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- **Assessing the Impact of Topic Interest on Comprehension Processes**

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Executive Summary

Cognitive ability and prior knowledge have been traditionally explored in terms of their influence on measures of academic performance. Many other variables, however, may influence these measures. Performance may be affected not only by knowledge and cognitive skills, but also by the extent to which students are motivated and engaged in an academic task. Motivational variables may even explain within-person variability across tasks that measure similar constructs. Understanding how these factors affect this variability is critical not only for basic research on cognitive processes, but also for educational practices and assessment.

The present study focuses on the motivational variable of interest, and how interest relates to processes involved in reading. Interest describes a particular relationship between a person and a content area that is characterized by focused attention and positive affect. This research was designed to examine how interest changes the processes related to comprehension while reading expository texts. Although evidence of the relationship between interest and reading comprehension has been accumulating in the literature, this relationship is not well understood. Studies have shown that interest and performance are related under some circumstances but not others. Moreover, there has been an emphasis in prior research on whether interest affects comprehension outcomes (e.g., performance on a standardized test), rather than how and why it affects the processes that occur during reading to support comprehension and under what conditions the interest–performance relationship emerges.

The purpose of the present study was to assess the extent to which interest affects processes that occur *during reading* and processes that support comprehension. We believe that focusing on this relationship can provide important insights into how and why interest can affect performance on outcome measures of comprehension. Furthermore, based on the assumption that other individual-difference factors (e.g., reading skill, prior topic-relevant knowledge) would be implicated in the interest–performance relationship, these individual-difference measures were also included in the current model. Finally, the relationships between interest and task performance may be reciprocal across time as readers interact with text. Therefore, interest both before and after reading was measured in order to explore the extent to which comprehension processes are an outcome as well as a predictor of interest. This allowed us to ascertain whether prereading interest corresponded to cognitive processes online, and whether cognitive processes online corresponded to changes in postreading interest.

The results indicated that higher-interest readers process texts more slowly, and demonstrate greater sensitivity to features that support the construction of a coherent mental model for a text, than lower-interest readers. Moreover, there is some evidence that interest helps less-skilled readers become more engaged with the text. These results provide some explanations for a growing body of literature that shows that text-topic interest affects performance on comprehension tests. Moreover, they suggest that topic interest could be used as a scaffold to promote comprehension.

Introduction

Interest emerges when a person has a positive interaction with a content area or a task (Dewey, 1913; Hidi & Renninger, 2006; Renninger, Hidi, & Krapp, 1992; Schiefele, 1991). It is characterized by heightened attention and emotional engagement. *Individual interest*, or interest that is sustained by the person and is relatively stable across time, involves the accumulation of knowledge about a given content area (e.g., history, biology) that the person values (Hidi & Renninger, 2006; Rathunde, 1993; Renninger, 2000; Renninger et al., 1992; Schiefele, 1991). The value that individuals ascribe to content domains includes both positive feelings (e.g., enjoyment, engagement) and personal meaning (Schiefele, 1991, 2001). In contrast to individual interest, *situational interest* is a form of interest that emerges in a particular context as a result of features of the immediate environment. Situational interest materializes quickly and can be short lived unless there are factors in the environment to sustain this initial experience (Hidi & Anderson, 1992; Hidi & Renninger, 2006; Murphy & Alexander, 2000). Finally, *topic interest* is measured in response to a particular lesson topic or text passage, and consequently it involves a fairly circumscribed content area (Renninger, 2000; Schiefele, 1996). Topic interest, likely to be influenced by both individual and situational interest (Ainley, Hidi, & Berndorff, 2002), has been used most often to assess performance gains in reading comprehension tasks. In the following few pages prior research on interest is described. In some cases it is specified that a particular type of interest was measured, but other times it is not possible to do so, either because the authors did not specify or because several studies that used different measures are being summarized. In these cases, the reference is to interest in general.

Interest is an important end in itself: Tasks that are interesting offer personal meaning and fulfillment in their own right (Renninger, 2000). Beyond the intrinsic value of interest, however, it is critical to consider whether or in what ways interest is a catalyst for learning and performance. Prior research suggests that there is a link between interest and task performance, but this relationship is complex (e.g., Bray & Barron, 2004). Moreover, the relationship may be reciprocal. In other words, interest may facilitate subsequent performance, and task performance may facilitate subsequent interest. Although both relationships probably exist, they may operate via different processes. In other words, the processes by which interest can facilitate performance may be different from the processes by which performance can facilitate interest. Outlines of and evidence for each type of process are outlined below.

The present study focuses on the impact of topic interest on comprehension processes and outcomes. It has been shown that interest effects occur for some texts, but not others—even within the same topic domain (Bray & Barron, 2004). One could interpret these effects as indicating a reader–text interaction in which interest in the text topic underlies whether interest effects are manifested for particular texts. For example, one can imagine a group of history students who are all interested in the general topic of history, but who have varying levels of interest in different historical periods or perspectives. In this case, interest in the general topic of history would not reveal variance across individuals, but these individuals may interact with texts differently depending on the text topics and their particular topic interests. Additionally, it is possible that interest could change in response to reading a text, which would only be revealed by measuring topic interest both before and after reading.

Evidence of the Relationship Between Interest and Performance

There are multiple perspectives regarding how and why interest may impact comprehension. Numerous theoretical accounts suggest that interest should promote task performance through attentional processes. In its most fundamental form, individuals pay close attention to and focus on objects that are interesting (Dewey, 1913; Izard, 1978; James, 1890). This assumption is at the center of most theorizing about how interest might facilitate task performance, the idea being that greater attention promotes performance. However, this relationship may manifest itself in different ways. One possibility is that the heightened attention given to objects of interest is deliberate (Anderson, 1982). In this case, interest may initiate intentional self-regulation that can ultimately contribute to performance gains. Consistent with this notion, interest has been related to a host of self-regulatory processes including goal adoption, deep learning strategies, and self-efficacy (Pintrich & Schunck, 2003). Another possibility is that the heightened attention given to objects of interest is fairly automatic. If this is the case, then task engagement depletes fewer resources for individuals with high levels of interest compared with individuals with low levels of interest (e.g., Hidi, 1990; Shirey & Reynolds, 1988). Consequently, individuals with higher-level interest have more resources available for processing elements of the task, leading to higher-quality performance (Hidi, 1990; Krapp, 1999; Schiefele, Krapp, & Winteler, 1992).

Interest, measured prior to task engagement, has been related to subsequent task performance, even after preexisting knowledge is accounted for in the analyses. For example, research shows that interest can predict comprehension, recall, and inference generation following a reading task (Alexander, Kulikowich, & Schulze, 1994; Artelt, Schiefele, & Schmeider, 2001; Ozgungor & Guthrie, 2004; Renninger & Wozniak, 1985; Schiefele, 1996; Shirey & Reynolds, 1988). However, these results do not always emerge. For example, Flowerday, Schraw, and Stevens (2004) found that neither situational nor topic interest predicted performance on a multiple-choice quiz following a reading task. Another study showed that topic interest did not directly predict performance but did lead to persistence, which ultimately predicted performance (Ainley et al., 2002). Other research revealed a relationship between interest measured at the outset of a course and course grades for some courses but not for others (Schiefele & Csikszentmihalyi, 1994). Taken together, there are inconsistencies in the literature with respect to the relationship between interest and performance, suggesting that the variables necessary for interest to facilitate performance are not well understood.

More specifically, interest has also been used to predict performance on standardized tests of reading comprehension. Bray and Barron (2004) found that participants' prereading topic interest predicted performance on standardized test items of comprehension overall, and that this relationship was stronger when controlling for vocabulary skill. Moreover, using hierarchical linear modeling, these authors showed that there was considerable variability in the interest–performance relationships even across different text passages. These data suggest that the question of how interest affects text comprehension depends on characteristics of the texts themselves and the type and depth of comprehension required for high performance on a test. A critical question that remains unanswered, however, is what those particular text characteristics are.

It is critical to note that the relationship between interest and performance is stronger when interest is measured after the task than when it is measured before the task. In classroom studies, a stronger relationship between interest and course grades emerges when interest is measured later versus earlier in the semester (Alexander, Murphy, Woods, Duhon, & Parker, 1997; Church, Elliot, & Gable, 2001; Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2007; Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Lopez, Lent, Brown, & Gore, 1997). In addition, similar to the results of classroom research, the positive relationship between interest and performance emerges more consistently in laboratory tasks if interest is measured after the task (Cury, Elliot, Da Fonseca, & Moller, 2006; Sadoski, Goetz, & Rodriguez, 2000; Wade, Buxton, & Kelly, 1999).

The stronger relationship between interest measured later in the task and task performance may reflect the dynamic nature of interest and comprehension and may foreshadow how these processes unfold over time. As suggested earlier, interest emerges when individuals interact positively with a task. Some individuals may not realize that they have an interest in a particular reading passage until they begin to read it. For these individuals, the interest that emerges may direct their subsequent online processing and comprehension. Alternatively, initial interest in a topic may be deflated if learners realize that the passage contains information they already know or is written at a level beyond their reading skill. These examples highlight the importance of measuring topic interest both before and after the task, as well as the need to consider additional individual-difference variables that may shape the experience of interest development and comprehension processes over time.

The present study acknowledges that the level of topic interest prior to reading may not be the same as the level of topic interest after reading, and therefore topic interest is measured at both time points. For the sake of brevity, topic interest measured before and after reading will be labeled as “preinterest” and “postinterest,” respectively, in order to highlight the timing of measurement. In addition, other reader-based variables were assessed that may interact with interest to predict comprehension. These variables include reading skill, prior general knowledge in the domain, prior knowledge of the specific topic, and working memory. These variables are of primary focus in research on reading comprehension among college students (e.g., Just & Carpenter, 1992; Magliano & Millis, 2003; McNamara & Kintsch, 1996). In addition to being important control variables, these variables take on a special role as potential moderators of the relationships between interest and comprehension processes. For example, if interest promotes comprehension through automatic processes, then the relationship between interest and comprehension may be evident only among individuals who otherwise have lower-level working memory. In comparison, those with higher-level working memory may evidence successful reading comprehension regardless of their level of interest. Moreover, initial level of knowledge of the topic may also play a role in that individuals who have high interest but low topic knowledge may be especially engaged in a text because the text offers a learning opportunity. In contrast, individuals with high interest and high topic knowledge may be less engaged in a text because they may already know the content of the passage.

Comprehension Processes and Interest

Comprehension arises from a series of cognitive processes—including word decoding, lexical access, syntactic processing, inference generation, reading strategies (e.g., self-explanation), and postreading processes (e.g., summarization, question asking and answering, argumentation)—that support the construction of a coherent mental representation that reflects the meaning of a text. These processes give rise to various mental representations, each capturing different aspects of comprehension (Balota, Flores d'Arcais, & Rayner, 1990; Graesser, Singer, & Trabasso, 1994; Kintsch, 1988; Zwaan & Radvanksy, 1998).

Theories of discourse processing assume that mental representations of texts contain multiple levels of meaning (Kintsch, 1988; Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). Readers construct a representation of the explicit text content, which is referred to as the *propositional textbase*. This representation contains a network of propositions that represent the explicit ideas contained in a text. The textbase is incrementally constructed in a network as the text is read. Relationships between the textbase propositions are established when they share an argument, or a similar concept (e.g., Kintsch & van Dijk, 1978). However, the textbase is not sufficient to establish a coherent representation of a text. Rather, coherence emerges with the construction of a situation model, which is a more holistic approach to comprehension involving both the textbase (as well as inferences that are not explicit in the text) and elaborations from real-world knowledge (Magliano, Zwaan, & Graesser, 1999; van Dijk & Kintsch, 1983; Zwaan & Radvansky, 1998). Specifically, readers generate inferences that are based on their real-world knowledge, which enables them to establish implied relationships among text constituents. As such, the situation model provides an index of text constituents along a number of dimensions, such as agents and objects, temporality, spatiality, causality, and intentionality (Magliano, Zwaan, & Graesser, 1999; Zwaan, Langston, & Graesser, 1995; Zwaan, Magliano, & Graesser, 1995; Zwaan & Radvansky, 1998). Although the textbase and situation model are often discussed as two separate representations, it is important to note that both aspects of comprehension are part of a highly integrated network that reflects the underlying meaning of a text (e.g., Graesser & Clark, 1985).

The situation model is constructed by readers as they make inferences. There are several types of inferences (e.g., Graesser et al., 1994). The present study adopted a relatively simple distinction advocated by McNamara and Magliano (2009b) that involved discriminating between integrative and elaborative inferences. *Integrative inferences* involve establishing relationships between text constituents (e.g., causal bridging inferences, pronominal references). These inferences require readers to activate prior text constituents represented in episodic memory and to establish how they are related to the current sentence. As such, these inferences provide the basis for establishing text coherence because they require readers to bridge across different text constituents (e.g., Graesser et al., 1994). In contrast, *elaborative inferences* involve incorporating relevant background knowledge into the mental representation (Graesser et al., 1994; McNamara & Magliano, 2009b; Potts, Keenan, & Golding, 1988). These inferences may be based on relevant schema that are activated during reading (Schank & Abelson, 1977) or can be computed "on the fly" through a process of reasoning (Kintsch, 1988).

A few studies have assessed the impact of interest on the products of comprehension as delineated by theories of discourse comprehension (McDaniel, Waddill, Finstad, & Bourg, 2000; Naceur & Schiefele, 2005; Schiefele, 1996). For example, Schiefele (1996) explored the impact of topic interest on memory for verbatim content, the textbase, and the situation model using a recognition paradigm. Specifically, measures of text-topic interest and other individual factors were collected prior to reading the passages. After reading the text, participants were presented a series of statements that varied in the extent to which they deviated from the original sentences that appeared in the text. A signal-detection paradigm developed by Schmalhofer and Glavanov (1986) was used to assess the strength of memory for verbatim text, the textbase, and the situation model. Regression analyses indicated that the relationship between interest and memory was independent for these different products of comprehension, and that the relationship was not consistent across dimensions. Specifically, interest was negatively related to memory for verbatim text, but positively related to memory for the situation model. This suggests that readers with high interest develop representations that reflect deep meaning, but this comes at the expense of maintaining a representation of the explicit content.

These studies suggest that interest has implications for the nature of comprehension, but they do not speak to its impact on the processes during reading that give rise to comprehension. As such, an adequate explanation as to why and how interest affects comprehension is lacking. The present study was designed to begin to provide such an assessment.

Researchers can gain insight into the inference and comprehension processes that occur while reading authentic, naturalistic texts (e.g., commercially produced texts as opposed to texts generated for experimental purposes) by bringing together information from multiple sources and showing convergence across sources. First, theory provides a basis for conducting content analyses of texts that are predictive of comprehension processes. For example, a causal network analysis can be used to determine the points in a text where readers should generate causal bridging inferences that establish causal relationships across sentences (Magliano, Trabasso, & Graesser, 1999; Suh & Trabasso, 1993; Trabasso & Suh, 1993; Trabasso, van den Broek, & Suh, 1989). Second, verbal protocols (e.g., think-alouds) are used, in which readers express the thoughts they have at different points in the text. Third, other independent behavioral measures (e.g., sentence reading times [RTs], probe response measures) are assessed. If the theoretical analyses account for variance in both measures, then this is seen as support for the idea that the processes revealed by those measures occur during normal reading situations. This approach has been used successfully to study inference generation during reading (Graesser et al., 1987; Long & Golding, 1993; Magliano et al., 1993; Magliano, Trabasso, & Graesser, 1999; Millis & Graesser, 1994;

Suh & Trabasso, 1993). For example, Magliano, Trabasso, and Graesser (1999) conducted a discourse analysis of the features of a text in order to predict inferences that were revealed in think-aloud protocols and reading-time data.

In the present study, discourse analysis of each text was conducted to identify factors varying across text sentences that could be correlated with the generation of bridging versus elaborative inferences. Specifically, each text sentence was evaluated along three dimensions: the extent to which it (a) contained nouns that had already been introduced in prior text sentences (argument overlap), (b) contained nouns that had not yet been introduced in the prior text sentences (new argument), and (c) was causally related to other sentences in the text (causality). When readers arrive at sentences with more argument overlap and causality, they are likely to make integrative inferences that bridge ideas within the text. In contrast, when readers arrive at sentences that contain new arguments they tend to make elaborative inferences (Magliano, Trabasso, & Graesser, 1999; Magliano, Zwaan, & Graesser, 1999). The characteristics of sentences across a text make it is possible to gauge the comprehension processes that occur across time while reading. The indicators of comprehension processes that were used in the present study included sentence RTs (Study 1) and responses to think-aloud probes following each sentence (Study 2).

The convergence of the theoretically based analysis of the text, inferences revealed in the think-aloud protocols, and sentence RTs indicate that these types of inferences are generated during reading and that they have different processing implications. However, the central question is how topic interest predicts integrative and elaborative processes, and how it moderates the effects of the text-level variables on these processes. Assessing these relationships should provide insight into how and why interest affects comprehension outcomes.

Interest and Online Versus Offline Processes

The comprehension processes described above represent a combination of online and offline processes. RTs are an example of online processes because they can be obtained without interfering with the process of reading. In contrast, recall is typically measured after reading, offline, and represents a summary of what occurred during reading. Finally, responses to think-aloud probes are likely to represent a hybrid of these two types; they are online to the extent that they occur while participants are still completing the reading task, but they are offline to the extent that the probes to produce verbal protocols interrupt the reading process.

This distinction between online and offline comprehension processes may be critical when summarizing the research related to interest and comprehension processes and making predictions. Most of the prior research showing a positive effect of interest on performance assessed offline processes of performance, and stronger relationships between interest and performance emerged for interest measured after the task. Consequently, the data suggest that interest assessed after the task (i.e., postinterest) may be a stronger predictor of offline processes. As a corollary, it may also be the case that interest measured before the task (i.e., preinterest) is a stronger predictor of online processes.

Overview of the Current Study and Research Questions

The goal of the present study was to assess the extent to which topic interest and other cognitive skills (prior domain knowledge, prior topic knowledge, reading skill, working memory) are related to inference and comprehension processes. The decision to focus on topic interest (rather than other types of interest) and performance was made because prior work that is most closely linked to the present study used measures of topic interest (Bray & Barron, 2004; Schiefele, 1996).

In Study 1, a group of participants read a set of simple texts silently while sentence RTs were collected. These RTs were correlated with the sentence characteristics that have been associated with different types of inferences (i.e., argument overlap, new argument, and causality). Magliano, Zwaan, and Graesser (1999) found that sentences with greater argument overlap and causality tended to facilitate RTs because these sentences allowed readers to generate inferences from within the text. In contrast, sentences with a greater number of new argument nouns tended to slow down RTs, presumably because they required readers to access information from background knowledge.

In Study 2, think-aloud protocols were collected to provide insight into what individuals were thinking about at a particular point in time while reading. Combining the think-aloud data and the discourse analysis, Magliano, Zwaan, and Graesser (1999) found that participants engaged in bridging (making text-based inferences) and elaboration (making knowledge-based inferences) at different sentences, depending on the sentence characteristics. The presence of text-based explanations (bridging) in the think-aloud data increased as implied causality increased, whereas the presence of knowledge-based explanations (elaboration) in the think-aloud data decreased as implied causality increased. Moreover, the likelihood of generating knowledge-based associations (elaboration) increased when new argument nouns were introduced into the discourse. In Study 2, a separate sample of participants read the same narratives as in Study 1, one sentence at a time. After reading each sentence, they were instructed to report their thoughts in the context of what they had read up to that point (for similar think-aloud instructions, see Trabasso and Magliano, 1996). The think-aloud responses that readers produced were quantified along two dimensions: (a) the number of bridging inferences that connected the current sentence to prior text sentences; and (b) the number of elaborative inferences that connected the current sentences to general knowledge of the world.

Research Question 1: *Does preinterest predict online processes?*

Prior research suggests that an important distinction to be considered is the timing of measures of interest in relation to task performance. If interest is measured prior to task engagement, then it should be indicative of the general approach to the task that individuals will take. For example, a lower-interest reader may adopt a strategy that reflects minimal engagement in the task (e.g., reading the text very quickly). It was hypothesized that interest measured prior to reading would predict online processes that are not interrupted by other measurements. In Study 1, RTs were measured as participants read each sentence of each text. Therefore, it was possible to evaluate how preinterest predicted readings times. Specifically, it was determined whether higher preinterest levels sped up RTs, because the attentional aspects of interest may facilitate the ease with which individuals bring to mind relevant knowledge and integrate concepts within the passage (Hidi, 1990); or whether they slowed down RTs, because participants with higher interest may process the material more thoroughly overall and at a deeper level.

The relationship between interest and RTs may depend on the characteristics of different sentences. Individuals with higher preinterest may be more sensitive to sentence-based cues and consequently may show valenced relationships between sentence characteristics and RTs that are similar to those of participants overall, but with steeper slopes. For example, whereas the presentation of new information has been shown to slow down RTs, this effect may be even more pronounced for those with higher versus lower interest. In parallel, whereas the reoccurrence of information from a prior point in the passage speeds up RTs, it might speed up RTs even more for those with higher versus lower preinterest in the topic. In this way, individuals with higher preinterest may be more flexible in their reading strategies, responding to the affordances of the sentences as they are processed rather than applying a similar strategy across all sentences.

Research Question 2: *Does postinterest predict offline processes?*

One of our primary outcome variables in both studies was recall of the idea units in each text. Because recall is an offline measure, the extent to which postinterest predicted recall following the passage was examined. Overall, it was predicted that postinterest would be a positive predictor of recall, having accounted for prior domain knowledge, prior topic knowledge, reading skill, and working memory. The extent to which this relationship was moderated by other individual-difference variables was also tested.

Research Question 3: *Does preinterest or postinterest predict verbal protocol responses?*

In Study 2 the extent to which text features and individual differences predicted think-aloud responses was examined. Specifically, participants' responses were coded for bridging (making connections with prior passage content) and elaboration (making connections with real-world knowledge). Think-aloud responses were collected while participants read the passage, but in order to ask participants their thoughts, it was necessary for them to stop reading and to reflect on their experience. Hence, the means by which think-aloud responses are collected makes them difficult to classify as either online or offline processes. Therefore, the relationships between interest and think-aloud responses were examined separately for preinterest and postinterest. The reasoning for this was that preinterest in the passage topic may increase the extent to which all comprehension processes occurred, because bridging and elaboration are rooted in the desire to understand and learn from text. In parallel, topic interest is associated with learning goals. However, it is also provocative to consider the possibility that individuals who developed interest in the topic while reading (postinterest) were more likely to engage in these processes. For example, it is possible that individuals who ultimately developed interest in the text were those who elaborated more and took a more active strategy for comprehension.

Research Question 4: *Do the effects of discourse variables, interest, and other individual-difference variables predict comprehension processes differently across texts?*

For each analysis, tests were conducted to determine whether the relationships between interest and each outcome variable varied based on other individual-difference variables. Specifically, prior knowledge of the specific topic, prior knowledge of the domain (history or science), reading skill, and working memory were identified as possible moderators of the relationship, because these variables offered resources to participants that may align with or complement those associated with interest.

The theoretical questions regarding topic interest and comprehension processes give rise to a practical and methodological issue. The issue centers on whether sentence characteristics associated with different inference processes operate similarly or differently across texts. Specifically, once the discourse analyses have been performed on the different texts, researchers have the option of analyzing (a) all of the texts simultaneously (usually dummy coding for text) or (b) each text separately. Combined-text analysis rests on the assumption that the relationships between features of individual sentences and text-comprehension processes are independent of the actual topic content of the passage. For example, this assumes that two sentences—each from a different passage—that require readers to access real-world knowledge to elaborate on a given idea will elicit elaboration similarly and independently of the topic. This approach is the one typically taken by researchers, and it has gone far in terms of identifying text features that promote comprehension processes (e.g., Haberlandt & Graesser, 1985; Magliano, Trabasso, & Graesser, 1999).

However, this assumption needs to be revisited once researchers begin to consider how differences between people may influence comprehension. The RAND report on reading comprehension (Snow, 2002) conceptualized comprehension as involving a complex interaction among the reader, text, and task. This framework has become prevalent in psychological and educational research and underscores that reading is an interactive process whereby individuals derive meaning from text content. In other words, the text is unchanging until it is interpreted by a reader, and it is likely that resources that vary by reader (e.g., prior knowledge, topic interest) will affect what meaning is derived from the text and how deeply it is processed. Continuing the example described above, two sentences that allow for elaboration using real-world knowledge require that individuals both have real-world knowledge and are able and motivated to access that knowledge in the pursuit of text comprehension. It is possible that the extent to which an individual elaborates in response to a given sentence will depend on the content of the passage and whether the individual has the ability and motivation to do so. Consequently, individuals with different levels of preexisting knowledge and/or interest may respond very differently to sentences that would otherwise appear similar from the perspective of discourse analysis.

This challenge was approached in two ways. First, in order to interpret the present study in light of prior research, the effects of sentence type on comprehension processes were examined with all texts combined. Then, in a second phase of the analyses, the effects of interest were tested separately for each text. Indeed, topic interest is inherently content specific, so this latter approach is typical in research involving the impact of topic interest on comprehension (Bray & Barron, 2004). It was possible then to identify any variation between combined-text and separate-text analyses.

Pretest

A pretest was conducted in order to select text passages for the studies. The passages were tested to determine whether they satisfied several criteria in order to be candidates for use. Most importantly, the texts to be used needed to have sufficient variability in preinterest and postinterest in order to have a range of scores that would be conducive to observing the hypothesized relationships.

Pretest Method

Participants. The participants in the pretest included 33 undergraduate students from Northern Illinois University, who completed the study for partial course credit.

Text passages. Twelve encyclopedic-like texts (6 history and 6 science) were pretested. The texts ranged in length from 283 to 434 words, with 20 to 27 sentences each. The Flesch–Kinkaid reading grade level of the texts ranged from 9.03 to 11.28. The topics are displayed in Table 1.

TABLE 1
Mean (SD) ratings of history (upper half) and science (lower half) texts used in pretest

Topic	Preinterest		Postinterest		Coherence		Vividness	
Economic causes of Civil War*	4.55	(1.40)	4.61	(1.56)	3.94	(0.71)	3.31	(1.08)
Labor strikes of garment workers*	4.39	(1.46)	4.80	(1.45)	3.98	(0.87)	3.55	(1.02)
Trail of tears	4.44	(1.40)	4.55	(1.55)	3.97	(0.87)	3.54	(1.05)
Japanese expansion	3.74	(1.39)	4.03	(1.42)	3.68	(0.75)	3.15	(1.00)
Democratic convention of 1968	4.29	(1.63)	4.73	(1.61)	3.82	(0.77)	3.71	(0.91)
Louisiana purchase	3.86	(1.46)	4.55	(1.44)	3.97	(0.76)	3.28	(1.12)
Erosion*	3.94	(1.42)	4.25	(1.31)	3.68	(0.87)	3.22	(0.85)
Species evolution due to isolation*	4.39	(1.46)	4.24	(1.39)	3.55	(1.09)	3.07	(1.16)
West Nile virus	4.85	(1.16)	4.90	(1.30)	4.11	(0.75)	3.36	(1.08)
Development of coal	3.67	(1.23)	3.89	(1.45)	3.37	(0.82)	2.98	(1.18)
Cancer cells	4.96	(1.45)	4.74	(1.43)	3.50	(1.08)	3.03	(1.21)
Pancreas functions	4.79	(1.37)	4.10	(1.45)	3.18	(0.98)	2.92	(1.28)

*Passages used in Studies 1 and 2.

Measures. Preinterest and postinterest were assessed with 7 items each. Each text was rated from 1 (Not at all) to 7 (Very much) on 4 feeling-related words (i.e., interesting, stimulating, boring [reversed], engaging) and 3 meaning-related words (i.e., meaningful, worthless [reversed], useful). These 7 ratings were averaged for each text. The reliability estimates (Cronbach's alpha) were high, ranging from .87 to .95.

Additional items were included to explore the relationship between interest and perceived coherence and vividness of the text. These items were taken from Schraw's (1997) work on interest in response to text. Three items asked participants to rate the extent to which the passage was vivid (e.g., "contained a lot of descriptive imagery," "contained vivid details") from 1 (Strongly disagree) to 5 (Strongly agree). The reliabilities for this measure were acceptable to high and ranged from .73 to .92 across passages. Participants also rated, on the same scale, 7 items about the coherence of each passage (e.g., "flowed smoothly," "was organized clearly"). The reliabilities for this measure were high and ranged from .82 to .95 across passages.

Procedure. Participants completed the study in small groups. They were given a brief statement of the topic of each passage and were asked to report their level of interest in each (preinterest). After reporting their preinterest for all 12 passages, they read each passage and, upon completing each, reported their interest in the passage (postinterest), perceived coherence, and perceived vividness. Participants completed the passages in one of four orders. These orders were determined randomly, except that two orders alternated science and then history (i.e., science, history, science, history), and the other two orders alternated history and then science (i.e., history, science, history, science).

Pretest Results

In order to select the passages for the subsequent studies, the distributions of preinterest and postinterest scores were examined for each essay. Recall that the primary aim was to identify passages with distributions of interest scores that were fairly wide and centered around the scale midpoint, allowing us to test the effects of interest on comprehension processes in the primary studies. The science passages identified for the subsequent studies included one on erosion and the other on geographic isolation and the evolution of new species (see Appendix). The history passages selected included one on the economic causes of the Civil War and the other on labor strikes among garment workers. Preinterest and postinterest ratings of these texts revealed moderate interest and sufficient variability across participants.

Study 1: Reading Times as a Measure of Comprehension Processes

In Study 1, participants read texts, one sentence at a time, and sentence RTs were collected. Individual-difference factors including prior domain knowledge, prior topic knowledge, reading skill, and working memory were also assessed.

Level 1 variables were based on sentence-level features of the discourse that influence processing; Level 2 variables were the individual-difference measures. Two-level hierarchical linear modeling (HLM) was used to analyze the repeated observations across the sentences in the text, nested within person, and to correlate both time-variant and time-invariant predictors with RT. This allowed us to accurately test whether individual-difference factors interacted with interest in the text on the time participants took to read individual sentences in each text.

Study 1 Method

Participants

A sample of 123 undergraduates at Northern Illinois University participated for course credit. The sample was 50% female (one person did not report gender). Individuals identified themselves as European American (62%), African American (19%), Hispanic (10%), and Asian American (7%). Two percent of participants reported that their ethnicity was something other than the options provided, and one person did not report ethnicity.

Materials

Participants read all four texts that were selected based on the results of the pretest (see Appendix). Preinterest and postinterest were assessed using the same measure that was used in the pretest.

The Gates–McGinitie (GM; Level 10/12, Form T) test of reading comprehension—a multiple-choice standardized test and also an experimenter-generated test—was used, which required participants to answer multiple-choice questions to expository passages. Raw scores were used on the test, with 48 being the maximum score.

To test working memory, participants first completed the computerized version of the operation span (OSPAN) task (Turner & Engle, 1989). In this task, the participant is presented with sets of multiple trials in which a mathematical operation is presented and followed by a random letter of the alphabet (e.g., IS 9 / 3 + 1 = 6? F). Participants are required to decide if the mathematical operation is true or false, indicate their decision by clicking the corresponding option on the screen, and remember the letter for later recall. Blocks consisted of 2–5 trials and a practice session was administered beforehand. An individual's working memory was computed as the number of letters the participant could recall in the order that they were presented by selecting them from a matrix of possible letters. Possible scores ranged from 0 to 75. The OSPAN task has been shown to be both reliable and valid, showing adequate internal consistency (.78) and test-retest reliability (.83) (Unsworth, Heitz, Schrock, & Engle, 2005).

General domain knowledge for science and history was assessed using an instrument developed by McNamara and colleagues (McNamara & the CSEP Lab, 2006). An approach developed by Todaro (2010) was used to compute topic-specific prior knowledge. In this procedure, participants are asked, before reading the text, to report everything they know on a topic associated with a text. Participants were asked to "List what you know about the following topic" and then the topics were provided (e.g., "The process of erosion and the factors that can affect the speed at which it occurs," "The contributing factors to the Civil War, including economic differences between the North and South," "The biological processes of adaptation that lead to the evolution of new species and the role of the environment in those processes," and "The labor strikes of women workers in garment factories during the late 1800s and early 1900s"). A prior knowledge score was computed between participants' prior knowledge protocols and each sentence of the text. These scores were generated using Latent Semantic Analysis (LSA; Landauer & Dumais, 1997), which provides a metric of semantic relatedness between any two segments of text. Cosines can technically range from –1 (completely opposite texts) to 1 (completely identical texts; Landauer & Dumais, 1997). For each participant, an LSA cosine was computed between their prior knowledge protocols and the entire text.

Recall Protocol Analyses

The recall protocols were scored to determine the number of idea units that were recalled. The text sentences and the recall protocols were parsed into idea units that consisted of verb clauses. The recall protocols were scored by determining whether a recall clause semantically overlapped with the text clauses. Inter-rater reliability was acceptable (Kappa = .76).

Ordinary least-squares regression was used to predict recall for each text separately. Therefore, one regression analysis was conducted for each text. In order to isolate the extent to which postinterest predicted passage recall, prior domain knowledge, prior topic knowledge, reading skill, and working memory were also included in the model. Therefore, each regression had five predictors: postinterest, general domain knowledge (history or science, depending on the text), topic knowledge, reading skill, and working memory. These were entered simultaneously in the first step and are reported below. Interactions between postinterest and the other variables were tested as well, using centered versions of the predictors. Each was entered by itself in the second step. Only one significant interaction emerged, and that is discussed below.

Reading Time Analyses

Hierarchical linear models (HLMs) were formulated such that Level 1 (i.e., within-text) variables were based on the discourse analyses of the text and Level 2 (i.e., person-level) variables were the individual-difference measures. Hierarchical linear modeling was used in this study because it was critical to link variability in RTs within participants (i.e., across sentences) to aspects of phrases in the text, as well as to test whether these relationships differed across individuals, depending on interest, prior knowledge, and working memory. For each sentence in the text, the extent to which features of the text (i.e., argument overlap, new argument, and causality) predicted RT variability was assessed, yielding coefficients for each individual describing the relationship between phrase characteristics and RTs. The second level of analysis included individual-difference variables (e.g., interest, prior domain knowledge, prior topic knowledge, reading skill, and working memory) to predict differences among individuals in these Level 1 coefficients. Using multiple regression analysis, the extent to which interest, knowledge, and working memory predicted recall of passage content was also tested.

Preliminary HLMs were run for the combined-text analyses primarily in order to assess the relationship between Level 1 variables and RTs. The combined-text analyses provided the optimal level of statistical power to assess these relationships. First, the Level 1 model was determined by adding the features of the text as time-variant covariates at Level 1, all grand-mean centered (Equation 1). These variables were as follows: sentence number (SN, to control for effects due to serial position); argument overlap (AO); new arguments (NA); and causality (C), allowing each partial regression coefficient to vary randomly across persons (RT_{ti} = reading time for person *i* for sentence *t*):

$$\begin{aligned}
RT_{ti} &= \pi_{0i} + \pi_{1i}(SN)_{ti} + \pi_{2i}(AO)_{ti} + \pi_{3i}(NA)_{ti} + \pi_{4i}(C)_{ti} + e_{ti} \\
\pi_{0i} &= \beta_{00} + r_{0i} \\
\pi_{1i} &= \beta_{10} + r_{1i} \\
\pi_{2i} &= \beta_{20} + r_{2i} \\
\pi_{3i} &= \beta_{30} + r_{3i} \\
\pi_{4i} &= \beta_{40} + r_{4i}
\end{aligned} \tag{1}$$

Those Level 1 predictors that did not randomly vary (i.e., VAR(r) = 0) were fixed in subsequent runs of the same model. β10 to β40 indicate the estimates of the Level 1 effects, averaged across persons. Next, a conditional model was run with both Level 1 and Level 2 variables, comprehension skill (CS), and working memory (WM), both grand-mean centered (Equation 2). In this model the tests of β01 and β02 estimate the effects of Level 2 predictors on RTs:

$$\begin{aligned}
RT_{ti} &= \pi_{0i} + \pi_{1i}(SN)_{ti} + \pi_{2i}(AO)_{ti} + \pi_{3i}(NA)_{ti} + \pi_{4i}(C)_{ti} + e_{ti} \\
\pi_{0i} &= \beta_{00} + \beta_{01}(CS)_{i} + \beta_{02}(WM)_{i} + r_{0i} \\
\pi_{1i} &= \beta_{10} + r_{1i} \\
\pi_{2i} &= \beta_{20} + r_{2i} \\
\pi_{3i} &= \beta_{30} + r_{3i} \\
\pi_{4i} &= \beta_{40} + r_{4i}
\end{aligned} \tag{2}$$

Separate analyses were conducted for each text in order to assess how prereading topic interest was correlated with RTs. The analyses of RTs by texts initially proceeded in the same way as for combined texts, with the same initial Level 1 model (see Equation 1). Level 1 random effects were modified to fixed effects using the same criteria as were used for the combined-text model. The Level 2 predictors differed, however, in the separate-text analyses to account for the main effect of interest, its interactions with other Level 2 predictors, and the cross-level interactions of interest with text features at Level 1. In the separate-text analyses, the following Level 2 predictors were added to the model: general knowledge (GK) of the topic (i.e., history or science), prior knowledge of the text topic (PK), comprehension skill (CS), working memory (WM), and preinterest (PRE-I) as predictors of the intercept. In addition, the Level 2 interactions of PK, CS, and WM each with PRE-I were added as predictors of the intercept. Preinterest was also added as a predictor of the AO/RT, NA/RT, and C/RT relationships to assess the cross-level interactions of interest with text features on RT (Equation 3). Note that Level 2 errors were only modeled for those Level 1 predictors that had significant variation in the unconditional model.

$$
\begin{aligned}
RT_{ti} &= \pi_{0i} + \pi_{1i}(SN)_{ti} + \pi_{2i}(AO)_{ti} + \pi_{3i}(NA)_{ti} + \pi_{4i}(C)_{ti} + e_{ti} \\
\pi_{0i} &= \beta_{00} + \beta_{01}(GK)_i + \beta_{02}(PK)_i + \beta_{03}(CS)_i + \beta_{04}(WM)_i + \beta_{05}(Pre-I)_i \\
&\quad \beta_{06}(PK * Pre-I)_i + \beta_{07}(CS * Pre-I)_i + \beta_{08}(WM * Pre-I)_i + r_{0i} \\
\pi_{1i} &= \beta_{10} + r_{1i} \\
\pi_{2i} &= \beta_{20} + \beta_{22}(Pre-I)_i + r_{2i} \\
\pi_{3i} &= \beta_{30} + \beta_{32}(Pre-I)_i + r_{3i} \\
\pi_{4i} &= \beta_{40} + \beta_{42}(Pre-I)_i + r_{4i}
\end{aligned} \qquad (3)
$$

Each of these series of models was run for each text. In this model, the main effects of the Level 2 predictors are estimated by β01 to β05; the Level 2 interactions of interest with other predictors are estimated by β06 to β08. The cross-level interactions with interest are estimated by β22 to β42 in this model.

Study 1 Results and Discussion

There were three sets of analyses. The preliminary analysis was conducted to assess the relationship between the Level 1 predictor variables and RTs. Combined-text rather than separate-text analyses were conducted; the former provided the statistical power required to best assess the relationship between Level 1 variables and RTs. The second set of analyses was conducted to assess the relationships between preinterest ratings and RTs. This required separate analyses to be conducted for each text. The third analysis was conducted to assess the relationships between postinterest and other individual-difference factors and recall performance.

Preliminary Analyses

There was statistically significant variation across texts in average RT, SN/RT relationship ($p < .001$), and C/RT relationship ($p < .01$), and there were differences in RTs between all texts and the Civil War text ($p < .001$; Table 2). The AO/RT and NA/RT relationships did not significantly vary across persons.

TABLE 2

Reading time by syllable for combined texts as a function of text features

Fixed Effects	β	*SE*	*df*
Intercept (β00)	194.29***	5.40	119
WM (β01)	−1.38**	0.50	119
CS (β02)	0.06	0.21	119
SN (β10)	−1.47***	0.22	121
Labor Strikes (β20)	33.98***	5.17	121
Erosion (β30)	11.72**	3.57	121
Evolution (β40)	13.20*	5.92	121
AO (β50)	−7.39***	0.74	11,092
NA (β60)	−6.28***	0.73	11,092
C (β70)	−7.31***	0.96	121
Random Effects	**Variance**		***df***
Intercept (r0)	2,865.29***		119
SN (r1)	3.38***		121
Labor Strikes (r2)	2,165.63***		121
Erosion (r3)	570.07***		121
Evolution (r4)	3,325.06***		121
AO (r5)	—		—
NA (r6)	—		—
C (r7)	64.06**		121
Level 1 (e)	11,257.45		

Note. AO = argument overlap; C = total causal statements; CS = comprehension skill; Erosion = indicator variable for erosion text; Evolution = indicator variable for evolution text; Labor Strikes = indicator variable for labor strikes text; NA = new arguments; SN = sentence number; WM = working memory.

*p < .05. **p < .01. ***p < .001.

With regard to the fixed effects, all of the Level 1 variables were statistically significant predictors of the variability in RTs across sentences. Sentence number, argument overlap, new arguments, and causality were significantly negatively related to RT ($p < .001$). Additionally, tests of the indicator variables for texts revealed that labor strikes ($p < .001$), erosion ($p < .01$), and evolution ($p < .05$) each had significantly longer RTs than the Civil War text (see Table 2).

TABLE 3

Reading time by syllable for each text as a function of text features and preinterest

	Civil War			Labor Strikes			Erosion			Evolution		
Fixed Effects	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*
Intercept (β00)	187.76****	6.27	113	231.87****	8.69	113	220.05****	7.46	113	189.12****	7.51	113
GK (β01)	–0.23	2.16	113	–0.01	2.73	113	0.12	2.99	113	3.28	3.65	113
CS (β02)	–0.87	0.68	113	–1.69**	0.70	113	–1.06	0.73	113	–1.74*	0.88	113
PK (β03)	–63.33**	24.17	113	–21.99	22.46	113	0.63	25.12	113	–15.25	26.82	113
WM (β04)	0.13	0.27	113	0.10	0.30	113	0.28	0.28	113	0.12	0.33	113
Pre-I (β05)	6.20**	3.07	113	11.69**	4.79	113	8.74*	4.50	113	1.34	4.75	113
Pre-I*WM (β06)	–0.26	0.23	113	0.24	0.21	113	–0.10	0.26	113	–0.14	0.32	113
Pre-I*CS (β07)	–0.14	0.43	113	–0.17	0.42	113	–0.63	0.70	113	–0.04	0.62	113
Pre-I*PK (β08)	18.44	14.79	113	–19.03	21.77	113	31.21	19.59	113	–11.95	15.23	113
SN (β10)	–0.86***	0.32	121	–2.05****	0.42	2,912	–2.62****	0.45	121	0.69	0.44	121
AO (β20)	–1.80*	0.98	3,034	–21.79****	3.56	120	–9.72****	1.67	120	–11.55****	1.32	2,546
Pre-I (β21)	–0.33	0.92	3,034	–8.44*	4.30	120	–0.63	0.80	120	–0.01	0.54	2,546
NA (β30)	–3.61****	0.96	3,034	–14.15****	1.47	2,912	5.40**	2.42	120	–2.68**	1.31	120
Pre-I (β31)	–0.84	0.74	3,034	–3.66***	1.39	2,912	0.21	1.37	120	–0.98	0.68	120
C (β40)	–4.41****	1.12	3,034	–11.33****	2.06	120	–4.33***	1.26	2,546	4.54*	2.69	2,546
Pre-I (β41)	–0.68	0.97	3,034	–4.11	2.53	120	–0.05	0.94	2,546	–1.83	1.56	2,546
Random Effects	Variance		*df*	Variance		*df*	Variance		*df*	Variance		*df*
Intercept (r0)	3,908.84****		113	3,075.50****		113	5,560.72****		113	5,645.51****		113
SN (r1)	7.40****		121	—		—	15.20****		121	256.00****		121
AO (r2)	—		—	898.38****		120	151.90****		120	—		—
NA (r2)	—		—	—		—	191.70***		120	177.25***		—
C (r3)	—		—	452.49****		120	—		—	—		—
Level 1 error (e)	5,456.08			20,111.88			7,970.46			6,654.85		

Note. AO = argument overlap; C = total causal statements; CS = comprehension skill; GK = general knowledge in history; NA = new arguments; PK = prior knowledge in specific topic; Pre-I = preinterest in topic; Pre-I*CS = preinterest in topic–comprehension skill interaction; Pre-I*PK = preinterest in topic–prior knowledge in specific topic interaction; Pre-I*WM = preinterest in topic–working memory interaction; SN = sentence number; WM = working memory.

*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

These analyses indicated that RTs decreased as a function of the presence of text factors that affect integration (i.e., argument overlap and causality). This is not surprising, as it has been shown that features that affect integration facilitate processing (e.g., Magliano, Trabasso, & Graesser, 1999; Magliano, Zwaan, & Graesser, 1999; Myers, Shinjo, & Duffy, 1987; Zwaan et al., 1995). It is somewhat surprising that the introduction of new argument nouns also negatively predicted RTs, although this replicated a finding by Todaro (2010). This is surprising because the introduction of new arguments has been shown to be positively correlated with elaborative processes, which should slow down processing (Magliano, Trabasso, & Graesser 1999; Magliano, Zwaan, & Graesser, 1999). This finding is difficult to interpret given the present data. However, one possibility stems from the fact that new arguments often occur in sentences that reflect a shift in topic, which is further explicated in the subsequent sentences. It is possible that readers speed up when new topics are introduced, operating under the assumption that future sentences will explain why they are relevant to the discourse topic. Obviously, further experimentation would be necessary to test this hypothesis.

Preinterest Analyses of Reading Times

Although there was significant random variability across individuals in average RTs across all texts ($p < .001$), there were considerable differences in the Level 1 coefficients that randomly varied across individuals across the four texts (Table 3). The relationships between text features and RTs were fairly consistent across texts. Argument overlap was significantly negatively related to RT in the labor strikes, erosion, and evolution texts ($p < .001$) and exhibited a similar negative trend in the Civil War text ($p < .1$). The number of new arguments was significantly negatively related to RTs in the Civil War, labor strikes ($p < .001$), and evolution texts ($p < .05$), whereas it was significantly positively related to RTs in the erosion text ($p < .05$). The total number of causal statements was significantly negatively related to RTs for the Civil War, labor strikes ($p < .001$), and erosion ($p < .01$) texts, while there was a trend in the positive direction for evolution ($p < .1$; see Table 3).

There are a number of effects of Level 2 individual-difference variables on RTs (see Table 3). Most importantly given the goals of this study, preinterest in the topic was significantly positively related to RTs for two of the history texts: Civil War and labor strikes ($p < .05$), and there was a trend in the positive direction for the erosion text ($p < .1$). Comprehension skill was significantly negatively related to RT in the labor strikes text ($p < .05$), and there was a trend in the negative direction in the evolution text ($p < .1$). Prior knowledge of the specific text topic was significantly negatively related to RT only for the Civil War text ($p < .05$). The effect of prior topic knowledge on RT only for the Civil War text may indicate that participants' knowledge of the Civil War surpassed that of other topics. General domain knowledge and working memory were not significantly related to RTs in any text. There were no significant interactions between preinterest and prior knowledge, comprehension skill, or working memory for any text (see Table 3).

The main effects of preinterest on RTs overall were that individuals who entered the task with higher interest spent more time reading than those who entered the task with lower interest. This was consistent with the hypothesis that interest involves deep learning strategies (Krapp, 1999; Schiefele, 1996). In other words, individuals who read the text with elevated preinterest may have spent more time reading because they wanted to immerse themselves in the topic and acquire as much knowledge from the reading material as possible. In addition, there was variability across texts in that this effect was strongest for both history texts, only marginally significant for erosion, and not significant for the evolution text. This variability in interest effects across texts may speak directly to the interaction between a person and a particular content domain that is inherent to the concept of interest (e.g., Renninger et al., 1992; Schiefele, 1991). Not only is the person critical to the way this interaction between person and text unfolds, but the characteristics of specific text passages are likely to afford different opportunities for learning.

There were two significant cross-level interactions involving preinterest. Preinterest was negatively related to the relationship between the number of new arguments and RT for labor strikes ($p < .01$): The negative relationship between new arguments and RT was stronger for those with higher preinterest (Figure 1; see Table 3). There was a similar trend in the interaction between argument overlap and preinterest for the labor strikes text: Higher preinterest was associated with a stronger negative relationship between argument overlap and RT ($p < .1$, Figure 2; see Table 3). Preinterest did not moderate the relationship between causality and RT in any text.

These main effects and cross-level interactions involving interest suggest that individuals with higher preinterest read the task more slowly overall, but then showed changes in speed in response to these text features. This shows that individuals with higher preinterest were especially sensitive to the relationship of nouns to the prior discourse, which may suggest that they were especially attentive to the discourse structure. Individuals with interest in a topic are responsive to the dynamics of a passage, within the topic that is of interest to them.

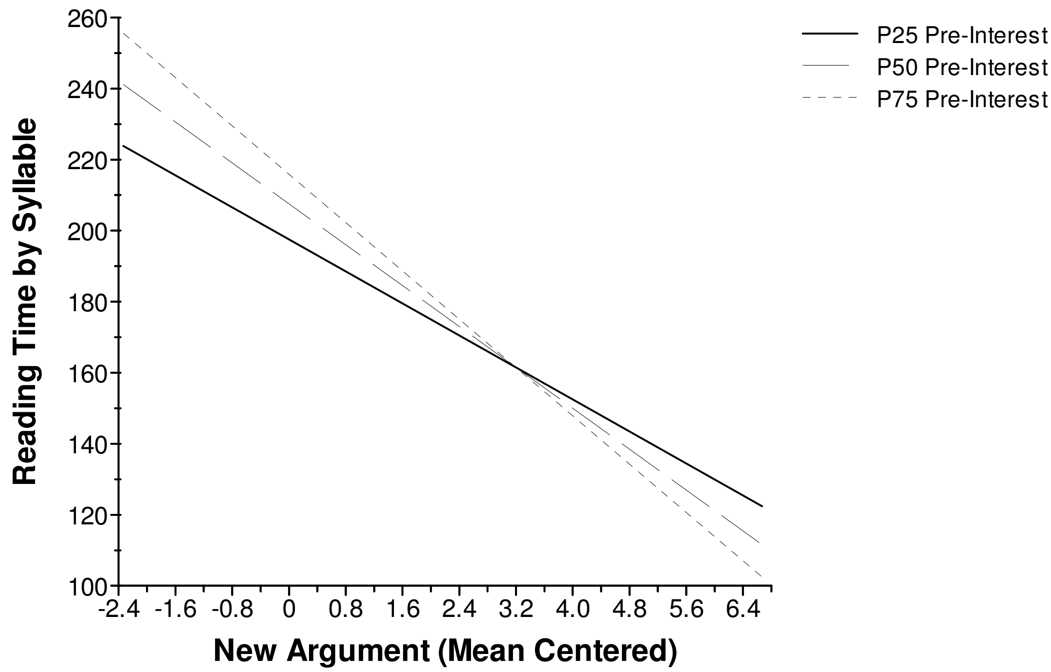

FIGURE 1. *The interaction between new arguments and preinterest in the prediction of RT by syllable for the labor strikes text*

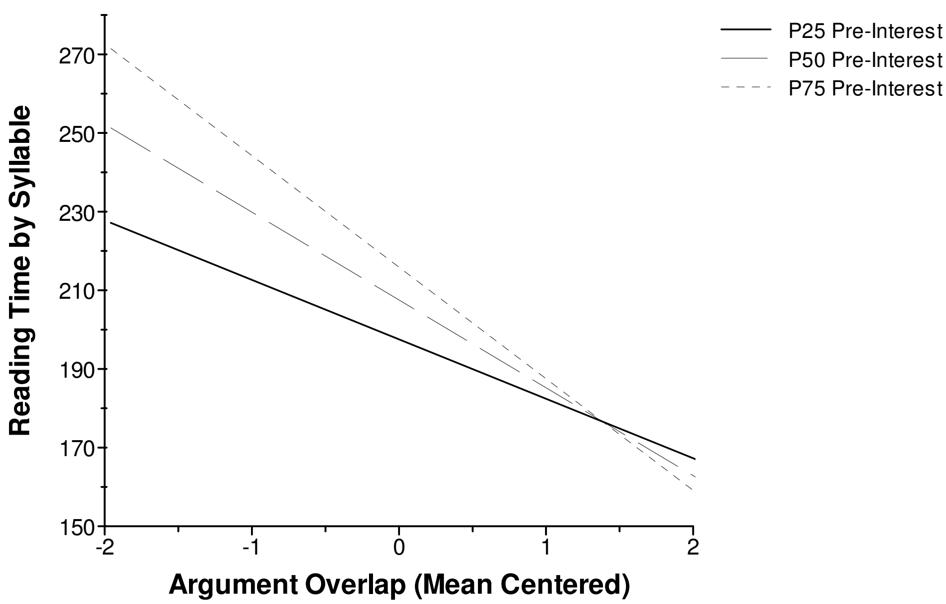

FIGURE 2. *The interaction between argument overlap and preinterest in the prediction of RT by syllable for the labor strikes text*

Recall Analyses

The variables in the first step of the regression predicting recall of the Civil War text accounted for significant variance overall, $F(5, 116) = 9.49$, $p < .01$, $R2 = .29$. The univariate effects indicated that postinterest positively predicted recall, $t(116) = 2.61$, $p = .01$, $\beta = .21$, such that individuals who finished the text with greater interest recalled more idea units from the text. In addition, general knowledge of history, $t(116) = 2.93$, $p < .01$, $\beta = .26$; and reading skill, $t(116) = 3.70$, $p < .01$, $\beta = .31$, positively predicted recall. When the interactions between postinterest and the other variables were tested, a significant interaction emerged between postinterest and prior topic knowledge for the Civil War text, $t(115) = -2.64$, $p < .05$, $\beta = -.21$ (Figure 3). This interaction revealed that the relationship between postinterest and recall varied by level of prior knowledge. Postinterest and recall were positively correlated among individuals with low initial knowledge, but not correlated among individuals with high initial knowledge.

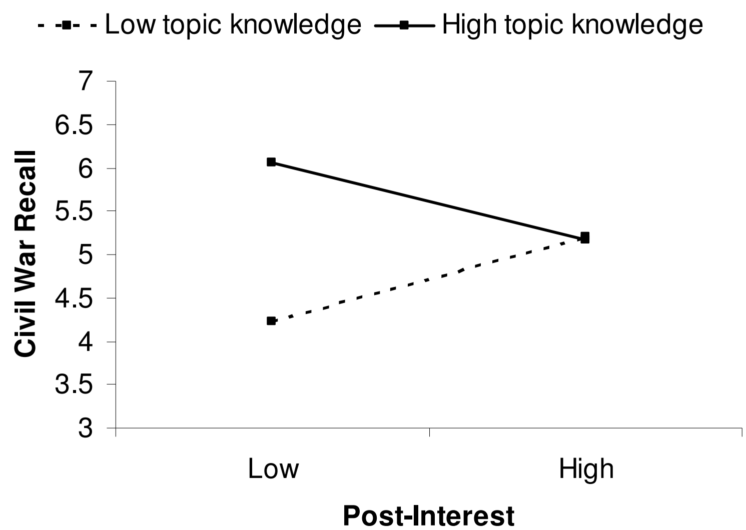

FIGURE 3. *Predicted slopes of the relationship between postinterest and recall for the Civil War text as a function of prior topic knowledge*

This interaction suggests that higher-knowledge readers are able to rely on a greater depth of background knowledge to support recall performance, such that the impact of interest on performance was attenuated. The comprehension processes for higher-knowledge readers are likely to be heavily supported by automatic, memory-based processes (e.g., McKoon & Ratcliff, 1998), and as such the amount of effort that they devote to processing the text matters less for supporting comprehension than it does for readers with lower knowledge. In contrast, postinterest was positively correlated with recall for lower-knowledge readers. The development of interest while reading the text may have given readers a resource to help them focus on the content and process the material more thoroughly (Hidi, 1990).

In the model predicting recall of the labor strikes text, again the variables accounted for significant variance, F(5, 116) = 7.61, $p < .01$, R2 = .25. As in the previous analysis, postinterest positively predicted recall, t(116) = 2.10, $p < .05$, β = .18. In addition, general knowledge of history, t(116) = 2.60, $p < .05$, β = .23; specific topic knowledge, t(116) = 2.55, $p < .05$, β = .22; and reading skill, t(116) = 2.33, $p < .05$, β = .21, were all significant positive univariate predictors.

The variables in the regression predicting recall of the erosion text accounted for significant variance overall, F(5, 116) = 11.57, $p < .01$, R2 = .33. The univariate effects indicated that postinterest positively predicted recall, t(116) = 3.50, $p < .01$, β = .27. In addition, prior topic knowledge of erosion, t(116) = 3.27, $p < .01$, β = .25; and reading skill, t(116) = 4.52, $p < .01$, β = .37, were also significant positive predictors.

In the model predicting recall of the evolution text, the variables accounted for significant variance overall, F(5, 116) = 11.54, $p < .01$, R2 = .33. As in the previous analyses, postinterest was a significant positive predictor of idea units, t(116) = 4.18, $p < .01$, β = .32, as were general knowledge of science, t(116) = 2.55, $p < .04$, β = .21, and reading skill, t(116) = 3.53, $p < .01$, β = .29.

There was one notable interaction between interest and prior knowledge that was revealed in only one text (i.e., Civil War; see Figure 3). Interest had less of an impact on recall for higher-knowledge readers than for lower-knowledge readers.

Given that postinterest was measured after participants had read the text, it is also necessary to consider the effects on recall from a different angle. It is possible that the development of knowledge, as evidenced by recall scores for individuals with low prior topic knowledge, led to feelings of interest and growth from reading the text. In this way, the extent to which individuals gained valuable knowledge from reading may have facilitated their postinterest (Alexander, Jetton, & Kulikowich, 1995).

Study 2: Verbal Protocols as a Measure of Comprehension Processes

The measures and procedures outlined for Study 1 were adopted for Study 2. However, rather than recording RTs as a processing measure, responses to think-aloud probes were collected using the Reading-Strategy Assessment Tool (RSAT), which provides a computer-based assessment of inference processes (Gilliam, Magliano, Millis, Levinstein, & Boonthum, 2007; Magliano, Millis, The RSAT Development Team, Levinstein, & Boonthum, in press). RSAT is designed to assess the extent to which readers engage in inference processes and strategies that are associated with comprehension, and it has been shown to correlate positively with human judgments of the presence of processes in the verbal protocols and outcome measures of comprehension (Gilliam et al., 2007; Magliano et al., in press).

RSAT is administered and scored on a computer. Users read narrative, history, and science texts, and in the context of this application of RSAT, are asked to answer questions that require them to produce think-aloud types of responses after each sentence in the texts. Computer-based algorithms are used to detect the extent to which readers engage in bridging (i.e., connecting sentences in the text) and elaboration (i.e., drawing upon prior knowledge outside of the text context).

Study 2 Method

Participants

A sample of 119 undergraduates at Northern Illinois University participated for course credit. The sample was 45% female. Individuals identified themselves as European-American (55%), African American (17%), Hispanic (7%), Asian American (4%), and Native American (1%). Sixteen percent of participants reported that their ethnicity was something other than the options provided, and one person did not report ethnicity information.

Materials

Study 2 used the same four texts and assessment instruments (preinterest, postinterest, prior domain knowledge, prior topic knowledge, reading skills, and working memory) as were used in Study 1. However, in Study 2, participants read and thought aloud for only two texts (one history, one science) because there was a concern regarding fatigue effects associated with reading and typing think-aloud responses to four texts. Participants read one science text and one history text, and the pairing of two history and two science texts was counterbalanced.

Apparatus

RSAT (Gilliam, et al. 2007, Magliano et al., in press) was used to present the texts, collect the data, and analyze the verbal protocols. RSAT is administered on personal computers in a Web-based environment. The texts are presented in black font in a gray field left-justified near the top of the computer screen. The title of each text remained centered at the top of the screen while participants read the entire text. In the current study, only one sentence of a text was shown on the screen during reading because this presentation has been shown to be a good predictor of comprehension skill (Gilliam et al., 2007; Magliano et al., in press). Participants navigated forward through the text by clicking on a “next” button, which was located near the bottom-left portion of the computer screen. After participants clicked the “next” button, the current sentence disappeared, and a prompt asking “What are you thinking now?” appeared. Participants typed their answers to the question in the response box just below the prompt. After typing a response, participants clicked a “next” button that was below the response box. When they did this, their response disappeared and the next sentence appeared. Responses were recorded on a computer server. When there was a shift to a new paragraph, participants were given the message “NEW PARAGRAPH.” Again, participants read only two texts, one from history and one from science, and text order was randomly determined by the program.

The RSAT tool evaluated the content words contained in each verbal response (Gilliam, in press, 2007; Magliano et al., in press). Content words included nouns, adverbs, adjectives, and verbs (semantically depleted verbs, such as “is” and “are” were omitted). Word matching was accomplished by literal word matching and Soundex matching (McNamara, Levinstein, & Boonthum, 2004), which detects misspellings and changes in verb forms (Birtwisle, 2002; Christian, 1998). With respect to the current study, two scores were computed. The bridging score was the number of content words that also appeared in any prior text sentences. The elaboration score was the number of content words in the answer that were not present in the text. These scores have been shown to be correlated with human judgments regarding the presence of these processes in verbal protocols, and mean bridging and elaboration scores were correlated with performance on standardized and nonstandardized measures of comprehension (Magliano et al., in press).

Finally, RSAT was designed to provide measures of comprehension processes that are indicative of comprehension. In prior research, protocols have been collected only at specific sentences that were especially indicative of comprehension (Magliano et al., in press). However, in the current study, protocols for every sentence in the texts were collected. In the primary analyses of verbal protocol responses, these were analyzed at the sentence level. However, they were also aggregated across sentences in a given text (as a Level 2 variable) so that they could be used to predict recall, which was a Level 2 variable.

Procedure

As was the case with Study 1, Study 2 took place in two sessions. The first session was identical to that of Study 1. The second session always started with RSAT. Participants were instructed to read two texts on the computer, one sentence at a time. They were told that they should “think aloud” while reading each sentence by reporting whatever thoughts came to mind immediately after reading each sentence in the text. In doing so, they were asked to focus on how they understood the sentence that they just read in the context of what they had read so far. These instructions mirror those advocated by Trabasso and Magliano (1996) and are intended to reveal processes that guide the integration of a sentence just read into the emerging mental representation of the text.

Before RSAT started, participants completed a paper-and-pencil practice packet. This practice required participants to read one sentence per page and produce verbal protocols after each sentence. They wrote out their thoughts directly on the practice packet. The experimenters provided them with general feedback prior to starting the computer version of RSAT. This feedback was restricted to instances in which participants typed uninformative responses, such as “I don’t know,” “OK,” or “Makes sense.” When these instances occurred, participants were instructed to reflect and report on their understanding of the text. Texts were presented in a random order. After completing RSAT, participants completed the postinterest measure and then were asked to recall the two texts. As was the case in Study 1, a brief overview of the passage was given as a prompt, and participants could recall content in any order that they wanted. Upon completion of the recall phase, participants were administered OSPAN.

Discourse Analyses

HLM analyses were conducted for both bridging and elaboration to test (a) the Level 1 relationships between aspects of the passage phrases (i.e., argument overlap, new arguments, causal antecedents) and verbal protocols; (b) the effect of individual-difference variables (e.g., interest, general knowledge, prior knowledge, attentional control, comprehension skill) on verbal protocols; and (c) the moderating effect of interest on Level 2 effects and on the Level 1 relationships.

The Level 1 variables in Study 2 were the same as those in Study 1; the Level 2 predictors were the same as those in Study 1, except separate analyses were run for preinterest and postinterest. Additionally, in Study 2 there were two dependent measures—bridging and elaboration—resulting in four series of HLM analyses overall, following the same analysis process as that for Study 1. Structurally then, Equations 1–3 could be also used to describe the analyses in Study 2.

Recall Analyses

As in Study 1, multiple regression was used in Study 2 to predict recall for each text separately. Each regression had five predictors entered in the first step: postinterest, general domain knowledge (history or science, depending on the text), topic knowledge, reading skill, and working memory. In the second step, the variables derived from the think-aloud responses were entered. These variables were mean bridging and elaboration scores for each participant. Then, each interaction between postinterest and the other individual-difference variables was entered alone in the final step, using centered versions of the predictors.

Study 2 Results and Discussion

There were three sets of analyses that mirrored those for Study 1: combined-text, separate-text, and recall. However, it is important to note that two dependent variables were derived from the verbal protocol responses: bridging and elaboration scores. Therefore, a pair of analyses was conducted for combined-text analyses and separate-text analyses. In addition, because think-aloud protocols are ambiguous in terms of whether they involve online or offline processing, both preinterest and postinterest were analyzed.

Preliminary Analyses

For bridging, there was statistically significant variability in average bridging across persons ($p < .001$), relationship between sentence number and bridging ($p < .01$), and difference in bridging between science and history texts ($p < .001$; see random effects, Table 4).

Of the fixed-effect tests of the Level 1 variables, sentence number was significantly positively related to bridging ($p < .001$), whereas argument overlap ($p < .01$) and new arguments ($p < .001$) were significant negative predictors of bridging. There was a trend in the difference in bridging between science and history texts, indicating more bridging for history texts ($p < .1$; see Table 4). Of the two Level 2 variables used to predict bridging on the combined-text analyses, only reading skill was a significant positive predictor of bridging (see Table 4).

TABLE 4
Think-aloud strategies for combined texts as a function of text features

	Bridging			Elaboration		
Fixed Effects	β	*SE*	*df*	β	*SE*	*df*
Intercept (β00)	0.74****	0.06	115	3.71****	0.20	115
WM (β01)	–0.00	0.00	115	–0.00	0.01	115
CS (β02)	0.02***	0.00	115	0.05***	0.01	115
SN (β10)	0.02****	0.00	117	–0.05****	0.01	117
Science (β20)	–0.10*	0.06	117	–0.46***	0.13	117
AO (β30)	–0.04***	0.01	5,233	0.10****	0.02	5,233
NA (β40)	–0.06****	0.01	5,233	0.12****	0.02	117
C (β50)	–0.01	0.01	5,233	–0.05**	0.02	5,233
Random Effects	Variance		*df*	Variance		*df*
Intercept (r0)	0.19****		115	4.30****		115
SN (r1)	0.00***		117	0.00****		117
Science (r2)	0.28****		117	1.64****		117
AO (r3)	—		—	—		—
NA (r4)	—		—	0.02***		117
C (r5)	—		—	—		—
Level 1 error (e)	1.16			3.20		

Note. AO = argument overlap; C = total causal statements; CS = comprehension skill; NA = new arguments; Science = Indicator variable for science text; SN = sentence number; WM = working memory.
*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

Contrary to expectations, the text features typically associated with text integration (argument overlap and causality) were not positively correlated with bridging score. In fact, bridging scores were significantly negatively correlated with argument overlap. These results are difficult to explain and are not consistent with prior research that shows that causality is positively correlated with bridging inferences (e.g., Magliano, Trabasso, & Graesser, 1999). One possible explanation involves the validity of automated scoring of bridging inferences used in RSAT. To obtain a bridging score, RSAT counts the number of words that are present in a given verbal protocol that also appeared in the prior discourse context. Although this measure is correlated with human judgments of the presence of bridging when comprehending narrative text (Magliano et al., in press), it is only a proxy for bridging. However, it is also important to note that Todaro (2010) used a similar measure of bridging and found the expected significant positive correlation between causality and bridging. An alternative explanation may be that the implicit causal structure of a text is less apparent to readers when comprehending expository text than when comprehending narrative text, but again Todaro (2010) used science texts as well. A final possibility is that the effect of causality and argument overlap on bridging is moderated by interest level (or other individual-difference variables for that matter).

In addition, there was a significant negative correlation between the presence of new arguments in the text and bridging. In other words, when individuals encountered new arguments in the text they were less likely to bridge. This is consistent with prior research (Magliano, Trabasso, & Graesser, 1999; Todaro, 2010) in that factors that are positively correlated with elaborations are negatively correlated with integration, suggesting that these processes do not co-occur (Todaro, 2010). This does show that readers' bridging processes were correlated with the text structure (Magliano, Trabasso, & Grasser, 1999).

There was statistically significant variability in average levels of elaboration across individuals ($p < .001$). Moreover, the sentence number–elaboration relationship ($p < .001$), the new argument–elaboration relationship ($p < .01$), and the difference in elaboration between science and history texts ($p < .001$) significantly varied across texts (see Table 4).

All Level 1 variables were statistically significant predictors of elaboration. Sentence number ($p < .001$) and causality ($p < .05$) were significant negative predictors of elaboration. The science text indicator variable was also a significant negative predictor ($p < .01$), indicating that elaboration was higher in history than in science texts. Argument overlap and number of new arguments were significant positive predictors of elaboration ($p < .001$; see Table 4). Of the two Level 2 variables, reading skill was a significant positive predictor of elaboration ($p < .01$; see Table 4).

These data are consistent with prior research suggesting that the introduction of new topics to the discourse is predictive of elaboration (Magliano, Trabasso, & Graesser, 1999). The current study found evidence that elaborative processes are negatively correlated with the presence of cues that support integration, namely causality (Magliano, Trabasso, & Graesser, 1999; Todaro, 2010). These findings suggest that readers tend to engage in integrative and elaborative processes at different sentences, based on how those sentences are related to the prior discourse structure.

Bridging–Preinterest Analyses

There was statistically significant variability in average bridging across individuals for each text ($p < .001$ for Civil War, labor strikes and erosion; $p < .05$ for evolution). Additionally, there was statistically significant random variability in the sentence number–bridging relationship for labor strikes ($p < .01$) and evolution texts ($p < .05$; Table 5). None of the other Level 1 variables had statistically significant random variability across texts.

For the Civil War text, only one Level 1 predictor had a statistically significant fixed effect: The relationship between sentence number and bridging was significant and positive ($p < .001$). However, the relationship between causality and bridging was negative ($p < .1$). Of the Level 2 predictors, only prior knowledge was a significant predictor of bridging ($p < .01$; see Table 5), and it was positively related. Preinterest and its interaction with Level 1 or Level 2 variables were not significant predictors of bridging for the Civil War text.

TABLE 5
Bridging for each text as a function of text features and preinterest

	Civil War			Labor Strikes			Erosion			Evolution		
Fixed Effects	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*
Intercept (β00)	0.74****	0.08	47	0.96****	0.11	52	0.61****	0.07	50	0.05****	0.09	50
GK (β01)	0.02	0.04	47	0.01	0.04	52	0.01	0.04	50	–0.05	0.04	50
CS (β02)	0.01	0.01	47	0.02**	0.01	52	0.01	0.01	50	0.04***	0.01	50
PK (β03)	1.02***	0.37	47	1.02***	0.31	52	0.26	0.38	50	0.53	0.40	50
WM (β04)	0.00	0.01	47	–0.01*	0.00	52	0.01	0.01	50	–0.00	0.00	50
Pre-I (β05)	–0.10	0.09	47	–0.05	0.08	52	–0.04	0.06	50	–0.03	0.05	50
Pre-I*WM (β06)	–0.01	0.00	47	0.00	0.00	52	–0.00	0.00	50	–0.00	0.00	50
Pre-I*CS (β07)	–0.01	0.01	47	0.00	0.01	52	0.00	0.01	50	–0.01***	0.00	50
Pre-I*PK (β08)	0.24	0.49	47	0.02	0.40	52	–0.14	0.29	50	0.09	0.29	50
SN (β10)	0.02****	0.00	1,324	0.01	0.01	60	0.03****	0.00	1,281	0.03****	0.01	58
AO (β20)	0.02	0.02	1,324	–0.07**	0.03	1,386	–0.08****	0.02	1,281	–0.03	0.02	1,163
Pre-I (β21)	0.02	0.02	1,324	0.01	0.03	1,386	–0.00	0.02	1,281	0.01	0.01	1,163
NA (β30)	0.00	0.02	1,324	–0.13****	0.02	1,386	–0.04	0.03	1,281	–0.03	0.02	1,163
Pre-I (β31)	0.00	0.01	1,324	0.03	0.02	1,386	–0.03	0.03	1,281	–0.00	0.01	1,163
C (β40)	–0.04*	0.02	1,324	0.04*	0.02	1,386	–0.02	0.02	1,281	0.04	0.05	1,163
Pre-I (β41)	–0.02	0.02	1,324	–0.04*	0.02	1,386	0.00	0.02	1,281	0.05	0.03	1,163
Random Effects	Variance		*df*	Variance		*df*	Variance		*df*	Variance		*df*
Intercept (r0)	0.24****		47	0.28****		52	0.27****		50	0.09**		50
SN (r1)	—		—	0.00***		60	—		—	0.00**		58
AO (r2)	—		—	—		—	—		—	—		—
NA (r2)	—		—	—		—	—		—	—		—
C (r3)	—		—	—		—	—		—	—		—
Level 1 error (e)	1.06			1.28			1.18			1.05		

Note. AO = argument overlap; C = total causal statements; CS = comprehension skill; GK = general knowledge in history; NA = new arguments; PK = prior knowledge in specific topic; Pre-I = preinterest in topic; Pre-I*CS = preinterest in topic–comprehension skill interaction; Pre-I*PK = preinterest in topic–preknowledge in specific topic interaction; Pre-I*WM = preinterest in topic–working memory interaction; SN = sentence number; WM = working memory.
*p < .10. **p < .05. ***p < .01. ****p < .001.

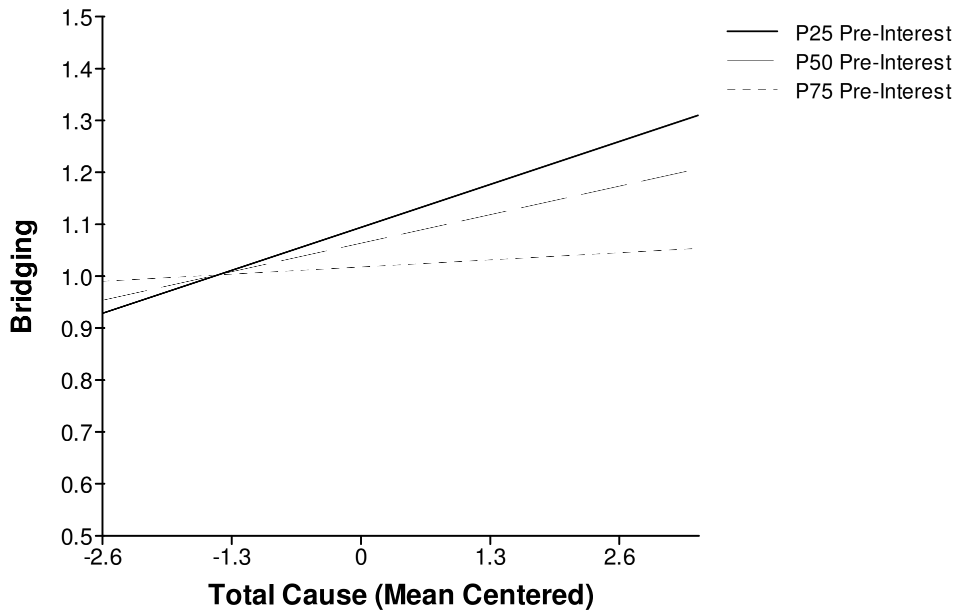

FIGURE 4. *The interaction between causality (total cause) and preinterest in the prediction of bridging for the labor strikes text*

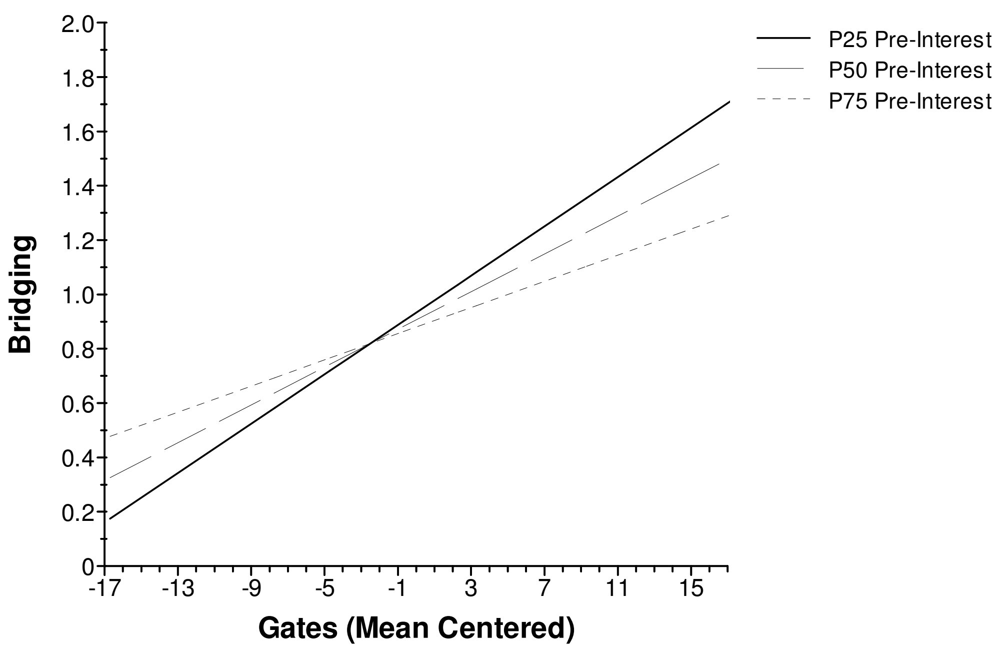

FIGURE 5. *The interaction between reading comprehension (Gates) and preinterest in the prediction of bridging for the evolution text*

There were a greater number of significant relationships to bridging for the labor strikes text. All three of the measures of features of the text were statistically significant predictors of—or at least exhibited a negative trend in predicting—bridging in the labor strikes text. Argument overlap ($p < .05$) and new arguments ($p < .001$) were significant negative predictors of bridging, and causality exhibited a negative trend in predicting bridging ($p < .1$; see Table 5). Of the Level 2 predictors, comprehension skill ($p < .05$) and prior knowledge ($p < .01$) were significantly positively predictive of bridging, but working memory was a negative predictor of bridging ($p < .1$). Additionally, preinterest exhibited a negative trend in the moderation of the causality–bridging relationship (see Table 5). As shown in Figure 4, those with lower preinterest had a stronger positive relationship between causality and bridging than those with higher preinterest. This interaction is the opposite of what one would expect. Specifically, lower-interest readers were more sensitive to causality than higher-interest individuals, as evidenced by a steeper slope for the former than in the latter.

For the erosion text, sentence number was significantly positively related to bridging ($p < .001$) and argument overlap was significantly negatively related to bridging ($p < .001$; see Table 5). None of the Level 2 variables or interactions was a significant predictor of bridging for the erosion text.

The only Level 1 variable that was a significant predictor of bridging for the evolution text was sentence number, which was positively related to bridging ($p < .001$; see Table 5). Of the person-level variables, comprehension skill was a significant positive predictor of bridging for the evolution text ($p < .01$). Additionally, preinterest was a significant negative predictor of the comprehension skill–bridging relationship: Those with lower preinterest exhibited a stronger positive relationship between comprehension skill and bridging (see Table 5; Figure 5). Lower-interest readers have to draw upon the resources that underlie skill to supporting interest more so than higher-interest readers. Another interpretation of this interaction is that it suggests that interest can be a resource for individuals with lower reading skill (de Sousa & Oakhill, 1996). Specifically, a high level of interest can support engagement in such a way that reading skill becomes less important for integrative processes.

Bridging–Postinterest Analyses

There was statistically significant variability in average bridging across individuals for each text ($p < .001$ for Civil War, labor strikes, and erosion; $p < .05$ for evolution). Additionally, there was statistically significant random variability in the sentence number–bridging relationship for two texts ($p < .01$ for labor strikes, $p < .05$ for evolution; Table 6). None of the other Level 1 variables had statistically significant random variability across texts.

TABLE 6

Bridging for each text as a function of text features and postinterest

	Civil War			Labor Strikes			Erosion			Evolution		
Fixed Effects	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*
Intercept (β00)	0.76****	0.06	47	0.92****	0.11	52	0.58****	0.07	50	0.51****	0.09	50
GK (β01)	0.03	0.03	47	0.03	0.04	52	–0.03	0.05	50	–0.05	0.04	50
CS (β02)	0.01	0.01	47	0.02**	0.01	52	0.01*	0.01	50	0.04***	0.01	50
PK (β03)	0.54	0.44	47	1.01***	0.35	52	0.07	0.34	50	0.44	0.30	50
WM (β04)	–0.00	0.00	47	–0.01**	0.00	52	0.00	0.00	50	–0.00	0.00	50
Post-I (β05)	0.10	0.07	47	0.07	0.05	52	0.04	0.05	50	–0.02	0.05	50
Post-I*WM (β06)	0.01***	0.01	47	0.00	0.00	52	0.01	0.00	50	–0.00	0.00	50
Post-I*CS (β07)	–0.00	0.01	47	0.01	0.01	52	–0.02*	0.01	50	–0.01	0.01	50
Post-I*PK (β08)	–0.34	0.28	47	0.34	0.30	52	–0.17	0.03	50	0.19	0.31	50
SN (β10)	0.02****	0.00	1,324	0.01	0.01	60	0.03****	0.00	1,281	0.03****	0.01	58
AO (β20)	0.02	0.02	1,324	–0.07**	0.03	1,386	–0.08****	0.02	1,281	–0.03	0.02	1,163
Post-I (β21)	0.02*	0.01	1,324	0.02	0.03	1,386	0.01	0.02	1,281	0.01	0.01	1,163
NA (β30)	0.00	0.02	1,324	–0.13****	0.02	1,386	–0.04	0.03	1,281	–0.03	0.02	1,163
Post-I (β31)	0.02	0.02	1,324	–0.00	0.02	1,386	–0.02	0.03	1,281	0.01	0.01	1,163
C (β40)	–0.04*	0.02	1,324	0.04*	0.02	1,386	–0.02	0.02	1,281	0.04	0.05	1,163
Post-I (β41)	0.01	0.02	1,324	–0.01	0.01	1,386	–0.01	0.02	1,281	0.04	0.03	1,163
Random Effects	Variance		*df*	Variance		*df*	Variance		*df*	Variance		*df*
Intercept (r0)	0.19****		47	0.29****		52	0.22****		50	0.09**		50
SN (r1)	—		—	0.00***		60	—		—	0.00**		
AO (r2)	—		—	—		—	—		—	—		—
NA (r2)	—		—	—		—	—		—	—		—
C (r3)	—		—	—		—	—		—	—		—
Level 1 error (e)	1.06			1.29			1.18			1.05		

Note. AO = argument overlap; C = total causal statements; CS = comprehension skill; GK = general knowledge in history; NA = new arguments; PK = prior knowledge in specific topic; Post-I = postinterest in topic; Post-I*CS = postinterest in topic–comprehension skill interaction; Post-I*PK = postinterest in topic–prior knowledge in specific topic interaction; Post-I*WM = postinterest in topic–working memory interaction,
SN = sentence number; WM = working memory.
*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

For the postinterest analyses, the Level 1 analyses are the same as for preinterest, so the results will not be reported again. For the Civil War text, postinterest had a positive trend as a moderator of the argument overlap–bridging relationship ($p < .1$); persons with higher postinterest had a stronger positive relationship between argument overlap and bridging than those with lower postinterest (Figure 6). This interaction suggests that higher-interest readers are more sensitive than lower-interest readers to some text features that support integration.

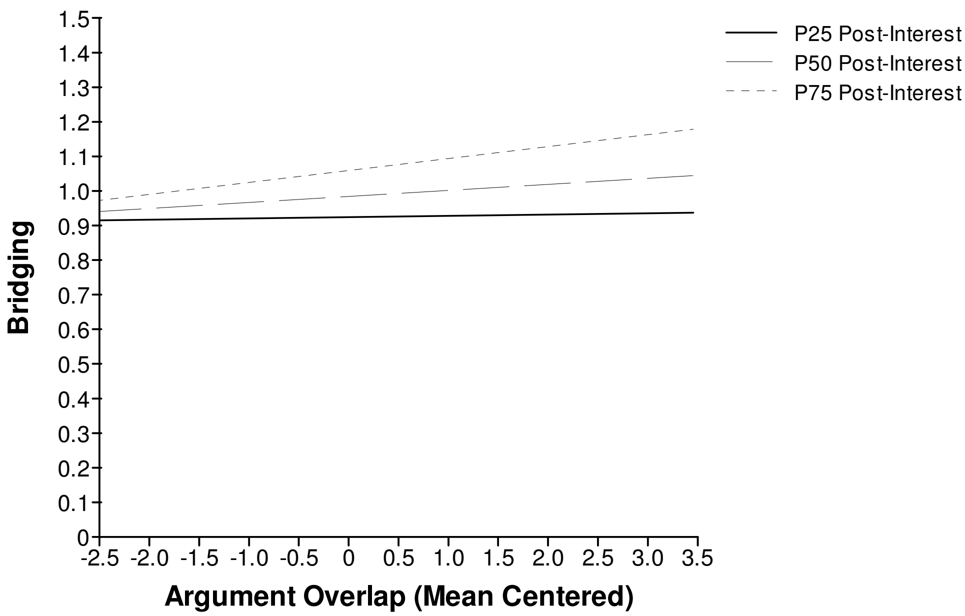

FIGURE 6. *The interaction between argument overlap and postinterest in the prediction of bridging for the Civil War text*

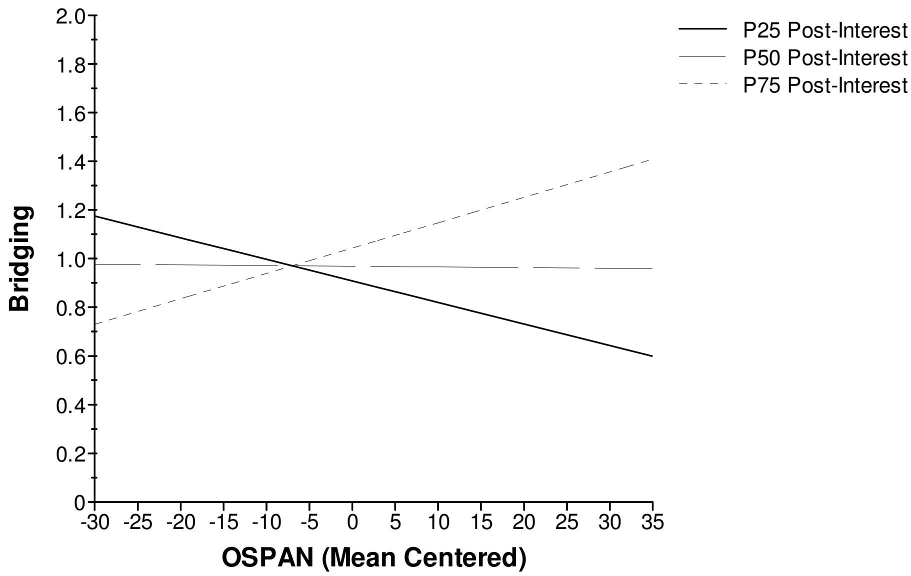

FIGURE 7. *The interaction between working memory (OSPAN) and postinterest in the prediction of bridging for the Civil War text*

Additionally, postinterest was a significant moderator of the working memory–bridging relationship, exhibiting a disordinal interaction. For persons with higher postinterest, the working memory–bridging relationship was positive and for those with lower postinterest, the working memory–bridging relationship was negative (see Table 6; Figure 7). To interpret these data, one must consider that the measure, OSPAN, supposedly measures attentional control in addition to working memory (Engle, 2002). Apparently higher-interest readers with higher-level working memory devote more recourse to bridging than lower-interest readers with higher-level working memory. The former may have been devoting attentional resources to constructing a coherent representation, whereas the latter were not.

In the labor strikes text, prior knowledge ($p < .01$) and comprehension skill ($p < .05$) were significant positive predictors of bridging, and working memory was a significant negative predictor of bridging ($p < .05$; see Table 6). Postinterest and its interactions were not significant predictors in the labor strikes text.

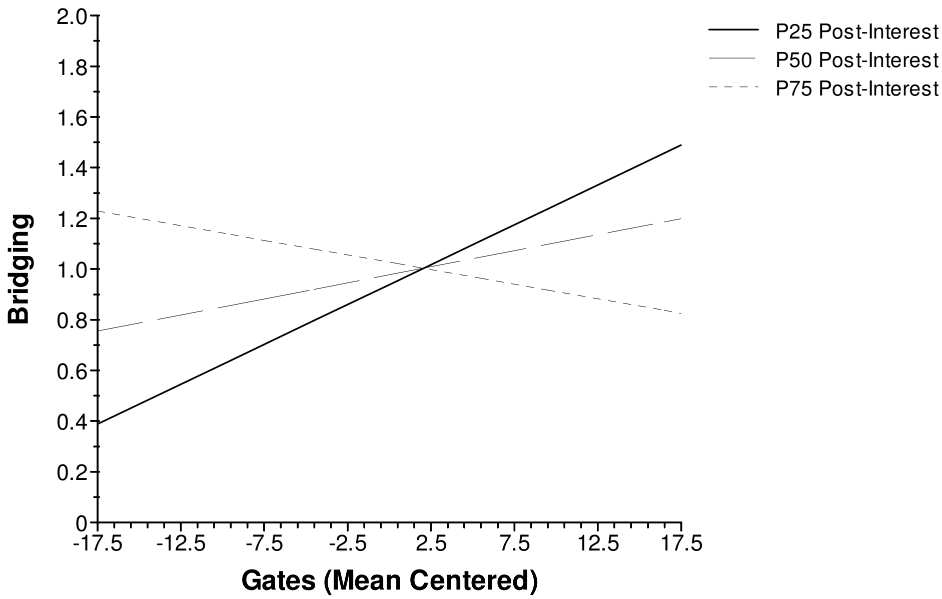

FIGURE 8. *The interaction between comprehension skill (Gates) and postinterest in the prediction of bridging for the erosion text*

Comprehension skill had a positive trend with bridging ($p < .1$) in the erosion text. Additionally, there was a negative trend of postinterest on the comprehension skill–bridging relationship ($p < .1$), exhibiting a disordinal interaction. For persons with lower postinterest, the comprehension skill–bridging relationship was positive and for those with higher postinterest, the comprehension skill–bridging relationship was negative (see Table 6; Figure 8). For lower-interest readers, comprehension skill positively predicted bridging, but for higher-interest readers, the slope was relatively flat and somewhat negative. The most straightforward interpretation of this interaction is that for higher-interest readers, skill had less of an impact on bridging processes, most likely because higher-interest readers were more engaged than lower-interest readers.

The only significant Level 2 predictor of bridging for the evolution text was comprehension skill ($p < .01$), which had a positive relationship with bridging (see Table 6). Postinterest and its interactions were not significant predictors in the evolution text.

Elaboration–Preinterest Analyses

With regard to random effects, there was statistically significant variability in the average elaboration across individuals for all texts ($p < .001$). Additionally, there was statistically significant random variability in the sentence number–elaboration relationship for all texts ($p < .001$). For the erosion text, there was statistically significant variability in the argument overlap–elaboration relationship across persons ($p < .05$; Table 7).

For the Civil War text, only one Level 1 predictor had a statistically significant fixed effect: The sentence number–elaboration relationship was significant and negative ($p < .001$), but the new arguments–elaboration relationship exhibited a positive trend ($p < .1$). Of the Level 2 predictors, general knowledge exhibited a positive trend with elaboration ($p < .1$; see Table 7). Preinterest and its interaction with Level 1 or Level 2 variables were not significant predictors of elaboration.

For the labor strikes text, the relationship between sentence number and elaboration was significant and negative ($p < .001$). Additionally, the relationships between the text features of argument overlap ($p < .01$) and new arguments ($p < .001$) were significantly positively related to elaboration (see Table 7). Comprehension skill ($p < .05$) and prior knowledge ($p < .01$) were significantly positively related to elaboration. In the labor strikes text, general knowledge exhibited a positive trend with elaboration; working memory exhibited a negative trend ($p < .1$).

TABLE 7

Elaboration for each text as a function of text features and preinterest

	Civil War			Labor Strikes			Erosion			Evolution		
Fixed Effects	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*
Intercept (β00)	3.49****	0.31	47	4.12****	0.32	52	2.92****	0.24	50	3.66****	0.34	50
GK (β01)	0.14*	0.07	47	0.17*	0.09	52	–0.00	0.08	50	–0.11	0.09	50
CS (β02)	0.02	0.02	47	0.05**	0.02	52	0.04**	0.02	50	0.08**	0.04	50
PK (β03)	–0.61	0.96	47	2.10***	0.72	52	0.40	0.72	50	–0.33	0.85	50
WM (β04)	0.00	0.01	47	–0.01*	0.01	52	0.00	0.01	50	–0.01	0.01	50
Pre-I (β05)	–0.25	0.18	47	–0.05	0.13	52	–0.03	0.12	50	0.09	0.12	50
Pre-I*WM (β06)	–0.13	0.01	47	–0.02**	0.01	52	–0.00	0.01	50	–0.01	0.01	50
Pre-I*CS (β07)	0.02	0.02	47	0.01	0.01	52	–0.01	0.02	50	–0.02	0.02	50
Pre-I*PK (β08)	–2.09	1.47	47	0.17	0.69	52	0.77	0.69	50	–1.44	0.89	50
SN (β10)	–0.04****	0.01	55	–0.06****	0.01	60	–0.04****	0.01	58	–0.05****	0.01	58
AO (β20)	0.06	0.04	1,324	0.19***	0.05	1,386	0.19****	0.04	57	0.00	0.04	1,163
Pre-I (β21)	–0.01	0.02	1,324	–0.05	0.05	1,386	–0.01	0.03	57	–0.01	0.03	1,163
NA (β30)	0.08*	0.04	1,324	0.15****	0.03	1,386	0.12***	0.04	1,281	0.13***	0.04	1,163
Pre-I (β31)	–0.02	0.04	1,324	–0.03	0.02	1,386	0.04	0.03	1,281	0.06**	0.03	1,163
C (β40)	–0.04	0.05	1,324	–0.03	0.04	1,386	–0.10**	0.05	1,281	0.18	0.11	1,163
Pre-I (β41)	–0.03	0.04	1,324	0.03	0.04	1,386	–0.04	0.04	1,281	0.17**	0.08	1,163
Random Effects	Variance		*df*	Variance		*df*	Variance		*df*	Variance		*df*
Intercept (r0)	5.63****		47	6.40****		52	2.67****		50	5.26****		50
SN (r1)	0.00****		55	0.01****		60	0.00****		58	0.01****		58
AO (r2)	—		—	—		—	0.03**		57	—		—
NA (r2)	—		—	—		—	—		—	—		—
C (r3)	—		—	—		—	—		—	—		—
Level 1 error (e)	3.21			3.67			2.35			3.17		

Note. AO = argument overlap; C = total causal statements; CS = comprehension skill; GK = general knowledge in history; NA = new arguments; PK = prior knowledge in specific topic; Pre-I = preinterest in topic; Pre-I*CS = preinterest in topic–comprehension skill interaction; Pre-I*PK = preinterest in topic–prior knowledge in specific topic interaction; Pre-I*WM = preinterest in topic–working memory interaction; SN = sentence number; WM = working memory.

*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

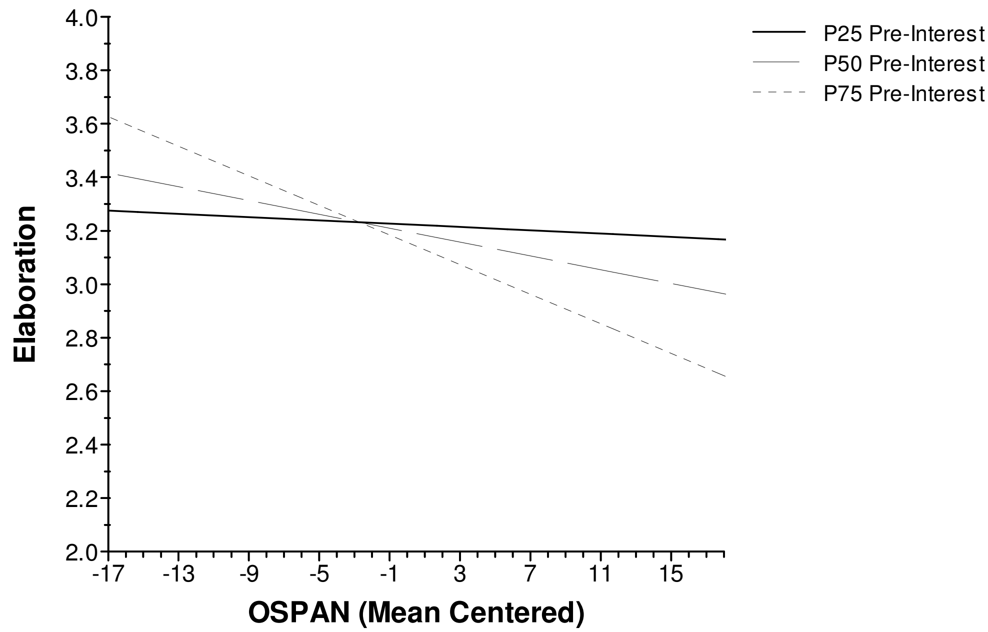

FIGURE 9. *The interaction between working memory (OSPAN) and preinterest in the prediction of elaboration for the labor strikes text*

Further, there was a significant negative interaction of preinterest with the working memory–elaboration relationship ($p < .05$): Those with higher preinterest had a stronger negative relationship between working memory and elaboration than those with lower preinterest (see Table 7; Figure 9). This interaction suggested that working memory was negatively correlated with elaboration among higher-interest readers. In contrast, the impact of working memory was relatively flat for lower-interest readers. This interaction may seem counterintuitive, because one would expect readers with higher-level working memory to have more resources to engage in elaboration (Just & Carpenter, 1992). This interaction is consistent with the interaction involving bridging reported in Figure 7, which suggests that interest dictates where readers with higher working memory devote their resources for processing the text. In particular, higher-interest readers will be more focused on text and will elaborate less to the extent that they have higher-level working memory. It is also important to note that not all elaborations are relevant and support comprehension (e.g., Coté, Goldman, & Saul, 1998). RSAT does not distinguish between relevant and irrelevant elaboration, and this interaction may reflect the fact that higher-interest readers with higher-level working memory were more apt to stay on task and generate appropriate elaborative inferences as opposed to more irrelevant elaboration. More detailed analyses of the protocols and elaborations would be required to assess this possibility.

For the erosion text, the relationship between sentence number and elaboration was significant and negative ($p < .001$). Additionally, the relationships between all the text features and elaboration were significant. Argument overlap ($p < .001$) and new arguments ($p < .01$) were each positively related to elaboration, while causality was negatively related to elaboration ($p < .05$; see Table 7). The only Level 2 predictor significantly related to elaboration in the erosion text was comprehension skill, which had a negative relationship ($p < .05$; see Table 7). Preinterest and its interaction with Level 1 or Level 2 variables were not significant predictors of elaboration for the erosion text.

For the evolution text, the relationship between sentence number and elaboration was significant and negative ($p < .001$). The number of new arguments was significantly positively related to elaboration in this text ($p < .05$; see Table 7). At level 2, comprehension skill was a significant positive predictor of elaboration ($p < .05$). Preinterest was a significant positive moderator of two Level 1 effects: the new argument–elaboration relationship and the causality–elaboration relationship ($p < .05$; see Table 7). In both cases, higher preinterest was associated with a stronger positive relationship between the text feature and elaboration than lower preinterest (Figures 10 and 11).

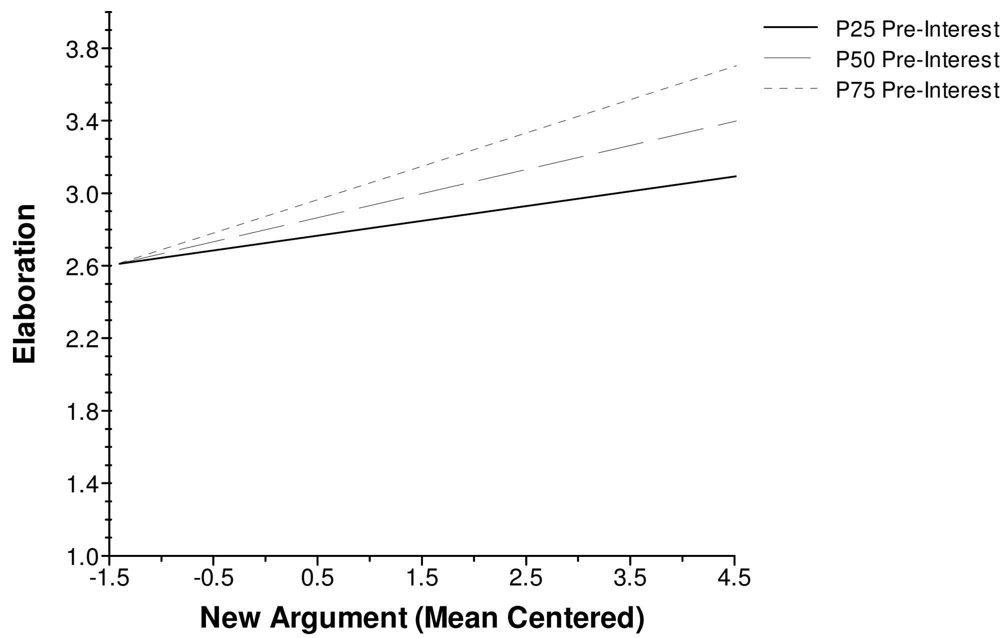

FIGURE 10. *The interaction between new argument and preinterest in the prediction of elaboration for the evolution text*

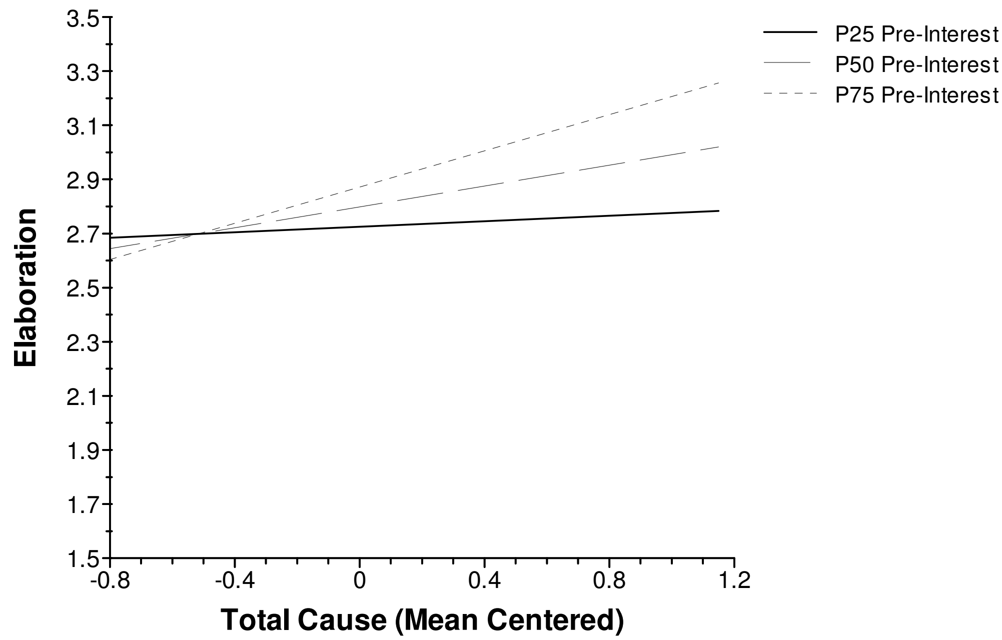

FIGURE 11. *The interaction between causality (total cause) and preinterest in the prediction of elaboration for the evolution text*

TABLE 8

Elaboration for each text as a function of text features and postinterest

	Civil War			Labor Strikes			Erosion			Evolution		
Fixed Effects	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*	β	*SE*	*df*
Intercept (β00)	3.49****	0.31	47	4.13****	0.32	52	3.01****	0.23	50	3.48****	0.29	50
GK (β01)	0.17**	0.08	47	0.16	0.10	52	0.02	0.10	50	–0.12	0.10	50
CS (β02)	0.02	0.02	47	0.05**	0.02	52	0.03*	0.02	50	0.08**	0.04	50
PK (β03)	–1.54	1.16	47	1.75**	0.80	52	–0.16	0.74	50	0.44	0.68	50
WM (β04)	–0.00	0.01	47	–0.02*	0.14	52	0.00	0.01	50	–0.00	0.01	50
Post-I (β05)	0.30	0.26	47	0.03	0.14	52	0.07	0.08	50	0.13	0.11	50
Post-I*WM (β06)	0.02*	0.01	47	–0.00	0.01	52	–0.01	0.01	50	0.00	0.01	50
Post-I*CS (β07)	–0.02	0.02	47	0.00	0.03	52	–0.02	0.02	50	–0.04	0.03	50
Post-I*PK (β08)	–2.51***	0.69	47	0.39	0.88	52	–0.20	0.52	50	0.36	0.86	50
SN (β10)	–0.04****	0.01	54	–0.06****	0.01	60	–0.04****	0.01	58	–0.05****	0.01	58
AO (β20)	0.06	0.04	1,323	0.19***	0.05	1,386	0.19****	0.04	57	0.00	0.04	1,163
Post-I (β21)	0.03	0.03	1,323	0.01	0.04	1,386	0.02	0.03	57	0.01	0.03	1,163
NA (β30)	0.08*	0.04	1,323	0.15****	0.03	1,386	0.12***	0.04	1,281	0.13***	0.04	1,163
Post-I (β31)	0.01	0.04	1,323	–0.01	0.02	1,386	0.01	0.03	1,281	0.05**	0.03	1,163
C (β40)	–0.04	0.05	1,323	–0.03	0.04	1,386	–0.10**	0.04	1,281	0.18	0.11	1,163
Post-I (β41)	–0.04	0.04	1,323	0.02	0.03	1,386	–0.07**	0.03	1,281	0.08	0.07	1,163
Random Effects	Variance		*df*	Variance		*df*	Variance		*df*	Variance		*df*
Intercept (r0)	5.07****		47	6.09****		52	2.46****		50	5.09****		50
SN (r1)	0.00****		54	0.01****		60	0.02****		58	0.01****		58
AO (r2)	—		—	—		—	0.03**		57	—		—
NA (r2)	—		—	—		—	—		—	—		—
C (r3)	—		—	—		—	—		—	—		—
Level 1 error (e)	3.20			3.68			2.34			3.18		

Note. AO = argument overlap; C = total causal statements; CS = comprehension skill; GK = general knowledge in history; NA = new arguments; PK = prior knowledge in specific topic; Post-I = postinterest in topic; Post-I*CS = postinterest in topic–comprehension skill interaction; Post-I*PK = postinterest in topic–prior knowledge in specific topic interaction; Post-I*WM = postinterest in topic–working memory interaction; SN = sentence number; WM = working memory.
**p* < .10. ***p* < .05. ****p* < .01. *****p* < .001.

The interest–new argument interaction suggested that the presence of new arguments was more positively correlated with elaboration among higher-interest readers and less positively correlated for lower-interest readers. A similar pattern emerged for the interest–causality interaction, the positive relationship between causality and elaboration being stronger for higher-interest than for lower-interest readers. This positive correlation is somewhat surprising: Causality usually leads to decreases in elaboration because causality refers to conceptual links within rather than beyond the passage (Magliano, Trabasso, & Graesser, 1999).

Elaboration–Postinterest Analyses

There was statistically significant variability in average elaboration across individuals for all texts ($p < .001$). There was also statistically significant random variability in the sentence number–elaboration relationship for all texts ($p < .001$). For the erosion text, there was statistically significant variability in the argument overlap–elaboration relationship across persons ($p < .05$; Table 8).

For the postinterest analyses, Level 1 analyses were the same as for preinterest, so the results are not reported again here. For the Civil War text, general knowledge was a significant positive predictor of elaboration ($p < .05$). Post-interest negatively interacted with the prior knowledge–elaboration relationship ($p < .01$): Higher postinterest was associated with a stronger negative prior knowledge–elaboration relationship than lower postinterest was (see Table 8; Figure 12). Elaborations may require strategic effort to generate (Magliano, Trabasso, & Graesser, 1999); as such, higher-knowledge readers do not have to devote resources to produce them. This interaction suggested that this trend is more pronounced in higher-interest readers.

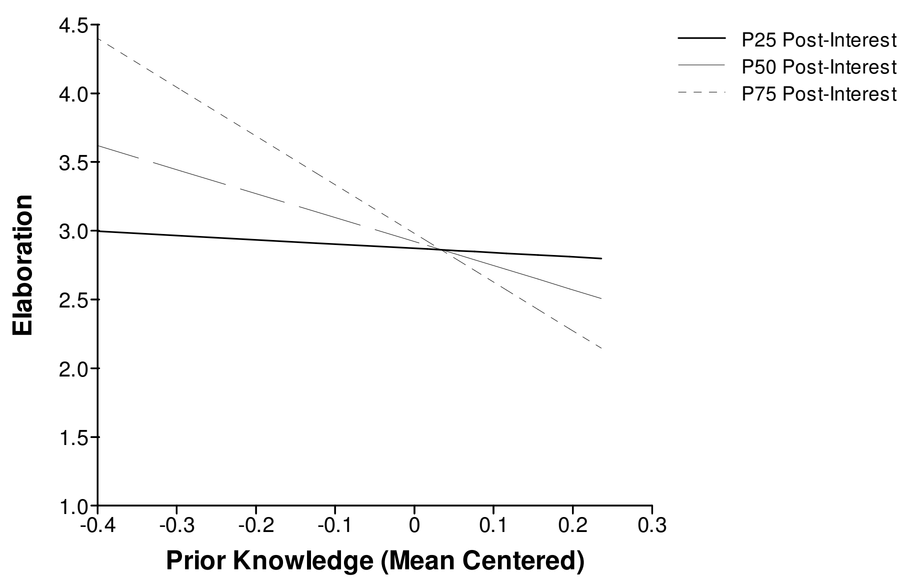

FIGURE 12. *The interaction between prior knowledge and postinterest in the prediction of elaboration for the Civil War text*

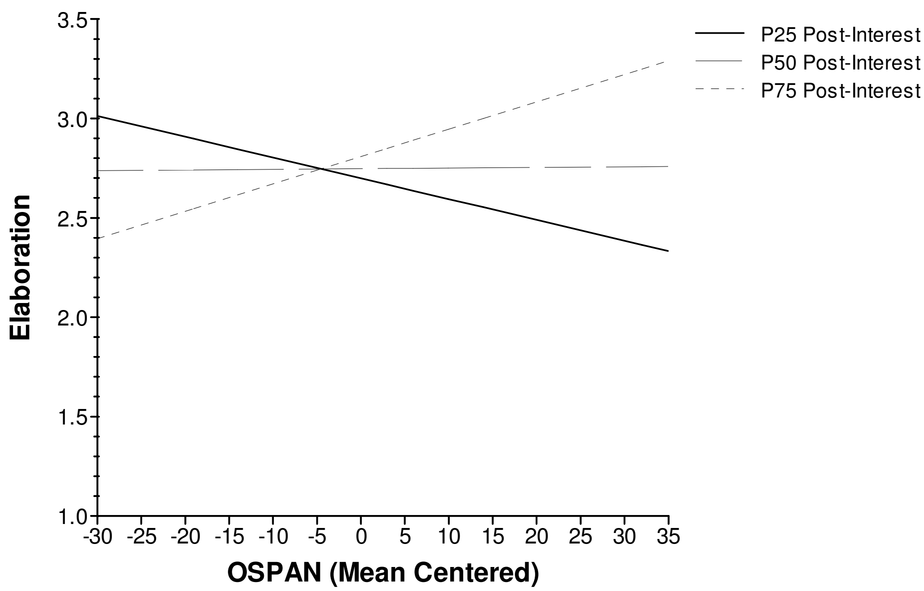

FIGURE 13. *The interaction between working memory (OSPAN) and postinterest in the prediction of elaboration for the Civil War text*

There was also a positive trend between working memory and elaboration ($p < .1$). In this disordinal interaction, those with higher postinterest exhibited a positive relationship between working memory and elaboration; those with lower postinterest exhibited a negative relationship between the two (see Table 8; Figure 13). There was an interest–working memory interaction as well (see Figure 13). This pattern was more or less the opposite of the preinterest–working memory interaction on elaboration for the labor strikes text. In general though, the postinterest–working memory interaction was somewhat more interpretable than the preinterest–working memory interaction, largely because the former suggests that working memory may be a resource for individuals as their interest develops because it can help them focus on the processes that facilitate comprehension.

Both comprehension skill and prior knowledge were positively related to elaboration ($p < .05$) for the labor strikes text. Working memory had a negative trend with elaboration ($p < .1$) in this text (see Table 8). Postinterest and its interaction with Level 1 or Level 2 variables were not significant predictors of elaboration for the labor strikes text.

For the erosion text, comprehension skill exhibited a positive trend with elaboration ($p < .1$). Further, postinterest was a significant negative moderator of the causality–elaboration relationship ($p < .05$) in that higher postinterest was associated with a stronger negative relationship between causality and elaboration than lower postinterest (see Table 8; Figure 14). This interaction suggested that higher-interest readers were more sensitive to causality than lower-interest readers, as evidenced by a steeper negative slope for the former than for the latter. As causality increased, elaborations decreased, but this was stronger for individuals with higher interest. Again, it is important to note that prior research has suggested that readers tend to elaborate less as causality increases, presumably because the presence of sentences with greater causality focuses readers on integration (Magliano, Trabasso, & Graesser, 1999).

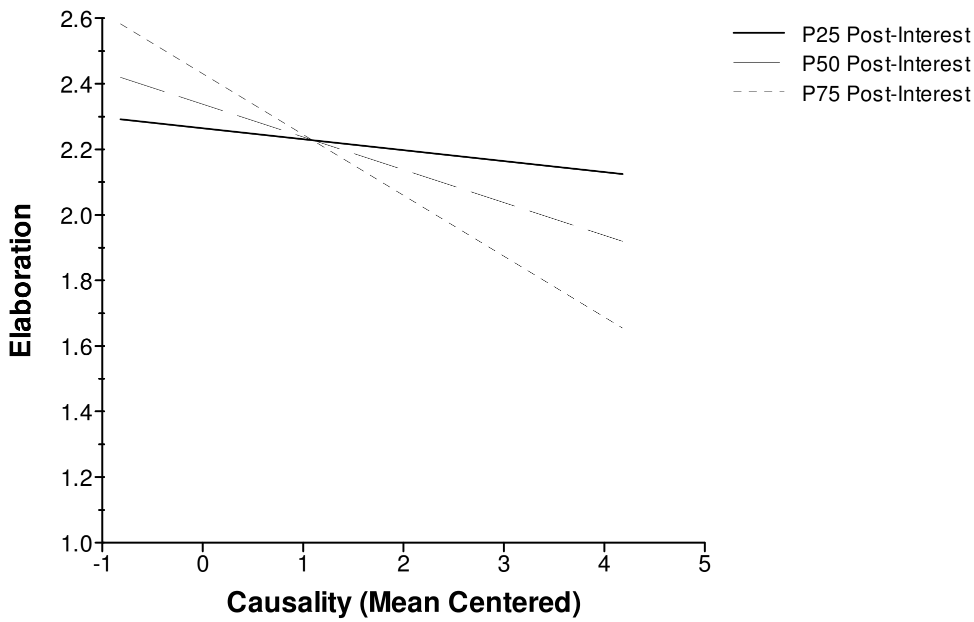

FIGURE 14. *The interaction between causality and postinterest in the prediction of elaboration for the erosion text*

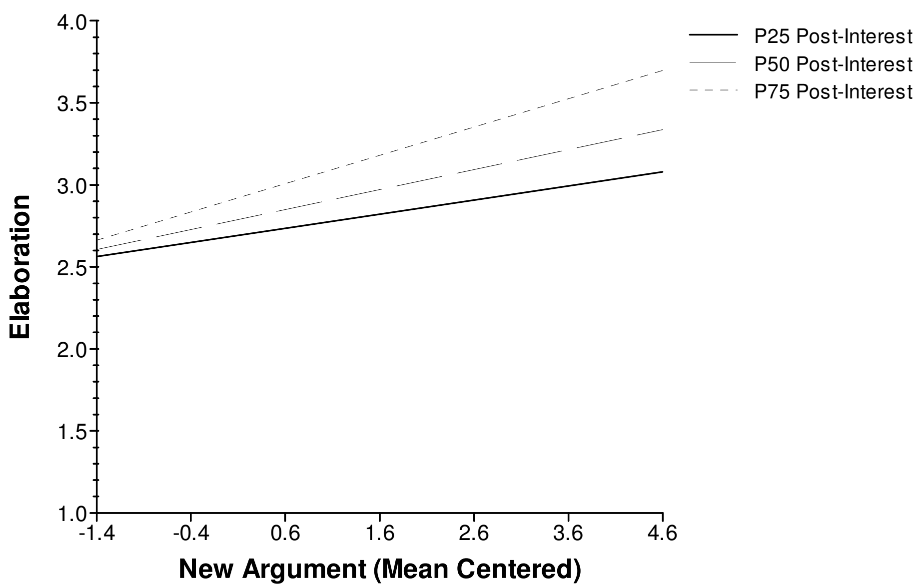

FIGURE 15. *The interaction between new argument and postinterest in the prediction of elaboration for the evolution text*

For the evolution text, comprehension skill was positively associated with elaboration ($p < .05$). There was also a significant positive interaction of postinterest with the new argument–elaboration relationship ($p < .05$): Higher postinterest was associated with a stronger positive relationship between the number of new arguments and elaboration than lower postinterest (see Table 8; Figure 15). This interaction indicated that higher-interest readers were more sensitive to new arguments than lower-interest readers, as evidenced by a steeper positive slope for the former than for the latter. When readers who developed higher interest encountered sentences with a greater number of new arguments, they were more likely to elaborate than were individuals who did not develop higher interest. This may reflect a more automatic process, whereby topic content that is of interest is more accessible during reading (Hidi, 1990), or it may reveal a more deliberate process whereby individuals with higher interest actively construct meaning by bringing their existing real-world knowledge to the process of reading (Krapp, 1999; Schiefele, 1996). More research would be required to determine which possibility provides the most viable explanation.

Recall Analyses

The variables in the regression predicting recall of the Civil War text did not account for significant variance in the first step, $F(5, 51) = 1.58$, $p = .18$, R2 = 13, and the univariate tests did not reveal any significant effects. In particular, the relationship between postinterest and recall was only marginally significant, $t(51) = 1.72$, $p < .10$, $\beta = .24$. When the predictors derived from the think-aloud responses were entered, only bridging showed a marginally significant positive relationship with recall, $t(49) = 1.83$, $p < .10$, $\beta = .29$.

When the model was used to predict recall in the labor strikes text, the variables entered in the first step did not account for significant variance overall, $F(5, 55) = 2.50$, $p < .05$, R2 = .19. The univariate effects revealed a significant positive effect of reading skill, $t(55) = 2.40$, $p < .05$, $\beta = .33$, but postinterest was again only a marginally significant predictor of recall, $t(55) = 1.88$, $p < .10$, $\beta = .24$. When bridging and elaboration were entered, bridging revealed a statistically significant positive relationship with recall, $t(53) = 2.04$, $p < .05$, $\beta = .38$.

The variables in the regression predicting recall of the erosion text accounted for significant variability in the first step, $F(5, 51) = 2.84$, $p < .05$, R2 = 22. As in the analysis above, reading skill was the only significant predictor of recall, $t(51) = 2.24$, $p < .05$, $\beta = .31$. Postinterest was not a significant predictor, $t(51) = 1.48$, $p = .15$, $\beta = .19$. However, when bridging and elaboration were entered in the second step, bridging revealed a statistically significant positive relationship with recall, $t(49) = 2.45$, $p < .05$, $\beta = .41$.

Finally, when the model was used to predict recall of the evolution text, the variables accounted for significant variance combined, $F(5, 54) = 4.00$, $p < .01$, R2 = 27. The only significant univariate predictor of recall was prior topic knowledge, $t(54) = 2.96$, $p < .01$, $\beta = .37$, showing that individuals with more prior knowledge of evolution recalled more idea units than those who had less prior knowledge. Postinterest was not a significant predictor, $t(54) = 1.13$, $p = .26$, $\beta = .15$, and neither was bridging or elaboration, when entered in the next step. One interaction effect was significant when entered by itself in the third step (Figure 16). Postinterest interacted with working memory to predict recall of the evolution text, $t(52) = -4.23$, $p < .01$, $\beta = -.44$. The pattern showed that the relationship between postinterest and recall is positive at lower levels of executive control of working memory and then flattens and becomes negative at higher levels of the two.

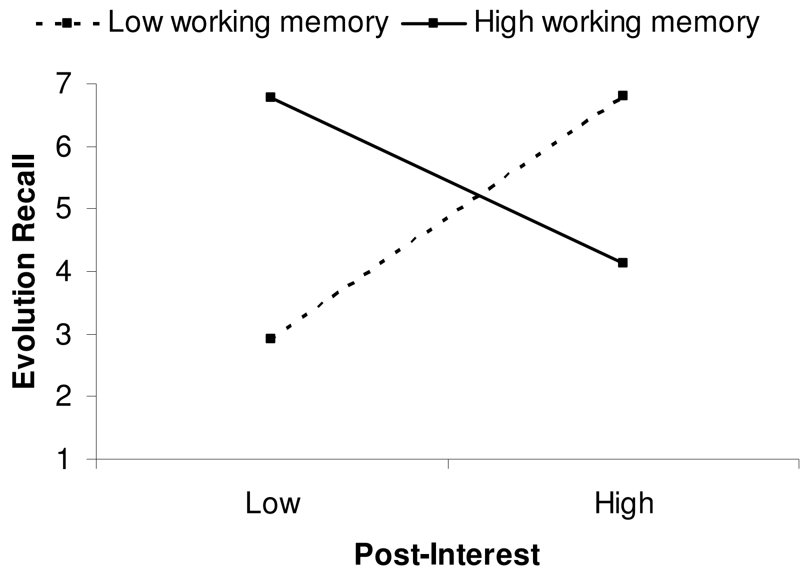

FIGURE 16. *Predicted slopes of the relationship between postinterest and recall for the evolution text as a function of working memory*

Conclusions Regarding Preinterest and Postinterest

The data support the argument that concurrent verbal protocols reflect aspects of online and offline processes. Specifically, both preinterest and postinterest variables predict bridging and elaboration scores, and very few of the significant effects that were revealed were reflected in both analyses involving preinterest and postinterest. These results suggest that both preinterest and postinterest measures are important to assess when using verbal protocol data. However, at this juncture, it is difficult to explain why some effects were manifested with one measure, but not with the other.

Ad Hoc Analyses

Does interest change as a consequence of reading, and what text characteristics predict those changes?

This final research question attempted to directly examine an assumption that underlies several of the issues that guided the research and were revealed in the data. Specifically, based on the assumption that the process of reading can change interest, and that preinterest and postinterest may have different implications for comprehension processes, the extent to which interest did change as a consequence of reading was analyzed (Durik, Liebman, Matarazzo, Knewitz, Holt, & Magliano, 2010). Preinterest and postinterest from the pretest, Study 1, and Study 2 were analyzed and compared. Moreover, data from the pretest were used to test whether characteristics of individual texts corresponded to these observed changes in interest. Finally, these changes across studies were compared, and a determination was made as to whether the methodology used in Study 1 versus that used in Study 2 allowed the results to be compared across the studies.

Although the primary focus was on the extent to which preinterest and postinterest predicted comprehension processes and recall, these data also afforded us the opportunity to explore a parallel issue having to do with the development of interest across time. As discussed above, interest emerges as a consequence of the ongoing interaction between individuals and the text while reading. Given that both preinterest and postinterest were measured, it was possible to examine change in interest as a consequence of reading. In addition, in the event that there were changes of interest from preinterest to postinterest, it was also possible then to examine text features that may have played a role in either the facilitation or undermining of interest.

First, preinterest and postinterest were compared for each passage using data from Study 1 and Study 2. Given that all participants in Study 1 read all four texts, a 2 (time: preinterest versus postinterest) x 4 (text passage) within-participants ANOVA was conducted. There was a main effect of time, $F(1, 122) = 23.02$, $p < .01$; a main effect of passage, $F(3, 366) = 24.24$, $p < .01$; and an interaction, $F(3, 366) = 13.78$, $p < .01$ (Figure 17). The pattern of results reveals that the process of reading increased interest for three of the four texts (Civil War, labor strikes, and erosion) but decreased interest for the text on evolution.

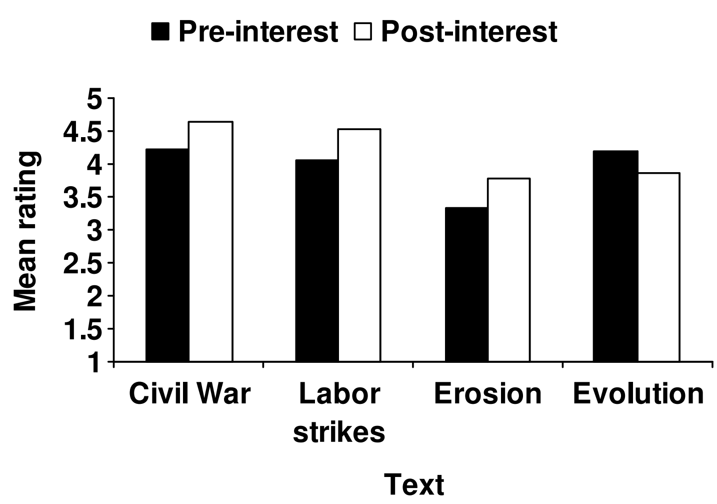

FIGURE 17. *Mean rating of preinterest and postinterest by text for Study 1*

In order to determine whether a similar pattern emerged for the preinterest and postinterest data from Study 2, further ANOVAs were conducted. However, because participants read only two of the four texts, separate analyses were conducted for each passage using data only from participants who read a given passage. Therefore, four separate ANOVAs were conducted comparing preinterest to postinterest. Three of the four analyses did not reveal significant effects related to the timing of administration of the interest measure (i.e., preinterest versus postinterest measures). However, the ANOVA examining preinterest versus postinterest for the erosion text did show an effect of time on interest, $F(1, 57) = 16.93$, $p < .01$ (Figure 18).

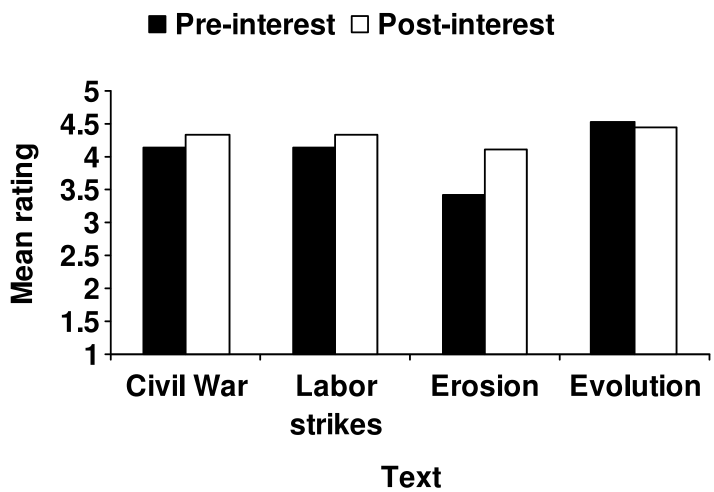

FIGURE 18. *Mean rating of preinterest and postinterest by text for Study 2*

These comparisons of changes in interest across studies provide further insight into the methodology used in Study 1 versus the methodology used in Study 2 and how these two approaches may have changed the experience of reading and subsequent comprehension. First, the data of preinterest and postinterest from Study 1 reflect the uninterrupted processes that occur during reading. The assessment of RTs does not directly impact the experience of reading, and therefore changes in interest observed in Study 1 are likely to be more consistent with the effects that would occur outside of the laboratory context. Data from Study 1 show that interest does change as individuals read texts, and that interest can either increase or decrease as a consequence of reading. In contrast to Study 1 participants, Study 2 participants were interrupted after reading each sentence and prompted to report their thoughts at that time. Given the more subdued differences in preinterest versus postinterest in Study 2, it is likely that this process of stopping and responding to the prompt impacted the experience of reading, and dampened the effects of reading processes on postinterest.

Finally, the data obtained in the pretest were looked at again to examine whether features of the text or perceptions of the text corresponded to changes in interest. Recall that 12 texts were used in the pilot study designed to select texts for the primary experiment. In this study, participants reported their preinterest after reading a description of the passage topics and then read the passages. After reading each passage, they reported their postinterest, perceptions of coherence, and perceptions of vividness. By aggregating across participants, mean preinterest and postinterest ratings for each of the 12 passages could be computed.

The study sought to determine whether text difficulty, perceptions of coherence, and perceptions of vividness were correlated with changes in interest after participants read the texts. To get a measure of change in interest, preinterest ratings were subtracted from postinterest ratings for each text; higher numbers reflected a greater level of interest after reading than before reading. Then these interest-change scores were correlated with features of the text. A strong negative correlation emerged between interest change and Flesch–Kinkaid reading grade level, $r(10) = -.62$, $p < .05$, revealing that as the reading difficulty increased, participants developed less interest in the text as a consequence of reading. Moreover, in the more difficult texts, interest decreased from before reading to after reading, as evidenced by negative values for change in interest. In addition, perceptions of vividness and perceptions of coherence were positively correlated with changes in interest: $r(10) = .59$, $p < .05$ and $r(10) = .63$, $p < .05$, respectively. This shows that interest was bolstered by the process of reading to the extent that participants perceived texts to be more vivid and coherent.

General Discussion

The goal of this study was to assess the extent to which topic interest affects comprehension processes, as evidenced by RTs and processes revealed when producing concurrent verbal protocols. Although there is a growing body of evidence that interest has an impact on comprehension (e.g., Bray & Barron, 2004; McDaniel et al., 2000), there is a dearth of knowledge regarding why this might be the case. This research was predicated on the assumption that an understanding of why interest affects comprehension could be revealed by an exploration of how it affects processing. The data do suggest that interest facilitates comprehension because it guides the appropriate application of processes that support it. There are complexities to addressing this research topic. First, readers come to a text with preexisting interest in a topic, but that level of interest may change as a function of reading a text, as was evidenced by the ad hoc analyses reported above. Additionally, comprehension is best understood as a complex interaction among the reader, text, and task (Snow, 2002). As such, it is likely the case that the effect of interest on processing and comprehension may not be the same across texts. There is evidence that this is the case in the literature (Bray & Barron, 2004), and the results of this study are most certainly consistent with these finding. Nonetheless, this study does reveal important insights into how topic interest (measured before and after reading) affects processing and memory. Interpretations of the data were organized around the four research questions posed in the introduction.

The answers to these questions do paint a consistent picture regarding how topic interest affects comprehension processes and comprehension. Three general conclusions of this research are outlined, as follows: First, higher-interest readers are more engaged and deliberate when reading than lower-interest readers. Second, higher-interest readers have increased sensitivity to the explicit and implicit discourse structure than lower-interest readers, which has an impact on how the text is processed.

Finally, this increased engagement positively affects comprehension, as evidenced by recall performance.

Research Question 1: *Does preinterest predict online processes?*

The data from Study 1 using RTs as the primary outcome is the best way to assess whether preinterest predicted online processing, because the assessment of RTs occurred without disrupting the process of reading. The results from Study 1 consistently showed that initial interest predicted longer RTs for three of the four texts. In response to our query regarding whether attentional processes related to interest and comprehension are deliberate versus more automatic, these data suggest the former. Specifically, individuals with higher topic interest spent more time reading most of the texts, suggesting that they may have processed the information with greater care and taken time to construct meaning from the text. These data are consistent with the idea that interest is related to learning goals (e.g., Harackiewicz et al., 2007; Pintrich & Schunk, 2002). Specifically, individuals with higher interest are more likely to set goals to learn and improve their knowledge and skills. Prior research has cited strong positive correlations between self-reported interest and self-reported learning goals, but the relationships found here between interest and RTs provide behavioral evidence to support these findings.

The positive relationship between preinterest and RTs is consistent with the idea that individuals with high interest are focused on knowledge acquisition. However, these data contrast with the results of Haberlandt and Graesser (1985), who showed that interesting parts of narratives are read more quickly than less interesting parts of narratives. This may highlight a critical difference between narrative and expository texts: People often read narrative texts for the purpose of enjoyment. Readers may speed up on sections of text that are especially intriguing in order to maintain and continue their involvement in the story. This may be especially evident in texts that involve suspense, because the interest that emerges during the reading of these types of texts will be resolved by events that occur later in the narrative (Iran-Nejad, 1987). In contrast, expository texts are read for the purpose of acquiring knowledge that can be extracted from the text. As a consequence, the interest that individuals bring with them to the reading opportunity may be focused on comprehending the information thoroughly and rehearsing it so that the knowledge may be accessible at a later time.

This increased engagement affects the extent to which readers are sensitive to the discourse structure. Implicit and explicit cues regarding how the current sentence is related to the prior discourse structure dynamically change across sentences (e.g., Haberlandt & Graesser, 1985; Todaro, 2010; van den Broek, Young, Tzeng, & Linderholm 1999). Successful comprehension requires readers to modulate their comprehension processes in light of these changes (McNamara & Magliano, 1999a, 1999b; Todaro, 2010). The current study found evidence that higher-interest readers were more sensitive than lower-interest readers to discourse structure, albeit the moderating effects of interest were manifested in only one text (labor strikes). Nonetheless, this suggested that the increased engagement as a result of interest increased sensitivity to structural features, which should benefit comprehension because it can increase a reader's ability to construct a coherent representation of what was read.

It is also worth noting that preinterest did not predict RTs for the evolution text. This may be a consequence of a complex interplay between interest and attitudes with regard to the topic of evolution. It is possible that individuals who reported higher interest in the topic of evolution may have had interest largely because of strong personal attitudes about evolution as an explanatory theory for the origin of humans. Specifically, a subset of individuals who reported higher interest in the topic may have held a creationist perspective on the origin of humans. Ironically, although these individuals may have reported higher interest, research from the literature on attitudes suggests that individuals are less likely to process information carefully if it is counter to their attitudes (e.g., Lord, Ross, & Lepper, 1979). Consequently, this may have canceled the relationship between preinterest and RTs observed among other individuals (who did not have negative attitudes toward evolution). This interpretation must be qualified by the fact that some significant effects involving interest in the verbal protocol data were found.

Research Question 2: *Does postinterest predict offline processes?*

To answer this question, the data predicting recall from both Study 1 and Study 2 were examined (Figure 19). The data from Study 1 are quite consistent: Postinterest was a statistically significant positive predictor of recall for all texts. In contrast, the results from Study 2 showed that it was only a marginally significant predictor in two of the texts. Taken together, the results across studies were different. Whereas individual differences in postinterest as well as reading skill and prior knowledge played a prominent role in predicting recall in Study 1, they played a minimal role in Study 2. Only reading skill was a significant predictor in Study 2.

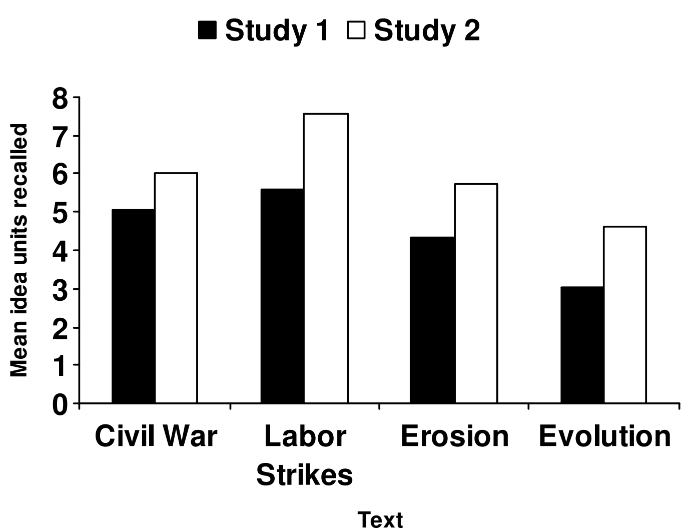

FIGURE 19. *Mean recall by text for Study 1 and Study 2*

The reduced statistical power in Study 2 may account for some of these differences. The statistical power for analyses was lower in Study 2 than in Study 1 because in Study 2 participants read only two of the texts, thereby dividing the sample in half. Given this, it is worth comparing the magnitude of relationships across studies. Whereas the standardized regression coefficients from Study 1 were all statistically significant and ranged from .18 to .32, the standardized coefficients from Study 2 ranged from .15 to .24, and none met the standard alpha criterion of .05. Although the effects that emerged in Study 2 were smaller overall, there was considerable overlap in their ranges, suggesting that more statistical power may have made a difference.

That said, it is important to point out other differences across these studies that could also account for the differences in recall, beyond the statistical-power explanation. Specifically, the process of producing verbal protocols in Study 2 may have changed the way participants read and responded to each text. The overall recall was higher in Study 2 than in Study 1 (see Figure 19). This may have occurred for two primary reasons. First, in Study 2, participants read only two texts (one history and one science text) instead of four texts, which reduces the difficulty of the recall task overall. Consequently, participants simply had less to remember in Study 2 than in Study 1, which may account for these differences. Second, as suggested above, the process of producing verbal protocols may have facilitated recall, especially among those with lower interest and prior knowledge. Specifically, the process of thinking aloud may have provided a type of instructional support that required readers to stop and consider the content of each sentence more fully than they might have done otherwise.

Bridging and elaboration scores were also used to predict recall in Study 2. Consistent with prior research (e.g., Magliano & Millis, 2003; Magliano et al., in press), bridging positively predicted recall for two texts and was a marginally significant predictor of recall for a third text. In contrast, elaboration did not predict recall. These data reveal that individuals who make bridging inferences across a text are more likely to recall ideas from the text. The process of bridging may help readers encode the main ideas of a passage and rehearse them in order to recall them later. To test the relationships between bridging and recall, it was necessary to aggregate the bridging scores across sentences (in order to use it to predict a Level 2 outcome, recall) rather than examining bridging across sentences within the passage that contain particular features. Given this, bridging scores created by aggregating across all sentences should be less strongly correlated with comprehension performance. Even so, a relatively consistent pattern emerged between bridging and recall.

Research Question 3: *Does preinterest or postinterest predict verbal protocol responses, and does either interact with other individual-difference variables to predict comprehension processes?*

One novel and important contribution of this research is that it explores the impact of interest on processes that support comprehension, as evidenced by concurrent verbal protocols. Participants were given instructions typical of think-aloud studies; that is, they were specifically instructed to report whatever thoughts came to mind as they read each sentence of a text (e.g., Trabasso & Magliano, 1996). However, in the current study, protocols were produced in RSAT, which involves having participants type their protocols rather than produce them orally. A remarkable similarity was seen between typed and verbally produced protocols (Munoz, Magliano, Sheridan, & McNamara, 2006). RSAT's automated scoring was used to provide measures of the extent to which readers engaged in bridging (i.e., integrative) and elaborative processes.

Concurrent verbal protocols constitute a process that is both online and offline of comprehension processes. They are online in the sense that participants produce their protocols after reading every sentence. They are offline in the sense that participants are asked to interrupt reading and access their mental representation of the text in order to produce their thoughts. As such, it was difficult to determine a priori whether preinterest or postinterest measures of interest were appropriate to analyze the verbal protocols. Both measures were used, and the results indicate that this was warranted. Specifically, there were five significant effects involving preinterest and seven significant effects involving postinterest. There was only one case in which the effects involving preinterest and postinterest were identical for the same text and displayed the same pattern. This suggests that these measures are both valuable in understanding how interest prior to reading and changes in interest during reading affect processing. To be certain, there is a high degree of complexity in interpreting these results given that there are so few effects that are convergent across texts and measures. Nonetheless, there are a number of very important and novel conclusions that can be drawn from the data. To elucidate these effects, interest will be discussed in general, rather than in terms of preinterest and postinterest measures.

It has been argued earlier in this study that these results indicate that interest level (both preinterest and postinterest) moderates sensitivity to text structure, such that processing measures were more strongly correlated with text structure for higher-interest readers than for lower-interest readers. There were six cross-level interactions involving either preinterest or postinterest measures, and five of these were consistent with this conclusion. Higher-interest readers tended to generate a greater number of elaborative inferences than lower-interest readers when new arguments were introduced. Additionally, prior research has shown that readers tend to elaborate less when there are implicit discourse features that promote integration (Magliano, Trabasso, & Graesser, 1999; Todaro, 2010), and our results on the Civil War text show that this effect is more dramatic for higher-interest readers than for lower-interest readers. Higher-interest readers tended to produce a greater number of bridges than lower-interest readers when there was argument overlap. There was a significant interaction in the labor strikes text between causality and interest for bridging: Lower-interest readers generated a greater number of bridges than higher-interest readers in response to sentences with more causal connections, a result that was not anticipated. It is unclear why higher-interest readers exhibited less bridging in response to causality in this passage; this is the only interaction that suggested that lower-interest readers were more sensitive to text structure.

There were at least two consistent findings regarding interactions between interest and other individual-difference factors for bridging. First, the two significant interactions involving interest and comprehension skill indicated that the relationship between comprehension skill and the ability to generate bridging inferences is more important for lower-interest readers than for higher-interest readers. This suggests that comprehension skill moderates the effect of interest on integrative processes. For individuals with lower interest, reading skill will be critical for determining whether these individuals engage in bridging and elaboration. However, for individuals with higher interest, reading skill will play a lesser role. In this way, the presence of interest may provide support for readers with lower reading skill. This is consistent with prior research showing that comprehension is better for lower-ability readers if they read texts of high versus low interest (de Sousa & Oakhill, 1996). The data from this research helps to illuminate why this might happen. Specifically, the presence of interest for lower-ability readers helps them bridge and elaborate more at the appropriate times in a text.

There were two interactions between interest and working memory that demonstrated that higher-interest readers with higher-level working memory engage in more bridging and elaborative processes than lower-interest readers with higher-level working memory. Again, OSPAN measures both overall working memory and executive control (Engle, 2002). In fact, this is one reason why this measure was chosen as opposed to other measures of working memory (e.g., Daneman & Carpenter, 1980). These data suggest that higher- or lower-interest readers with higher-level working memory differentially devote working memory resources to processes that support comprehension. The current data are not sufficient to explain why this would be the case. It is noteworthy, however, that in contrast to the finding that interest can ameliorate the negative effects of lower-level reading skill, interest did not appear to operate in this way with respect to working memory. Instead, working memory seemed to have had a facilitative effect that overlapped with interest. For those with higher interest, greater working memory facilitated processes related to comprehension. In other words, if individuals have a higher interest in a task, their working memory may serve them well by helping them focus on knowledge acquisition. This is the first piece of data to our knowledge that supports an idea posited by James (1890), who suggested that interest is maintained to the extent that an individual can keep an idea from becoming static. In other words, what is interesting to individuals is interesting because it continues to change in perception and interpretation. In the context of reading, this ability to maintain change may take the form of switching between integration and elaboration at appropriate times while reading. Working memory may be a critical variable for maintaining interest once it is triggered, and this may occur during reading as a consequence of making inferences. Consistent with this, readers have shown higher interest when they have been required to make certain inferences while reading narratives (Kim, 1999).

There was one significant interaction between interest and prior topic-specific knowledge that emerged in the Civil War text. Interest moderated the impact of prior knowledge on elaborations in a counterintuitive way. Higher-interest readers actually decreased elaboration as prior knowledge increased; lower-interest readers' elaborations were relatively unrelated to prior knowledge. The relatively flat correlation between prior knowledge and elaborations for lower-interest readers makes sense because lower-interest readers were less engaged in processes that support comprehension. However, it is reasonable to have expected a positive correlation between prior knowledge and elaborations for higher-interest readers. It may be the case that these readers with greater prior knowledge actually did not need to engage in effortful elaborations. Rather, relevant prior knowledge is automatically activated and incorporated into the mental representation when readers have a high amount of topic-relevant prior knowledge. Given that higher-interest readers are more engaged and process the text more closely, more relevant knowledge would be activated from topic-relevant prior knowledge via automatic, memory-based processes (e.g., McKoon & Ratcliff, 1998; Myers & O'Brien, 1998). It is possible that this effect emerged only for the Civil War text because participants had a wider range of knowledge about this topic relative to the other topics used in this study. Given that the Civil War is part of the school curriculum across years of school, some individuals are likely to have had a fairly high and fluid understanding of the topic, which may have allowed this effect to materialize in the data.

In summary, the data from the verbal protocols reveal complex relationships for both preinterest and postinterest. The preinterest effects were less prominent in the verbal protocols than they were with regard to RTs. Study 1 showed that individuals with higher preinterest read more slowly overall than individuals with lower preinterest. However, the effect on verbal protocols was not consistent. This may be because the verbal protocols interrupted the reading process and therefore represented a summary of preinterest and emerging interest that had unfolded up to that point in the text. Alternatively, it is possible that the texts were on topics that were sufficiently novel as to reduce the utility of preinterest. In other words, given the novelty of the topics, it is possible that the interest ratings were fairly uninformed, rendering them less predictive of how individuals would bridge or elaborate given parts of the text. Postinterest, in contrast, represented a more informed evaluation of the content after reading the text. Individuals who reported higher interest after reading the text developed interest as a consequence of reading. One way to interpret these effects is that as postinterest was developing, individuals began to respond to text features in ways that have been shown previously to support comprehension. In some cases, this ameliorated some otherwise deleterious effects of low-level reading skills on comprehension processes. Moreover, individuals who had higher-level working memory were more capable of sustaining the reading comprehension processes to the extent that they were developing interest while reading. Taken together, these data reveal how reading skill can be applied widely to texts even in the absence of interest, whereas working memory may be more instrumental for comprehension to the extent that interest is guiding its application.

Research Question 4: *Do the effects of discourse variables and interest predict comprehension processes differently across texts?*

These results are very consistent with the perspective that reading is an activity that can best be construed as involving a complex interaction between the reader, text, and task (Snow, 2002). Readers approach a text with a number of proficiencies (e.g., Oakhill, 1994; Perfetti, 1985) and dispositions (Guthrie & Wigfield, 1999; Schraw, 1997; Schraw & Bruning, 1996, 1999) that will affect processing and comprehension. Moreover, these factors may differentially manifest themselves across texts. The results of this study suggest that topic interest is one factor that may affect how these factors dynamically affect processing and comprehension.

These data reveal, overwhelmingly, that interest is inherently content specific. Individuals with high interest zero in on the content of a passage and are responsive to the content. Moreover, it is not simply the topic of content that is relevant here, but the nature of the content itself. Individuals with high interest become engaged with topic-related content, with the goal being to learn and acquire knowledge. Rather than having just a general goal to learn, however, individuals with high interest have their own specific learning-driven goals and are choosey about the way they interact with text. The passage content must offer them an opportunity to learn from the text. People with higher interest may behave idiosyncratically during testing, but this behavior is not random: They are engaging with the text in a way that meets their own individual needs.

The ad hoc analyses of data from the pretest revealed that interest was more likely to increase from pretest to post-test if the passage had a lower level of difficulty. In addition, interest increased from pretest to post-test the more that individuals perceived the text to be coherent and vivid. Given that there are in-depth analyses of only four of the texts evaluated at the pretest, and because these four texts were selected for their similarity rather than their variability on such features, it is not possible to know how passage features such as reading level, coherence, and vividness would have changed the dynamics of reading for low- versus high-interest readers. This is an area ripe for further research. Specifically, it is possible that the variables of reading ease, coherence, and vividness help readers keep reading dynamically so that the activity does not become static. This would suggest that low-interest readers may be more sensitive to these cues because they would maintain this ongoing activity and facilitate conceptual change. This is consistent with the research on these text variables in that these variables have been identified as text characteristics that facilitate interest in text. In other words, these are variables that, when applied to a specific text, engage a broad range of readers, allowing those with lower as well as higher preinterest to develop postinterest (Schraw & Lehman, 2001). The implication is that they affect interest for readers in general. That said, it is possible that higher-interest readers may be more in tune with the content of the passage, more focused on the idea units conveyed, and less reliant on cues that would facilitate change. Moreover, higher-interest readers with high-level working memory may be in the best position to read text and keep it dynamic. Not only will these individuals be focused on the content, but their working memory may be able to help them engage in comprehension processes such as bridging and elaboration at the times that will most likely facilitate comprehension.

Implications of the Study and Concluding Remarks

The results this study have implications for assessment. Bray and Barron (2004) demonstrated that topic-level interest can affect performance on a standardized text. The current study indicates that it does so by increasing engagement with the texts. More specifically, the presence of interest can lead to better comprehension because it can facilitate the processes that support comprehension. There are three approaches one could take in light of these findings. One approach would be to minimize interest in testing situations by presenting text topics that are likely to be unfamiliar to the test takers. However, the results of the ad hoc analyses suggest that interest can change as a result of reading a text, so there is no guarantee that these attempts could control the effects of interest during reading. A second approach would be to try to maximize interest by presenting texts for an assessment that are likely to be of interest across a variety of students. One argument for this would be that doing so would provide the best assessment of how students comprehend when they are engaged. But this is not an optimal solution because it would be difficult, if not impossible, to identify topics that cut across all populations of readers. A third and more viable approach would be to allow students to choose texts topics, which may positively affect engagement (Malone & Lepper, 1987). Assessing comprehension proficiency when students are engaged may provide a more accurate picture of the capabilities of a student, although it would also be meaningful if students performed differently under conditions of low engagement. Of course, the psychometric implications of allowing students to choose texts would have to be explored.

That students appeared to be more engaged to the extent that they were interested in a text also has implications for instruction. The present results suggest, however, that topic interest could serve as a scaffold to support comprehension and that interest level can moderate the relationship between comprehension skill and online comprehension processes. This provides further support for the idea that interest level could be leveraged to support comprehension.

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Appendix

The Power of Erosion

Erosion represents one of nature's most powerful forces. Over periods of thousands to millions of years, erosion has created countless spectacular landforms including the Grand Canyon, the fjords of Norway, the sand dunes of the Sahara, and the white beaches of Malibu, California.

The varied forces of erosion are continually shaping and reshaping the surface of Earth and the many landforms upon it. Weathering begins the processes of erosion, in which solid rock chemically decays and begins to physically break down. Rock beds and large boulders are reduced to rock debris, soil particles, and sand.

Given enough time, almost any exposed rock will eventually be worn away. There are several factors that determine whether this process will take months, years, centuries, or millennia. Rocks vary in their hardness, texture, and chemical solubility. Rocks composed of hard minerals such as quartz crystals are resistant to weathering and break down quite slowly. However, if these rocks are marred with fractures and joints, they can be quite vulnerable to weathering. Such cracks provide an entry place for water, bacteria, and plant roots. This can cause the rock to break apart from within, exposing more of its surface to the forces of weathering.

Climate is another important factor in erosion and the preliminary process of weathering. Hot and humid climates accelerate many of the chemical reactions that lead to weathering. Such weather conditions can stimulate the chemical conversion of the mineral feldspar into the soft white clay known as kaolinite, which is more vulnerable to erosion. Water can also accelerate the process of erosion. Heat energy often provides fuel for these reactions. In the absence of water, chemical weathering slows tremendously. This fact explains the amazing endurance of the pyramids and other ancient monuments. From crashing ocean waves, to strong desert winds, the process of erosion will continue to erode and sculpt Earth.

Geographic Isolation and the Origin of New Species

Different species arise when, for one reason or another, members of a population cease to interbreed. When something prevents populations from mating, they are said to be reproductively isolated from one another. Two reproductively isolated populations cannot randomly exchange genetic material with each other. The groups diverge as they evolve independently of one another. The members of each group become so different that they can no longer successfully interbreed. At this point, a new species has formed.

Anything that hinders interbreeding is called an isolating mechanism. Geographic barriers can isolate populations. A barrier, such as a stretch of sea or a mountain range, can prevent members of one population from interacting with those of another. The population can become reproductively isolated. Members of this population are able to reproduce, however, if they possess traits that are suited for the environment. These traits are passed on to subsequent generations. Eventually an entirely new species can then form in the isolated population through a process called allopatric speciation.

This mechanism of speciation is evident in the many different populations of pupfish that live in the Death Valley region of California and Nevada. About 50,000 years ago, this region had a damp, rainy climate and was peppered by lakes and ponds connected by streams and rivers. Over time, rainfall decreased significantly, and by about 4,000 years ago, this region was a desert. The interconnected lakes and streams dried up. In their place remained a series of small, isolated stream-fed ponds. Each pond is home to a different species of pupfish, specially adapted to its pond's unique temperature and mineral composition. Biologists speculate that all of these species of pupfish descended from a single species that inhabited the interconnected lakes and streams of the region about 50,000 years ago.

Socio-Economic Causes of the Civil War

It is impossible to narrow the cause of the Civil War to a single issue or act. Most people assume that the primary cause was slavery. But while it is true that it was one of the most important contributing factors to the conflict, it was not the single cause. In truth, there were a myriad of reasons for the war, including growing political, economic, and social rifts between the North and the South.

It is important to know what the United States was like in the mid-1800s. Unlike today, prior to the Civil War, the United States was like two separate countries living together as one. The North and South were more different than alike. They were like a bickering couple on the verge of divorce, who couldn't bear to live together anymore. A short 10 years before the war, the vast majority of Americans in both the North and South lived in rural areas rather than cities. Agriculture remained the biggest contributor to the nation's economy, and in many ways the two regions were alike.

However, during the 1850s and 60s, the nation's biggest cities—mostly in the North—received a massive influx of immigrants. The nation's population increased 35 percent to nearly 31 million. But the South didn't benefit from the influx. By the end of the 1850s, only a third of the Americans lived in the South, compared to half at the beginning of the century. An industrial revolution began in the North, fueled by an increased population. The North quickly took advantage of the amazing new technologies and products.

The population of the South remained primarily rural and its economy exclusively based on agriculture. In fact, this was one of the deciding advantages of the North over the South during the war. By 1860, the South was producing nearly three-fourths of the raw cotton used throughout the world and nearly all the cotton used by the North.

However, the South lacked manufacturing capabilities and a workforce to support the industry. The South was forced to buy back goods made from its agricultural products. The South was placed at a severe economic disadvantage. Southerners were not happy with this disparity and made their feelings known in the national political arena. This inequity played a large role in widening the division between the North and the South.

Labor Strikes of Garment Workers

During the late 1800s and early 1900s, thousands of people from all over the world came to America in hopes of a better life, a brighter future, a way to better their chances of living comfortably. In Russia, the Singer sewing machine had been introduced 2 decades earlier and symbolized the guarantee of a good livelihood. Among those who came were 50,000 young Jewish girls from Russia. Most of the young women who came over were highly skilled. However, the reality of the working class in America was not conducive to their plans.

Constituting 1/3 of the garment industry's workforce in 1910, these women labored for long hours in intensely cramped and unsafe working conditions. To complicate matters, wages paid in these jobs were not sufficient to survive. For many of these women, their dream of America was shattered.

By 1910, small spontaneous strikes began erupting at several of the garment factories. Although the women asked certain unions to help unify the strikers, these unions lacked the resources to mobilize such a massive action. The power to do so had to come from the people themselves.

On the night of November 22, thousands of workers attended a mass meeting organized by the women strikers. In the packed hall, their bodies were restless and taut with anger, they heard speaker after speaker advise them to be patient and act cautiously. Clara Lemlich, a fragile looking teenager, rushed suddenly to the platform and passionately articulated the pent-up feelings of the audience.

The next morning, 15,000 workers were on strike. The East Side was a seething mass of agitated women, girls, and men. The strikers swelled in number, to over 20,000; they were overwhelmingly Jewish. The demands of the strikers included a 52 hour week, overtime pay, and union recognition. As they picketed, the strikers were arrested by the police and beaten by thugs. The courageous strikers impressed the community; they were proudly described as "our wonderful fervent girls."

The strike was powerful, intimidating, and by February, more than 300 of some 450 firms in the New York industry had been forced to make some kind of settlement. These labor struggles represented a watershed in Jewish-American history. The "uprisings" of this era sharpened a shared sense of ethnicity, a Jewish immigrant identity in America.

TABLE A-1

Level 1 Descriptive statistics for Civil War text in Study 1

Variable	*n*	*M*	*SD*	MIN	MAX
SN	3,050	12.00	7.21	0.00	24.00
AO	3,050	2.44	1.60	0.00	6.00
NA	3,050	1.64	1.44	0.00	6.00
TC	3,050	1.88	1.18	0.00	4.00
RT/SYL	3,050	177.39	90.13	1.64	1,714.00

Note. AO = argument overlap; NA = new argument; RT/SYL = reading time by syllable; SN = sentence number; TC = total cause.

TABLE A-2

Level 1 Descriptive statistics for labor strikes text in Study 1

Variable	*n*	*M*	*SD*	MIN	MAX
SN	2,928	11.50	6.92	0.00	23.00
AO	2,928	1.96	1.17	0.00	4.00
NA	2,928	2.33	1.86	0.00	9.00
TC	2,928	2.50	1.61	0.00	6.00
RT/SYL	2,928	206.77	165.74	2.85	4,605.00

Note. AO = argument overlap; NA = new argument; RT/SYL = reading time by syllable; SN = sentence number; TC = total cause.

TABLE A-3

Level 1 Descriptive statistics for erosion text in Study 1

Variable	*n*	*M*	*SD*	MIN	MAX
SN	2,562	10.00	6.06	0.00	20.00
AO	2,562	2.43	1.33	0.00	6.00
NA	2,562	1.57	0.90	0.00	3.00
TC	2,562	1.76	1.23	0.00	6.00
RT/SYL	2,562	193.43	111.03	1.15	1,672.78

Note. AO = argument overlap; NA = new argument; RT/SYL = reading time by syllable; SN = sentence number; TC = total cause.

TABLE A-4

Level 1 Descriptive statistics for evolution text in Study 1

Variable	*n*	*M*	*SD*	MIN	MAX
SN	2,562	10.00	6.06	0.00	20.00
AO	2,562	2.48	1.68	0.00	7.00
NA	2,562	1.48	1.56	0.00	6.00
TC	2,562	1.76	0.68	0.00	3.00
RT/SYL	2,562	195.15	108.02	1.57	1,266.18

Note. AO = argument overlap; NA = new argument; RT/SYL = reading time by syllable; SN = sentence number; TC = total cause.

TABLE A-5

Level 1 Descriptive statistics for combined texts in Study 1

Variable	*n*	*M*	*SD*	MIN	MAX
SN	11,102	10.95	6.68	0.00	24.00
AO	11,102	2.32	1.47	0.00	7.00
NA	11,102	1.77	1.53	0.00	9.00
TC	11,102	1.99	1.27	0.00	6.00
RT/SYL	11,102	192.94	123.00	1.15	4,605.00

Note. AO = argument overlap; NA = new argument; RT/SYL = reading time by syllable; SN = sentence number; TC = total cause.

TABLE A-6

Level 2 descriptive statistics for civil war text in Study 1

						Correlations						
Variable	*n*	*M*	*SD*	MIN	MAX	1	2	3	4	5	6	7
1. GK-H	122	5.43	2.10	0.00	9.00	1.0	—	—	—	—	—	—
2. Gates	122	27.48	7.80	10.00	47.00	.35****	1.0	—	—	—	—	—
3. PK-CW	122	0.37	0.20	0.00	0.66	.34****	.24***	1.0	—	—	—	—
4. OSPAN	122	38.91	17.02	0.00	75.00	.27***	.16*	.25***	1.0	—	—	—
5. PrI-CW	122	4.24	1.30	1.00	7.00	.14	.19**	.16*	.10	1.0	—	—
6. PoI-CW	122	4.65	1.19	1.00	7.00	.07	−.02	.19**	.14	.54****	1.0	—
7. Rec-CW	122	5.08	2.45	0.00	11.00	.40****	.41****	.23***	.18**	.14	.23**	1.0

Note. GK-H = general knowledge in history; PK-CW = prior knowledge in Civil War; PoI-CW = postinterest in Civil War; PrI-CW = preinterest in Civil War; Rec-CW = recall of Civil War.

**p* < .10. ***p* < .05. ****p* < .01. *****p* < .001.

TABLE A-7

Level 2 descriptive statistics for labor strikes text in Study 1

						Correlations						
Variable	*n*	*M*	*SD*	MIN	MAX	1	2	3	4	5	6	7
1. GK-H	122	5.43	2.10	0.00	9.00	1.0	—	—	—	—	—	—
2. Gates	122	27.48	7.80	10.00	47.00	.35****	1.0	—	—	—	—	—
3. PK-LS	122	0.34	0.21	0.00	0.73	.08	.27***	1.0	—	—	—	—
4. OSPAN	122	38.91	17.02	0.00	75.00	.27***	.16*	.15*	1.0	—	—	—
5. PrI-LS	122	4.08	1.35	1.00	7.00	.08	.13	.22**	−.03	1.0	—	—
6. PoI-LS	122	4.54	1.42	1.00	7.00	−.01	.03	.24***	−.04	.41****	1.0	—
7. Rec-LS	122	5.61	3.06	0.00	14.00	.29***	.33****	.32****	.01	.16*	.24***	1.0

Note. GK-H = general knowledge in history; PK-LS = prior knowledge in labor strikes; PoI-LS = postinterest in labor strikes; PrI-LS = preinterest in labor strikes; Rec-LS = recall for labor strikes.

**p* < .10. ***p* < .05. ****p* < .01. *****p* < .001.

TABLE A-8

Level 2 descriptive statistics for erosion text in Study 1

Variable	*n*	*M*	*SD*	MIN	MAX	Correlations 1	2	3	4	5	6	7
1. GK-S	122	5.74	1.84	2.00	10.00	1.0	—	—	—	—	—	—
2. Gates	122	27.48	7.80	10.00	47.00	.34***	1.0	—	—	—	—	—
3. PK-ER	122	0.29	0.20	0.00	0.69	.16*	.14	1.0	—	—	—	—
4. OSPAN	122	38.91	17.02	0.00	75.00	.27**	.16*	.13	1.0	—	—	—
5. PrI-ER	122	3.34	1.24	1.00	6.29	–.10	.01	–.04	.04	1.0	—	—
6. PoI-ER	122	3.78	1.32	1.00	6.71	.00	–.03	.06	.05	.62***	1.0	—
7. Rec-ER	122	4.34	2.66	0.00	10.00	.25**	.42***	.33***	.09	.03	.27**	1.0

Note. GK-S = general knowledge in science; PK-Er = prior knowledge in erosion; PoI-Er = postinterest in erosion; PrI-Er = preinterest in erosion; Rec-ER = recall for erosion.

**p* < .10. ***p* < .01. ****p* < .001.

TABLE A-9

Level 2 descriptive statistics for evolution text in Study 1

Variable	*n*	*M*	*SD*	MIN	MAX	Correlations 1	2	3	4	5	6	7
1. GK-S	122	5.74	1.84	2.00	10.00	1.0	—	—	—	—	—	—
2. Gates	122	27.48	7.80	10.00	47.00	.34***	1.0	—	—	—	—	—
3. PK-EV	122	0.29	0.20	–0.05	0.64	.23**	.15*	1.0	—	—	—	—
4. OSPAN	122	38.91	17.02	0.00	75.00	.27**	.16*	.09	1.0	—	—	—
5. PrI-EV	122	4.19	1.55	1.00	7.00	.04	.00	.10	.15	1.0	—	—
6. PoI-EV	122	3.84	1.42	1.00	7.00	.08	.08	.15	.15	.60***	1.0	—
7. Rec-EV	122	3.02	2.51	0.00	11.00	.35***	.40***	.25**	.10	.19*	.38***	1.0

Note. GK–S = general knowledge in science; PK-Ev = prior knowledge in evolution; PoI-Ev = postinterest in evolution; PrI-Ev = pre-interest in evolution; Rec-EV = recall for evolution.

p* < .10. ** *p* < .01. * *p* < .001.

TABLE A-10

Level 2 descriptive statistics for combined texts in Study 1

Variable	*n*	*M*	*SD*	MIN	MAX	Correlation	
						Gates	OSPAN
Gates	122	27.48	7.80	10.00	47.00	1.0	—
OSPAN	122	38.91	17.02	0.00	75.00	.16*	1.0

*$p < .10$.

TABLE A-11

Level 1 descriptive statistics for Civil War text in Study 2

Variable	*n*	*M*	*SD*	MIN	MAX
SN	1,342	14.67	8.31	1.00	28.00
AO	1,342	2.54	1.55	0.00	6.00
NA	1,342	1.62	1.47	0.00	6.00
TC	1,342	1.96	1.14	0.00	4.00
Bridging	1,340	0.98	1.15	0.00	7.00
Elaboration	1,340	2.76	2.44	0.00	19.00
Global	1,340	1.35	1.04	0.00	3.00

Note. AO = argument overlap, NA = new argument, SN = sentence number, TC = total cause.

TABLE A-12

Level 1 descriptive statistics for labor strikes text in Study 2

Variable	*n*	*M*	*SD*	MIN	MAX
SN	1,403	15.04	8.04	2.00	28.00
AO	1,403	2.04	1.12	0.00	4.00
NA	1,403	2.35	1.90	0.00	9.00
TC	1,403	2.61	1.55	0.00	6.00
Bridging	1,402	1.06	1.31	0.00	12.00
Elaboration	1,402	3.23	2.63	0.00	22.00
Global	1,401	1.39	1.04	0.00	3.00

Note. AO = argument overlap; NA = new argument; SN = sentence number; TC = total cause.

TABLE A-13

Level 1 descriptive statistics for erosion text in Study 2

Variable	*n*	*M*	*SD*	*MIN*	*MAX*
SN	1,298	14.55	7.65	2.00	27.00
AO	1,298	2.41	1.27	1.00	6.00
NA	1,298	1.45	0.94	0.00	3.00
TC	1,298	1.82	1.15	1.00	6.00
Bridging	1,297	0.97	1.23	0.00	7.00
Elaboration	1,297	2.34	1.95	0.00	13.00
Global	1,297	1.37	0.98	0.00	3.00

Note. AO = argument overlap; NA = new argument; SN = sentence number; TC = total cause.

TABLE A-14

Level 1 descriptive statistics for evolution text in Study 2

Variable	*n*	*M*	*SD*	MIN	MAX
SN	1,179	12.55	6.54	2.00	23.00
AO	1,179	2.60	1.63	0.00	7.00
NA	1,179	1.40	1.56	0.00	6.00
TC	1,179	1.85	0.57	1.00	3.00
Bridging	1,179	0.86	1.20	0.00	11.00
Elaboration	1,179	2.79	2.42	0.00	17.00
Global	1,179	1.36	1.15	0.00	3.00

Note. AO = argument overlap; NA = new argument; SN = sentence number; TC = total cause.

TABLE A-15

Level 1 descriptive statistics for combined texts in Study 2

Variable	*n*	*M*	*SD*	MIN	MAX
SN	5,246	14.26	7.76	1.00	28.00
AO	5,246	2.39	1.42	0.00	7.00
NA	5,246	1.73	1.56	0.00	9.00
TC	5,246	2.07	1.22	0.00	6.00
Bridging	5,241	0.97	1.23	0.00	12.00
Elaboration	5,241	2.77	2.40	0.00	22.00
Global	5,241	1.36	1.05	0.00	3.00

Note. AO = argument overlap; NA = new argument; SN = sentence number; TC = total cause.

TABLE A-16

Level 2 descriptive statistics for Civil War text in Study 2

Variable	*n*	*M*	*SD*	MIN	MAX	Correlations 1	2	3	4	5	6	7
1. GK-H	56	5.84	1.90	1.00	9.00	1.0	—	—	—	—	—	—
2. Gates	56	28.64	8.10	11.00	46.00	.28**	1.0	—	—	—	—	—
3. PK-CW	56	0.40	0.18	0.00	0.64	.18	.16	1.0	—	—	—	—
4. OSPAN	56	40.05	15.97	10.00	75.00	.00	.11	.04	1.0	—	—	—
5. PrI-CW	56	4.15	1.03	1.57	6.00	.41***	.03	.39***	.02	1.0	—	—
6. PoI-CW	56	4.34	1.12	1.14	6.43	.02	.11	.31**	.06	.17	1.0	—
7. Rec-CW	56	5.89	3.24	0.00	14.00	.04	.24*	.14	–.10	.13	.27**	1.0

Note. GK-H = general knowledge in history; PK-CW = prior knowledge in Civil War; PoI-CW = Postinterest in Civil War; PrI-CW = preinterest in Civil War; Rec-CW = recall for Civil War.

**p* < .10. ***p* < .05. ****p* < .01.

TABLE A-17

Level 2 descriptive statistics for labor strikes text in Study 2

Variable	*n*	*M*	*SD*	MIN	MAX	Correlations 1	2	3	4	5	6	7
1. GK-H	61	5.46	1.88	2.00	10.00	1.0	—	—	—	—	—	—
2. Gates	61	27.84	8.43	11.00	46.00	.34***	1.0	—	—	—	—	—
3. PK-LS	61	0.30	0.21	0.00	0.67	–.21	–.10	1.0	—	—	—	—
4. OSPAN	61	37.31	18.01	0.00	75.00	.00	.22*	.05	1.0	—	—	—
5. PrI-LS	61	4.12	1.06	1.14	6.57	–.21	–.10	–.10	–.11	1.0	—	—
6. PoI-LS	61	4.31	1.21	1.57	7.00	–.09	.06	.30**	.05	.60****	1.0	—
7. Rec-LS	61	7.75	5.40	0.00	27.00	.18	.36***	.08	.12	.06	.23*	1.0

Note. GK-H = general knowledge in history; PK-LS = prior knowledge in labor strikes; PoI-LS = postinterest in labor strikes; PrI-LS = preinterest in labor strikes; Rec-LS = recall for labor strikes.

**p* < .10. ***p* < .05. ****p* < .01. *****p* < .001.

TABLE A-18

Level 2 descriptive statistics for erosion text in Study 2

						Correlations						
Variable	*n*	*M*	*SD*	MIN	MAX	1	2	3	4	5	6	7
1. GK-S	59	5.81	1.70	2.00	9.00	1.0	—	—	—	—	—	—
2. Gates	59	28.51	8.64	11.00	46.00	.37**	1.0	—	—	—	—	—
3. PK-Er	59	0.30	0.18	−0.02	0.63	.39**	.33*	1.0	___	—	—	—
4. OSPAN	59	39.59	16.99	10.00	75.00	−.10	.09	.03	1.0	—	—	—
5. PrI-Er	59	3.44	1.25	1.00	6.71	.12	−.01	.29*	.10	1.0	—	—
6. PoI-Er	59	4.15	1.33	1.14	6.86	.03	.05	.17	.19	.53***	1.0	—
7. Rec-Er	59	5.71	2.66	0.00	12.00	.29*	.38**	.26*	−.02	.14	.21	1.0

Note. GK-S = general knowledge in science; PK-Er = prior knowledge in erosion; PoI-Er = postinterest in erosion; PrI-Er = preinterest in erosion; Rec-Er = recall for erosion.

*$p < .05$. **$p < .01$. ***$p < .001$.

TABLE A-19

Level 2 descriptive statistics for evolution text in Study 2

						Correlations						
Variable	*n*	*M*	*SD*	MIN	MAX	1	2	3	4	5	6	7
1. GK-S	59	5.98	1.88	2.00	10.00	1.0	—	—	—	—	—	—
2. Gates	59	27.71	8.01	11.00	45.00	.44****	1.0	—	—	—	—	—
3. PK-Ev	59	0.33	0.19	−0.01	0.57	.16	.24*	1.0	—	—	—	—
4. OSPAN	59	38.05	17.34	0.00	75.00	.26*	.22*	−.13	1.0	—	—	—
5. PrI-Ev	59	4.50	1.33	1.43	7.00	.23*	.34***	.51****	.01	1.0	—	—
6. PoI-Ev	59	4.41	1.29	1.00	7.00	.21	.28**	.23*	.28**	.70****	1.0	—
7. Rec-Ev	59	4.50	3.27	0.00	12.00	.18	.33**	.41***	.14	.20	.30**	1.0

Note. GK-S = general knowledge in science; PK-Ev = prior knowledge in evolution; PoI-Ev = postinterest in evolution; PrI-Ev = preinterest in evolution; Rec-Ev = recall for evolution.

*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

TABLE A-20

Level 2 descriptive statistics for combined texts in Study 2

						Correlation	
Variable	*n*	*M*	*SD*	MIN	MAX	Gates	OSPAN
Gates	59	27.71	8.01	11.00	45.00	1.0	—
OSPAN	59	38.05	17.34	0.00	75.00	.15*	1.0

*$p < .10$.