those ideas is also generative.

Previous literature supports the value of reinforcement. For instance, re-reading is commonly associated with increased recall and comprehension (e.g., Bromage & Mayer, 1986; Rawson, Dunlosky, & Theided, 2000; Howe, 1970). This would explain the value of reinforcement to ideas that had previously been synthesized for meaning. Similarly, revisitation of previously read information has been shown to increase facts learned and strengthen weak connections among the material read (Lawless & Brown, 1997). On the Web, users may return to text read previously once it is deemed relevant at a later time (Junivo, 2006; Wen, 2003). They may also return to previously read resources to verify or retrieve information or revisit challenging ideas after learning more about them elsewhere (Desjarlais, 2010) and revise constructed meaning (Afflerbach & Cho, 2008). However, all of these perspectives demonstrated the effect of readers choosing to revisit the exact text they had already read at least once.

Reinforcement, as proposed in this theory, is when the same (or very similar) *ideas* emerge multiples times, but in different resources. This is what allows for elaborative and generative potential, often based on the new context, perspective, or timeframe of the new resource. Reinforcement is akin to the notion of revisitation and conceptual variability in CFT (Spiro, Collins, & Ramchandran, 2006; Spiro et al. 1992; Spiro & Jehng, 1990), which described how hypertext systems could facilitate flexible understanding through revisiting the same ideas

at different times, in various contexts, with different purposes, and from different conceptual perspectives. However, two differences are apparent between the CFT/CFH and reinforcement as proposed here. First, most CFT and related CFH systems were closed systems with a finite amount of information related to a specific topic. As such, the opportunities for serendipitous or unplanned reinforcement to occur and for these to occur in resources that are topically far afield from the task were more limited in CFT/CFH systems than that afforded in an open online environment. The availability of resources that are more far afield from the task on the open-Web may provide the potential for more generative synthesis, given that creative insights often result from combining ideas from different domains of knowledge (Ward, Smith, and Finke, 1999) Second, CFT and CFH systems often pre-selected the themes to be explored in this way for users to specifically select as part of the navigational options of the systems. In this way conceptual variability use in CFT and CFH systems promoted a synthesis for meaning of the multiple texts included in the systems, the ultimate goal for which was to prepare learners for flexible application of that meaning in new contexts. Where as, reinforcement as proposed here is in the context of both synthesis for meaning and generative synthesis. For instance, if a Web-based reader has an in-the-moment insight that provides new ways of thinking about a particular idea, the reinforcement of that idea later on serves to crystallize and/or adapt that generative insight.

Reinforcement can also demonstrate an affective component that is beneficial to the reader's motivation and even their reading strategies. For instance, if the reader questions or disagrees with the text and this insight is reinforced later by the text, the reinforcement can be encouraging to the reader in a way that may promote even more questioning and disagreement. Similarly, any time the reader is reinforced for synthesizing meaning or generative synthesis, the

potential for increased positive affect exists. As such, there may be an impact on self-efficacy (Bandura, 1994); motivation to learn (Brophy, 2004); intrinsic motivation (Deci & Ryan, 1985); flow (Chen, Wigand, & Nilan, 1999; Csikszentmihalyi, 1990); or, interest (Hidi & Renninger, 2006). The motivational benefits may be especially relevant for forms of generative synthesis, which involves more cognitive engagement and personal investment than synthesis for meaning.

Finally, it should be noted that reinforcement can manifest in minimally beneficial ways. As was demonstrated in Beth's case study, synthesizing an idea in a list of bullet points the first time it occurs, and then reading it again in another list elsewhere did little for the emerging knowledge construction. Similarly, reading strategy can impact the potential benefits of reinforcement. For example, if the reader is only reading small segments of text all of the time and never considers the different contexts or perspectives when the same idea occurs in different resources, the effects of reinforcement may be minimized. And, if the resources visited over time are too similar and repeat the same information several times in simple ways or without a change in context, perspective or time, there may be decreasing returns to the value of reinforcement. This may be related to keyword search phrase development, in that a narrow scope of largely consistent phrases or even divergent phrases in the same general area may decrease the potential benefits of reinforcement by resulting in resources that are too similar in context or complexity.

Note-Taking

An abundance of research indicates that taking notes is beneficial to learning in a variety of contexts (e.g., Kiewra, 1989; Kintsch & Kintsch, 1996; Makany, Kemp & Dror, 2009). The data in this study extend those findings and demonstrated that note-taking is also a critical element in the process of Web-mediated knowledge synthesis. Across eight participants, all of

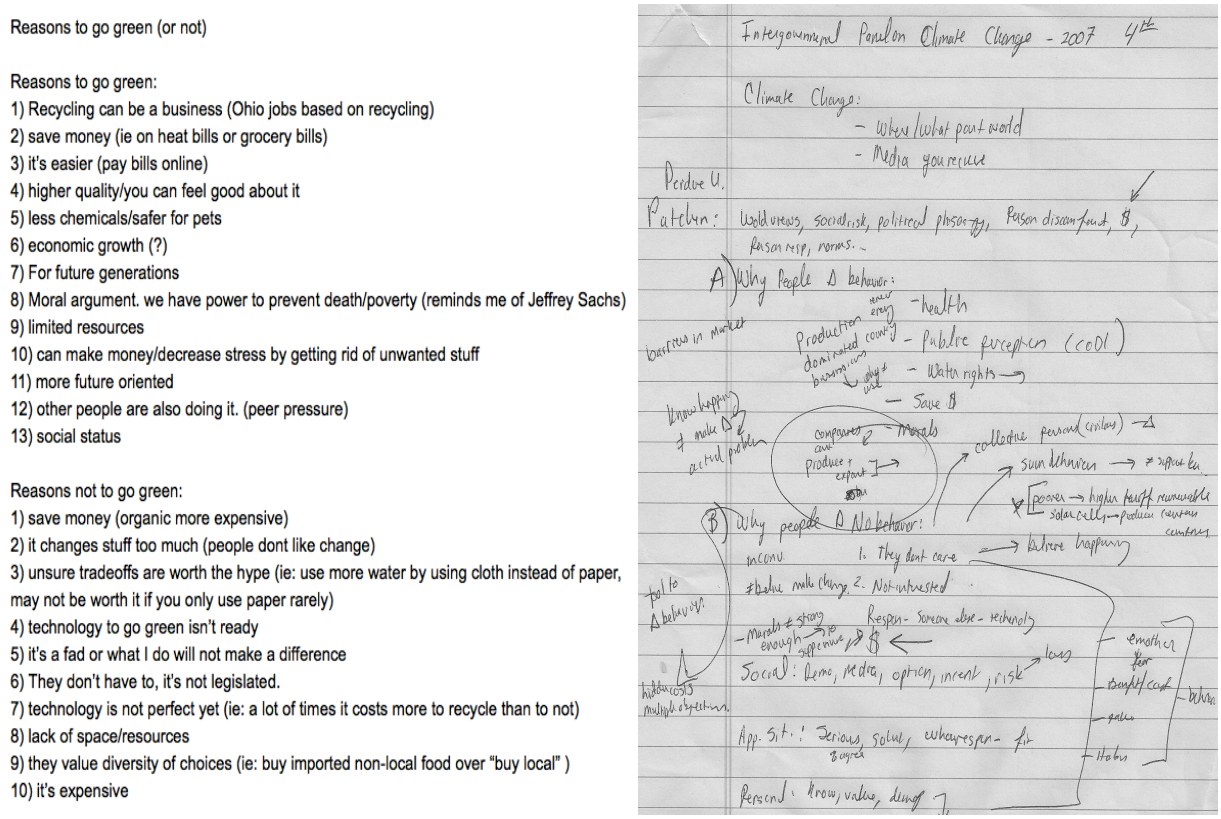
them took at least some notes. As demonstrated above in case study #1, Olivia was particularly effective with her notes. She supported synthesis for meaning with both verbatim and summary notes. Several of her insights were prompted by reviews of her notes. Review of her notes also informed the development of keyword search phrases. And, adding ideas to her notes (either for meaning for in generative ways) facilitated the repurposing of those same ideas to other sections of the notes. Several of her generative insights were supported by conscious idea-play based on the information in her notes. Finally other more "random" insights occurred when working with her notes. These may have been facilitated by the opportunity for internal incubation that leaving Web-text(s) to review or add notes may have provided (i.e., letting up of her focus on the Web text(s) may have allowed for subconscious idea-play resulting in insight).

Beth also used her notes extensively, especially during her reading-to-do task. In addition to many of the benefits to synthesis Olivia demonstrated, Beth used her reading-to-learn notes through the entirety of her reading-to-do task as if they were an additional stand-alone text in the universe of available texts on the Web. Many of the ideas that she synthesized into her reading-to-do notes were synthesized for meaning from her reading-to-learn notes and several generative syntheses in her reading-to-do task were based on her reading-to-learn notes. This contrast highlights how one of the potential advantages of online notes is that they integrate well into the Web-mediated synthesis environment.

As such, this theory proposes that note-taking is a fundamental part of Web-mediated knowledge synthesis. This relationship is unique to theories designed to explain online reading. For instance, the Taxonomy (n.d.) outlines the importance of note-taking for successful online reading comprehension, but in the context of communication. Based on the data here, note-

taking should be considered integrated, and an activity that directly supports both synthesis for meaning and generative synthesis.

While the differences between online and online notes were not within the scope of this study, as Figure 6 demonstrates, these affordances may be very different. Among those taking notes on the computer, bullet points, lists, and outlines were common, where as offline notes also included lists, but were more freeform in their structures. It is possible that the freeform use of offline notes is beneficial to some elements of Web-mediated synthesis, and the easily integrated nature of online notes to others. These are questions for further examination in future studies. However, based on the data in this study, both offline and online notes supported Web-mediated knowledge synthesis in substantive ways.



Reasons to go green (or not)

Reasons to go green:
1) Recycling can be a business (Ohio jobs based on recycling)
2) save money (ie on heat bills or grocery bills)
3) it's easier (pay bills online)
4) higher quality/you can feel good about it
5) less chemicals/safer for pets
6) economic growth (?)
7) For future generations
8) Moral argument. we have power to prevent death/poverty (reminds me of Jeffrey Sachs)
9) limited resources
10) can make money/decrease stress by getting rid of unwanted stuff
11) more future oriented
12) other people are also doing it. (peer pressure)
13) social status

Reasons not to go green:
1) save money (organic more expensive)
2) it changes stuff too much (people dont like change)
3) unsure tradeoffs are worth the hype (ie: use more water by using cloth instead of paper, may not be worth it if you only use paper rarely)
4) technology to go green isn't ready
5) it's a fad or what I do will not make a difference
6) They don't have to, it's not legislated.
7) technology is not perfect yet (ie: a lot of times it costs more to recycle than to not)
8) lack of space/resources
9) they value diversity of choices (ie: buy imported non-local food over "buy local")
10) it's expensive

Figure 6. Computer based versus written notes. The text in this figure is not meant to be readable. The figure is simply intended to demonstrate linear vs. non-linear note-taking.

As it relates, one of the specific affordances of note-taking that should be considered when integrating notes into Web-mediated knowledge synthesis is their permanence or lack thereof. That is, Beth easily integrated her reading-to-learn notes as a stand-alone text during her reading-to-do task, in part because they became a permanent part of the Web in Google Docs. Similarly, the fact that Olivia effectively ignored her offline notes from her reading-to-learn tasks (with the exception of what she could recall from them), is potentially indicative of the temporary nature of offline notes in an online world. As such, the value of notes to the "in-the-moment" processes of Web-mediated knowledge synthesis should be considered based on their various online and offline affordances. Based on these ideas, using *both* offline and online notes may be valuable to the Web-mediated knowledge synthesis. However, the existence of evolution of touch screen technology and cloud computing may facilitate the merging of the various affordances of offline and online note-taking, rendering concerns over permanence and structure unnecessary.

Finally, note-taking in this environment should also be considered as a broader spectrum of activity than is typically associated with and reading and learning. Though participants in this study did not use many of the new types of online note-taking tools that facilitate clipping, tags, keyword searching, and inline annotation (e.g., Evernote and Diigo) these activities and others should be considered in the context on their note-taking value to Web-mediated synthesis. In a follow-up study to this project (DeSchryver, in preparation), the value of clipping and tagging in Diigo is explored in this area through data provided when Olivia and Beth returned for additional research sessions. Prior to these additional sessions, both participants were taught how to use Diigo, and then encouraged to continue using it during research sessions with similar learning environments to their first sessions. The value of these activities to the synthesis elements

proposed in this theory will be explored, both in case studies specific to those sessions, and in comparison to Beth and Olivia's use of more traditional notes in this study.

Creative Synthesis

The sequential occurrence of several of the synthesis elements above, including instances where they are experienced at virtually the same time, comprises a creative synthesis. It represents a substantially generative way of interacting with Web text(s), background knowledge, idea-play, notes, and the task undertaken. An online reader could read single or multiple online texts and practice generative synthesis without ever experiencing creative synthesis, since the data from both Olivia and Beth demonstrated how the elements above can and do exist in isolation. However, as proposed, creative synthesis is essential if Web-mediated knowledge is to be constructed in ways that can address the *big* questions that ill-structure topics pose.

As such, in this theory, the concept of creative synthesis is largely the application of the creative process to reading and synthesizing Web text(s). In this way, the theory moves both scholarly conceptions of reading and creativity in new directions. As noted above, it opens the definition of synthesis in reading research up for more creative and generative examinations. Similarly, creativity scholarship is often from the perspective of problem solving, science, inventions and the arts (e.g., Weisberg, 2006), workplace dynamics (e.g., Amabile, Conti, Coon, Lazenby &Herron, 1996), or psychological processes (e.g., Sternberg & Lubart, 1999). To be creative (or generative) in one's thinking while reading text (or in this case Web text) is a unique perspective on creativity.

However, both bodies of work help to explain the phenomenon that emerged in this study. Reading comprehension scholarship explains many of the skills both Olivia and Beth

integrated during their creative syntheses (e.g., synthesis for meaning, summary, inference, prediction and accessing background knowledge). At the same time, the multiplicity of synthesis elements in the creative syntheses Olivia experienced are consistent with Root-Bernstein and Root-Bernstein's (1999) conception of layering their own creative thinking skills one on top another, often in multiples more than two. Finally, as noted above, Csikszentmihalyi's (1990) notion of flow informed how creative synthesis can be recognized in a Web-mediated environment.

Web-Mediated Knowledge Synthesis

Together, these elements comprise a Theory of Web-mediated synthesis. The presentation of these elements is not provided in a sequential fashion nor intended to imply a linear relationship. All elements of the model can and do interact and work in concert with the other elements. Both insights and ideas synthesized for meaning can be repurposed or reinforced. The use of divergent keyword search phrases may precede synthesis for meaning, insights, repurposing, and reinforcement at various times. Ideas synthesized for meaning, repurposed, and reinforced, as well as insights and notes, can all inform subsequent divergent keyword search phrases. Similarly, notes support synthesis for meaning, insight, repurposing and reinforcement. And, in various combinations, these elements all support creative synthesis. Figure 7 demonstrates these relationships.

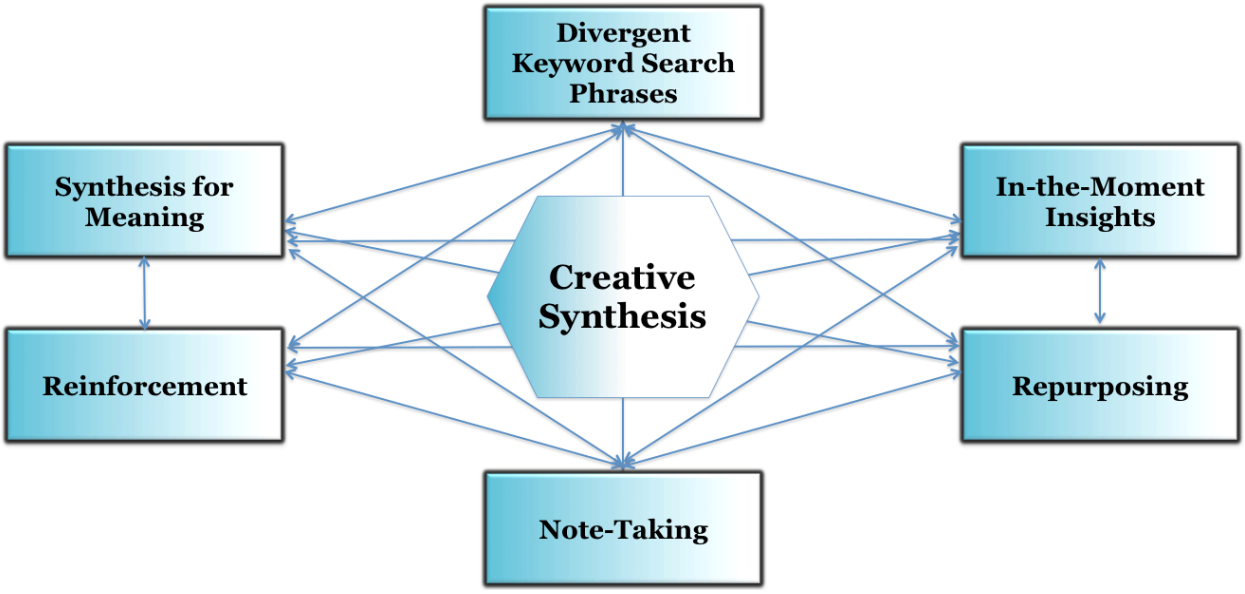


Figure 7. The Theory of Web-Mediated Knowledge Synthesis

CHAPTER 7

SUMMARY

Introduction

This study examined how eight advanced learners synthesized knowledge when using the Web to explore and apply ideas about an ill-structured topic, climate change behavior. It was conducted from a *post-comprehension* perspective in order to better understand generative synthesis experiences, wherein knowledge is constructed that is neither explicit nor implied in the online texts viewed. This final chapter summarizes its findings and discusses the specific implications of these findings through descriptive, inferential and applied perspectives. It also presents the limitations of the study.

Synthesis for Meaning and Generative Synthesis

One of the primary contributions of this study is descriptive. That is, based on an analysis of previous literature about synthesis, with an emphasis on the implications of creativity, this study specifically delineates the difference between *synthesis for meaning* and *generative synthesis*. Providing these two specific lenses from which to observe reading and learning online clarifies an important distinction related to synthesis, while respecting its complexity. For instance, the terms combine, rearrange, and summarize are equated with synthesis. Similarly, reading researchers have used the term synthesis to describe summarizing (e.g., Dole, et al, 1991) or inferencing (Dole, et al; Kintsch, 1994; Scharere, Pinnell, Lyons & Fountas, 2005). However, summary and inference are typically utilized in the context of understanding textual meaning, not a generative synthesis of it. In this study, I define generative synthesis as activity that provides value-added knowledge, which is neither explicit nor implied in the text(s). As

such, this study proposes a specific terminology, *synthesis for meaning*, to account for common ways of operationalizing synthesis online - these include the ability to sort relevant information from irrelevant information, organize and understand the texts available ("Taxonomy", n.d.) and assimilate multiple sources across multiple modes (Glister, 2000). It also contributes new terminology, *generative synthesis,* to extend ideas about synthesis so that they include more creative activities. As such, this theory provides substantial descriptive clarity to researchers and practitioners interested in synthesis.

Summary of Findings from Research Questions

Five research questions about synthesizing knowledge in an open online environment guided this study. This section provides a summary of the findings specific to each question.

RQ1 - How do synthesis for meaning, VCS synthesis, and creative synthesis manifest for advanced learners in Web-mediated reading-to-learn and reading-to-do environments? Previous literature and scholarly insights provided the foundational framework for this study - synthesis for meaning, VCS synthesis, and creative synthesis. The data across eight participants operationalized definitions and corroborated findings regarding synthesis for meaning and creative synthesis. Synthesis for meaning was the most widely used form of synthesis across participants, was common to both reading-to-learn tasks and reading-to-do tasks, and was supported by both soft and hard resources. Creative synthesis emerged as a related sequence of the other forms of synthesis, and was primarily apparent in the reading-to-learn tasks. Both hard and soft resources also supported it.

However, as first defined, VCS synthesis did not fully explain the data. As such, this definition was broadened to include VCS as part of a larger category of generative synthesis activity called in-the-moment insights that represented a point of overlap between creativity

theory and reading theory in the construction of the Theory of Web-mediated Knowledge Synthesis. One of the foundations of creativity is that a multiplicity of ideas is necessary; this is also one of the affordances of the Web. As such, even when insights in this study were determined to be specific to one resource, they were in the context of many ideas from many resources in a relatively short period of time (60 minutes for the reading-to-learn task and 45 for the reading-to-do task). The juggling of these ideas, whether in bulleted lists, through skimming, from deeper reading, in soft and hard resources, and with topics both close to the task and more far afield, demonstrated a creative stew amenable to generative insights.

When reading about how people tend to hope that future technology will save the world from climate change, one participant had the insight that the broader issue may be that people just like to put the responsibility on someone else. This idea was neither explicit nor implied in the text, but a generative idea on the part of the reader. As defined in the literature, VCS would imply that such an insight be from multiple resources considered in virtual simultaneity. The broader category of insight defined herein accounts for such activity based on singular resources (often as simple as a sentence, as was the case in this example).

RQ2 - What other forms of generative synthesis emerge from the data, and how do they manifest, for advanced learners in Web-mediated reading-to-learn and reading-to-do environments? Three synthesis activities identified in the data could not be explained by the elements found in RQ1. This resulted in the operationalization of three additional elements - divergent keyword search phrases, repurposing, and reinforcement. Divergent keyword search use (i.e., using keywords that were not included in the instructions or task text) provided a gateway to other forms of synthesis, and was itself somewhat generative when it actively opened up new topics and domains of information to the reading and learning processes. It was used

nearly three times as often as consistent search phrases across all eight participants in this study. Divergence was also evidenced across participants, by the fact that in 14 hours of Web-based learning, only one keyword search phrase was duplicated across participants. A downstream impact of this was that out of 233 Web sites visited, only seven were visited by more than one participant.

Repurposing emerged as a form of synthesis and involved modifying existing ideas, either from Web text, notes, or background knowledge, in substantive and generative ways, with much of its process being similar to the creativity literature. That is, not all creative ideas are "new." In fact, Hofstadter (1985) indicated "making variations on a theme is really the crux of creativity" (p. 233). His analogy was that concepts can often be defined and described by knobs, and that creativity results from tweaking one or more of these knobs. These knobs are the abstractions, essences, and attributes of ideas. The data in this study demonstrated in detail how participants changed one or more of these knobs, while the remaining knobs stayed the same, as they repurposed knowledge in generative ways. This was often from one context to another, by using ideas in the opposite way they were intended in the text(s), or by scaling ideas up or down. For instance, when reading about how most people indicate a willingness to make financial sacrifices to help combat climate change, one reader incorporated this ideas in the exact opposite way, that many people who do not change their behavior do it because it is too expensive.

Reinforcement emerged as a generative act of seeing ideas (from Web text, insights, notes, or background knowledge) in new resources and contexts in ways that facilitated a strengthening of the original knowledge construction. This manifested in various ways - hard resources reinforced soft resources; ambiguous ideas were reinforced with more clarity; and simple ideas were reinforced with more complexity. For instance, after synthesizing the notion

that people only act about things like climate change when it affects them personally from a generic behavioral paper, a reader saw the same idea in the context of water rights. Like synthesis for meaning and in-the-moment insights, both repurposing and reinforcement occurred during reading-to-learn tasks and reading-to-do tasks, and were seeded by both soft and hard resources.

All of the elements of synthesis that emerged from RQ1 and RQ2 manifested in a variety of ways. In fact, together they represent a process that is itself complex, multiplicitous, unpredictable, and ill structured. They manifested in a variety of context-dependent ways. They all appeared during both deeper and more cursory reading strategies, but in no predictable manner (e.g., see the differences in general reading strategies in case study #1 and case study #2). They all integrated soft resources at some point in the knowledge synthesis, but without a discernible pattern. Each element of synthesis was supported at one time by task-relevant resources (e.g., the National Oceanography and Atmospheric Administration Web site), and at others by resources more far-afield (e.g., a Web site outlining how to get people to take the stairs instead of the escalator). Some participants utilized more of one synthesis element than another based on the task (reading-to-learn vs. reading-to-do), while others used them more equally. One consistent finding in the environment for Web-mediated synthesis was that the description of the task and supporting instructions were used extensively during both reading-to-learn and reading-to-do, often directly supporting synthesis activities (as was the case in both case study #1 and case study #2).

RQ3 - How do synthesis for meaning activities and generative synthesis activities interact for advanced learners in Web-mediated reading-to-learn and reading-to-do environments? The primary way that the elements of synthesis interacted in this study was to

work in concert to support creative synthesis. Once again, this occurred in unpredictable ways. This study examined five specific instances of creative syntheses from two participants. One was comprised primarily from knowledge repurposed from previous synthesis for meaning activities. Another relied primarily on generative forms (insights, repurposing, and reinforcement) working in close sequence. A third emerged from several generative elements, as well as synthesis for meaning processing the same paragraph of text. A fourth creative synthesis during a reading-to-do task was comprised of both syntheses for meaning and generative syntheses based on several different resources: (1) reading-to-do notes; (2) reading-to-learn notes; (3) task instructions; (4) browser history text; (5) four Web texts from the reading-to-learn task; and, (6) background knowledge. A final creative synthesis occurred without any Web searches at all. That is, the makeup of creative synthesis was not consistent in any way.

Outside of the context of a creative synthesis, the other elements of synthesis often appeared in close proximity to each other, or complemented each other directly. Synthesis for meaning seeded divergent keyword search phrases, as did insights and repurposed knowledge. On the other hand, divergent keyword search phrases directly preceded insights, syntheses for meaning, repurposing and reinforcement. However, so did consistent phrases. Knowledge synthesized for meaning was repurposed and reinforced, but so was knowledge based on insights and participants' backgrounds. The model that emerged indicates that an organic, but unpredictable pattern of interactions supports Web-mediated knowledge synthesis with all of these elements potentially supporting each other at any given time.

RQ4 - What role does background knowledge play to support the knowledge synthesis of advanced learners in Web-mediated reading-to-learn and reading-to-do environments? Participants in this study accessed background knowledge during keyword

development, made insights based on background knowledge, repurposed background knowledge, and integrated background knowledge during creative syntheses. This was clear. What was not clear was the *extent* to which background knowledge contributed to each of these activities - all of these processes worked so often in rapid sequence or in virtual concert, parsing background knowledge from acquired knowledge proved most difficult. This is consistent with previous indications that the role of background knowledge "may be somehow less important when reading on the Internet" (Coiro, 2011, p. 360; Spiro & DeSchryver, 2010), and that the implications of background knowledge may be increasingly less obvious.

This study contributed a descriptive framework for future studies in its attempts to differentiate idea-play, insight and background knowledge. Specifically, the ability to access both background knowledge and insight typically occurred in relatively quick time frames, whereas idea-play occurred over a longer period of time. However, idea-play may have been based on both insight and background knowledge, since recalling background knowledge may lead to an insight, and idea-play may also result in the same. These complications were detailed in the second creative synthesis for case study #1.

RQ5 - What role does note taking play to support the knowledge synthesis of advanced learners in Web-mediated reading-to-learn and reading-to-do environments? The role of note-taking in the web-mediated synthesis process was much clearer. All participants took notes, either offline or online, and sometimes both. Nearly every documented case of synthesis activity in this study was directly supported by note-taking, or in the context of participants reading their own notes. Unlike previous frameworks that identified note-taking as a separate online reading process from synthesis (e.g., see "Taxonomy", n.d.), this study demonstrated that note-taking integrated with every aspect of synthesis. Keyword development

was even, at times, seeded by participants reading over notes taken earlier in their research sessions.

One open question regarding note-taking is the extent to which online notes may better integrate with Web-mediated synthesis than offline notes. The in-depth case studies in this project provided the following: the first participant took all of her notes offline and did not access any of the notes from her reading-to-learn session during her reading-to-do session; whereas the second participant took all her notes online and made extensive use of her reading-to-learn notes during her reading-to-do session. Whether this was an individual preference and cognitive style, or was based on the affordances of online notes could not be determined in this study. A follow-up study is underway with data from these two participants taken during additional research sessions that examines more closely the specific affordances of online note-taking.

The Theory of Web-Mediated Knowledge Synthesis

Together, the results from these research questions provided the theoretical structuring and illustrated examples of a new framework for considering synthesis in open online environments. As such, the primary contribution of this study is a Theory of Web-Mediated Knowledge Synthesis detailed in chapter 6. It is based on the interdependent elements of divergent keyword search phrase development, synthesis for meaning, in-the-moment insights, repurposing, reinforcement and note-taking. Taken together, these elements lead to creative synthesis. Extensive data in this study supported each of these elements. This theory combines information from the reading literature, previous scholarship about creativity, and results from this study to propose a post-comprehension perspective for reading online. In so doing, it provides a lens through which to better explore and understand generative reading and learning

activities online.

The need for a theory that incorporates a creative or generative perspective for reading and learning online is based in large part on the original motivations for this study. Primary among these is the new ecology of information, knowledge, teaching, learning, and thinking brought about by ubiquitous access to the Web. Anderson & Rainie (2010) surveyed multiple experts who indicated that the Web will shift cognitive capacities in ways that require that we think harder and spend less time on memorization - "Google allows us to be more creative;" Google "supports SOME parts of human intelligence, such as analysis, by REPLACING other part such as memory;" "Google will make intelligence different." At a time when this sort of transformation is occurring, we need more theories to guide our exploration of the related phenomenon, and the Theory of Web-Mediated Knowledge Synthesis is one such attempt.

These changes in available technologies and the cognitive implications of them are rapidly shifting. As such, this theory is intended to be just a beginning. As Olson (2005) indicated, one of the properties of a valuable theory is that it is open to elaboration and refinement over time. For this theory in particular, not only is it open to elaboration and refinement, but this is expected. New elements of synthesis will be added, and branches of the proposed elements will emerge from further study. Given that this theory was constructed based on data from advanced adult learners, developmental heuristics will be needed to indicate what expectations for Web-mediated synthesis are appropriate for various age levels. This theory will also need to adapt as technologies themselves become smarter and more refined.

Though technological progress requires new theories like this to describe and explore the related cognitive implications, one of the other motivations for this study was cultural. That is, the world continues to be more and more complex. Whether technology proves to offload

memory and allow for more creative thinking or not, we still need more creative thinking to be better able to address the increasingly complex issues facing society. Complexity is apparent at the individual, local, regional, national, and international levels (e.g., Blaufus & Ortlieb, 2009; Gunther, 2010; Hanoch, Wood, Barnes, Liu, & Rice, 2011; Hollander, 2004; Mitroff, Alpasian & Green, 2004; Schwab, 2001; Thaler & Sunstein, 2008). The complex, ill-structured and wicked problems that face us at home and at work need better methods of learning to address them than are currently the norm. This theory provides a starting point from which to develop such methods in order to better address the increasing complexity of the world.

Implications of the Theory

While Chapter 5 provided the specifics for a Theory of Web-Mediated Knowledge Synthesis, it also outlined the importance of theory. It identified how theories are typically conceptual systems (Olson, 2005) that "abstract from the complexity of everyday events and practices" (p. 6). They break down complex phenomenon into their essences in order to help others know what to look for, identify how some of the essences are defined in terms of others, and allow for inference and prediction to be made based on these essences. Specific to educational theories, Mishra and Koehler (2005) outlined how once these essences are determined, their value can be viewed through descriptive, inferential, and applied lenses. As such, the following explores the specific contributions that the Theory of Web-Mediated Knowledge Synthesis provides in each of these areas.

Descriptive. The notion of synthesizing information when reading and learning online is a complex and multi-faceted phenomenon, and it has proven difficult to observe (e.g., e.g., Leu, Zawilinski, et al., 2007). This difficulty may in large part be due to the lack of specificity and

clarity regarding what to look for when observing it. This theory endeavors to ameliorate these issues in four ways.

First, as highlighted above, one of the primary contributions of this study is descriptive, in that differentiating synthesis for meaning from generative synthesis provides researchers and practitioners alike with a more precise conception of synthesis related activity than existed in prior literature.

Second, this theory provides several specific details about the conception of generative syntheses that learners and readers may experience online. The concepts of in-the-moment insights, repurposing, reinforcement, and creative synthesis further clarify what researchers might look for when observing this phenomenon. Though the activities that these terms describe are not "new" in the sense that each can be traced to scholarly antecedents, this theory is unique in that it includes all of them as a way to describe one specific phenomenon, that of Web-mediated knowledge synthesis. In particular, the borrowing of terminology from the field of creativity research provides additional ways to describe the various forms of synthesis when learning and reading online.

Third, this theory integrates the importance of note-taking (both traditional and nascent online tools that support a myriad of similar processes) in the process of Web-mediated knowledge synthesis. Prior conceptions of online learning and reading have identified note-taking as an important component of online reading (e.g., TICA, n.d.), but they did so as a separate process from that of synthesis. From a descriptive perspective, this theory makes the case that it should be difficult to conceptualize online synthesis without considering a variety of note-taking techniques.

Finally, the Theory of Web-Mediated Knowledge Synthesis explicitly provides a foundation for appreciating the relational complexity among all of its components. While components of the theory may manifest in isolation, (e.g., synthesis for meaning) it is their inter-relationships that best describe the complexity of Web-mediated knowledge synthesis. In this way, this theory provides a roadmap for observing and describing the components in disaggregated ways, but also emphasizes the importance of considering how each supports or facilitates the others.

Inferential. While the descriptive clarity and specificity and the emphasis on inter-relational activity outlined just above allows researchers to better see what Web-mediated synthesis look like, it also provides a solid foundation from which to make inferences and predictions about how they interact. In this way, it opens up the field to several testable hypotheses that may not have otherwise been considered. For instance, based on the specific description of divergent keyword search phrases, one might predict that extensive and extended use of divergent keyword search phrases will lead to increasingly creative syntheses of knowledge. Similarly, this theory provides a foundation for predictions about the role of soft vs. hard resources and task relevant vs. far afield resources (e.g., do task relevant resources seem more amenable to insights or repurposing when compared to resources that are more far afield?). Given the complexity and rapidly changing contexts within which Web-mediated knowledge synthesis occurs, myriad inferential possibilities exist. However, this theory provides parameters for the predictions and inferences to be made that may make the process of hypothesis construction more manageable.

Application. The field of educational research is particularly prone to creating gaps between research and practice, theory and pragmatics. However, as Mishra and Koehler (2006)

have noted, "a good theory or framework offers us the right level of analysis in order to bridge the gap between description and design" (p. 29). In this way, the Theory of Web-Mediated Knowledge Synthesis offers two benefits to practitioners and those working with them. First, it provides a new lens with which to view existing, and possibly too-simplistic, perspectives of online synthesis. For instance the TICA ("Taxonomy", n.d.) provides an excellent framework for developing questions, locating information, evaluating information, and communicating information from which numerous successful professional development sessions have been run (e.g., http://www.lite.iwarp.com/CoiroVT2008.html). The addition of the Theory of Web-Mediated Knowledge Synthesis to expand upon the more limited details provided by the TICA about synthesis for future professional development sessions may serve fruitful to practicing teachers. Second, several ideas from it can be reviewed from the perspective of educational change. Given the speed with which the new ecology of information, of reading, of knowledge, of teaching, of learning, and of thinking is emerging, it is not practical for schools to wait for the traditional sequence of theory development, experimental research, and replication to be complete before considering better ways to teach and learn. Consequently, this theory provides an additional perspective through which educators can think about the future of education. The Theory of Web-Mediated Knowledge Synthesis is largely based on an assumption that educational environments will increasingly move toward 1-1 ubiquitous access to digital devices and that this technical evolution requires an evolution in what and how teaching and learning take place. For those who believe that there will be less emphasis on rote learning and memorization and more time for higher-order thinking, this theory provides them with ideas from which to build their vision of the future of education.

Limitations

There are several limitations in this study to consider. The limitations of *subjectivity* were discussed in the method section, Chapter 2. In addition, though the *use of think-alouds* is commonly used for reading and Web-based research, it only provides "only a small window into the inner workings of the mind...limited by the awareness of [participants] of their own thought processes and their ability and willingness to communicate this awareness" (Hartman, 1995, p. 530). Though the participants in this study were advanced learners who may have had a higher awareness than most in this area, the limitation still applies. *Topical limitations* were inherent in this study, given that the first author chose the topics. If a topic was more relevant to one participant than another, their willingness and ability to synthesis may have been enhanced or diminished. However, since this study endeavored to demonstrate and explicate synthesis, the fact that one participant may have synthesized more than another would not have impacted the development of the theory or the findings of the individual in-depth case-studies. Finally, it should also be noted that the *interviews* included in the design of this project were intended to serve primarily as a source for triangulation of the think-aloud data. Unfortunately, interview data netted very little useful information. This was in part due to the time constraints of the sessions, but was also due to the emergent nature of the study. The interview protocols did not have questions designed to target several of the elements of synthesis, given that they did not emerge until during data analysis. However, the combination of think-aloud data with screen video and expert review provided ample data with which to address assumptions about the think-alouds.

APPENDICES

Appendix A

Profile for Olivia

Prior to the study, Olivia provided the following information about herself in a survey of Web Learning. She reported using the Web for more than four hours per day on a typical day, and for three hours per day for learning. On a likert scale of 1-5 (5 being the most), she reported that she like to use the Web for learning tasks at a 5 level. She reported having recently used the Web to learn about animal approval forms, differences between Affymetrix gene chips and EST arrays, performing animal surgery, the cost of gavage needles, and information about traveling to Memphis. She reported using browser history, bookmarking, multiple browsers and notecards to organize and manage her Web resources and was unfamiliar with the concept of tagging. When asked to provide possible search phrases to learn about the effects of climate change on global poverty she listed: [climate change affect poverty], [global warming affect on poverty], [climate change third world country], [climate change poverty], [economics of climate change], [climate change affects economics of world], and [climate change affect world poverty]. She noted that choosing keyword search phrases was easy for her and that she "picks out the main words of what I want to know and leaves out the other nonsense words like 'the, of, on.' I also will think of multiple ways to say the same thing – also the way in which other people are most likely to say something." She noted that "aha" or "light bulb" moments when learning on the Web usually came to her when "learning about something I do not understand in grad school – finally I am able to connect enough pieces together to get the overall picture – that is when it comes together to make sense." On a scale of 1 (beginner) to 5 (expert) she rated her abilities in the following categories:

Finding information related to your studies	4
Organizing/managing the Web information you find that is relevant to your studies	2
Determining the reliability of Web sites	3
Determining the relevance of Web sites to your specific tasks	5
Determining the bias/stance of Web sites that you use for learning	2
Synthesizing information from the Web into coherent solutions	3
Using the Web to construct creative solutions to problems	2
Using the Web to have "aha" moments of conceptual breakthrough	2
Setting goals in your Web learning tasks	1
Staying focused when using the Web to learn	2

At the beginning of the first research session, I asked Olivia to tell me everything she knew and her background and experiences on the topic of climate change. Her response provided the following details:

> So, as for climate change, I guess it can be controversial with people, as to whether or not they think that climate change and or global warming is actually taking place. I have read about climate change, and I believe that it is in fact taking place….and what impressed me, when I think climate change automatically, I think about Al Gore's documentary on the whole situation…and being a scientist, I believe that its actually taking place when reading from the scientific papers…and when you see the picture, too, from, for instance, that arctic circle many years ago versus now…there's not doubt that its taking place…now, I know there's controversy around it because some people will actually say that it is the governments way of controlling what we do and how we act by saying that we have to regulate ourselves and regulate what we use…and

they don't believe it so they aren't going to do certain things so that would help prevent climate change and or global warming from taking place. Usually when people confront me like this, I usually hold my tongue because I'm informed and the only thing I can do to try to combat the problem and to make wiser decisions involving climate change. I've noticed that the change, whether its warming or cooling is taking place because our weather has been quite dramatic here as I've gotten older, it's just variable. I remember when I was younger, it used to be cold in the winter and hot in the summer, but now it seems to be jumping all over the place. But, that may be just because people are telling me it is taking place, but I don't know if personal experience can go along with that. I also read about animals and plants and how they are becoming more and more extinct because the climate is changing, and how different niches are not being filled and how that's leading to a greater catastrophe other than just global warming…and the ozone layer and stuff like that that are taking place…I know I hear politicians talking about it…I know now that we're talking about climate change I was thinking about Al Gore's documentary and in my mind comparing it to Michael Moore, because I know these documentaries…even though you agree with them…they can get all hyped up and overdramaticized…I've not had any classes specific to global warming. I've had classes that focus on the ability of organisms to change their genetics, or evolve to adapt to the changing climate…I've read about that and I've seen that data…

Appendix B

Olivia's Synthesis for Meaning Example

As part of this activity, Olivia said "somebody else's opinion was that it depends on the type of media, or subset of media, you received…" then wrote in her notes "media you receive." The text to which she was referring (a personal blog) had been read a few minutes earlier in the first article, which she read out loud.

> This is about how science, politics, and the media 'place' discussions about climate change, global warming, emissions policy and the like...There appears to be an underlying assumption that the 'frame' of debate within which public awareness is constructed is definable as a subset of the range of views on climate change. My intuition, based on personal experience on the Netweather.tc website, on of my favoured for a, is that the range of public opinion is much greater than the 'framing' concept allows for.

Appendix C

Olivia Synthesis for Meaning - Multiple Perspectives from a Soft Resource

Olivia read the first comment on a Reddit page, "I don't act against climate change because there's nothing one person can do = bullshit. You don't act because it inconveniences you." Then, she said, "OK, so I guess inconvenience, and because they honestly don't believe that they can make a change," while also writing "inconvenience" and "don't believe make change" in her notes under why people do not change behavior. She continued "And then somebody here says no single raindrop believes it is to blame for the flood" reading a comment from a different user. She read a reply to this comment, "No single raindrop *is* to blame for the flood. It's just a single raindrop" then commented, "Yeah, OK, I get what they are getting at." She read a second reply from another user, "I'd be interested to know how many of those "raindrops" are actually civilians and how many of those raindrops are government-subsidized industrial contributors, " then said "Oh, oh, so not single raindrop is to blame for the flood (rereading)…I'd be interested to know how many of those are actually civilians (rereading)…oh, so… OK that's kind of a hitting on the government here…" She read another reply from the very first user "'government-subsidized industrial contributors are organizations of individuals…sum of their behavior" and said "it's the sum of their behavior that makes it bad or good." She then said "So…so…I guess sum of behavior" as she wrote "sum of behavior" near why people do not change behavior in her notes. She continued reading the same reply "'Big Polluters' wouldn't exist if those who worked for them didn't support that behavior, " then continued on to the next reply, "Yes, that's true, but government-subsidized industrial contributors are more able to get special discounts…to externalize their environmental costs…civilian usage constitutes something less that 10% of water consumption…" She then said "Oh, OK, so because maybe

people actually…individual people actually…it's collective, and the individual person, or civilians can't actually make a change…maybe that's what they are feeling," while writing "collective persons (civilians) can't change" in her notes. This last note represented a summary of several different ideas on the page. She read further in the same comment "Moreover the industrial et al users get special discount rates. Even if civilians were especially wasteful, which they aren't, changes in the consumption rate would never have any real effect…" The, she read a reply from yet another user "Where do you live? Most states in the Web have water rights," and said "Ah, that's true, I guess why people would change their behavior, is if they have water rights," writing "water rights" under why people change behavior in her notes, and saying "so again, this goes back to affecting them." She read on further, from another new user "Being morally superior is more important that getting results!" Then, she said "Ah, yes, so morals," writing "morals" under why people change behavior.

Appendix D

Olivia's Path to Synthesis for Meaning based on Verbatim Notes

After first searching for [people's opinions on climate change] and writing down just a few notes Olivia said to herself:

> I think now…normally if I wanted to know more about climate change, I would probably go to Google Scholar, and look at...um…but again, Google Scholar I think is just going to give me more scientific facts, and this things asking for people's opinions…and so do not choose, so why people choose to change their behavior or not change their behavior (reading from the task). Ok, so I've learned about some climate change, now I'm going to write in [why people change behavior on climate change] (typed in as new keyword search phrase).

She selected the first article based on its Google results stub "How the science of behavior change can help with sustainability" read through it, and took some notes based on repurposing the information provided therein. As she left this page, she said "but this is totally not about global warming." Upon returning to the Google results, she read the next stub "How the science of behavior change can help environmentalists" but did not select it, then read "Putting" the first word of the next Google stub, and then read the full title to "Public Attitudes and Behavior about Climate Change" exclaiming "Yes (with increased volume in her voice), and this I see is by M Patchen, looks…Purdue…OK, looks like a good…" and then opened the PDF. She went on to read through the table of contents "Summary, Introduction, Theoretical Frameworks, Benefits, Emotions…Appraisals of the Situation, Personal Characteristics" noting to herself "yeah, that… definitely, I can see that" and then finished "Social Influences." She added "This definitely seems like a PDF I want to read, but it is 58 pages long, and I only have

and hour, so I'm probably just going to skim it." She skimmed the first five paragraphs of the introduction "…effects that can cause serious harm to humans (from second para)…blah blah blah Why do some people (from fifth para)…that's right why do some people concerned but others don't care (comment linked to "care" in notes and from previous article)." Then, she read in more detail the sixth paragraph "Since climate change has become a topic of…discussion…(skips rest of first sentence)…pro-environmental behavior…support for green policies…affected by a variety of factors ((parts of second sentence skipped…increased volume on factors)…These include…" and then read the full third sentence and notes the list above about these factors.

Appendix E

Olivia's Insights Related to the Text(s) Read

First, as Olivia bounced from one idea to another in a long PDF, reading only section titles and segments of first sentence, she jumped to a section of text about ways that people deal with climate change and read "Some people have hope that new or future technology will save them," and then immediately said "so, I guess, maybe putting the responsibility on somebody else" as she wrote "response – someone else – technology" in her notes about why some people don't Δ behavior.

Second, when reading through a list of reasons why people may not care about climate change, Olivia read "Third, we've become distanced from nature, " and said "yeah, I would agree with that," while writing "distanced from nature" in her notes. After her verbatim notes, she then said, "so, we don't value nature, I guess, as much," adding "(value)" to the notes about distance.

Third, in the context of exploring information about religious views on climate change, she read the text "U.S. Legislators, backed by the Christian right vote again these issues with near-perfect consistency. That probably doesn't surprise you, but this might: Those same legislators are equally united and unswerving in their opposition to environment protection." She then noted "opposition to environmental protection" as a reason people might not change. As she did so, Olivia stated, "Could be a reason why…because you want less government, so maybe your politics…" and then added "less government" after her previous note.

Fourth, Olivia read through an article about Religion and Climate Change. As she skimmed the text, she focused in on a particular section and read:

> As environmentally minded clerics, and greens with a spiritual bent, confer in increasing numbers, in particular over climate change, acquaintances are being struck that transcend many ethnic, ideological, a theological obstacles….And such encounters are not just a curiosity. The might make all the difference to the planet's future…So these hymns…about faith…and the environment…

She then said, "So, they sing songs about the environment and faith," and continued reading (some of the text for a second time):

> …and greens with a spiritual bent, confer in increasing numbers, in particular over climate change, acquaintances are being struck that transcend many ethnic, ideological, a theological obstacles….And such encounters are not just a curiosity. The might make all the difference to the planet's future…

Finally, she said, "Hmmm. So I guess it's a way to make people passionate about something," and noted **"**passionate about climate" in the section of her notes devoted to religion.

Appendix F

Olivia's Repurposing Examples

For instance, after entering the search phrase [why people change behavior on climate change], Olivia selected the first result based on its title "How the science of behavior change can help with sustainability." She then read the subtitle "Les Robinson shares his tips on how the science of behavior change can help make sustainability more effective," predicting "so how…basically…it seems to me though about how people are already interested in changing their behavior, and this is about how to make their behavior more effective." After skimming and reading several headings in the article, she read a header "What if people just aren't interested?" and said "So, I guess, maybe if people don't change their behavior with global warming, maybe they're just not interested," and wrote "they don't care, not interested" under the heading "why people **Δ** no behavior." After reading several more headings, she clicked away from the page, saying, "but this was totally not about global warming." As such, in this case, she repurposed the idea of caring (or not caring) from the context of sustainability to climate change. And, while it is arguable that these topics are largely similar, Olivia did not think they were, and yet still repurposed information from the article to her evolving knowledge about the climate change task. It is also worth noting that the search phrase she used ([why people change behavior on climate change]) was intended to find sites about why people *do* change their behavior, but she synthesized information explaining why they might not. Openness of this sort to finding and valuing information that you might not be seeking at the time is a characteristic of the CFT-W model (Spiro & DeSchryver, 2010) and may be particularly relevant to finding information that can be repurposed.

Several times, Olivia used information found on the Web in opposite ways that it was presented in the text. For example, as noted above, she read "most people are willing to make some financial sacrifices," and then commented, "yeah, that can be it, too, so not change behavior…money…" Notice how the text is written in a way that indicates people *will* make financial sacrifices related to climate change, but she repurposed this to explain why some people might *not*. Similarly, as noted above, when reading through the Reddit comments about climate change, Olivia read "Being morally superior is more important that getting results!" said "Ah, yes, so morals," and wrote "morals" under why people change behavior. Just thereafter, however, she also said "so, some people, I guess, their morals aren't strong enough towards…um…aren't strong enough (as she writes notes)…um…to their…um…hmm….to support environment…hmmm," as she wrote "morals ≠strong enough" under why people don't change behavior. Notice the slight differences between these two examples. In the first example, the idea as written does not apply to either changing or not changing behavior. The notion that people will make financial sacrifices to lessen climate change does not explain why they might not. Olivia had to repurpose this as she did to integrate it into her knowledge construction. However, in the second case, the text as written could (and was) synthesized "as is" to contribute to meaning across texts, but was also repurposed.

Olivia also repurposed by scaling ideas down in her reading-to-learn task. For instance, when reading an article entitled *Trade Flows, Barriers and Market Drivers in Renewable Energy Supply Goods*, she scanned through the table of contexts, and then began skimming pages. After looking at a few charts, she read a shaded area "This paper seeks to establish correlation between production and export capacity in renewable energy," then summarized it for herself "so the ability to produce and export energy." She then paused and said, "hmm…I don't…produce and

export energy…how would this change people's behavior? Some countries can produce and export these goods…and I guess that maybe some companies can't do this…so maybe that's why they [people] don't [change behavior]," writing "companies can't produce and export" under why people might not change. Olivia repurposed this idea from international commerce to individual behavior, but it is also important that she deliberately stopped in the middle of an otherwise unrelated article to ask how the text might apply to her task.

A few minutes later, she did the same thing again, reading "Applied tariffs for all except India…in the single digit range. Developing countries apply higher tariffs…" and said, "Oh, so I guess if you come from a poorer country you might have a higher tariff on these renewables…on renewable energy…so that's…no wonder. That's not really fair…" She then wrote "poorer→higher tariff renewable" under why people don't change. In both cases, ideas intended at an international scale were reduced and repurposed to explain individual behavior in ways not intended by the authors.

Olivia repurposed another idea in two different ways. That is, after searching for [rich people change behavior global warming] and reading through an article entitled *Global Warming and Social Justice*, she skimmed text fragments from several paragraphs - "Questions of corrective justice…our goal here is to answer those questions…to motivate…First, the world taken as a whole would benefit…" and said "Yeah, we know that, but let's see here…Oh, yes, yes, yes…" She then read the first few words of a paragraph about carbon taxes "Suppose for example, that the world…" and then said "That's right…so a tax benefit…could make them…if they do this voluntarily…they get a tax benefit…you know…if they switch over," while adding "tax benefit" to the her notes about how to change high SES people's behavior. Two things happened here. First, Olivia scaled the idea down from its international context (i.e., she was

reading about how the world as a whole would benefits) to individual behavior. The idea could have been repurposed on this change alone, i.e., carbon taxes could be applied to individuals to change their behavior. However, Olivia repurposed the idea yet again, essentially from a stick to a carrot.

Finally, after reading through a list of "advantages of global warming" on about.com, including "longer growing seasons," saying "yeah, that would be good," and adding it to her notes, Olivia had an insight about this idea and combined it with a repurposed idea from earlier in a layered generative synthesis interaction. That is, soon after reading the list, she said, "All right, but I guess we're looking at behavior here…um..but I guess there are advantages as to why people maybe would want global warming, like if you're a farmer, for example…so you wouldn't want to change your behavior, even though you know there are many bad things going on with global warming, it just may be good for you." This comment integrated an idea from an earlier article when she read, "so many people willing to act on the negative consequences of environmental change…affect them personally, affect a larger social unit, or affect the biosphere. Perceptions of greater risk or threat…have been shown to increase people's willingness [to take pro-environmental actions]…" In this previous segment, she emphasized the importance of "affect them personally" though increased volume in her speech and connected it to willingness to make positive change. In her comment about the farmer, she repurposed this in the opposite way, in that if something affects someone personally, they might *not* change their behavior in positive ways. This was integrated with an insight about longer growing seasons providing a specific advantage to farmers, making them act regardless of their knowledge of the larger issues.

Appendix G

Olivia's Reinforcement Examples

Reinforcing synthesis for meaning. Several times, ideas that Olivia synthesized for meaning in her notes were reinforced by text encountered later in her task. For instance, seven minutes and two resources after identifying "media you receive" as a contributor to individual behavioral decision-making, the she confirmed it by a more reliable resource than the first time. The first time she noted this issue, it was based on a blog titled *Old man in a cave* and the second time it was embedded in a graphic titled *A Model of Determinants of Behavior Relevant to Climate Change* in a sociology research paper from Purdue.

In another case Olivia read about how water rights might impact individual behavior (detailed above from her review of Reddit comments) and connected this change in behavior back to things that impact people personally by saying "so, again, this goes back to affecting them…" This was about five minutes after reading in another resource (the Purdue study) about how conditions that "affect them [people] personally" impact their willingness to act. Several things happened here that demonstrated the emergence of a complex relationship among these synthesis elements: (1) Olivia synthesized the idea of water rights for meaning in her notes; (2) she had an insight about how water rights would affect people personally that was not explicit or implied in the text, and (3); this insight reinforced the text read earlier. However, the difficulty of designing models to fully deconstruct and explain this behavior is also demonstrated well here. Is the insight Olivia had based on the text, since it was read relatively recently (i.e., are these ideas still in working memory), or had she committed them to long-term memory, in which case the insight would be based on background knowledge? That level of detail is not the goal of

this study, however, it is fair to say based on this data that the then current text itself did not reinforce the idea of being affected personally, but her insight about it did.

In another instance, the reinforcement of an idea synthesized for meaning earlier effectively clarified and simplified it for Olivia. When reading through a HuffingtonPost article identifying reasons people don't care about climate change, she read the first sentence of the fourth idea, "…many of us don't believe we can make a different in the our world," and noted "once person doesn't matter ≠ enough make big difference." This reinforced the idea of collective vs. civilian impact she encountered earlier, but in a much simpler way. When reading about this the first time, is was when she skipped from one comment to another on the Reddit page, while the metaphor of the raindrops, a discussion of government-subsidized contributors, and the example of 10% of water usage being civilian may have made the bigger idea more difficult to understand. In fact, her notes based on the initial reading read "collective persons (civilians) **Δ.**" This is somewhat ambiguous when compared to her "once person doesn't matter ≠ enough make big difference."

In that case, Olivia was able to make a complex interaction simpler by reinforcement. In yet another, reinforcing an idea served to provide an additional level of useful complexity to the first instance. When exploring an article about the opposition of Republican senators to regulating CO2 emissions in Utah, Olivia read, "It's not coming at us. If this is happening, there's very little scientific…" and commented, "…so again, they may not want to change because they believe there is a lack of scientific evidence." Given that the earlier interaction about belief did not mention science or evidence, this instance may serve to reinforce her background knowledge about science. However, her use of the phrase "so again" suggests that

this interaction with text was reinforcing for her, and did further explain the belief text she synthesized for meaning earlier in the session.

Reinforcing insights. Olivia also experienced times when the text reinforced her own insights. One of these insights occurred when reading about how some people hope new technologies reduce the impact of climate change, when she stopped reading and said "technology…I don't know…its just…i don't know if I'd rely on that." As she continued to read, the next paragraph stated "The study by Kempton and his colleagues found that most people in all of the groups…rejected…" and then said "That's right, other people agree with me, not that my opinion is the only one that matters here, I'm trying to get a lot of people's…but I agree with that." That the reinforcement happened so quickly may impact how significant the effect of this interaction might be on long-term memory. However, this example provides two important features about reinforcement. First, questioning the text can be considered a generative form of synthesis in that it provides a value-added that is neither explicit nor implied in the text. As such, the reinforcement that occurred here might have an impact on the knowledge synthesis that Olivia experienced, but its secondary effect might be to encourage her to question the text even more as she reads on. That is, the effect of questioning the text and having the text (or even a later text) agree with your assertion might increase affect and be motivating to continue to do so. If so, the affective and motivational component of reinforcement may also be higher when generative forms of synthesis are reinforced, as opposed to syntheses for meaning, when the reader is arguably less cognitively invested or responsible for the ideas that are reinforced.

Another insight that was reinforced was that of money being influential in the individual behavioral process related to climate change. As discussed above, the idea that money might be

a meaningful reason for people to change behavior was an insight Olivia had while synthesizing a list of other reasons from the Purdue study for meaning. Thereafter, the text reinforced this idea several times. First, it she encountered this idea again within the same article, in the context of financial sacrifice, reading "most people are willing to make some financial sacrifices…yeah" and then saying "that can be it, too, so not change behavior…money." In this case, the reinforcement of money as a motivator was not achieved until Olivia had repurposed money from the current text to a reasons people might *not* make change, as discussed above. In this way, the reinforcement occurred, but in a way that broadened her scope of application for money. The issue was reinforced even more by reading about how "government-subsidized contributors are more able to get special discounts...to externalize their environmental costs" and then said "so then we go back to money…which definitely is an issue here." The scope of money was broadened yet again to include industrial financial implication on individuals. The next reinforcement of money came later in the same resource, based on her reading of the following comment, "I act again climate change because saving energy saves me money…" to which she responded "ooh, saving money, why people change their behavior would be to save money" while noting "save $" under why people **Δ** behavior. In this case, however, the reinforcing idea lead her to elaborate even further. She said, "but I guess, others would say that it will actually increase their costs because they have to pay more for these light bulbs, and so, you know…for certain things." The next instance both reinforced and further clarified how money might be a reason for people not to make changes. In a HuffingtonPost article Olivia read, "…it costs money…" and said "that's right, that's what other people have said." She read on

> …so, I still drive and SUV, I bought it 130,000 miles ago when we lived were snow could fall four feet in a weekend. I thought SUV…safest…now I live in a place where it never snows…I have not reason to drive it, except I can't afford a hybrid and then said, "so, money, can't afford a hybrid

as she wrote "$≠afford" in her notes. In this case, the text was actually reinforcing another reinforcement (when she repurposed some text and said "that can be it, too, so not change behavior…money," noted above) making it more detailed. That is, the notes she took in the latter case were a "$" in the why people no behavior section, with minimal connection to the text. Where as, the second note was more specific and connected to a concrete example in the text. Finally, when exploring government incentives for mitigation on greenfacts.org, Olivia read "Climate change policies related to energy efficiency and renewable energy are often economically beneficial," commented "Oh, so they are often beneficial for money," and noted "long term beneficial to society – government." In this case, the context in which the idea of money was reinforced was at a much more sophisticated and global level than anything she had yet encountered about money. As such, the text both reinforced and facilitated elaboration on this important idea for her.

Appendix H

Olivia's Creative Synthesis #1

When first presented with the reading-to-do task, Olivia started out with the following activity:

> Right now, I'm just going to write down a few things I learned from the hour before I go searching, or just things that I think I can come up with in general…Some voluntary ways to get religious people to change their behavior would be to…increase the value of mother nature as it relates to the bible or whatever religion, Koran, or whatever religion it is. [noted 'increase value mother nature bible']
>
> I know they also suggested making some hymns, this one Web site talked about making hymns…about nature and singing those types of hymns. [noted 'hymns about nature']
>
> Also, something religious people like to…a lot of times its a *community*…so we can..they can do community things together that would persuade them to…so community activities together that would persuaded them to clean up the environment whether its to participate in recycling together…whether its to…just do something as a community collectively, since they follow this group…it will make them hopefully want to do it a little bit better…so there is that Web site that said that. [noted 'community: clean up enviro, recycling']

Olivia continued this creative synthesis with ideas based on insights. She made several insights, which appeared to be largely based on background knowledge that became the foundation for her answer to the reading-to-do task. When first thinking out loud about how to

target college students, she said, “In terms of…um…the college aged students…a good way to make some ideas to persuade them to volunteer to help lessen climate change would be to make it cool and or put it on a social network,” and then noted “be cool, social networking.” She then said

> another way would be to make it fun, so, for example, it would be to take them to other countries, possibly, maybe not by airplane to reduce that carbon footprint, but I guess…somehow get them to other countries and to invest them…maybe by traveling and volunteering in other countries to reduce the problems associated

and noted “fun → other countries travel volunteering reduce problems.” Finally, she said

> So, college students, another way to get them would be to I guess, to make different campus groups and I would still say that do fun things…allow them to meet people…and allow them to feel good about themselves..because again I learned that you may change if you feel it directly affects you…so maybe increase their…them feeling good about themselves and that they are making a difference collectively…

and noted “groups, fun, meet people, feel good about yourself.”

This was the first time that the ideas of social networking, fun, travel, or feeling good about oneself emerged in either the reading-to-learn or reading-to-do session. Olivia did not read about these in any text(s), or in this case, have insights about them based on text. However, **notice how the idea-play in this example emerged**. She considered several different ideas from the reading-to-learn session - cool was an insight in the first task, collective activity was synthesized for meaning and then reinforced in the first task, being personally affected was synthesized for meaning and then reinforced in the first task - which prompted several “new”

insights based on her background knowledge (social networking, fun, travel, feeling good about oneself). As such, an argument can be made for another "downstream" influence of the Web texts from the reading-to-learn session. That is, the ideas of "cool" and "collective activity" together contributed to Olivia's insight about social networking; the idea of "cool" contributed to her insight about "fun;" and the idea of "being personally affected" contributed to her insight about feeling good about oneself. As such, this creative synthesis about college students demonstrated the complicated interaction between background knowledge, idea-play, and Web text, and the difficulty parsing one from the other.

Appendix I

Olivia's Creative Synthesis #2

This example from Olivia's reading-to-do session is more explicitly scaffolded by her use of the Web at that time. For example, just after the creative synthesis in Appendix H about religion and college students, she said

> and the high money making people, I think, how could we change their behavior…I think this depends on if they care about spending their money or if they don't care about spending their money…because one way you could spend it is…we're going to do these things to try to save you money, so if you don't need to save money, I'm not really sure…I'm going to have to look that one up…

She then searched for [rich people change behavior global warming], selected an article about global warming and social justice, and repurposed carbon taxes to tax benefits for the rich. Thereafter, she continued reading the same article, "United States is not as vulnerable…to serious losses from climate change…agriculture…United States might be a net loser from…a world wide carbon tax…" and said "Or, one way you could make…I guess…um…let's see…" She skimmed more text segments from several paragraphs, "We accept the view that in many domains resources should be redistributed from rich nations to poor nations…To understand the issues of justice and motivations…United States…China…top emitters…" leading to the following insight, "So…they care about money…because they are rich…they probably also care about their family." After skimming further, Olivia read the following

> From the standpoint of distributive justice, it is temping to suggest that because of its wealth, the United States should be contributing a great deal to the climate change problem…far more that would otherwise be its fair share…Let us simply

> stipulate that it would be a good idea for wealthy people in wealthy nations to transfer resources to poor people in poor nations. Even if this is so, the claim runs into three problems…the first problem is that emissions reductions would help future poor people rather than current poor people.

and then said, repurposing this information, "Oh, so I guess…maybe…if rich people are caring and giving they could give to future generations of the poor people," and noted "giving: future generations poor people." She continued reading

> If the goal is to help the poor, it is odd for the United States to spend significant resources to help posterity while neglecting the present…The second problem is that emissions reductions are an in-kind benefit. Poor people in poor nations would in all likelihood prefer a cash transfer…perhaps India would prefer to spend the money on education or AIDS prevention…The third problem is that many of the beneficiaries of emissions reductions are wealthy, and many of the losers are poor. Wealthy people…Global warming will also produce monetary benefits in many places like productivity…

Olivia then verbalized an insight about the importance of determining investment

> So, I guess just thinking about this then…the question to me comes if I want to change the behavior what are rich people invested in? And, whatever they are invested in we need to target that. So they are invested in money, so we can give them a tax benefit…if they are invested in helping other people, they can give to future poor people by trying to reduce their emissions now…

Her focus then shifted as she had the following insight

> If they are invested in the typical Hollywood type ordeal…and…I guess…fame…and recognition…we could say that if they give, there will…depending on the amount, be a public plaque, or the bricks in a park…and they would get their names on the bricks..depending on how much they give, or on a fountain…or on a birdhouse or something, depending on how much they give, whether its money, or whether its time…or a that they put in to trying to voluntarily change global warming or climate change…so give them some sort of *incentive*…

while noting "Hollywood/Fame/recog: Give→plaque - bricks...in a park...name...fountain...birdhouse...$." She then repurposed several ideas saying "so, college students too...we could also reduce the cost of meals, for example if they learn to recycle…so I would definitely say incentives," while noting "reduce cost meals→recycle." She continued by repurposing this idea again "So, for religion, the reason why, the incentive would be to do it for God or to do it for your community…more of a moral obligation for those reasons…and then money...I'd say, yeah, depends, on what they're interested in..." She had another insight "College Students…well. They want to be cool, save money, have fun…and they also want to learn," while noting "be cool, save $, have fun, learn." Olivia continued, saying "so I guess you could make a class, which I have not taken, on the effects of global warming…or we can try to start integrating concepts of global warming into multiple disciplines, such as math science, sociology…" and noting "class on effects global warming...integrating global warming into multiple disciplines." Finally, Olivia read through her notes "So they can take a class…reduce cost of meals…they can go someplace…" said, "actions that they can do that would be fun…"

continued reading her notes, “fun other countries…travel in other countries…groups, fun, meet people…feel good about yourself…reduce cost…” and, said

> Oh something cool would be for college students would be to design exercise equipment that runs off of energy, your energy that your produce during exercise, so like and engineering class…so they could make projects…in different classes…that focus on global warming and reducing and changing behavior…

before noting “design exercise runs off of energy produced during exercise” and “projects in class.”

Appendix J

Olivia's Creative Synthesis #3

Another example from Olivia's reading-to-do session demonstrated the multiplicity creative syntheses exhibit in a different way. In this case, the different elements of synthesis were mostly acting in concert as she processed the same Web text chunks.

Beginning just after creative synthesis #2, Olivia said to herself "I had read something earlier that talked about how to get people to change behavior" which lead to a search for [how to change a behavior voluntarily]. As she skimmed the results, she read a title "Public Perception of Climate Change: Voluntary Mitigation," commented, "so I know mitigation now means lessening..." and selected the result. The ensuing page was an abstract from the *American Journal of Preventative Medicine*. She read, "...mitigating…not only government…consumers…population…awareness…behavior…data…subject…awareness …vast majority reporting some level of concern…a multivariate analysis revealed significant predictors of behavior change…individuals with heightened concern…" She continued reading, and said

> so we want to...so in order to get individuals to change behavior…you know…voluntarily…again, we are going back to what I had read earlier…that they need to be concerned…oh, it's better if they have more education about it…younger tends to do it…and let's see…Of those who changed behavior..reduced energy usage, reduced gasoline…oh, so if more people are likely to reduce something…what they can do is reduce energy, reduce gas, and recycle…are the tops ones…top EASY ways, this is easy, people like easy, easy way to change behavior…

While doing so, she noted, "(1) concerned (2) education (3) younger → ↓ energy ↓ gas recycling" and labeled the last three as "easy ways to △ behavior." In so doing, Olivia demonstrated three different elements of synthesis. First, she synthesized the ideas about education and age from the current text for meaning. Then she had an insight about how the ideas in this text were examples of easy ways to change behavior. Finally, she reinforced the idea of caring, which had been originally from text in the reading-to-learn session, then reinforced several times, and finally repurposed only minutes before during the reading-to-do task. She continued reading, "Government policy must eliminate economic, structural and social barriers," and said "yes there are barriers, we are aware of that...so the barriers." She then noted "barriers," reinforcing the idea of barriers to climate change behavior from Web text in her reading-to-learn session (text from *Trade Flows, Barriers and Market Drivers in Renewable Energy Supply Goods* which, at the time, prompted insights, and was later repurposed).

Before reading on, Olivia revisited this information in the context of her different groups of individuals and said

> so, I guess for religion…we can encourage [reading her notes] reduction in gas…reduction in…encourage them to care more...So, I guess reinforcing the Earth, and why God…or whoever…or a higher being…created earth...paganism…if they like nature…that may be important

while she noted "earth why God/higher being earth" and "paganism → nature..." In this activity, Olivia reinforced the idea of "creation care" from her reading-to-learn task and synthesized the idea of pagan values about nature for meaning from her reading-to-learn notes. She then said

> so for people who are rich…how to get the them to save…reduce energy…reduce gas…ooh, hybrid cars…super cool...hybrid cars…convenient…and cool…and

> unattainable to what others may have…assuming they want…assuming that they are rich and they want something unique

while she noted "hybrid cars, convenient, cool, unattainable, unique" in her notes about high SES individuals. These interactions demonstrated how Olivia had an insight about the impact of unattainable or unique goods on this population, repurposed an idea about hybrid cars from the first session (i.e., she read about how hybrid cars are too expensive for many and might have been a reason for people not to change their behavior), repurposed cool from idea-play about how to target college students earlier in the reading-to-do session, and synthesized the ideas of reducing energy and reducing gas for meaning from the current Web text.

Before moving on, Olivia continued looking at her notes and said "and, for all of these things, uh...I'd say you need to make it easy, same with...[rich] people...easy...I think religious people would do it even if it weren't easy because the are doing it out of different reason..." In this case, Olivia elaborated on her original insight about "easy" from the text, and provided even more value to it (i.e., that it may not be necessary for the religious group), and demonstrated what might be considered an insight about her own insight. This generative synthesis about her own insight was specifically prompted by a review of her notes.

Continuing on, Olivia visited a Google result about behavior change in Africa, she decided, "no, no, I don't want that" and revisited her search phrase. She adapted it and searched for [how to change climate change behavior voluntarily], selecting a result titled *Voluntary versus Mandatory Approaches to Climate Change Mitigation.* While skimming the first two paragraphs, she read "...voluntary programs are best understood as a weak instrument..." and said "so they are weak, so I wonder how to make them stronger...so if voluntary is generally weak...compared to mandatory, I wonder how to make voluntary programs...to maybe enhance

the efficacy...but I'm going to keep reading anyway..." while noting "voluntary → weak, how to make vol program, enhance efficacy." In questioning the text in this way, Olivia essentially made an insight, or generative synthesis of the text.

She read on in the article, and bounced from one header to the next for almost two minutes, at one time saying, "This is not really what I thought it was." However, one particular section caught her attention, entitled *Clinton, the Carbon Tax, and the Climate Change Action Plan*. She read, "When the administration presented its climate change action plan later in the year, the focus had shifter from mandatory regulations to financial subsidies (including $200 million per year to stimulate the adoptions of more energy efficient technologies)" and said, "Oh, so money…so you get money…that could be another benefit, get money…if adopt behavior, and this is used in the government" and, noted "get $ if adopt behavior" in her college section. In doing so, she repurposed the notion of government subsidies to individual behavioral payments, at the same time reinforcing the multiple instances of money she encountered in the reading-to-learn session.

Continuing on in the same paragraph, Olivia read, "Among the voluntary programs were Green Lights, Climate Wise, Motor Challenge, and Energy Star Buildings. Firms participating in these programs received several benefits. They were given case studies detailing the cost savings…" and said,

> Yes…so that would be a good thing…I guess to continue to show the cost savings…which they do at Michigan State…they show the cost savings in each dorm and percent of saved, and for instance the amount of school busses each dorm or apartment complex saves each year in trash, electricity…you could make it a competition…

and noted, “cost saving dorm/% saved among of school busses each dorm, apt, saves each yr, trash, elect…” This particular text, combined with Olivia’s background knowledge about Michigan State, facilitated three generative syntheses. First, she repurposed the notion of cost savings from federal programs to dorm activities. Second, she made an insight about using competition to make this work. Third, the entire interaction reinforced yet again the importance of money in considering behavior regarding climate change.

After skimming the rest of this article without much interest, she immediately changed her search phrase to [improving efficacy of voluntary behavior change], a direct result of her questioning the text about weak voluntary program just prior. After looking at one result about health behavior change, she returned to her search and said “um...improving...um...maybe take out efficacy and put in climate change” and changed the search to [improving of voluntary behavior change climate change]. She then selected a PPT about “empowering the public to voluntarily change behaviors...” and it opened to the title slide “Water Stewardship Program: A Success Story in Behavior Change and Public Participation.” She skimmed the first several slides, reading keywords from each very quickly and making occasional comments,

> systems point of view...empower the public to change behavior...25 year research tools on community empowerment...15 year research applied to environment...dozens...blah, blah, blah...tools addressed to address range of issues including non-point source water, air pollution...empowerment model...social marketing...where do I start...the barriers...carefully crafted actions...blah, blah, blah

before slowing down on a results slide. She read this slide, “20,000 people achieved the following savings, 40% reduction solid waste, 32%…” and said “using this program

methodology." She backed up one slide to the "Household EcoTeam Program Methodology" slide and read part of the first bullet point "distinct topic areas." She then said, "we will need to make each goal…maybe…distinct goals…and with distinct areas…easy actions…support group, hold each other accountable…self-directed meeting…trained volunteer coach…they'll have somebody they can go to…" while reading text on the screen with the following bullet points:

•Carefully crafted actions in easy-to-use recipe format

•Peer support group of 5 to 8 household

•Self-directed meeting guides

•Trained volunteer coach

During this time, she also took notes in the margin of her paper for "goal dist, dist area," easy actio," "support group hold account," "self-dir," and "coach." In so doing, Olivia repurposed these ideas from water stewardship behavior to climate change behavior, and also reinforced her ideas about easy (an insight she had based on Web text earlier in this task). Finally, her comments on this text provide further evidence of how inference and summary are incorporated into the synthesis process. That is, her comments about how support groups hold each other accountable was an inference she made about the meaning of "peer support." Also, her comments and notes in this example all represent an *in-situ* summary of the bullet points she was reading. In these ways, inference and summary may also be used when repurposing Web text.

As she moved through the PPT, she continued reading small segments of text from different slides, saying to herself "what is this program here, because I need ways to persuade people, and want the most effective ways." This commentary represents her continued and consistent adherence to the task, but also how she has synthesized some of her new ideas to guide the exploration. Specifically, she is making reference to an insight she made about eight

minutes prior when reading about the weakness of voluntary behavior change programs and how to enhance their efficacy. Just thereafter, she read the selling points for neighborhoods from the current slide "environmental improvement, neighborhood livability, community building," and repurposed the first idea for college students, "...so for college students, we would want to improve environment," noting that in the appropriate section. She then added "same with...I guess really for everybody...we would want to improve the environment...no matter what's the group."

She quickly clicked by a few more slides about social diffusion, research questions, and funding of program, the program design, before stopping on a slide and reading the first bullet about lifestyle assessment. She read "lifestyle assessment," and said, "Oh, so, OK, so they give everybody an assessment...so they know where to begin, where to go, " and noted "assessment." In so doing, Olivia repurposed this idea from water stewardship behavior to climate change behavior, and also reinforced the idea of empirical assessment that she synthesized for meaning earlier in her reading-to-do session when reading about federal programs.

One slide later, Olivia read "A less measurable feature was the social capital built…program participants met their neighbors," and said "Ah…yes…so enhance social…cohesiveness….so enhance cohesiveness…they were engaged...and this could work for all three groups," noting "enhance cohesiveness, engaged." Again, she repurposed this idea from water stewardship behavior to climate change behavior while reinforcing several ideas from earlier (e.g., groups, fun, meet people, and social networking were all insights from her initial reading-to-do idea-play and the idea of collective or community action had been introduced and reinforced several times prior in both sessions).

Thereafter Olivia finished skimming the PPT, and said “Let’s see here...so I want to exit out of this...and I’m going to go here [back to her Google results]...to...let’s see here...” and then re-read the task instructions out loud. She continued “I’m going to just type in then, I guess...” and looked at the same results again, before finally returning to the Google search box and slowing saying and typing in “climate” before deleting is and then saying/typing “maybe...fun projects for climate change.” In so doing, Olivia switched gears and effectively ended the creative synthesis series of events related to her first search about changing behavior voluntarily approximately 15 minutes prior.

Appendix K

Profile for Beth

Prior to the study, Beth provided the following information about herself in a survey of Web learning. She reported using the Web for more than four hours per day on a typical day, and for three hours per day for learning. On a likert scale of 1-5 (5 being the most), she reported that she like to use the Web for learning tasks at a 4 level. She reported having recently used the Web to learn about probability theory, the Fed's intentions on quantitative easing, the Cholera outbreak in Haiti, and the symptoms of a sinus infection. She reported using bookmarks, emailing URLs, printing articles, posting articles to Facebook and Google news alerts to organize and manager her Web resources and was unfamiliar with the concept of tagging. When asked to provide possible search phrases to learn about the effects of climate change on global poverty she listed: [climate change and global poverty], [UNDP climate change], [Millennium Development Goals and global poverty], [UN global warming], [Al Gore global warming poverty], and [climate change scientist global poverty]. She noted that choosing keyword search phrases was easy for her and that she

> [thinks] of things I associate with the main topic and use them to expand my search. If I don't know anything about the topic, I run the first search, look for associated ideas, and then expand or narrow my search based on what I find.

She noted that "aha" or "light bulb" moments when learning on the Web usually came to her when "finding solutions to math homework." On a scale of 1 (beginner) to 5 (expert) she rated her abilities in the following categories:

Finding information related to your studies	4
Organizing/managing the Web information you find that is relevant to your studies	3
Determining the reliability of Web sites	4

Determining the relevance of Web sites to your specific tasks	5
Determining the bias/stance of Web sites that you use for learning	4
Synthesizing information from the Web into coherent solutions	4
Using the Web to construct creative solutions to problems	3
Using the Web to have “aha” moments of conceptual breakthrough	3
Setting goals in your Web learning tasks	2
Staying focused when using the Web to learn	2

At the beginning of the first research session, Beth was asked to talk about everything she knew, her background and experiences, on the topic of climate change. She responded:

> I know it is a hot political topic, so I try to stay away from it. I know that there was a big thing with scientists forging their results about it about a year ago. I also know that a lot of the right, politically, does not think it is real…and the left thinks that climate change is real and we’re all going to die. I know Al Gore is really big in the climate change awareness stuff and I saw him at LiveEarth when I was in Washington D.C. about three years ago…They run those commercials about the polar bears not having any ice, and I had someone from Greenpeace come up and tell me that the polar bears were going to run out of habitat unless I donated money. I know back in the 14 and 1500’s there was a period of time when it was warmer than normal, which lead to a lot of population growth, which also I think might be part of the reason we had the industrial revolution, but I’m not entirely sure…and…um…I think it would be silly to think that there is no such thing as climate change and we are not effecting the environment, that we can just spew crap into the environment and its not going to change anything. On

the other hand, I think the doomsday stuff might be a little overzealous. I also think that the one good thing about awareness is that it is going to make us have more green technologies, which will lead to economic growth…but that's my economist talking…You hear a lot about all of these animals that were going extinct when I was little, like the bald eagle and stuff, and due to conservation they've come back. So, hopefully, that's something we can kind of keep doing, even as climate change removes habitats, not let species go extinct…It's one of those things people will kind of like joke about…that sounds bad…but, its one of those, it's like politically polarizing…so, the extent to which I discuss climate change is making…jabbing at other peoples political values...

Appendix L

Beth's Synthesis for Meaning Examples

For instance, when first reading about recycling, Beth skimmed an Ohio DNR page. She read"...benefits of recycling...reduces waste...recycling is a big business in Ohio...also supports the many companies and employees doing this work," said "so, they are actually making an economic argument for recycling..." and noted "Recycling can be a business" while commenting "although, I'm kind of disagreeing 'cause a lot of stuff isn't cost effective to recycling." Though the synthesis for meaning is simple in this case, Beth, like Olivia, did engage in high level reading skills. In this case, she utilized summary of the main ideas (i.e., that they are making an economic argument) and questioned the text.

Beth also spent time skimming an article from the *US News and World Report* citing research about why some people go green and others don't. She read

> some review out of Stanford said a third of US consumers are ready to buy green products...um...they aren't sure what makes someone a green consumer...let's see...book argues that political affiliation has very little to do with consumer decisions...um...and its largely determined whether you consume green products based on personality traits, not political beliefs...(she says "now that's interesting")...um...now let's see...people bought considered their personalities and habits...each survey questions...("they wrote a survey")...they asked people questions about whether or not they slow down for yellow light to see how risk averse they are...blah, blah, blah...about personality...Idea consumer...green consumers not only buy stuff, but they also buy ideas...most consumers daily purchases aren't motivated by ideology...um...let's see...buying a Prius often says

> something about the buyer that he or she is concerned about gasoline consumption...for green consumers, that ideological benefit of the purchase often outweighs the practical benefit...um all right...certain intangible parts of a purchase are more important than the product practical use...huh...OK...so altruism...people who donate blood are regularly give to charity are more likely to be green consumers...um...time minders...they balance short-term and long-term costs and benefits...yeah..all right...um...[clicks to next page]...green consumers, they tend to think much more about the future.

after which she said "so reasons to behave green" and noted "more future oriented." She read on "Me tooers...busy restaurant...indicates...if other people in their network go green, they're going to do it too so they're part of the team," and noted "other people are also doing it." In both cases of note-taking, Beth synthesized meaning from the ideas directly stated in the Web text. Of interest here is also what Beth did not explicitly synthesize for meaning. The idea of altruism is a powerful reason for people to "go green" or act in ways that might lessen climate change, but she did not directly indicate it was important to her or synthesized for meaning. Similarly, she "overlooked" the notion that broader personality characteristics are indicative of green behavior.

Appendix M

Beth's Insight Examples

First, Beth searched for [how to lessen climate change] and then selected an article titled "Reduce Effects of Climate Change." It was a paragraph of text followed by a list of twenty items. Beth read

> change light bulbs, already read that...use alternative methods of transportation, such as walking riding a bike, purchasing a hybrid vehicle or car pooling...design your own solar cooker...right...um oh, apparently my oven is horrible and energy wasting, this web site sounds biased...stop purchasing bottled water...eat less meat...give rid of the excess concrete and plant trees...move into a smaller house...wash laundry in cold water and hang it to dry outside...that's not practical in Michigan in the winter...start a home business...pay your bills online

She then said, "well, people do that because it saves money and because its easier, so it's easier, pay bills online" while taking the notes "it's easier (pay bills online)." Before returning to the article, she looked over her notes and said "...lets see...reasons not to go green might be it changes stuff too much, which isn't a good way to put that, but people don't like change" while noting "it changes stuff too much (people don't like change)" and saying "which wasn't actually on any of the Web sites, it's just what my brain came up with." Beth returned to the article and read "purchase local food," saying "that's just yummy...it's yummy, is that a reason to go green? sometimes green products are higher quality...you can feel good about" while noting "higher/quality/you can feel good about it." She then said "personal opinion, not actually like from the Web site is people do this kind of stuff because they feel good about it." Beth returned a final time to the article and read "Live a simpler life...be creative with your trash...turn soup

tins into pen holders...give green gifts...use white vinegar for some of the cleaning" and said "I do that, I didn't realize it was a green habit...but, reason to do it...less chemicals..safer for pets" as she noted the latter two ideas.

In a similar way, a shorter list of ideas helped Beth make an insight later in the reading-to-learn task. In this second example, Beth searched for [can I lessen climate change] then selected a *Nature.org* page entitled "Climate Change: What You Can Do." She read one sentence from the first paragraph "small change in our everyday lives can make a big difference," and then the first sentence two paragraphs later, "climate change threatens natural communities and human-well being." Beth then scrolled and read a list of "Easy things you can do...travel light...teleconference instead of flying..." before she switched back to her notes and said

> Reasons people go green...is it reasons to go green or reasons people go green?
>
> New thought...people may accidentally do things that help lessen climate change without that being the motivation...i.e. hold teleconference because it is cheaper than flying to meet customer...motive is still profit not being green.

After noting this insight, she continued reading through the list, "recycle and use recycled products...inflate your tires...plant native trees...turn down the heat...act globally eat locally." Then, she switched to her notes and said "reasons people do not go green...they value diversity of choices, i.e., buy imported buy imported non-local food over buy local." Neither the notion of accidental green behavior or valuing diversity was explicit or implied in the current or previous Web text(s). Like the list discussed above, the one is not about "why" people make decisions to do these activities, and that slight difference from her topic may have promoted insight more that an article with "the answer" to her question.

In a third example of insight from Beth, she skimmed an opinion article on *associatedcontent.com* from Yahoo, reading "going green meant growing vegetables, turning off light when you left the room. Now you have to have cleaner burning fuels..." She scrolled down and laughed, saying "Her first question is what will you use to line trash cans? She says she switched to reusable grocery bags and then she realized she didn't have small trash bags for the bathroom trash can." Beth read on, "How strong are you really? Ah, reusable shopping bags are heavy...this article should be why you shouldn't use reusable shopping bags...How much laundry do you want to do? um...cloth napkins an placements." She then said "let's see...pros and cons...reasons not to go green..." and noted/said "unsure tradeoffs are worth the hype (i.e., use more water by using cloth instead of paper may not be worth it if you only use paper rarely)." Though this insight results from reading about cloth napkins, the concept of tradeoffs was traced to several ideas from previous resources. When discussing and repurposing ideas about money only ten minutes earlier, Beth identified both that money can be saved by going green and be a reason people don't (e.g. because organic foods are more expensive). And, only a minutes prior, she had read the list of 20 ways to reduce the effects of climate change, many of which could involve tradeoffs (e.g. eating less meat, living in a smaller house, purchasing local food, taking shorter/colder showers).

Finally, similar to Olivia, Beth also experienced insights in the middle of synthesizing other information for meaning. As noted above, as she read a *Washington Post* article, Beth synthesized information about fads and morals from the Web text. At the same time, just after taking her notes about the faddish nature of green behavior, Beth stayed on the notes page and added a repurposed idea about economic growth. She returned to the *Post* article for one second before saying "Oh, another reason to go green...for future generations...although

nothing's actually said that, I don't know where that came from...I think he's going to argue that, though," as she added "for future generations" to her notes.

Appendix N

Beth's Reinforcement Examples

When Beth first encountered the idea of changing light bulbs to save energy, it was as part of a long list of ways to save energy. Her reading strategy on the page was primarily to read the paragraph headers and then move on, such that in reading the text in Figure 4, she read "seal up the house" made some comments about how she should do that in her own apartment, and then read "avoid chores...change light bulb." In reading only the headers, Beth reduced the potential benefits of context, perspective, etc. To make things worse, the second time she saw information about energy saving light bulbs, the text was in list form without any supporting text. When she saw this idea the second time, Beth just said, "I've already read that." The third time she saw this idea, it was again structured like figure 5, with a short bolded title and text following each bullet. Her response here was much the same as she read the headers "change 5 lights...look for energy star products...heat and cool smartly..." and then said, "these are all the same." However, upon closer examination of the text after the "change 5 light" header, it talked about how if every household in the US changed five bulbs, greenhouse gasses equivalent to 10 million cars would be reduced. The new perspective of collective action was available and might have lent more weight to the idea of energy saving light bulbs for Beth, but her reading strategy did not allow for this.

She also reinforced her own insight about people going green for "future generations" in an article later on when she read "to ensure the bright future of our children." She commented, "see, I already had that one" with a positive affect that may have been beneficial motivationally. Similarly, she read the item "to reduce pollution" and said, "I already talked about chemicals." However, in both cases due to the list-like structure of the new text (see figure 5), very little in

the way of new context or perspective was immediately available. What is different about this list is that each item is itself a hyperlink. Both the link about the bright future for our children and reducing pollution linked to much longer articles about those topics that did provide new contexts and perspective that could have provided that these opportunities for reinforcement that was elaborative and generative.

Later, when reading about the top five reasons to go green besides climate change, she read "you save water...water is no longer cheap" and commented, "they are making the economic argument again." This provided a reinforcement of the "economic argument" in a new context of water prices. Similarly she read later on from the same page "recycling benefits...what are the changes we will need...clear up your storage and make money off recycling...it also means that the product is being constantly utilized reducing carbon footprint." Thereafter, she said/noted "can make money/decrease stress by getting rid of unwanted stuff." In this latter case, Beth's ideas about recycling were reinforced, but also lead to an insight (about decreasing stress). The structure of this page was the same as those in figure 4, bolded section titles followed by a paragraph of text for each item. However, for both water and recycling on this page, Beth read beyond the header and was able to facilitate elaborative reinforcement and even an insight, by reading more deeply into the Web text.

Appendix O

Beth's Creative Synthesis #1

One of the differences between Olivia and Beth's reading-to-do tasks was how each started out. While Olivia did not use the Web for almost five minutes, Beth started out by re-reading the task instruction, saying "luckily I just read a whole bunch of ways to do that, for the most part" and then transitioned right away to a search for [how to lessen effect of climate change]. This was a search phrase she used in the reading-to-learn task, and led her to select an article listing 20 things a person can do to reduce the effects of climate change that she had visited earlier. She scrolled up and down this list for 10 seconds without saying anything, returned to her notes, and then commented,

> So, for college students, I personally think the best angle is something along the lines of like 'it's good for you too.' Going back to our earlier conversation, you know, they're most likely to accidentally do it, by saving money. It doesn't have to be expensive...(wrote "it doesn't have to be expensive" in college student section of reading-to-do notes)...individuals with strong religious affiliations...I think it's easier to go with (switched to notes from first session) the...see that's hard cause everyone already does that it's God's kingdom or whatever stuff...OK...um...let's see...(scrolled up and down in her notes from the reading-to-learn task and read)...for future generations...(switched back to notes from second session and wrote "for future generations" in the religious section)...cause going back to that one article I read...if I can find it (looking through history of browser)...there was that one article about altruism...and (clicked on show all history for browser)...um...(read titles from history)...why I won't not go

green...peer pressure plays a key role...it was this one, the US news and world report...why some people go green and others don't...um...edit find...I don't remember if this actually talked about...it didn't actually talk about (searched the page for "relig" and it was not found) religion...(change page search to "Christian") nope it didn't actually talk about Christianity either...and yes I know I'm assuming by religious you mean Christian...um all right...let's see...me-too'ers...I need to go back a page (history link in browser had taken her to the second page of this article)...(as the first page loaded) so I feel like the religious people...hurry up Internet...hurry up Internet...(after 15 seconds the page did not lead and she returned to her reading-to-do notes)...OK...um...the future generations...(read from the task instructions) hear any thoughts you have...your ideas should be new and creative...they should be backed up with some evidence...potential to be successful strategies...so evidence...this Web site that won't load...oh (as she recognized it is now loaded in another tab)...there we go...all right...so it talks about why people decide to make the decisions they do (while copying and pasting the URL from this article to her reading-to-do notes under "evidence")...um...all right...back to this article...OK...so it's based more on personality traits than political belief...so...idea consumers...green consumers...altruism...I don't know that religious people are necessarily more altruistic than other people...all right...um...so I feel like that's a generalization...but...(returned to her reading-to-do notes) for future generations...call on altruism...(added "call on altruism" to the same line as future generations in religious section)...college students...it doesn't have to be

expensive...making environmentally decisions can save money (said and added to notes under college students)...I'm stuck on this high socioeconomic status thing...all right...let's just stick with the other two...see, I don't know, I'm arguing with myself...cause strong religious affiliation doesn't have to mean Christian, so you don't want to, like, quote the bible or anything...but then there are all those Bible verses that are good for this...but then, it's like, I don't know…all right...back to college students, we'll do that...um...future generations (noted under college students)...chance to make a difference (noted under college students)...could be this generation's social movement (noted under college students)...that idea came from the *Washington Post* civil rights type article...which I need to find...history...show all history...um...*Washington Post...Washington Post...*going off that because I can't find it (clicked on a different article from the reading-to-learn task about peer pressure)...peer pressure plays a key role...(scrolled up and down)...so...um...greenwash, I didn't see that last time I looked at this...the idea of sustainability can be a remarkably effective way of shifting patently unsustainable goods (from text)...what am I doing...(read from task instructions) creative ideas about how to persuade...(clicked back to session two notes)...so...(read from notes)...chance to make a difference...for those with high socioeconomic status...going back to my pros and cons (switched to notes from first session, scrolls to "reasons to go green" section)...OK...so...I'm going to pull on something that I didn't read on the Internet...which is like the idea that people want to be like kind of near the first to adopt new stuff, and have new stuff, if that makes sense...so...in some way you have to make it like be a

trendsetter type thing (noted ‘be a trendsetter’ in high SES section)...um...it’s responsible (noted ‘it’s responsible’ in high SES section)...um...(read from notes)...for future generations, call on altruism...(switched back to reading-to-learn notes)...all right...Google...(opened Google page)...

Appendix P

Beth's Creative Synthesis #2

Beth's second creative synthesis occurred during a period of time between minute 10 and minute 20 in her reading-to-do task. During this time she started by searching for [marketing green products to upper class], but expressed her disappointed in the results. As she looked at the first page of results she said "this isn't helpful...plus I want creative ideas, I don't want to read what everyone else has done..." The first selection she made was based on a title "who are the green consumers and what to they want?" which took her to *essaymanina*, a place that writes paper for students, about which Beth was not happy. She then selected an article about "green branding," which was a research paper she deemed too long to read. Her final choice from this search was for the article "How to Read Green Consumers - Using Psychographics to Define Your..." which took a long time to load. After waiting 17 seconds, the page had still not loaded, and she said "all right, going back to marketing plan" (her reading-to-do notes). The following creative synthesis then occurred

> All right, so (said/wrote) What I see for the religious people, is a poster of something with beautiful landscape…and…something implying God's planet and then somehow connecting this poster with the idea of preservation and perhaps a list of ways to make more earth conscious decisions...enforce the idea that making sustainable decisions will be good... connect with possible bible verses and just make making good decisions re: climate change "feel good"...um...college students...what I see: not emphasizing that everyone is doing is, make it a personal decision type thing...imply that its good, but focus more on economic aspects, saving money, and ability to bring about change/help others...(read) a

change to make a difference...(said/wrote) help poor who will be most affected...(read) be a trendsetter, be responsible for the high SES...(said/wrote) emphasize plight of those in poverty...(said/wrote) Make it seem charitable and visible...(said) my biases are showing here...so... (said/wrote) what I see, simple, classy, emphasize how a small change can make a big difference...don't recommend moving into smaller house...(said) like that one Web site suggested...emphasize health benefits...that could probably go up here in college, too...emphasize health benefits...I don't know why I don't think religious people want their health benefits emphasized, but I don't...(switched to reading-to-learn notes, read)...reasons people don't go [green]...counteracting those...um...let's see...(looking over reading-to-learn notes)...it changes stuff too much...emphasize small change can have a big impact...(said/wrote in SES section of reading-to-do notes) small changes can have a big impact...(back to reading-to-learn notes, read)...unsure if tradeoffs worth the hype...(said/wrote in reading-to-do notes under high SES) if possible provide data...showing potential impact (but for what actions?)...um...let's see (looking over reading-to-do notes)...(read) individuals with strong religious affiliations...(said/wrote) good for you, now...um...(read) emphasize health benefits...doesn't have to be expensive...(said/wrote) for example insulting or turning off light saves money...eating less meat saves money...(read)...future generations...(said/wrote after health benefits for college students)...biking/walking versus driving...(said/wrote in high SES section) emphasize helping others...

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