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The Interplay of Reader Goals, Working Memory, and Text Structure During Reading

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Abstract

In the current study we examined the complex interactions of instructional context, text properties, and reader characteristics during comprehension. College students were tasked with the goal of reading for study versus entertainment (instructional context) while thinking-aloud about four different expository text structures (text properties). Working memory also was assessed (reader characteristics). Reading goals and working memory interacted to influence paraphrasing and non-coherence processes when thinking aloud. Reading goals, working memory, and text structure all interacted to influence text-based inferences. Text structure also influenced knowledge-based inferences. Post-reading recall was highest for those with the instructional goal of reading for study (compared to entertainment), as well as for problem-response and compare-contrast texts (compared to descriptive and chronological texts). Implications of the findings are discussed.

Keywords

comprehension; reading goals; working memory; text structure; think-aloud

1. Introduction

Reading and comprehending texts is one of the principal modes by which individuals learn. In many settings, such as in school, at work, or when reading magazines and newspapers, it is critical to develop a coherent understanding of what texts convey (Kirsch et al., 2002). In these contexts, texts can be structured in many different formats, such as historical timelines, instructions for constructing various objects, editorial pieces that offer potential solutions to a problem, comparisons of different concepts, or descriptions of scenes (Geiger & Millis,

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2004; Meyer, 1984). In addition, readers approach texts with different goals and skills (Linderholm, Cong, & Zhao, 2008). All of these factors co-determine successful understanding of the information being put forward by the text (van den Broek & Kremer, 1999).

Reading comprehension, in turn, depends on the successful execution and integration of many processes (Goldman & Bisanz, 2002; Jenkins, 1979; van den Broek, 1994; van den Broek, Virtue, Gaddy, Tzeng, & Sung, 2002). Readers encode information from the text to build a mental representation of what the text is about (Gernsbacher, 1990, 1997; Kintsch & van Dijk, 1978), make inferences to connect different parts of the text (Graesser, Singer, & Trabasso, 1994; Zwaan & Radvansky, 1998), and activate background knowledge to explain textual information (Best, Floyd, & McNamara, 2008; van den Broek & Kendeou, 2008). It is critical to understand the factors that can influence these processes in order to understand everyday reading activities, improve comprehension, provide appropriate text structures and settings, and assist individuals with reading difficulties.

Although a variety of variables can individually influence comprehension (i.e., a reader might engage in different strategies when reading a novel compared to a science textbook), real-world settings are often complex, and contain many variables that dynamically influence one another (Alexander, 2012). For example, a reader with test anxiety may struggle in high-pressure situations regardless of the type of text. This same reader may thrive in more relaxed environments, but only when reading novels. In contrast, another reader may be motivated to perform well in high pressure testing situations, but only when reading historical fiction. Thus, understanding interactions between multiple variables could help to establish settings that optimize comprehension. In an attempt to synthesize the large number of factors that can influence comprehension, van den Broek and Kremer (1999) proposed three overarching factors that can individually and interactively affect comprehension processing: characteristics of the reader, text properties, and the instructional context in which reading occurs. Likewise, several other frameworks advocate the importance of studying interactions between the reader, task, and text (Kirsch et al., 2002; Rapp & van den Broek, 2005; Snow, 2002).

Understanding such interactions and their influences on reading comprehension is also important for current theories and models of comprehension. Among these models, the construction-integration (CI) model (Kintsch, 1998; Kintsch & van Dijk, 1978) makes explicit assumptions about how the information in a text and a reader's background knowledge interact and combine to form a coherent representation of the text in a reader's memory. In the context of the CI model, background knowledge is portrayed as an associative network of concepts and propositions, whereas frames of reference and reading goals represent global knowledge structures reflective of the context. According to the CI model, comprehension involves two steps: construction and integration. In the first step, readers construct a mental representation of the text from textual information and the activation of related background knowledge. In the second step, textual information and activated background knowledge are integrated in the mental representation (what is termed as the situation model) while irrelevant or contextually inappropriate information is deactivated and falls out of the mental representation (Kintsch, 1988).

In the CI model, the text drives the activation of information during the construction process via associative priming. However, a reader's prior knowledge also influences activation and integration processes. Finally, task demands and reading goals can also influence activation and integration by shifting a reader's attention during reading to task relevant information. Thus, the CI model accounts for multiple interactions during reading: information contained within the text, a reader's background knowledge, and the context (which includes task demands and special reading goals; Kintsch, 1988).

Consistent with the CI model, the Landscape model (van den Broek, Risden, Fletcher, & Thurlow, 1996) also posits that the activation levels of text concepts fluctuate as a function of the current text and the reader's background knowledge. An additional component this model proposes is the reader's standards of coherence. Standards of coherence are criteria for comprehension the reader sets explicitly or implicitly over the course of reading; these standards are influenced directly by the reading context and goals (van den Broek, Bohn-Gettler, Kendeou, Carlson, & White, 2011; van den Broek, Risden, & Husebye-Hartmann, 1995).

Although the aforementioned models of text comprehension advocate for the importance of examining multiple factors, only a few studies have empirically examined interactions between more than two variables (van den Broek, Rapp, & Kendeou, 2005). Examining interactions between the reader, text, and task can yield important, and sometimes surprising, findings. For example, McNamara and colleagues examined the interaction between text difficulty and reader knowledge (but did not account for the instructional context). These studies revealed what has been termed the "reverse cohesion effect": When text cohesion varies (i.e., either high or low cohesion) readers with low prior knowledge of the content demonstrate better comprehension for high cohesion texts. However, readers with high prior knowledge of the content demonstrate better comprehension and improved processing for low cohesion texts, presumably because the readers are forced to generate connections between text concepts that are left to be inferred (McNamara, 2001; McNamara, Kintsch, Songer, & Kintsch, 1996; O'Reilly & McNamara, 2007). These findings not only demonstrate the importance of examining interactive effects but also have the potential to improve reading comprehension. Because a wide body of research focuses on only one or two factors, more work is needed to understand the dynamic relations between the reader, the text, and the task (Alexander, 2012; E. Fox & Dinsmore, 2009).

The primary aim of the current study is to systematically examine the interactive contributions of these three factors during comprehension in an effort to better understand how readers learn from texts in naturalistic settings. To accomplish this aim, we asked readers to think-aloud while reading expository texts, and we manipulated different components of the text and context. With respect to text properties, we focused on text structure; with respect to instructional context, we focused on reading goals; and with respect to reader characteristics, we focused on one important source of individual differences, working memory. We hypothesized that the instructional context (whether a person is reading with the goal of studying versus being entertained), text structure (when reading compare-contrast, descriptive, problem-response, and chronological texts), and

working memory would individually and interactively influence the moment-by-moment processing of expository texts.

In the current study, we chose to manipulate just one aspect of each factor in order to begin the systematic documentation of these complex interactive effects. Furthermore, because of the complexity of these interactions, we opted to utilize manipulations shown to be successful in previous research. In this way, we could replicate and extend prior work to understand better specific interactions between the reader, the text, and the instructional context in which reading takes place. In the following, we first briefly review evidence documenting the influence of the specific factors we considered in the present study. Second, we present the specific hypotheses of the study and our methodological approach.

1.1. Instructional Context: Reading Goals

Goals can encourage readers to focus their attention on specific textual information or to adopt general processing strategies (Anderson & Pichert, 1978; Kaakinen & Hyönä, 2005; McCrudden & Schraw, 2007; Rothkopf & Billington, 1979; van den Broek, Risden, Tzeng, Trabasso, & Basche, 2001). The current study is motivated by previous work in which college-aged students were instructed to read a text with the general goal of studying for an essay exam or browsing through a magazine for entertainment. These goals represent common approaches to reading, and are distinct from one another in that they elicit different types of processing during comprehension (Horiba, 2000; Linderholm et al., 2008; Linderholm & van den Broek, 2002; Lorch, Lorch, & Klusewitz, 1993; Narvaez, van den Broek, & Ruiz, 1999; van den Broek, Lorch, Linderholm, & Gustafson, 2001).

Indeed, empirical evidence from a variety of different methodologies documents how the processes that occur during reading vary as a function of these goals. When thinking aloud during reading of expository science texts, college-aged readers tasked with the goal of studying have better memory for the text and engage in processes that enhance comprehension, such as paraphrasing, connecting textual information, and incorporating background knowledge to explain the text. In contrast, when tasked with the goal of being entertained, college-age readers have decreased memory for the text and engage in processes that do not necessarily enhance comprehension, such as making associations with background knowledge that were not related to understanding the text, or providing opinions that did not further their understanding of the text (Geiger & Millis, 2004; Linderholm & van den Broek, 2002; van den Broek, Lorch, et al., 2001). Therefore, asking college students to read with different goals can directly influence comprehension processes and products.

1.2. Reader Characteristics: Working Memory

A variety of reader variables can affect comprehension processing, such as age (Bohn-Gettler, Rapp, van den Broek, Kendeou, & White, 2011; Cain, Oakhill, & Lemmon, 2004; Daneman, Hannon, & Burton, 2006; Nation & Snowling, 1999), prior knowledge (Braten & Samuelstuen, 2004; Fincher-Kiefer, 1992; Kendeou & van den Broek, 2007; McKeown, Beck, Sinatra, & Loxterman, 1992; McNamara, 2001), and working memory (Daneman & Carpenter, 1980; Just & Carpenter, 1992). The current study focused on working memory, which refers to an individual's capacity to manage and manipulate multiple pieces of

information in memory. Working memory is related to successful text comprehension (Daneman & Carpenter, 1980; Just & Carpenter, 1992; Kintsch, 1998; Kintsch & van Dijk, 1978), and specifically to successful comprehension of expository texts (Britton, Stimson, Stennett, & Gulgoz, 1998).

Importantly, working memory is related to the degree to which readers adjust their processing and focus attention as a function of reading goals. High working memory readers are more likely to focus on text information that is consistent with their reading goals or perspectives in comparison to their low working memory counterparts (Kaakinen, Hyönä, & Keenan, 2003). In addition, high working memory readers are better able to strategically adjust inferential processing to align with their general reading goal of studying versus being entertained (Linderholm & van den Broek, 2002).

1.3. Text Properties: Structure

The current study examined the role of structure when comprehending expository texts. Expository texts provide factual information (Brewer, 1980; Wolfe, 2005), tend to be hierarchically organized around a global topic, and contain several subtopics related to the global topic (Hyönä, Lorch, & Kaakinen, 2002). We examined four specific expository text structures often found in college-level textbooks (Meyer, 1985): Compare-contrast, chronological, problem-response, and descriptive. Compare-contrast texts relate ideas to one another on the basis of similarities and differences. Chronological texts report events in chronological order, but do not necessarily specify causal relations between the events. This is often a series of sentences in which a date is provided, followed by a description of an event that occurred on that date. Problem-response texts present some type of problem, and then describe a potential solution (or solutions) to that problem. The solutions provided are explained with direct connections to the main problem. Finally, descriptive texts provide attributes and details about a location or item.

These various text structures have differential effects on comprehension. Compared to the other structures, descriptive texts tend to be the least organized and are the most associated with memory deficits (Graesser, Leon, & Otero, 2002; Meyer, 1975, 1985; Meyer & Freedle, 1984; Wylie & McGuinness, 2004). Findings regarding the other text structures are somewhat mixed, with most showing improved memory for compare-contrast and problem-response texts because they are the most organized (Meyer & Freedle, 1984; Wylie & McGuinness, 2004). This is consistent with research indicating that texts that are organized in a clear, logical manner are high in cohesion and thus easy to comprehend (Baker & Brown, 1984; Geiger & Millis, 2004; Lehman & Schraw, 2002). Furthermore, these text-structure driven effects persist when tested in a variety of contents, suggesting that the structure of the text itself, not the content, is driving these findings (Meyer, 1975; Meyer, Wijekumar, & Lin, 2011; Meyer et al., 2010).

1.4. The Present Study

The present study sought to document potential interactions between the reader, the text, and the instructional context. Examining such interactions could provide valuable information about how readers come to understand and learn from texts in naturalistic settings, as well as

add to theoretical models of comprehension. Because what happens during moment-by-moment reading has been found to be related to post-reading memory (e.g., Goldman & Varma, 1995; van den Broek et al., 2005; Zwaan & Singer, 2003), it is important to consider both processes and products when examining the interactive contributions of reader, text, and task instructions.

To assess moment-by-moment processing we utilized the think-aloud methodology (Ericsson & Simon, 1993; Trabasso & Magliano, 1996). During think-aloud tasks, individuals read a text while verbalizing their thoughts after each sentence. These verbalizations can provide a measure of the actual cognitive processes readers engage in during comprehension (Fox, Ericsson, & Best, 2011). Although the think-aloud methodology can introduce task-level factors that can influence reading processes (Magliano & Graesser, 1991), under certain conditions these influences can be minimized. For example, by providing general prompts, think-alouds can reveal when readers rehearse text, generate intertextual connections, make connections with background knowledge, provide opinions, and react to the text in a variety of ways. As such, it enables the direct examination of readers' cognitive processes during reading and thus served as the preferred method for the current study.

To assess post-reading memory, we asked participants to provide a summary for each text. Summaries are useful because they provide an index of participants' ability to identify the main ideas, which is a reliable indication of overall comprehension (e.g., Hyönä et al., 2002; Lorch, Lorch, & Inman, 1993; Taylor, 1984).

In summary, the present study assessed the different think-aloud processes readers engaged in as a function of reader characteristics, the instructional context, and text structure. Specifically, participants with high and low working memory thought aloud about expository texts of different structures, while keeping in mind the reading goals of studying versus being entertained. They also summarized the text after reading it.

1.5. Hypotheses

The aim of the current study was to examine the potential interactive influences of the reader, text, and task while college-age students read expository texts and thought-aloud. Our primary hypothesis was that readers' working memory, whether they were reading for study versus entertainment, and text structure (compare-contrast, descriptive, problem-response, and chronological texts) would interactively influence the moment-by-moment processing of expository texts. This hypothesis not only seeks to replicate previous findings, but it also extends the extant literature.

1.5.1. Replication—With regard to replication, we made several hypotheses, each of which were consistent with current models of reading comprehension (following the CI and Landscape models). In the current study we manipulated the task environment by asking readers to approach the text with the general goals of studying versus being entertained. We anticipated that even though in both instances readers would strive to build a coherent understanding of the texts, the criterion for that understanding would differ depending on the goal. Specifically, constructing a deep and long-lasting understanding of the text is

necessary for test performance but not for being entertained. Thus, cognitive processes reflective of deep processing should be more evident in the study condition. This could come in the form of making inferences to connect information within the text and with relevant background knowledge, as well as paraphrasing (that typically serves as the “stepping stone” for inference generation; McNamara, 2004). Thus, we hypothesized that readers given an explicit goal of reading for study would engage in more coherence-building processes and would have better memory for the text than readers given the goal of reading for entertainment (consistent with van den Broek, Lorch, et al., 2001).

It is important to note that in this study we considered paraphrasing as a coherence-building process (consistent with van den Broek, Lorch, et al., 2001) because it can improve comprehension in at least two ways: (a) paraphrasing may help to improve readers’ memory and understanding for the current sentence through verbalizing the meaning of the sentence in their own words (Coté, Goldman, & Saul, 1998; Keenan, Baillet, & Brown, 1984; Trabasso & Magliano, 1996), and (b) paraphrasing builds the foundation for more complex processes to follow, such as inference generation (McNamara, 2004; van den Broek, Lorch, et al., 2001). However, it is also possible that paraphrasing may do little to improve comprehension because it may serve as a replacement to making connections between different components of the text (Magliano & Millis, 2003; Millis, Magliano, & Todaro, 2006).

Second, because the limited capacity of working memory varies between individuals and working memory is critical during the construction and integration of information during reading (following both the CI and Landscape models), we hypothesized that high working memory readers would be more likely than their low working memory counterparts to adjust processing as a function of reading goal (consistent with Linderholm et al., 2008; Linderholm & van den Broek, 2002).

Third, because text content also influences the construction and integration of information during reading (following both the CI and Landscape models), we anticipated that processing may vary as a function of text structure. More specifically, we hypothesized that that the compare-contrast and problem-response texts, compared to descriptive and chronological texts, would be associated with more coherence-building processes and better memory for the text (consistent with Meyer & Freedle, 1984).

1.5.2. Extension—With regard to extending previous work and examining possible interactions, several potential hypotheses are in order. It is important to note that even though these hypotheses have been informed by previous research to some extent, they remain exploratory in nature and rather broad. This was necessary considering the limited number of studies in the literature addressing three-way interactions between the reader, text, and task factors.

First, previous work indicates that readers with high working memory have enough mental resources to allow them to adjust processing as a function of reading goals (Linderholm et al., 2008; Linderholm & van den Broek, 2002). This cognitive flexibility may likewise allow readers to adjust their processing also as a function of other factors, such as text structure.

Therefore, we hypothesized that high working memory readers would be most likely to adapt their processing as a function of text structure when compared to their low working memory counterparts.

Furthermore, reading for study is associated with the utilization of processes intended to improve comprehension (van den Broek, Lorch, et al., 2001). Previous work also suggests that teaching students to modify their reading behaviors as a function of text structure can improve their comprehension (Meyer, Brandt, & Bluth, 1980; Meyer & Poon, 2001; Meyer, Young, & Bartlett, 1989). Because environments oriented towards study are linked to utilizing strategies that improve comprehension, we hypothesized that adaptations of processing based on text structure would be most likely to occur when reading for study (as opposed to reading to be entertained). However, only readers with high working memory adapt processing as a function of instructional context (Linderholm & van den Broek, 2002), thus we hypothesized that readers with high working memory, when reading for study, should be most likely to adapt processing as a function of text structure.

Second, previous research provided evidence for the reverse cohesion effect, in which readers with low background knowledge benefit from more cohesive texts, whereas readers with high background knowledge benefit from less cohesive texts (McNamara, 2001; McNamara & Kintsch, 1996). A second hypothesis might be that, similar to the reverse cohesion effect, low working memory readers will benefit from more structured texts, whereas high working memory readers will benefit from less structured texts. Furthermore, this could vary as a function of the instructional context because context poses different constraints to readers. For example, readers with low working memory may particularly benefit from highly structured texts, but only in study environments that facilitate coherence-building processing and memory. Alternatively, such study environments can invoke stress and anxiety among readers with low working memory, placing additional load on these readers' already limited cognitive resources, impeding coherence-building even when reading more organized texts.

Of course, the possibility exists that no three-way interactions will emerge. Although we intend to replicate the finding that reading goals interact with working memory to affect processing, it is unknown whether this will vary as a function of text structure. Most research examining text structure examines main effects or two-way interactions. In fact, to our knowledge, although teaching students to adapt processing as a function of text structure is associated with improved comprehension (Meyer & Poon, 2001), readers may not spontaneously do so as a function of reading goal. Thus, it is possible that text structure elicits the same pattern of processing among diverse readers in a variety of settings.

1.6. Methodological Approach

To assess moment-by-moment processing of texts during reading we used the think-aloud methodology. Traditionally, two different approaches have been utilized for thinking aloud about texts. One approach allows participants to choose when to think-aloud during reading, whereas a second approach guides participants to think-aloud at specific points in the text. The first method is used primarily to assess global problem-solving strategies, whereas the second method is used to assess primarily the construction of a mental model (Ericsson &

Simon, 1993; Pressley & Afflerbach, 1995). In the current study, we were interested in examining how think-aloud processes were generally invoked during mental model construction, rather than focus on specific types of problem-solving or metacognitive strategies. Hence, we adopted the second method and prompted readers to think-aloud after each sentence in an effort to track their moment-by-moment processes during the construction and integration of information over the course of reading.

2. Method

2.1. Participants

In the present study, 83 native English-speaking undergraduates in introductory psychology classes participated in exchange for course credit. We examined college-aged readers because such individuals have been exposed to various texts in science, history, English, and other coursework and thus have developed sensitivity to different expository text structures.

The data from 10 participants were not included in the analyses because of inaudible voice recordings, technical malfunctions, or inattentive participation. Of the remaining participants, there were 13 males, 55 females, and 5 who chose not to report their gender. The average age was 19.44 years ($SD = 2.87$). There were 50 Caucasian, 5 African American, 3 Hispanic, and 9 Asian participants, as well as 6 participants who did not specify their ethnicity. On average, the number of years they had spent in college was 1.73 ($SD = 1.03$).

2.2. Materials

2.2.1. Working Memory—The participants completed the reading span task of working memory (Singer & Ritchot, 1996) that was adapted from the original version by Daneman and Carpenter (1980). In the task, participants read several sets of unrelated sentences on a computer screen. Participants began with smaller sets of sentences (three sets of two sentences each) and proceeded sequentially to larger sets (three sets of five sentences each). After reading each set of sentences, participants were asked to recall the last word of each sentence in the order originally presented. After recalling the last word of each sentence, participants were then presented with one of the sentences from the set with two words missing, and were asked to fill in the correct words. A participant's final score was calculated as the total number of end-of-sentence words correctly recalled in the sets for which the fill-in-the-blank question was answered correctly (i.e., Friedman & Miyake, 2005). Research indicates that span tasks have high reliability and validity. For example, reading span tasks are positively correlated with reading comprehension (Miyake, 2001; Waters & Caplan, 2003). Using the scoring method utilized in the present study, split-half reliability was .83, Cronbach's alpha was .84, and test-retest reliability was .80.

2.2.2. Texts—A total of 16 expository texts were used. The passages were adapted from frequently used textbooks in English literature and composition courses that provided examples of several different expository text structures (e.g., Clouse, 2002; Flachman & Flachman, 2002; Kennedy, Kennedy, & Aaron, 2003). The texts were chosen such that they represented topics for which readers would have general world knowledge about (i.e., the

basic differences between airplanes and helicopters). The purpose of selecting such texts was to avoid confounding prior knowledge. Within the 16 passages, there were four passages that represented each of the four most common text structures, as described by Meyer (1985): Compare-contrast, problem-response, description, and chronological. The participants read one text from each category for a total of four texts. The texts chosen, and the order in which the texts were presented, were counterbalanced across participants. The counterbalancing of the texts chosen and the text order served to reduce any potential confounds as a function of the text read. In addition, different texts were used within each text structure in an effort to increase the generalizability of the results, and avoid any text-specific (not structure-specific) effects. The average grade level of the texts was 9.7, and the average word count was 205.15. Each text was an average of 12.88 sentences long, and each sentence was, on average, 17.12 words long. Sample texts can be found in the Appendix. Although the texts were relatively short and simple, they were pulled from college level literature and composition textbooks, and thus represented texts that college students would typically encounter.

Following Meyer (1985), the compare-contrast texts described how two equally weighted topics were similar and different (comparing the features of helicopters versus airplanes, Robert E. Lee versus Ulysses S. Grant during the Civil War, sloppy versus neat people, and the lives of two children growing up in different countries). The average grade level was 8.6, and the average word count was 199.8. The problem-response texts first described a problem and then proposed a solution that had causal relations with the problem (reducing school dropout, creating national identity cards, reducing juvenile crime, and increasing the number of women in politics). The average grade level was 8.8, and the average word count was 204.0. The descriptive texts portrayed specific attributes about a physical setting (describing the condition of a trailer and its surrounding landscape, a cemetery in Haiti, a fruit orchard, and a grandmother's home). The average grade level was 8.5, and the average word count was 209.0. The chronological texts listed a sequence of events in chronological order; however, no causal markers linked the events (a listing of the events that led to the civil war, nuclear power, the personal computer, and racial integration in schools). This is consistent with Meyer, Young, and Bartlett's (1989) sequence texts. The average grade level was 13.0, and the average word count was 207.8. Text analysis using the Coh-Metrix tool (Graesser, McNamara, Louwerse, & Cai, 2004; McNamara, Louwerse, Cai, & Graesser, 2005, January 1) showed that there were no differences between the various text structures with regard to important text easability scores, including narrativity, word concreteness, referential cohesion, and connectivity (F -values < 3.03). There were also no significant differences between the various text structures on measures of referential cohesion, including noun overlap, argument overlap, stem overlap, and content word overlap (F -values < 3.26). Thus, Coh-Metrix measures indicated that the texts were relatively equivalent in terms of difficulty. Furthermore, the topics of the texts were selected so that they addressed common knowledge for college students in an effort to control for background knowledge.

2.3. Procedure

Following the consent process, participants completed the reading span task of working memory (Singer & Ritchot, 1996). Next, participants engaged in a practice think-aloud task

(e.g., Ericsson & Simon, 1993; Trabasso & Magliano, 1996). During the practice task, the experimenter explained and demonstrated the think-aloud procedure. After this demonstration, the participants practiced thinking-aloud with the remainder of the practice text. Participants were asked to read the text, one sentence at a time, with each sentence printed on a separate index card in a sorted stack. After reading each sentence aloud, participants were asked to state their thoughts out loud before turning to the next index card. The participants received no help with decoding words or answering questions about the text, but received non-leading prompts (e.g., “What are you thinking now?”) if they forgot to think-aloud.

The participants were randomly assigned to either a study or an entertainment condition and were tested individually. In the study condition, participants sat at a desk with textbooks displayed and were asked to imagine that they were preparing for an essay exam. In the entertainment condition, participants sat on a couch with magazines displayed on a coffee table in front of them and were asked to imagine that they were browsing through a magazine and had come upon an article of interest. These environmental conditions replicate the methods utilized in van den Broek, Lorch, et al. (2001).

The goal instructions were followed by the think-aloud task with four different texts: one compare-contrast, one descriptive, one chronological, and one problem-response. The text selection and order of the texts were counterbalanced across participants. The procedure for the think-aloud task was exactly the same as for the practice texts, with the exception that the experimenter did not demonstrate specific examples. Participants were reminded to read for study or entertainment before thinking-aloud about each text. The entire session was tape recorded and transcribed.

After thinking-aloud about all four texts, the participants were asked to verbally summarize each text in the same order in which the texts were read. Participants were provided with the title of each text prior to summarizing. The summarizations were tape-recorded and transcribed. The entire session, including consent, practice, goal assignment, thinking-aloud, and summaries, averaged 45 minutes in length; all participants finished within one hour.

2.4. Scoring of the Think-Aloud Data

Participants' responses to each sentence in the texts were parsed into events, which are generally defined as subject-verb phrases. Each event was scored into categories by four judges who had no knowledge of the experimental condition. These categories helped identify the type of process engaged in by a reader at the point in the text a particular comment was provided. Four raters trained on 20% of the transcripts until a 90% agreement rate was reached. Following that, 20% of the remaining transcripts were coded by all of the raters for reliability. Inter-rater agreement was $k = .83$. Disagreements between raters were resolved through discussion.

The categories of responses were adapted from those used by van den Broek and Lorch et al. (2001) and Bohn-Gettler and Rapp (2011), and included the following: associations (comments providing information not related to text coherence); elaborative inference/ explanations (comments employing background knowledge to explain the current text

sentence); connecting inference/explanations (comments mentioning an immediately preceding sentence to explain the current text sentence), and reinstatement inferences (comments mentioning information from earlier in the text, but not the immediately preceding sentence, to explain the current sentence). Connecting inferences were exclusive to local connections between adjacent sentences. However, reinstatement inferences were sensitive to distal connections (which are often predictive of comprehension, Magliano, Millis, Levinstein, & Boonthum, 2011). When a reinstatement inference was present, the raters would indicate which sentence the participant was referring back to. In addition, the categories of responses included several other processes, including predictive inferences (comments that anticipate the upcoming text); paraphrases (comments that capture the gist meaning of the current sentence); opinions (opinions about the text); and statements of uncertainty (comments that reflect that the participant did feel certain about the text, such as “I don’t know”). Non-responses and responses that did not fall into any of these categories were scored as other. In addition, if a participant made a comment fitting any of these categories that reflected a misunderstanding of the text, it was also coded as invalid.

The frequencies with which participants engaged in each type of think-aloud process described were calculated. These frequencies were then divided by the total number of think-aloud coded processes produced by the participant such that they were averaged into proportion data. Because the texts were not all of the same length, transforming the data into proportions was necessary for comparison. Because proportion data is often non-normal, an arcsine transformation was performed on all of the data. The think-aloud categories were then combined into two groups that represented *coherence-based* and *non-coherence-based* processing.

The first category was paraphrases. Paraphrases were considered a coherence-based process because they can help increase memory for the text. In line with this, van den Broek, Lorch et al. (2001) found that paraphrasing occurred more often when reading with a study goal compared to an entertainment goal.

The second category contained inferences that were focused on the text itself, which we termed text-based inferences, and included connecting and reinstatement inferences. These processes also were considered coherence-based because they have been found to be related to successful comprehension of a text, to better memory and to a more coherent mental representation of the text (Kendeou, Muis, & Fulton, 2011). In addition, they are found more often among individuals reading with a study goal (van den Broek, Lorch, et al., 2001).

The third category contained inferences that focused on the activation of background knowledge, which we termed knowledge-based inferences, and included elaborative and predictive inferences. Elaborative and predictive inferences are often explicitly associated with going beyond the information contained in the text (e.g., Graesser et al., 1994). Knowledge-based inferences are considered coherence-based because making these inferences contributes to the construction of a coherent representation of the text (Kendeou & van den Broek, 2005, 2007).

The fourth category contained responses that were not in the service of building coherence, which we termed non-coherence processes, and included associations, opinions, statements of uncertainty, and the other category. The associations included the activation of background knowledge that was not relevant to the text, and thus do not enhance comprehension. The statements of uncertainty were not metacognitive comments, as participants simply either generally stated “I don’t know” with no explanation, or “I don’t know [that word]” with no explanation. Thus, they were not indicative of any true monitoring of their understanding of the text. The “other” category constituted less than 1% of the data, so it was omitted from the analysis. See Table 1 for definitions and examples of each of the think aloud categories.

Pearson correlations between the arcsine-transformed proportions of the variables were computed (see Table 2). The correlation analysis was also conducted with the non-transformed scores, and the two sets of correlations demonstrated the same general pattern of results. To confirm these groupings, a confirmatory factor analysis was conducted using maximum likelihood estimation. The model had a good fit to the data: $\chi^2(15) = 7.20, p > .05$; root mean square error of approximation (*RMSEA*) = .04, Comparative Fit Index (*CFI*) = .96.

2.5. Scoring of the Summary Data

Each text was parsed into events to score the participants’ verbal summaries. An event was generally considered to be a subject-verb phrase (consistent with Kendeou, Bohn-Gettler, White, & van den Broek, 2008). Then, each participant’s summary protocol was also parsed into events and compared with the text to determine how many text events each participant recalled. A text event was credited as having been recalled if the participant recalled all or part of the event verbatim or if the gist of the text event was accurately reproduced. If a recalled event did not match an event in the text, it was coded as “other”. However, very low incidents of this occurred, and thus were not considered in the analyses.

In line with Lorch, Lorch, and Inman (1993), each participant was scored on the proportion of the total number of unique textual events recalled, which provided a measure of overall text recall. In addition, the main important ideas were also identified in each text, and the participants received a score on the proportion of important ideas that they included in their summary, as an index of comprehension. Two raters were trained on 20% of the transcripts until a 90% agreement rate was reached. Following that, 20% of the remaining transcripts were coded by both raters for reliability. The same two raters also identified the important ideas in each text. Inter-rater agreement was $k = .84$. Disagreements were resolved through discussion.

3. Results

3.1. Think-Aloud Processes

To examine the influence of instructional context, text structure, and characteristics of the reader on cognitive processes during reading, four 2 (condition: study versus entertainment, between subjects) by 4 (text type: compare-contrast, descriptive, problem-response, versus

chronological, within subjects) by 2 (working memory: high versus low, between subjects) mixed ANOVAs were conducted in which the dependent variables were each of the four categories of think-aloud processing (paraphrases, text-based inferences, knowledge-based inferences, and non-coherence processes). As described, because the texts were all of different lengths and participants provided different numbers of responses, the frequency of each think-aloud process was divided by the total number of processes produced by each participant. However, the resulting proportion data were positively skewed. Thus, an arcsine transformation was performed. The arcsine transformed proportion data, separated by condition, text type, and working memory (high versus low, determined by a median split) are presented in Table 3.

For the paraphrases, there was a main effect of text type, $F(3, 207) = 5.65, p = .001, \eta^2 = .09$ (see Figure 1). Post-hoc tests with the Bonferroni adjustment revealed that the problem-response texts elicited the least amount of paraphrasing relative to all other text types (t -values $> 2.94, p$ -values $< .005$). There were no main effects of condition or working memory (F -values < 2.26). However, there was an interaction of condition by working memory, $F(1, 69) = 5.32, p = .02, \eta^2 = .09$ (see Figure 2). Post-hoc Tukey tests revealed that readers with high working memory engaged in more paraphrasing in the study condition compared to the entertainment condition ($t(15) = 3.65, p = .02$). No such difference was found for readers with low working memory. There were no other statistically significant interactions (F -values < 1.77).

For the text-based inferences, there were no main effects (F -values < 1.85) or two-way interactions (F -values < 1.23). However, the three-way interaction was significant, $F(3, 207) = 3.30, p = .02, \eta^2 = .06$ (see Figure 3). Post-hoc tests with the Bonferroni adjustment revealed that the readers with low working memory, when in the entertainment condition, utilized different degrees of text-based inferences depending on the text they were reading. Specifically, low working memory readers in the entertainment condition utilized more text-based inferences when reading the compare-contrast texts in comparison to the descriptive ($t(10) = 4.12, p = .002$) and chronological texts ($t(11) = 2.29, p = .04$). This same group of readers also utilized more text-based inferences when reading the problem-response texts in comparison to the descriptive ($t(10) = 2.56, p < .03$) and chronological texts ($t(11) = 2.71, p = .02$).

For knowledge-based inferences, there was a main effect of text type, $F(3, 207) = 4.72, p = .003, \eta^2 = .07$ (see Figure 1). Post-hoc tests with the Bonferroni adjustment revealed that the problem-response texts elicited more knowledge-based inferences than all other text types (t -values $> 2.14, p$ -values $< .02$). The compare-contrast texts also elicited more knowledge-based inferences than the descriptive texts ($t(69) = 2.31, p = .02$). None of the other main effects were significant (F -values < 3.54 , although $p = .06$ for the main effect of working memory, such that readers with high working memory engaged in more knowledge-based inferences than readers with low working memory). Also, none of the interactions were significant.

For the non-coherence processes, there was a main effect of condition, $F(1, 69) = 4.75, p = .03, \eta^2 = .08$, such that participants in the entertainment condition engaged in more non-

coherence processes than participants in the study condition. None of the other main effects were significant (F -values $< .92$). The interaction between condition and working memory was significant, $F(1, 69) = 3.98, p < .05, \eta^2 = .07$ (see Figure 2). Post-hoc tests revealed that participants with low working memory did not engage in differential processing as a function of whether they were reading for study versus being entertained ($t(17) = .31, p > .05$). Participants with high working memory, however, engaged in more non-coherence processing when reading for entertainment versus study ($t(15) = 3.11, p < .05$). None of the other interactions were significant (F -values < 2.20).

3.2. Summaries

To examine the influence of instructional context, text structure, and characteristics of the reader on overall recall, a 2(condition: study versus entertainment, between subjects) by 4 (text type: compare-contrast, descriptive, problem-response, versus chronological, within subjects) by 2 (working memory: high versus low, between subjects) ANOVA was run, in which the dependent variable was the arcsine proportion of the total number of unique textual events recalled. The arcsine transformed proportion data can be found in Table 4.

There was a main effect of condition, such that participants who read for study remembered more than participants who read for entertainment, $F(1, 69) = 8.49, p = .005, \eta^2 = .10$. There was also a main effect of text type, $F(3, 177) = 11.11, p < .001, \eta^2 = .13$ (see Figure 4). Post-hoc tests with the Bonferonni adjustment revealed that participants recalled more information from the problem-response and compare-contrast texts in comparison to the chronological and descriptive texts (t -values $> 3.05, p$ -values $< .003; t(75) = 2.27, p < .03$ for the comparison between the compare-contrast and descriptive texts). There was no main effect of working memory. None of the interactions were significant.

Next, to examine the recall of the important ideas of each text, a 2(condition: study versus entertainment, between subjects) by 4 (text type: compare-contrast, descriptive, problem-response, versus chronological, within subjects) by 2 (working memory: high versus low, between subjects) ANOVA was run, in which the dependent variable was the arcsine proportion of the total number of unique important textual events recalled. The non-transformed proportion data can be found in Table 4.

There was a main effect of condition, such that participants who read for study remembered more than participants who read for entertainment, $F(1, 69) = 4.53, p < .04, \eta^2 = .07$. There was also a main effect of text type, $F(3, 207) = 5.90, p = .001, \eta^2 = .09$ (see Figure 4). Post-hoc tests with the Bonferonni adjustment revealed that participants recalled more important ideas in the compare-contrast and problem-response texts in comparison to the chronological texts (t -values $> 2.90, p$ -values $< .005$). Although participants also recalled more important ideas in the compare-contrast and problem response texts in comparison to the descriptive texts, these effects were not statistically significant (t -values $> 1.81, p$ -values $< .10$). There was no main effect of working memory. None of the interactions were significant.

4. Discussion

In the present study, we examined the interactive influences of readers' working memory, whether they were reading for study versus entertainment, and text structure on the moment-by-moment think-aloud processing of expository texts. This aim encapsulated both the replication of previous findings and extension of the current literature. First we will discuss the findings that replicate previous work, and then we will discuss the findings that extend previous work.

The current study provided converging evidence for a number of effects reported in the literature. First, we hypothesized that readers would adjust their processing depending on their reading goal. As expected, participants with the goal of studying had better memory for the text, engaged in more coherence-building processing (e.g., paraphrasing), and engaged in less non-coherence building processing, than participants with the goal of being entertained. These findings align with previous research demonstrating that providing readers with general instructions to adopt reading goals can lead readers to establish general criteria for how well they should comprehend a text, which in turn, influences their moment-by-moment processing and memory for texts (Anderson & Pichert, 1978; Geiger & Millis, 2004; Kaakinen & Hyönä, 2005; Linderholm & van den Broek, 2002; Lorch, Lorch, & Klusewitz, 1993; McCrudden & Schraw, 2007; McCrudden, Schraw, & Hartley, 2010; van den Broek, Lorch, et al., 2001). These findings also are in line with both the construction-integration (CI) and Landscape models, such that features of the task (e.g., reading goals) directly influence reading processes and products (Kintsch, 1988; van den Broek et al., 1996).

Second, we hypothesized that high working memory readers would be more likely than their low working memory counterparts to adjust their processing as a function of reading goal. As expected, readers with high working memory engaged in more paraphrasing (a coherence-based process) and less non-coherence processing when reading with the goal of studying the text. However, when reading with the goal of being entertained, readers with high working memory engaged in less paraphrasing and more non-coherence processes. This differentiation of processes as a function of goals did not occur for readers with low working memory. This pattern of findings replicates previous studies showing that readers with high working memory can strategically focus on text information that is consistent with their goals or perspectives (Kaakinen et al., 2003; Linderholm et al., 2008; Linderholm & van den Broek, 2002). These findings also are in line with both the construction-integration (CI) and Landscape models, such that readers who have a more limited working memory should therefore have fewer resources available to adjust processing.

Third, we hypothesized that the structure of the text should influence readers' text processing. More specifically, we hypothesized that compare-contrast and problem-response texts, compared to descriptive and chronological texts, would be associated with more coherence-building processes and better memory for the text. As expected, problem-response and compare-contrast texts resulted in better memory relative to chronological and descriptive texts. This is consistent with previous research documenting that more organized texts result in better comprehension (Baker & Brown, 1984; Graesser et al., 2002; Kieras,

1985; Meyer, 1975; Meyer et al., 1980; Meyer & Freedle, 1984; Vidal-Abarca & Sanjose, 1998; Wylie & McGuinness, 2004). During reading, problem-response texts elicited the lowest degree of paraphrasing, but the highest degrees of knowledge-based inferences. Research indicates that, when compared to narratives, expository texts usually prompt readers to integrate textual information with prior knowledge (McDaniel & Einstein, 1989; Wolfe & Goldman, 2005; Wolfe & Mienko, 2007). Therefore, it is possible that some structures of expository texts may prompt more integration with prior knowledge than others. Perhaps problem-response texts elicited more knowledge-based explanations because readers are incorporating background knowledge in an attempt to find and evaluate solutions to the various problems presented. In either case, future work examining the role of prior knowledge when explaining expository texts should consider that various text structures might differentially elicit the incorporation of background knowledge. These findings also are in line with both the construction-integration (CI) and Landscape models, such that text characteristics can activate particular schemes and prior knowledge (Kintsch, 1988; van den Broek et al., 1996).

4.1. The Importance of Examining Interactions

The main contribution of the current study is to document that accounting for the reader, text, and instructional context can reveal unique and important interactions. In general, the results provide evidence for the CI model's unique prediction that complex interactions can arise among text, reading context, and reader variables (Kintsch, 1988). Other models based on the CI model (such as the Landscape model; van den Broek et al., 1996), also make similar predictions. We proposed two potential hypotheses to extend the literature. First, we hypothesized that readers with high working memory are more likely to adjust processing as a function of study goal, and thus should likewise be most likely to adapt processing as a function of text structure, especially when reading for study. Second, we hypothesized that, similar to the reverse cohesion effect (McNamara et al., 1996; O'Reilly & McNamara, 2007), low working memory readers would benefit from more structured texts, whereas high working memory readers would benefit from less structured text. However, this would vary as a function of the study environment. Here, we offered two competing hypotheses: readers with low working memory may only benefit from highly structured texts in study environments that encourage coherence-building processes, or that such study environments may invoke stress among low-working memory readers, thus impeding coherence-building processes regardless of text structure. The current study provided evidence for the latter hypothesis.

Specifically, readers with low working memory in the entertainment condition employed differing degrees of text-based inferential processing as a function of text structure. These readers engaged in a higher degree of text-based inferences when reading compare-contrast and problem-response texts compared to descriptive and chronological texts. This finding suggests that even readers with low working memory may be able to adjust processing under certain conditions. In particular, when the text structure is more organized and supportive of comprehension, it can enable low working memory readers to adapt processing a positive way. But, why would this occur when those with low working memory are reading for entertainment rather than for study?

Consistent with our hypothesis, one possible explanation might be that instantiating a study goal could introduce some level of negative affect, such as stress or anxiety, among low working memory readers. Negative affect can influence processing by leading to a focus on analytic processing in which readers are less likely to make inferential connections (Bohn-Gettler & Rapp, 2011; Ellis & Ashbrook, 1989; Ellis, Ottaway, Varner, Becker, & Moore, 1997; Ellis, Varner, Becker, & Ottaway, 1995; Fiedler, 2001; Forgas, 1995, 2000; Seibert & Ellis, 1991). In addition, individuals with low working memory demonstrate poorer emotion regulation (Schmeichel, Volokhov, & Demaree, 2008), which may allow emotions to influence their text processing to a greater degree (Bohn-Gettler & Rapp, 2011). In the entertainment condition, the possible negative affect that may be associated with reading for study is no longer present, which could free up mental resources for low working memory readers. Perhaps that, coupled with reading texts that are more cohesive and help lower-skilled readers make connections (as is the case with compare-contrast and problem-response texts), led to this finding.

We acknowledge that the notion that instructional contexts associated with entertainment might reduce the cognitive load of readers with low working memory is only one potential explanation. Regardless, this finding suggests an interesting line of future research exploring how emotions may be associated with various instructional manipulations to influence processing. Furthermore, this finding demonstrates the critical importance of accounting for the individual and interactive contributions of the reader, text, and task as one or more of these can function in a compensatory way for a limitation of the other (e.g., low working memory is compensated by well-organized text structures). It demonstrates this by showing a situation (reading for entertainment) in which readers with lower cognitive resources can engage in more complex processing (i.e., text-based inferencing to build coherence) as a function of text structure. Without manipulating multiple aspects of reading simultaneously (i.e., accounting for the reader, text, and the instructional context), this nuanced finding would not be accounted for.

This type of finding is parallel to the reverse cohesion effect, in which readers with low background knowledge benefit from more cohesive texts, whereas readers with high background knowledge benefit from less cohesive texts (McNamara, 2001; McNamara & Kintsch, 1996). Although the current study examines structure (rather than cohesion) and working memory (rather than prior knowledge), it aligns with the notion that interesting, and sometimes surprising findings can occur when examining interactions between the reader and the text. The current study also adds to this work by documenting that perhaps these surprising results are subject to the limitations posed by the instructional context in which reading takes place.

4.2. Limitations and Future Directions

The present study represented a first attempt at documenting interactions between the reader, text, and instructional context during reading comprehension. For the purposes of the current study, we manipulated one aspect of each factor to document the effects. Furthermore, we utilized research-based manipulations that have resulted in differential processing of and memory for texts to systematically build upon previous work. This enabled the replication of

well-documented two-way interactions, but also extended this work by documenting a new three-way interaction that influences moment-by-moment text processing while thinking-aloud.

There are likely a variety of other reader-based, text-based, and context-based factors that could also be examined (e.g., van den Broek & Kremer, 1999). For example, the present study did not assess readers' prior knowledge. Instead, we utilized texts about topics for which readers would have general knowledge: the texts described general settings (such as a fruit orchard), compared and contrasted well known topics (such as airplanes versus helicopters), discussed problems that participants likely had general knowledge about (such as encouraging women to become more involved in politics), or provided a general timeline of well-known historical events (such as nuclear power). That being said, research has certainly documented the effects that prior knowledge can have on comprehension (Alvermann & Hague, 1989; Braten & Samuelstuen, 2004; Fincher-Kiefer, 1992; Kendeou & van den Broek, 2007; McKeown et al., 1992; McNamara, 2001). In future research, it would be worth directly investigating the role prior knowledge plays when considering these different structures of expository texts, as prior knowledge may compensate for weak organization or low cohesion. For example, readers with low prior knowledge tend to benefit from texts that are higher in cohesion and more organized (McNamara, 2001; McNamara & Kintsch, 1996), and also from refutation texts (Kendeou & van den Broek, 2005, 2007). It may be the case that certain structures of texts interact with prior knowledge, whereas others do not.

The present study utilized short and simple texts about general topics for which readers likely had prior knowledge. The simplicity and relative low difficulty level of the texts may have affected the type of processing in which readers engaged. Such texts were selected to ensure that all readers had the skills and knowledge necessary for comprehension, and thus not confound text difficulty and prior knowledge with reading goal. That being said, investigating the interaction between text difficulty with text structure, reading goal, and working memory could represent an interesting avenue of future research, especially when considering work documenting that text difficulty can interact with prior knowledge to affect processing and memory (McNamara, 2001; McNamara et al., 1996; O'Reilly & McNamara, 2007).

Another important consideration is whether college students would read such texts for entertainment. If not, it is possible that participants did not respond as they normally would to a text that they might normally read for entertainment. Thus, future research might consider the role of preferences when reading texts. In addition, contextual issues or the sociocultural context could likewise affect reading comprehension. For example, a student from a lower socioeconomic background may not have much knowledge or experience with airplanes and helicopters, thus making this text more difficult to understand. In the current study, the participants were all college students, and thus represented a relatively homogeneous sample of individuals who would be likely to have knowledge of the topics described in the texts.

In the current study, we asked participants to think aloud about the texts as they read them. This type of task enables the investigation of different types of inferential processing during reading, as well as the exploration of how readers focus their attention (Ericsson & Simon, 1993; Trabasso & Magliano, 1996). Unlike other, less obtrusive online methodologies, such as eye-tracking or reading time paradigms, think-aloud methodologies can introduce task-level factors that can influence the process of reading (Magliano & Graesser, 1991; Nisbett & Wilson, 1977). For example, reading one line at a time may encourage readers to focus on local information in the sentence, and less on making connections to prior text or background knowledge. In contrast, allowing readers to have access to the entire text may enable more integration processes (Rapp & Mensink, 2011). Therefore, although think-aloud methodologies are useful in the exploration of the processes that occur during reading, other methodologies should be employed to provide converging evidence for the interaction between the reader, text, and instructional context.

When thinking-aloud, we did not control for reading time. Controlling for reading time is difficult with thinking-aloud, because reading the text out loud and verbalizing thoughts represents a task demand that depends on individual differences (for example, in reading speed). However, controlling for and looking for interactions with skill in reading fluency could represent an interesting avenue for future research. For example, skilled readers may likely have more memory resources available to adjust processing as a function of the reading task or the text structure (e.g., the verbal efficiency hypothesis; Perfetti, 1986; Perfetti & Hart, 2002).

4.3. Implications

Taken together, the instructional context, reader characteristics, and text characteristics interacted to influence moment-by-moment processing of expository texts. Although previous studies have documented the interactions between any two of these variables, understanding the individual and interactive contributions of all three variables during reading, and their effects on memory, is important in order to obtain a full and complete picture of the processes and products of reading comprehension.

In applied settings, it is particularly important to consider the interplay between all of these variables. Although research designs isolate each variable to better understand how it affects comprehension, the reality of applied classroom settings is that these factors continuously change and interact with one another. Therefore, incorporating the complexity of the interactions that occur in real-world learning settings into empirical research designs will be a valuable, albeit challenging, task as researchers continue to find ways to improve comprehension.

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Appendix

Sample Texts

Compare-Contrast

“Airplanes and helicopters are both important forms of air travel, but they are very different. The first big difference between airplanes and helicopters is their shape and design. Airplanes, for example, have long, slender bodies with wings. Helicopters have round bodies and propellers rather than wings. Another difference between airplanes and helicopters is their speed. Airplanes can travel extremely fast. They reach speed of over 1,875 miles (3,000 kilometers) per hour. Helicopters, on the other hand, are much slower than airplanes. The final difference between airplanes and helicopters is their direction of takeoff and flight. Airplanes take off horizontally and can move in a forward direction only. They need a lot of space for takeoff and landing. Airplanes regularly carry several hundred passengers. Helicopters, however, take off vertically and can move in any direction. Helicopters require a very small takeoff or landing space. They usually carry only two to five passengers. Because of the great differences between airplanes and helicopters, each is used for a specific purpose. Airplanes can carry many people quickly. Helicopters are useful when a few people need to land in a small space.”

(Scribd, 2009, September; This specific text can be found at the following URL: <http://www.scribd.com/doc/20327221/Compare-and-Contrast-Essay-Examples>)

Descriptive

“And all the time the fruit swells and the flowers break out in long clusters on the vines. And in the growing year the warmth grows and the leaves turn dark green; the prunes lengthen like little green bird’s eggs, and the limbs sag down against the crutches under the weight. And the hard little pears take shape, and the beginning of the fuzz comes out on the peaches. The men who work in the fields, the owners of the little orchards, watch and calculate, and the year is heavy with produce. And men are proud, for of their knowledge they can make the year heavy: they have transformed the world with their knowledge. The short, lean wheat has been made big and productive: little sour apples have grown large and sweet, and that old grape that grew among the trees and fed the birds its tiny fruit has mothered a thousand varieties, red and black, green and pale pink, purple and yellow; and each variety with its own flavor. The men who work in the experimental farms have made new fruits: nectarines and forty kinds of plums, walnuts with paper shells. And always they work, selecting, grafting, changing, driving themselves, driving the earth to produce.”

(Kelley, 2002, p. 114-115)

Problem-Response

Despite universal suffrage and the prominence of a few female leaders, the number of women in European legislatures is low. Even in Scandinavian countries, which have the best record on women’s rights, women make up only 30-40% of Members of Parliament (MPs). In other countries, women rarely hold more than a quarter of the seats. In the UK, France

and Greece, women make up less than 10% of MPs. There are many reasons for this low number. One is that the “boy’s’ game” image of politics does not encourage women to become candidates. Another is that women fear they will be judged more harshly than men if they are politicians. What could make politics more inviting for women? There are several options. Colleges and universities could develop programs aimed at training female politicians. There, students could practice debating and learn about the realities of running for office. These programs might inspire women who otherwise would not consider politics. In addition, many parliaments still have no childcare. Women may feel that they have to choose between being parents and being politicians. Creating decent childcare at work would send a strong signal that governments want to encourage women to participate.

(adapted from Turner, 1998)

Chronological

“In January 1950, President Truman ordered the Atomic Energy Commission to make the hydrogen bomb. In February 1950, Senator Joseph McCarthy launched a crusade to rout out communism in America. In June 1950, the Korean War began as North Korean forces invaded South Korea. In December 1951, the first usable electricity from nuclear fission was produced at the National Reactor Station, later called the Idaho National Engineering Laboratory. In December 1953, in his Atoms for Peace speech, President Eisenhower proposed joint international cooperation to develop peaceful uses of nuclear energy. In January 1954, the first nuclear submarine, U.S.S. Nautilus, was launched. In April 1954, Army McCarthy hearings were on TV for five weeks. By the end, Senator McCarthy was publicly disgraced. In August 1954, the Atomic Energy Act of 1954 was passed to promote the peaceful uses of nuclear energy through private enterprise. In July 1955, Arco, Idaho became the first U.S. town to be powered by nuclear energy. In October 1956, the Hungarian revolution was crushed by Soviet tanks. In July 1957, the Sodium Reactor Experiment in Santa Susana, California made the first power from a civilian nuclear reactor. In September 1957, the United States set off first underground nuclear test in a mountain tunnel in the remote desert 100 miles from Las Vegas.”

(Education Database Online, 2006)

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Highlights

- Readers with high working memory adjust processing as a function of reading goal
- Reading goals, text structure, and working memory interactively affect inferencing.
- Post-reading recall increases when reading with a study goal.
- Post-reading recall increases for compare-contrast and problem-response texts.

Figure 1.

Arcsine proportions of think aloud paraphrases and knowledge-based inferences. Problem-response texts elicited the least degree of paraphrasing, and the highest degree of knowledge-based inferences, compared to all other texts. The compare-contrast texts also elicited more knowledge-based inferences than the descriptive texts. Standard errors are represented in the figure by the error bars attached to each column.

Figure 2.

Arcsine proportions of think aloud paraphrases and non-coherence processes generated. Readers with high working memory were more likely to paraphrase when reading for study compared to entertainment, but this difference was not found among the readers with working memory. Readers with high working memory were also more likely to engage in non-coherence processing when reading for entertainment compared to study, but this difference was not found among the readers with low working memory. Standard errors are represented in the figure by the error bars attached to each column.

Figure 3.

Arcsine proportions of think aloud text-based inferences generated. Readers with low working memory in the entertainment condition generated more text-based inferences when reading compare-contrast texts than descriptive and chronological texts. The same group of readers also utilized more text-based inferences when reading problem-response texts in comparison to descriptive and chronological texts. Standard errors are represented in the figure by the error bars attached to each column.

Figure 4.

Arcsine proportions of text information recalled. Participants recalled more unique ideas and more important ideas for the problem-response and compare-contrast texts in comparison to the descriptive and chronological texts. Standard errors are represented in the figure by the error bars attached to each column.

Table 1

Definitions and Examples of the Think Aloud Codes

Process	Definition	Text Excerpt	Example of Participant Response
Association	Comments providing information not related to text coherence.	According to the U.S. Department of Justice, crimes by juveniles have gone up by 60 percent since 1984.	Think that was a George Orwell book.
Elaborative Inference	Comments employing background knowledge to explain the current sentence.	But I support a national identity card with a chip that can match the holder's finger print.	So that's how the cards couldn't be stolen, or used by someone else.
Connecting Inference	Comments mentioning an immediately preceding sentence to explain the current sentence.	But I support a national identity card with a chip that can match the holder's fingerprint. It could be an effective tool for preventing terrorism.	If it has your fingerprint on the card.
Reinstatement Inference	Comments mentioning information from earlier in the text, but not the immediately preceding sentence, to explain the current sentence.	At Fort Sumter, South Carolina troops sent away a supply ship trying to reach the fort. [I intervening sentence.] It had not delivered its supplies.	Because South Carolina sent them back.
Predictive Inference	Forward inferences that anticipate upcoming text or content.	In January 1861, the South left the Union.	So this is gonna be about the civil war between the U.S.
Paraphrase	Comments that capture the gist meaning of the current sentence.	When Abraham Lincoln, a known opponent to slavery, was elected president, the South Carolina legislature saw a threat.	They didn't like Lincoln.
Opinion	Comments that express an opinion the text.	It's not new for children to commit violent crimes at younger ages.	This is...kinda weird.
Statement of Uncertainty	Comments that reflect that the participant did not feel certain about the text.	Also in 1956, the first transistorized computer was completed at the Massachusetts Institute of Technology.	I'm not sure what kind of computer that is.
Other	Nonresponses and any other response that do not fall into any of the above categories.	The name transistor is short for "transfer resistance."	[No response]
Invalid	Comments that reflect a misunderstanding of the text.	They have cavalier attitudes toward possessions, including family heirlooms; everything is just another dust-catcher to them.	...they just like the idea of everything being there.

Table 2
Intercorrelations between the Arcsine Proportions of the Think-Aloud Categories

	1	2	3	4	5	6	7	8
	<i>n</i> = 73							
1. Paraphrases	-	.21 [†]	-.15	-.51 ^{***}	-.41 ^{***}	-.56 ^{***}	-.76 [*]	-.67 ^{***}
2. Connecting Inferences		-	.51 ^{***}	.25 [*]	-.003	-.22 [†]	-.47 ^{***}	-.38 ^{***}
3. Reinstatement Inferences			-	.53 ^{***}	.14	-.04	-.11	-.10
4. Elaborative Inferences				-	.23 [*]	.25 [*]	.07	.17
5. Predictive Inferences					-	.05	.36 ^{**}	.17
6. Associations						-	.38 ^{***}	.44 ^{***}
7. Statements of Uncertainty							-	.64 ^{***}
8. Opinions								-

 $p < .001$.

**
 $p < .01$.

*
 $p < .05$.

[†]
 $p < .10$.

Table 3
Arcsine transformed proportions (and standard deviations) of the think-aloud processes
by condition and working memory

Think-Aloud Process	Text Type	Study Condition		Entertainment Condition	
		Low WM ^a (n = 19)	High WM (n = 17)	Low WM (n = 15)	High WM (n = 17)
Paraphrases	Compare-Contrast	.65 (.33)	.81 (.28)	.67 (.36)	.49 (.29)
	Descriptive	.67 (.36)	.83 (.36)	.78 (.31)	.61 (.33)
	Problem-Response	.58 (.33)	.74 (.38)	.53 (.39)	.45 (.31)
	Chronological	.58 (.39)	.90 (.39)	.76 (.30)	.51 (.35)
Text-Based Inferences	Compare-Contrast	.18 (.22)	.30 (.19)	.32 (.18)	.21 (.23)
	Descriptive	.25 (.22)	.23 (.17)	.09 (.12)	.17 (.20)
	Problem-Response	.23 (.19)	.30 (.21)	.23 (.22)	.19 (.21)
	Chronological	.20 (.24)	.24 (.27)	.08 (.17)	.25 (.21)
Knowledge-Based Inferences	Compare-Contrast	.54 (.28)	.54 (.27)	.45 (.24)	.66 (.25)
	Descriptive	.51 (.28)	.46 (.27)	.29 (.25)	.58 (.30)
	Problem-Response	.53 (.34)	.67 (.23)	.55 (.20)	.71 (.29)
	Chronological	.51 (.28)	.43 (.28)	.53 (.25)	.62 (.37)
Non-Coherence Processes	Compare-Contrast	.42 (.33)	.20 (.26)	.35 (.35)	.59 (.45)
	Descriptive	.27 (.35)	.25 (.30)	.40 (.46)	.52 (.38)
	Problem-Response	.37 (.32)	.31 (.36)	.41 (.39)	.63 (.42)
	Chronological	.44 (.42)	.12 (.33)	.41 (.49)	.66 (.58)

^aWM = Working Memory

Table 4
Arcsine transformed proportions (and standard deviations) of clauses recalled by
condition and
working memory

		<u>Study Condition</u>		<u>Entertainment Condition</u>	
Text Type		Low WM^a (<i>n</i> = 19)	High WM (<i>n</i> = 17)	Low WM (<i>n</i> = 15)	High WM (<i>n</i> = 17)
Unique Textual Clauses	Compare-Contrast	.43 (.14)	.44 (.18)	.35 (.15)	.36 (.10)
	Descriptive	.41 (.17)	.39 (.18)	.29 (.16)	.29 (.17)
	Problem-Response	.43 (.19)	.50 (.21)	.32 (.09)	.42 (.09)
	Chronological	.29 (.17)	.36 (.18)	.32 (.13)	.26 (.16)
Unique Important Ideas	Compare-Contrast	.61 (.14)	.67 (.18)	.55 (.26)	.60 (.13)
	Descriptive	.60 (.26)	.59 (.40)	.41 (.28)	.48 (.34)
	Problem-Response	.52 (.27)	.65 (.18)	.60 (.25)	.60 (.23)
	Chronological	.42 (.23)	.49 (.22)	.46 (.19)	.39 (.21)

^aWM = Working Memory