The Pennsylvania State University

The Graduate School

Department of Educational Psychology, Counseling, and Special Education

INDIVIDUAL DIFFERENCES IN DEEP LEVEL COMPREHENSION:

CONTRIBUTIONS OF TEXT STRUCTURE, COMPREHENSION SKILL, AND PRIOR KNOWLEDGE

A Dissertation in

Educational Psychology

by

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Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

December 2013

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ABSTRACT

This study investigated the influence of expository text structure on college readers' inferencing after reading. I examined whether type of expository text structure influenced bridging inferences made after reading by comparing readers' comprehension of two text structures: problem-solution and listing-description. The goal of this study was to examine whether the problem-solution structure, which may be more facilitative of readers' memory for text, also facilitated readers' inferencing from expository text. Additionally, this study explored whether two sources of individual differences in inferencing, overall comprehension skill and prior content knowledge, moderated the effect of text structure on readers' inferences. Using a between-participants, experimental design, participants were randomly assigned to read one of two structural versions of an educational psychology text (problem-solution or listing-description). Participants (n =168) were undergraduate students, enrolled in an educational psychology course. Prior to reading experimental texts, all participants completed a topic knowledge test and a reading comprehension test. After reading, participants completed a written free recall and answered short answer, bridging inference questions. Due to the low reliability of the topic knowledge test, it was not included in statistical analysis.

Text structure did not significantly predict readers' performance on inference questions. However, readers with high levels of awareness of text structure had better performance on inference questions, particularly for those students who read the listing-description text. Comprehension skill was associated with performance on inference questions; however, the interaction between text structure and comprehension skill was not significant. The findings from the study suggest that text structure may have a minimal influence on bridging inferences made after reading. However, readers' ability to use the structure of the text may be beneficial for bridging inferences.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to thank the members of my committee, Bonnie Meyer, Jim Nolan, Rayne Sperling, and Robert Stevens. I appreciate all the feedback, guidance, and support that you have given me.

I would especially like to thank my advisor Robert Stevens for all of his help through this entire process. From last minute meetings to frequent emails, thank you for taking the time to listen and provide assistance. Your patience in answering all of my questions both large and small has been invaluable.

I am also extremely grateful for the mentorship that I have received from Bonnie Meyer. Thank you for teaching about text structure and helping me to develop the materials and recall scoring for this study. I am also grateful for all of the mentorship that you have given me throughout my time at Penn State.

I would also like to thank Chelsea Cameron, and Mengyi (Elaine) Li for their help with scoring. Additionally, this research project was partially supported by funding through the Institute of Education Science pre-doctoral training grant entitled, 'Training Interdisciplinary Education Scientists' (Award #R305B090007). The views expressed in this article are mine and do not represent the granting agency.

Finally, I would like to thank my friends and family. I am especially grateful for the support that I have received from my sisters, Andy and Sam, and my parents Ron, Sheila, and Carol.

Chapter 1

Introduction

Literacy skills are an essential component of college success. The ACT (2006) reported that in comparison to students who had below readiness benchmark performance on the ACT reading test, students' who demonstrated college readiness were more likely to be successful in college courses that required large amounts of reading, like psychology and history. Similarly, Wyatt, Korbin, Wiley, Camara, & Proestel (2011) found that students who had proficiency level performance on the SAT critical reading test had higher GPAs than those students who scored below the proficiency standard. In addition, literacy skills may be associated with both continued enrollment and degree completion. Students who are "college ready" readers are more likely to persist in their studies and obtain college degrees in comparison to students who have below benchmark performance (ACT, 2006; Radunzel & Nobel, 2012; Wyatt, Korbin, Wiley, Camara, & Proestel, 2011). Unfortunately, many students enter college underprepared for the demands of college reading. Both the ACT and the College Board have reported that nearly 50% of graduating seniors who took the ACT and SAT reading tests obtained test scores below readiness benchmarks (ACT, 2012; Wyatt et al., 2011)

Sources of Difficulties in College Reading

The sources of this lack of preparedness are likely complex, as numerous factors may contribute to students' college readiness. However, difficulties in the cognitive processes associated with reading comprehension may contribute to lower levels of literacy readiness.

Successful reading comprehension requires the coordination of multiple processes at the word, sentence, and text level (Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007; Haenggi & Perfetti, 1994). These comprehension processes are often divided into lower level processes aimed at accurate and fluent word reading, and higher order processes aimed at the integration of text ideas and understanding the text as a whole (Rapp et al., 2007). These higher level processes may include the construction of inferences, use of text structure, and monitoring of comprehension (Cain, Oakhill, & Bryant, 2004). For adolescent and adult readers, both lower and higher level processes significantly predict performance on reading comprehension measures (Cromely & Azevedo, 2007; Hannon, 2012).

Comparisons of more skilled and less skilled readers indicate notable differences in several aspects of higher level comprehension processes. Less skilled readers are less likely to construct inferences during reading (Long, Oppy, & Seely, 1994; Hannon & Daneman, 1998; Zwann & Brown, 1996). Moreover, less skilled readers have difficulties recognizing structural relationships within the text (Hiebert, Englert, & Brennan, 1983) and integrating topic information during reading (Lorch, Lorch, & Morgan, 1987). Additionally, less skilled readers are often less adept at monitoring comprehension and using strategies to resolve comprehension difficulties (e.g. Garner & Taylor, 1982; Hare & Borchardt, 1985). Less skilled readers may also be less strategic readers in general (e.g. Kletzien, 1991; Kozminsky & Kozminsky, 2001).

It is important to note that for many studies, comprehension skill level is determined by readers' performance on a standardized comprehension test relative to other study participants. In other words, skilled readers are individuals within a study sample that have higher scores in relation to other study participants. Because of this relativistic categorization, it may be difficult to make conclusions across studies. This classification may also make it more difficult to define what makes a reader more or less skilled.

Influence of Textual Characteristics

Readers' abilities to successfully comprehend a text are likely related to both the skills and strategies they bring to the text and the features of the text itself (e.g. Best, Rowe, Ozuru, & McNamara, 2005; Meyer & Rice, 1983). For college readers, the organizational features of texts may be particularly important. College readers frequently encounter expository texts. These texts may pose a challenge to readers because they may place greater demands on prior knowledge (Best, Floyd, & McNamara, 2008). Structural features, which indicate organizational relationships between textual ideas, may facilitate comprehension because they make the relationships between these ideas more explicit, which may in turn encourage the integration of textual ideas (McNamara & Kintsch, 1996; McNamara, Kintsch, Songer, & Kintsch, 1996). These structural characteristics include text signals (e.g. titles, previews/overviews, headings, and logical connectives), top-level (rhetorical) structure, and text cohesion.

Numerous studies have provided evidence that structural characteristics influence text comprehension. Texts with signals that indicate the organization of topic information are often associated with greater memory than texts that lack explicit marking of the structure (e.g. Lorch & Lorch, 1995; Lorch, Lorch, & Inman, 1993; Loman & Mayer, 1983). Similarly, the cohesion of texts has often been associated with comprehension. Cohesion refers to the extent to which ideas within a text and the relationships between text ideas are fully explained (O'Reilly & McNamara, 2007). It includes the occurrence of text signaling, as well as the degree of argument overlap (repetition of ideas) and explanation of concepts (McNamara et al., 1996). More cohesive texts have been associated with better performance on recall and other assessments of text comprehension (Lehman & Schraw, 2002; Linderholm, Everson, van den Broek, Mischinski, Crittenden, & Samuels, 2000).

Moreover, there is evidence to suggest that readers' memory for text is closely related to its rhetorical structure. Expository texts are frequently organized hierarchically, consisting of higher level ideas (macro-proposition) and lower levels ideas (Weaver & Kintsch, 1991). Readers' memory of text may be influenced by this hierarchy, with readers having better recall of higher level ideas than lower level ideas (Meyer, 1975). Furthermore, the type of structure used to organize text may also influence comprehension. Expository texts can be classified according to one or more top-level rhetorical structures. These top-level structures include causation, comparison, collection, description, and problem-and-solution (Meyer, 1975, 1985). Top-level structures can be conceptualized as existing on a continuum from more structured to less structured, with more structured texts, like causation and problem-and-solution, containing more structural components than less structured texts like description (Meyer & Freedle, 1984). For adult readers, more structured texts have been associated with greater memory than less structured texts (Meyer & Freedle, 1984; Spooren, Mulder, & Hoeken, 1998). It is important to note that text structure is similar to text cohesion in that both can be used to describe the degree of organization contained in a text; however, cohesion is typically considered a broader concept that encompasses both structural relationships and conceptual overlap. In contrast, top-level structure is primarily concerned with the type of structures used to describe the organizational relationships that connect text ideas.

The Interaction between Reader and Structure

In many cases the effect of structural characteristics varies in relation to the prior knowledge and comprehension skill level of the reader. Prior knowledge refers to students' understanding of the concepts discussed within a text (topics) and the larger domains (e.g.

biology, world history) to which texts refer (Alexander, Kulikowich, & Schulze, 1994). Comprehension skill refers to readers' overall comprehension proficiency.

The interaction between these three influences is likely complex. Some previous research indicates that the benefits of increases in structure (e.g. text signaling, high cohesion) depend on readers' need to rely on these indicators of structure to guide their comprehension. For example, there is some evidence that the benefits of text signaling may be greater for less skilled readers (Meyer, Brandt, & Bluth, 1980; Naumman et al., 2007). Likewise, studies of text cohesion have indicated that more cohesive texts may be more beneficial for readers with low domain knowledge (McNamara et al., 1996; McNamara & Kintsch, 1996). Because indicators of text structure highlight the relationships between text ideas, they may be particularly beneficial to readers who have difficulty identifying these relations due to lower levels of comprehension skill (e.g. Linderholm et al., 2000, Meyer et al., 1980) or content knowledge (e.g. McNamara et al., 1996). Increases in text structure may provide the supports needed for these readers.

At the same time, readers' knowledge and comprehension skill may also limit the benefits of more structured texts. Low levels of prior knowledge or low levels of reading skill may make it more difficult for readers to recognize the structure of a text. For example, although more organized top-level structures are associated with increases in memory, these texts may be challenging for readers with lower levels of content knowledge (Wylie & McGuinness, 2004; Armand, 2001). Similarly, increases in text cohesion may be more beneficial for more skilled readers than less skilled readers (O'Reilly & McNamara, 2007; Ozuru, Dempsey, & McNamara, 2009). Although more structured texts may be beneficial, a requisite level of knowledge and skill is likely needed. Conflicting findings regarding the interaction between knowledge, skill, and structural characteristics may also be related to methodological differences across studies including: a) classifications of high and low knowledge/ skill, b) texts used, and c) structural characteristics being investigated.

Several models and definitions of comprehension have been created to explain these interactions between readers and the text. These models stress that comprehension is influenced by factors both within and outside of the reader. The Rand Reading Study Group (2002) has proposed that comprehension is influenced by a number of factors related to the reader, the text, the reading activity, and the sociocultural context. Similarly Meyer and Rice (1983) posited that comprehension is dependent on the characteristics of the reader, the text, and the task. Within these frameworks, comprehension is determined not only by the individual contributions of each of these sources, but also the interplay between them (Rand Reading Study Group, 2002; Meyer & Rice, 1983). Similar to a tetrahedral model of learning (e.g. Bransford, 1979; Brown, Campione, & Day, 1981), in these views, readers' comprehension is dependent on the situation in which reading occurs. Successful comprehension occurs when readers have relevant knowledge and skills and are able to apply them to a given text. Comprehension is impeded when a misalignment occurs between these factors. For example, a text may be cohesive and well-organized, but if readers have no relevant content knowledge, they may struggle to make sense of the text.

Focus of this Study

This study examined the influence of top-level structure, overall comprehension skill, and prior knowledge on expository text comprehension. Specifically this study explored whether type of top-level text structure had an impact on college readers' construction of inferences from text. Inferences require comprehension that moves beyond readers' memory for information explicitly stated in the text and encompasses their interpretation of textual ideas. Readers' inferences serve as indicators of readers' deeper level comprehension of text (Best et al., 2005).

Although the influence of top-level structure on memory has been well established, few empirical studies have explored the possible influence structure has the construction of inferences (e.g. Walker & Meyer, 1980). More organized top-level structures have been associated with

increases in memory (Meyer & Freedle, 1984). This increase in memory is likely because readers have generated a more organized mental representation, in which concepts are linked according to the text structure. It is possible that these benefits to memory may also extend to readers' ability to construct text-based inferences after reading because readers are better able to recall the ideas needed to make inferences. In order to examine the effect of top-level structure on inferences, I compared performance on inference questions of college students who read either a problem - solution or listing of descriptions version of the same educational psychology text. Furthermore, because the effect of structure on inferences is likely through the organization of readers' memory for text, I also examined the relationship between the organizational ratings of students' written recalls of the text and their performance on inference questions.

Additionally, this study explored the possible interaction between the top-level structure of the text, students' comprehension skill, and their prior knowledge of the content. Although an extensive amount of research exists regarding the influence of comprehension skill, knowledge, and structural characteristics, relatively fewer research studies have investigated the relationship between them. Previous research which has examined the relationship between all three influences primarily has focused on text cohesion (e.g. Ozuru et al., 2009). Although studies of cohesion are informative for other aspects of organization, they are limited in their ability to explain the role that type of text structure plays. Additionally, much of the research which has examined the interaction between reader and text has focused on either science or history texts (e.g. Linderholm et al., 2000; McNamara et al., 1996). Fewer studies have examined this relationship with texts from other domains. A secondary goal of this study was to extend the research literature by exploring the interaction between reader and text structure, when reading text in a social science (educational psychology).

This exploration of text structure may have important implications for instruction. Current recommendations for comprehension instruction stress the importance of explicit

instruction of comprehension strategies (Kamil, Borman, Dole, Kral, Salinger, & Torgesen, 2008). One strategy that has been shown to be effective in improving comprehension is the structure strategy. Instruction in this strategy teaches students how to identify the structures of expository texts and organize their own understanding according to these structures (e.g. Meyer, Wijekumar, & Lin, 2011; Meyer, Wijekumar, Middlemiss, Higley, Lei, Meier, & Spielvogel, 2010; Williams, Nubla-Kung, Pollini, Stafford, Garcia, & Snyder, 2007). Readers who have received structure strategy instruction have achieved greater performance on both standardized and experimenter constructed measures of comprehension (e.g. Meyer et al., 2010). Although there is sufficient evidence to support structure strategy instruction, in order for instruction to be maximally effective it should address the needs of readers from diverse backgrounds. One way to provide insights into the needs of individual learners is to explore how text structure influences the comprehension of readers who vary in terms of their prior knowledge and comprehension skill. Additionally, by examining the relationship between the organization of memory and inferences, this study would be able to provide new insights into the possible extent of the benefits of structure strategy instruction.

Chapter 2

Review of Literature

At its core reading comprehension is about readers' ability to create meaning from text. When readers have understood a text, it is no longer just a collection of words, sentences, and paragraphs, but instead is an integrated, meaningful whole. In the case of narratives, this whole reflects the story that readers have constructed. For expository text, this whole could be several things including the definition of an idea, the explanation of a process, or the comparison between two entities. In short, when readers have comprehended a text, they have constructed a meaningful, mental representation of the text (Kintsch, 1998). They have achieved what researchers refer to as coherence. Coherence refers to the extent to which readers establish clear, meaningful relationships between the mental propositions generated from a text (Todaro, Millis, Dandotkar, 2010; van den Broek, Young, Tzeng, & Linderholm, 1999). When readers fall short in this endeavor, their memory for text may be fragmented, muddled, and/or incomplete (Kintsch, 1998).

Several theories have been proposed to explain the comprehension process. One of the most relevant for expository text comprehension is the construction-integration model. This model proposes that comprehension involves the cyclical use of two interrelated processes: construction and integration. In the construction process, readers generate a loosely associated network of propositions derived from the text and prior knowledge (Kintsch, 1998). In the integration process, readers establish stronger connections between propositions through "a constraint satisfaction" process (Kintsch, 1998, p.99). In this process, the propositions that are most relevant to the context of the text, as well as the relationships between them, are

strengthened, while weakly related concepts are deactivated (Kintsch, 1998; McNamara & Kintsch, 1996).

Through these comprehension processes, readers construct a mental representation of the text that can be characterized in terms of multiple levels. The two levels most relevant for comprehension are the textbase and the situational levels. The textbase often represents readers' literal understanding of the ideas contained in the text and involves the construction of a mental representation that closely resembles the text in terms of both its content and organization (Kinstch, 1998, 2004). Readers' situational models represent their comprehension and organization of textual ideas in terms of their existing knowledge networks (Kintsch, 1998, 2004). Kintsch (1998) has suggested that readers use "knowledge about the language, about the world in general, and about the specific communicative situation" to further interpret the text and enhance the coherence of their mental representations (p. 103). This application of knowledge helps readers to construct a situational model. Situational models may assume several forms because prior knowledge may vary in both quantity and quality across readers (Kintsch, 2004).

Deep level comprehension is closely related to the concept of a situational level of comprehension. Best, Rowe, Ozuru, and McNamara (2005) have asserted that deep level comprehension requires readers to "construct a global meaning that integrates multiple sentences" (p. 66). Similarly, Lehman and Schraw (2002) define deep processing as "the construction of an integrated representation of text in memory" (p. 740). In these views, deep level comprehension reflects readers' abilities to establish a coherent mental representation of the text as a whole. This may be accomplished by incorporating the text with prior knowledge (Best et al., 2005). In contrast, shallow processing of the text, which is similar to the concept of a textbase, generally reflects readers' ability to recognize and recall those ideas made explicit in the text (Lehman & Schraw, 2002). When readers have achieved deeper level comprehension, they are not only able

to retell or recognize the ideas presented in the text, but also are able to understand their significance and the relationships between them.

Inferences as Indicators of Deep Level Comprehension

Deep level comprehension is typically assessed by readers' ability to make inferences. Readers construct inferences both during and after reading. While both inferences made during and after reading are indicative of deeper level comprehension, they reflect different processes. During reading, inferences reflect readers' attempts to integrate ideas into a mental representation (Graesser, Singer, & Trabasso, 1994; Trabasso & Magliano, 1996). After reading, inferences provide insights into the quality, and more specifically the coherence, of readers' mental representations at the situational level as well as readers' deeper understanding (Best et al., 2005; McNamara & Kintsch, 1996). In other words, while measures of inferences during reading capture comprehension processes, measure of inferences after reading capture the results of those processes.

Although this study is primarily concerned with inferences constructed after reading, it is important to also consider inferences made during reading because these inferences may be indicative of the quality of readers' situational models. Indeed, Millis, Magliano, and Todaro (2006) found that readers' integration processes during reading were predictive of inferential comprehension. Millis et al. (2006) compared latent semantic analysis (LSA) cosines of college readers' typed verbal protocols of expository texts in order to examine whether integration during reading was predictive of performance on various measures of comprehension.

In their study, college readers read texts sentence by sentence and typed their thoughts after each sentence. LSA was used to examine the commonalities between texts and is based on conceptual similarity; higher cosines indicated a greater degree of similarity (Millis, Magliano, &

Todaro, 2006). Cosines were calculated for each protocol statement, by comparing the statement to the current sentence being read and any distal and local cause sentences associated with that sentence (Millis et al., 2006). A local cause was causal information presented in the sentence before the one being read. A distal cause consisted of causal information presented two more sentences before the sentence being read (Millis et al., 2006). If a readers' protocol statement contained a high distal cosine that indicated that when the reader thought about the event or situation described in a sentence they recalled information about its' cause, and this causal information occurred earlier in the text (Millis et al., 2006). Millis et al. found that distal cosines significantly predicted performance on inference questions. A higher a degree of integration during reading was associated with higher scores on answers to inference questions (Millis et al., 2006).

Theoretical Perspectives on Inferencing

Theoretical perspectives of inferential processing seek to explain both the degree to which readers engage in inferencing during reading and the types of inferences readers generate. Contrasting perspectives have been offered regarding the occurrence of inferences during comprehension. The minimalist perspective, proposed by McKoon and Ractcliff (1992), posited that readers only generate those inferences needed to maintain local and/or referential coherence. According to this perspective, global inferences which involve connections across non-adjacent sentences/clauses occur only when readers possess a strategic goal to generate them (McKoon & Ratcliff, 1992). In contrast, the constructionist perspective developed by Graesser, Singer, and Trabasso (1994) proposed that readers actively try to establish both local and global coherence during reading. In this perspective, readers may generate numerous inferences during reading aimed at global understanding including goal, thematic, and causal inferences (Graesser et al., 1994).

In relation to types of inferences, several taxonomies have been offered to explain inferential processes. An important classification of different types of inferences is based on the direction of the inference. Directionality concerns whether inferences relate ideas in working memory to previous event/ideas or future events/ideas. Trabasso & Magliano (1996) described three types of inferences: explanations, associations, and predictions. Explanations are essentially backward inferences in which readers attempt to establish the cause of an event or state currently being processed (Trabasso & Magliano, 1996). According to Trabasso & Magliano, explanatory inferences are usually required to establish coherent relationships between ideas. Associations are attempts to connect the text with prior knowledge in order to provide additional description (Trabasso & Magliano, 1996). These inferences are similar to elaborative inferences in that usually they are not required to maintain coherence (Long & Golding, 1993; McKoon & Ratcliff, 1992; Singer, 1993). Predictions are characterized as forward inferences that attempt to forecast likely outcomes (Trabasso & Magliano, 1996). Predictive inferences may also be considered to be elaborative.

Inferences may also be classified in terms of the source of the information used to generate the inference. Sources for inferences include the text and readers' prior knowledge. Trabasso & Magliano (1996) and van den Broek, Young, Tzeng, and Linderholm (1999) further differentiate text-based sources into two categories: text ideas from the immediately preceding comprehension cycle that are carried over and text ideas from previous cycles that are retrieved from the reader's mental representation. Prior knowledge sources include readers' use of world, domain, and topic knowledge and include carryover of knowledge activated in the preceding cycle (Trabasso & Magliano, 1996).

Although these dimensions are typically used to describe inferences made during reading, similar qualities are used to describe inferences constructed after reading as well. Specifically, inferences made after reading are usually classified in terms of type and source (McNamara &

Kintsch, 1996). This includes distinctions between elaborative and coherence inferences (Cain, Oakhill, Barnes & Bryant, 2001), knowledge-based and text-based (McNamara & Kintsch, 1996), and global and local (Ozuru, Best, Bell, Witherspoon, & McNamara, 2007; Ozuru et al., 2009). The majority of research on readers' inferences after reading has focused on the construction of bridging inferences. These inferences are often referred to as bridges because they require readers to establish a meaningful relationship between two or more text propositions, using ideas from the text and world knowledge (Magliano et al., 2011; McNamara & Kintsch, 1996). They are similar to explanatory inferences, but vary in terms of their necessity for comprehension.

Individual Differences in Inferencing

Individual differences across readers influence both the quality and quantity of inferences that individuals construct. There are several possible sources of individual differences. One important influence is working memory capacity. Readers with larger working memory spans are able to maintain a larger number of concepts in working memory, which may facilitate the integration of the concepts needed to make inferences (Singer & Richot, 1996). As previously mentioned, prior knowledge is also a powerful predictor of inferences because many inferences require readers to link text information with existing knowledge. Readers with higher levels of prior knowledge are better able to activate the relevant concepts needed to make inferences (McNamara & McDaniel, 2004; McNamara, O'Reilly, & de Vega, 2007). Additionally, the comprehension skill and strategies readers possess may facilitate inferencing by helping readers to recognize the need to construct an inference (Hannon & Daneman, 1998) and engage in the cognitive actions involved in inferencing (Cain et al., 2001). Finally, the degree to which readers engage in inferences may be related to their standards for coherence. Standard for coherence refers to the level of coherence that readers set as necessary for comprehension (van den Broek,

Lorch, Linderholm, & Gustafson, 2001). It is closely related to readers' goals/purpose (van den Broek et al., 2001) and overall level of comprehension skill (Todaro et al., 2010; Todaro, 2010). Readers with higher standards for coherence are more likely to construct inferences during reading than those with lower standards (van den Broek et al., 2001).

The current study focused on two sources of individual differences that may influence inferencing: prior content knowledge and overall comprehension skill. This study focuses primarily on readers' topic knowledge. Alexander, Kulikowich, & Schulze (1994) distinguished domain and topic knowledge by their scope and level of specificity. While domain knowledge broadly describes the major principles/concepts of an area of study, topic knowledge refers to those concepts that relate most immediately to the text (Alexander et al., 1994).

Overall comprehension skill refers to readers' general proficiency in constructing meaning from text. Although comprehension is usually considered a multidimensional construct (e.g. Cromley & Azevedo, 2007; Britton, Stimson, Stennett, & Gülgöz, 1998), establishing overall proficiency levels is helpful when describing differences in inferential processes. It is important to note that in this study, as in many studies, readers' overall level of comprehension was established relative to other participants. With this type of classification, conclusions about the influence of overall proficiency are often restricted to the characteristics of the sample.

Prior Knowledge and Inferences during Reading

Readers with higher levels of domain and topic knowledge generally produce more accurate inferences both during and after reading. With regard to inferences made during reading, Kendeou and van den Broek (2007) examined the relationship between the accuracy of readers' domain knowledge and the accuracy of inferences through the use of verbal protocols. This examination occurred within the context of a larger study that explored the interaction

between text structure (refutational vs. expository) and readers' misconceptions of physics (Kendeou & van den Broek, 2007). Students' verbalizations were classified into several categories, including paraphrases, inter/intra-sentential connections, and accurate and inaccurate inferences (Kendeou & van den Broek, 2007). Kendeou and van den Broek found that readers with less accurate domain knowledge (more misconceptions), generated fewer correct inferences and more incorrect inferences than readers who had more accurate domain knowledge (few misconceptions).

Prior knowledge may also be associated with the type of inferences readers generate during reading. Fincher-Kiefer (1992) explored the influence of domain knowledge (baseball) on local and global inferences, by comparing reading times. In this study, readers were classified into three knowledge groups (high, intermediate, and low) based on their performance on a baseball knowledge test (Fincher-Kiefer, 1992). In order to examine inference generation, Fincher-Kiefer identified sets of sentences in a written account of a game that implied local or global inferences. Local inferences were those needed to maintain coherence, whereas global inferences were those which prompted predictions (Fincher-Kiefer, 1992). The researcher then compared reading times of sentences associated with both local and global inferences to filler sentences. In this study, longer reading times for inference sentences served as an indicator of inferencing (Fincher-Kiefer, 1992). Fincher-Kiefer found that for local inferences, readers from all knowledge groups had longer reading times for these sentences in comparison to filler sentences. In contrast, while readers with high and intermediate levels of prior knowledge had significantly slower reading times for global inference sentences, for low knowledge readers there was no significant difference in reading times between global and filler sentences (Fincher-Kiefer, 1992). Fincher-Kiefer concluded that while all readers generated local inferences, only readers with higher domain knowledge showed evidence of global inferences. The findings from

this study suggest that readers with higher levels of prior knowledge are more likely to generate predictive inferences during reading.

Prior Knowledge and Inferences after Reading

Domain Knowledge

Much of the research regarding the influence of prior knowledge on inferences comes from studies of inferences made after reading. In their studies of the relationship between knowledge and text cohesion, McNamara and colleagues (e.g. McNamara et al., 1996; McNamara, 2001; O'Reilly & McNamara, 2007; Ozuru et al., 2009) have found evidence that high knowledge readers have better performance on inferential questions. For example, McNamara (2001) compared the performance of readers with high and low domain knowledge on two types of inference questions related to a science text. Bridging questions that required the integration of text sentences, and situational model questions that asked readers to draw and explain the biological process described in the text (McNamara, 2001). The goal of situational model questions was to assess readers' integration of text ideas that described the major processes presented (McNamara, 2001). Both questions were designed to assess the quality of readers' situational models. McNamara found that high knowledge readers had better overall comprehension in comparison to low knowledge readers, including scores on both bridging and situational model questions.

Topic Knowledge

Research of topic knowledge has produced similar results. In a study of the influence of knowledge and interest, Baldwin, Peleg-Bruckner, and McClintock (1985) examined seventh and eighth grade readers' inferential comprehension on four texts. Texts varied with regard to the level of topic knowledge and interest readers possessed for the topic. In order to match readers to

texts, students first completed a knowledge assessment and interest rating for a larger pool of texts (Baldwin, Peleg-Bruckner, & McClintock, 1985). Then for each reader, four different texts were selected: high knowledge-high interest, low knowledge-high interest, high knowledge-low interest, and low knowledge-low interest (Baldwin et al., 1985). For each text, students completed a short comprehension test which included inference and text explicit items. Baldwin et al. (1985) found that prior knowledge significantly predicted comprehension scores; readers had higher test scores for texts for which they possessed a higher level of topic knowledge. Topic interest was also positively associated with performance (Baldwin et al, 1985). The interaction between prior knowledge and interest was non-significant; however, texts associated with the highest performance were the high-knowledge- high interest texts (Baldwin et al., 1985).

Boscolo and Mason (2003) found similar results in their investigation of the influence of knowledge and interest. They compared groups of high school readers classified into one of four groups based on their topic knowledge and topic interest. Bridging inference and problem-solving questions were used to assess readers' situational level comprehension (Boscolo & Mason, 2003). Problem-solving questions asked readers to integrate text ideas and then apply this information to new contexts (Boscolo & Mason, 2003). On both bridging and problem solving questions readers in the high knowledge- high interest group had significantly higher scores than readers in both low knowledge groups (including readers with both high and low interest) (Boscolo & Mason, 2003). Similar to Baldwin et al. (1985), readers with high knowledge and high interest had the highest scores (Boscolo & Mason, 2003). Moreover, given that only the group with high interest and high knowledge demonstrated significantly higher performance over low knowledge groups, the findings suggest that the combined influence of knowledge and interest may be important for deeper level comprehension (Boscolo & Mason, 2003). The findings also suggest that interest alone (as in the case of low-knowledge, high interest readers) may not fully compensate for a lack of prior knowledge when making inferences.

The Influence of Prior Knowledge on Inferencing

Prior knowledge may influence inferencing in several important ways. High knowledge readers possess a greater number of relevant concepts stored in memory that are activated during comprehension (McNamara et al., 2007; Britton et al., 1998). Moreover, these concepts may be stored in a more complete and organized knowledge network (Britton & Gülgöz, 1991). As a result, during reading, high knowledge readers can more quickly and easily access the relevant knowledge needed to construct inferences.

McNamara and McDaniel (2004) found evidence that prior domain knowledge may facilitate activation of relevant concepts during reading. The researchers compared readers with high and low baseball knowledge on their response times to a word verification task. College students read a series of sentences that were either related or unrelated to baseball. Students read sentences that either contained an ambiguous word (homograph) or sentences with an unambiguous word that had the same meaning (McNamara & McDaniel, 2004). For example, readers were either presented the sentence "Baseball is played on a diamond" or "Baseball is played on a field" (McNamara & McDaniel, 2004, p. 470). After each sentence readers completed a verification task in which they were presented a word and were asked to judge if it was related to the sentence they had read (McNamara & McDaniel, 2004). All verification words were unrelated to the sentence and reflected the alternative definition of the ambiguous word (McNamara & McDaniel, 2004). For example, after reading either "Baseball is played on a diamond" or "Baseball is played on a field", a reader would be presented the word "ring" (McNamara & McDaniel, 2004, p. 470)

McNamara and McDaniel (2004) were interested in the presence of an ambiguity effect in which slower response times for sentences with ambiguous words indicated that the alternative definition remained activated in memory. McNamara & McDaniel found that for baseball sentences, low knowledge readers demonstrated an effect for ambiguity. Low knowledge readers

had significantly slower response times for ambiguous sentences (e.g. “Baseball is played on a diamond”), suggesting that the unrelated concepts remained active (McNamara & McDaniel, 2004). High knowledge readers, however, did not show an ambiguity effect. For non-baseball sentences both low and high knowledge readers had slower response times after ambiguous sentences (McNamara & McDaniel, 2004). McNamara and McDaniel concluded that when readers had high domain knowledge, they were better able to activate related concepts, which in turn was associated with decreased activation of minimally related ideas. This ability to more quickly activate relevant concepts suggests that readers with greater content knowledge may have better access to concepts stored in memory, which may in turn facilitate their ability to make inferences.

Additionally, prior knowledge may facilitate comprehension through the use of cognitive schemata (Anderson, Reynolds, Schallert, & Goetz, 1977; Rumelhart & Ortony, 1977). Readers with prior knowledge of a domain likely have developed schemata for that domain. They possess knowledge of the more abstract concepts used to describe phenomena and the relationships among these concepts (Rumelhart & Ortony, 1977). When they encounter texts within familiar domains, these schemata are activated and can be used to guide integration of textual ideas into a mental representation. In sum, prior knowledge may have both a bottom-up influence on inferencing through knowledge activation and a top-down influence through cognitive schema.

Comprehension Skill

Readers classified as more skilled, typically generate more thematic inferences and explanatory or bridging inferences. Regarding thematic inferences, using a lexical decision task, both Long, Oppy, and Seely, (1994) and Hannon and Daneman (1998) found that more skilled readers were more likely to construct these inferences. In these studies participants read sentence

pairs containing an ambiguous content word (homographs) (passages were created by Till, Mross, & Kintsch, 1988, as cited in Long, Oppy, Seely, 1994). For example, readers were presented the following passage which contained the homograph "mint"

> "The townspeople were amazed to find that all of the buildings had collapsed except the *mint*. Obviously, it had been built to withstand natural disasters" (Long, Oppy, & Seely, 1994, p. 1458).

After each pair, readers completed a lexical decision task, which required them to decide if a letter string was a word. Long et al. (1994) were interested in response times for two types of words: associate words that shared conceptual overlap and topic words that represented thematic inferences. For each type of word, they compared response times and accuracy for inappropriate and appropriate words. Inappropriate words corresponded to the alternative meaning of the ambiguous word in the sentence (Long et al., 1994). In the preceding example, an appropriate associate would be the word "money" and an appropriate topic would be the word "earthquake", while an inappropriate associate would be the word "candy" and an inappropriate topic would be the word "breath" (Long et al., 1994, p. 1458).

For Long et al. (1994) the primary goal was to determine whether skilled and less skilled readers differed in both inferencing and recognition of related concepts, including the time needed for both processes. The time needed to construct inferences was examined by varying the onset of the words in the lexical decision task (Long et al., 1994). Long et al. found that for associates, less skilled and skilled readers had significantly faster response times with appropriate than with inappropriate words. For thematic inferences, however, skilled readers had faster response times with appropriate words (Long et al., 1994). In contrast, for less skilled readers, there was no significant difference in response times between appropriate and inappropriate topic words (Long et al., 1994). This finding suggests both groups of readers recognized information

related to the text. However in relation to thematic inferences, only skilled readers provided evidence that they constructed inferences during reading.

In relation to bridging inferences, Singer, Andruisiak, Reisdorf, and Black (1992) found a significant, negative correlation between answer times for bridging inference questions and performance on Nelson Denny comprehension and vocabulary tests. Skilled readers were able to construct accurate inferences faster than less skilled readers (Singer, Andrusiak, Reisdorf, & Black, 1992). Similarly, Zwann and Brown (1996) compared the inferential processes of skilled and less skilled readers, utilizing a verbal protocol procedure. These researchers found that skilled readers produced significantly more explanatory inferences and fewer associative inferences in comparison to less skilled readers; however, differences in associative inferences were not significant (Zwann & Brown, 1996). Moreover, the source of skilled and less skilled readers' inferences differed. While skilled readers relied more on prior knowledge, less skilled readers' inferences tended to rely on the text (Zwann & Brown, 1996). Zwann and Brown suggested that this difference reflected differences in the representation guiding comprehension. Skilled readers relied on situational models, whereas less skilled readers relied primarily on the textbase (Zwann & Brown, 1996).

The Influence of Comprehension Skill on Inferences

Several factors may contribute to less skilled readers' difficulties in inferencing. Less skilled readers often have shorter working memory spans (e.g. Daneman & Carpenter, 1980; Britton et al., 1998) and may lack the cognitive capacity to construct an inference. Less skilled readers may also lack the metacognitive knowledge needed to recognize that an inference needs to be made (Hannon & Daneman, 1998), or may possess a lower standard of coherence (Todaro et al., 2010; Todaro, 2010).

Of particular relevance to this study is readers' use of comprehension strategies and their ability to access concepts from memory (both from text and prior knowledge). Skilled readers

typically have more strategies at their disposal and assume an active processing approach to reading (O'Reilly & McNamara, 2007). One such strategy that distinguishes skilled readers from less skilled readers is the use of a structure strategy (Meyer et al., 1980). Skilled readers are much more likely to approach text with the goal of establishing a structure to their mental representations (Meyer et al., 1980). In contrast, less skilled readers are more likely to use a list-like strategy in which the text is processed as a series of loosely related ideas (Meyer et al., 1980). As a result of this listing strategy, less skilled readers may be less likely to integrate topics during reading (Lorch et al., 1987), produce less organized recalls (Meyer et al., 1980; Ray, 2011; Taylor, 1980), and recall fewer ideas from text (Meyer et al., 1980; Ray, 2011). Because less skilled readers may be less likely to recognize and integrate the explicit relationships indicated in the text, they may construct a textbase mental representation that is more fragmented (Meyer et al., 1980). It is also possible that this lack of coherence is present at the situational level as well.

In relation to access, Long et al. (1994) hypothesized that one of the reasons that less skilled readers failed to make inferences was because of difficulties in access to text concepts stored in memory. For all items, less skilled readers had longer response times at later onsets (Long et al., 1994). Long et al. proposed that because less skilled readers have difficulty in access (Gernsbacher, Varner & Faust, 1990), this process may result in longer decision times and a lower probability of making an inference. In a follow-up study, Long et al. investigated the influence of comprehension questions on inferencing. Comprehension questions were presented either after each text (distributed) or after each set of texts (blocked) (Long et al., 1994). Long et al. argued that if access issues were associated with performance, then the presence of questions after each text would be beneficial because it might encourage readers to keep more text concepts active in memory. Long et al. found that the presence of distributed questions was associated with improvements in less skilled readers' performance. Less skilled readers who answered questions after each text had faster response times than those who answered questions after a set

of texts (Long et al., 1994). However, the presence of questioning was not enough to encourage inferences. Even with questions, less skilled readers' responses times to appropriate and inappropriate topic inference words did not differ significantly (Long et al., 1994).

Like Long et al., (1994), Hannon and Daneman (1998) found evidence that contextual supports may facilitate readers' access to concepts, helping readers to generate inferences. Hannon and Daneman (1998) explored the influence of contextual supports on inferencing using passages and procedures similar to Long et al. (1994). They examined whether the presence of key words and questions would increase thematic inferencing in less skilled readers. In their examination of key words, Hannon and Daneman generated a two-word heading for each passage, which contained related content words. For example, in the following passage the words "thumbtack" and "chair" served as headers.

> "The thumbtack was carefully positioned on the chair by one of the pupils. Everyone watched as the newcomer went to his assigned seat." (Hannon & Daneman, 1998, p. 155).

Hannon and Daneman compared the response times of inappropriate and appropriate thematic inferences across key word conditions. The researchers found that less skilled readers had similar response times in the keyword and no key word conditions (Hannon & Dane man, 1998).

However, the presence of comprehension questions did influence less skilled readers' inferencing. Hannon and Daneman (1998) investigated the effect of questioning by changing one of the sentences in the text into an inference question that required the integration of the text concepts and activated world knowledge. For example, readers were presented the passage

> She asked, 'Why was the thumbtack carefully positioned on the chair by one of the pupils?' Everyone watched as the newcomer went to his assigned seat (Hannon & Daneman, 1998, p. 164).

Less skilled readers demonstrated significantly shorter response times with appropriate topic words when reading texts that contained inference questions (Hannon & Daneman, 1998).

However, the effect on inferencing was only present when the presentation rate of the text was slowed (Hannon & Daneman, 1998).

As the findings of Hannon & Daneman (1998) suggest, less skilled readers' difficulties with inferencing may be related to their abilities to access prior knowledge. Knowledge access refers to readers' ability to retrieve world knowledge (Singer et al., 1992). Less skilled comprehenders may have poorer access to prior knowledge (Cain et al., 2001, Hannon & Daneman, 2001). Singer et al. (1992) found that individuals with high scores on knowledge access measures had significantly faster answer times on bridging inference questions. Moreover, they found a significant positive correlation between performance on comprehension tests and performance on measures of knowledge access (Singer et al., 1992). Taken together these findings suggest that knowledge access may be a contributing factor in less skilled readers' difficulty in constructing inferences.

This difficulty in accessing prior knowledge may be related to problems with suppression. According to comprehension models, readers generate mental representations by strengthening the relationships between related concepts and deactivating irrelevant concepts (Kintsch, 1998; Gernsbacher et al., 1990). Less skilled readers may have difficulty in constructing inferences because too many irrelevant concepts remain activated during comprehension (Gernsbacher et al., 1990; Todaro, 2010). In other words, less skilled readers may have difficulty suppressing unrelated concepts that come to mind when they read (Gernsbacher et al., 1990). Gernsbacher, Varner, and Faust (1990) explored issues of suppression, using lexical judgment tasks in which participants were asked to judge whether a word matched the meaning of a short sentence they had just read. Some of the sentences contained ambiguous words, and participants were presented a judgment word that corresponded to a definition of the ambiguous word that did not match the sentence they had read (Gernsbacher et al., 1990). Additionally for each sentence with an ambiguous word, a corresponding sentence

was presented which had the same meaning but contained an unambiguous synonym. The same judgment words also appeared after the unambiguous sentences (Gernsbacher et al., 1990). In examining interference, which was measured as the difference in response time between these two sentence contexts, Gernsbacher et al. (1990) found that immediately after reading, both skilled and less skilled readers experienced a significant amount of interference. After a delay, only the less skilled readers experienced significant interference (Gernsbacher et al., 1990). This finding indicated that for both groups of readers, unrelated concepts were activated during reading. However, skilled readers were better able to deactivate these concepts as they continued to process the text.

However, this skill based account of suppression and activation has been questioned (McNamara et al., 2007). In their study, McNamara and McDaniel (2004) investigated the possibility that rather than comprehension skill, knowledge activation is closely tied with readers' domain knowledge. When considering knowledge and comprehension skill, McNamara and McDaniel (Experiment 1) found that the ambiguity effect was smaller for skilled readers than less skilled readers (suggesting suppression); however, both groups had slower response times for ambiguous sentences. Moreover, when they considered the effect of prior knowledge on skilled readers' responses for baseball sentences, they found that while low knowledge, skilled readers had slower responses to ambiguous sentences, for high knowledge, skilled readers there was no effect for ambiguity (McNamara & McDaniel, 2004). From these findings, McNamara and McDaniel concluded that the benefits of comprehension skill were at least partially explained by readers' prior knowledge. Moreover, they suggested that domain knowledge may be a more important predictor of activation than comprehension skill.

Taken together these studies suggest that less readers' difficulties in inferencing may be related to difficulties in accessing information from memory. This difficulty may be associated with their overall level of comprehension skill, strategy use, and/or prior knowledge deficits.

Moreover, these studies suggest that when readers are given supports that facilitate access, especially those that also encourage the integration of ideas, they may be better able to engage in inferencing.

The Relationship between Prior Knowledge and Comprehension Skill

The issue of the relative contributions of knowledge and skill in activation and suppression underscores the complex relationship between knowledge and skill in inferencing. Studies that have investigated the comprehension of low skill readers with high domain knowledge have suggested that knowledge may help less skilled readers achieve a greater level of comprehension (e.g. Adams, Bell, & Perfetti; Schneider, Korkel, & Weinert, 1989; Walker, 1987). In relation to inferences, Yekovich, Walker, Ogle, and Thompson (1990) explored the possibility that knowledge may compensate for skill deficits. Yekovich et al. conducted a series of studies which examined the influence of domain knowledge (baseball) on the inferential processes of adolescent readers with low verbal abilities. They found that high knowledge-low verbal readers had higher scores on implied main idea questions, when reading baseball texts than non-baseball texts (Yekovich, Walker, Ogle, & Thompson, 1990). Conversely, for readers with low domain knowledge, there was no significant difference in inferences across domains (Yekovich et al., 1990). Moreover, they found evidence that domain knowledge mitigated differences between high verbal and low verbal readers. Yekovich et al. (1990) examined inferences generated by high knowledge readers during a commentary of a baseball game. They found little difference between high and low verbal readers' inferences, suggesting that domain knowledge compensated for readers' lack of comprehension skill (Yekovich et al., 1990).

The findings of Yekovich et al. (1990) also raise the issue of the relative importance of knowledge and skill in inferencing. In their study of the contribution of knowledge and skill in inferential comprehension, Ozuru, Dempsey, and McNamara (2009) used a hierarchical regression analysis to compare the relative contributions of college readers' scores on the Nelson

Denny Reading Test and knowledge tests on scores for local and global bridging questions. Ozuru et al. (2009) found that when knowledge was entered into an equation after the Nelson Denny Reading Test, it explained a significant proportion of the variance in performance on both local and global inference questions. Moreover, Ozuru et al. found that in the case of global inferences, when prior knowledge was entered after skill, comprehension skill was no longer a significant predictor. This finding suggests that for inferences that require integration of text ideas, domain knowledge may be a stronger predictor of performance than comprehension skill.

Both readers' overall comprehension skill and content knowledge are important predictors of inferencing. It is possible that their relative influence may vary in relation to readers' overall level of prior knowledge. When readers have more knowledge about a domain or topic, they can use this knowledge to construct appropriate inferences; however, when knowledge is low, it is possible that readers rely more on their skills and strategies (Voss & Silfies, 1996). Moreover, it is possible that knowledge and skill are interconnected. In order to construct accurate inferences readers require not only sufficient content knowledge, but also the skills and strategies needed to select and apply this knowledge. Current knowledge-based theories of inferences (McNamara et al., 2007), support this dual influence of strategies and knowledge and emphasize that both are important for the construction of a situation model.

The Influence of Text Structure on Inferencing

The top-level structure of a text may influence comprehension by affecting both readers' encoding and retrieval of textual ideas (Meyer & Rice, 1982). As previously mentioned, skilled readers, who approach text with a "structure strategy", actively seek indicators of the overall structure of texts (Meyer et al., 1980). The top-level structure can influence readers' use of a structure strategy by indicating the nature of the hierarchical relationships in text. When a text

contains a clear, well-organized structure, readers are better able to recognize the organization, and in turn are more likely to implement a structure strategy (Lorch & Lorch, 1995; Taylor & Samuels, 1983).

For skilled readers, this process typically results in a mental representation that is hierarchically organized according to the rhetorical structure of the text. This hierarchical organization may influence memory for text by facilitating a top-down retrieval process, in which readers move from high level to low level ideas (Britton, Meyer, Hodge, & Glynn, 1980; Meyer & Rice, 1982). Previous research on differences in readers' memory of high and low level ideas generally supports this process. Readers tend to recall more ideas contained in the top of a text's rhetorical structure, than lower level ideas (Meyer, 1975; Britton, Meyer, Simpson, Holdredge, & Curry, 1979). However, the greater recall of higher level ideas may be related to the task used to measure recall (Britton et al., 1980). These findings also have important implications for the influence of structure on access to concepts in one's mental representation of text, suggesting that readers have better access to higher level ideas.

Variations in the type of structure(s) used to organize a text may influence the nature of the organization of readers' mental representations. Meyer and Rice (1982) examined whether these structural variations had an impact on the organization of readers' recall, by comparing skilled, adult readers' recall of a text that varied with regard to the type of structure emphasized. In this study, the source text was organized according to a comparison text structure, but contained detail sentences that could indicate a sequence of events (Meyer & Rice, 1982). Participants read one of five versions of the same text. Text versions varied in relation to a) whether the overall comparison text structure was signaled (contained words/phrases labeling the structure), b) whether specific detail information was present (including mention of dates), and c) whether this detail information was emphasized (Meyer & Rice, 1982). Meyer and Rice found that participants who read a text that contained no comparison signaling but did contain specific

time-related details produced recalls that were frequently organized using a time order. This finding suggests that skilled readers attend to indicators of the text structure (text signaling), and use them to guide their construction of a mental representation of the text.

Differential effects on readers' organization of memory may contribute to the number of ideas recalled after reading. Meyer and Freedle (1984) hypothesized that those top-level structures that contained more high-level, structural components (more organized structures) would be associated with increases in memory because these components could serve as retrieval cues for one another. With the exception of comparison, these structural components connect ideas in terms of both time and causal relations, with problem-solution being the most organized structure (Meyer & Freedle, 1984). For example, in the case of causation, in order to have a complete structure, a reader must construct a mental representation in which a cause is linked to its effect(s). When asked to recall what they have read, reader's recall of the cause may facilitate recall of its effect(s) (Meyer & Freedle, 1984). Conversely, for listing and description structures, readers may organize ideas without a fixed time or causal order (Meyer & Freedle, 1984). As a result, they may construct a loosely organized mental representation. Subsequently, they may have more difficulty recalling ideas from the text (Meyer & Freedle, 1984).

In order to examine the effect of type of structure on memory, Meyer and Freedle (1984) compared adult readers' recall of four different structural versions of the same text: description/collection, causation, problem/solution, and comparison. Different structures were created by manipulating the information contained in topic sentences of paragraphs and the types of signaling words used (Meyer & Freedle, 1984). Participants listened to one of the four texts and completed an immediate written free recall, a delayed free recall, and a delayed recall test. Meyer and Freedle found that the causation and comparison structures were associated with a significantly higher number of ideas recalled on the free recall task in comparison to the collection/description structure. Similarly, for the delayed recall questions, the comparison

structure was associated with greater recall than the collection/description text (Meyer & Freedle, 1984). The exception to this pattern of greater recall for more structuresd text was the problem-and-solution structure. A follow-up analysis of readers' interpretations of the texts suggests that their interpretations may have encouraged an alternative organization (Meyer & Freedle, 1984). Additionally, the majority of participants used the same structure to organize their recalls as the one they had heard (Meyer & Freedle, 1984). Similar to the findings of Meyer and Rice (1982), participants in this study appeared to use the indicators of text structure (topic sentences, signals) to organize their understanding.

Other researchers have found similar results when comparing the influence of less structured and more structured texts on memory. In particular, they provide evidence that the problem-and- solution structure is associated with greater recall than the listing structure. For example, Sanders and Noordman (2000), compared recall of target sentences within short texts that were linked to preceding sentences by either a problem-solution or listing structure. They found that the problem-solution structure was associated with significantly greater recall of the target (linked) sentence (Sanders & Noordman, 2000). This effect of structure was present regardless of whether the relationship was signaled, indicating that the effect of structure may be distinct from signaling (Sanders & Noordman, 2000). Spooren, Mulder, and Hoeken, (1998) found similar results (Experiment 3). In their study, a text which contained a clearly indicated solution was associated with greater memory for text, as measured by performance on a sentence recognition test, in comparison to a text in which solution information was presented in a more list-like organization (Spooren, Mulder, & Hoeken, 1998). However, in both studies (Sanders & Noordman, 2000; Spooren, Mulder, & Hoeken, 1998), researchers were primarily interested in memory of a specific sentence, which may limit the generalization of their findings to memory of longer texts.

Top-Level Structure and Inferencing

There is some evidence to suggest that the hierarchical organization of expository texts may influence inferencing. Walker and Meyer (1980) examined the effect of height of text information on bridging inferences, using a sentence verification task. Height of text information (high vs. low ideas) was determined by their location in the hierarchical structure of the text, with high ideas located in the "top half", and low ideas located in the "bottom half" (Walker & Meyer, 1980, p. 266). Participants in the study read descriptive texts about a fictional country and completed a verification task in which they were asked to decide whether a sentence was true or false (Walker & Meyer, 1980). Sentences included both correct and incorrect inferences. In order to examine the effect of height on inferences, Walker and Meyer compared accuracy and response times of statements for which the information needed to construct the inferences was high in the text structure to those sentences for which necessary information was located low in the text structure. Walker and Meyer found that readers had greater accuracy in verifying correct inferences when the information needed to make the inference was located high in the text structure. Like memory for text, readers may be better able to draw inferences from high level than lower level ideas.

With regard to type of rhetorical structure, less is known about how different structures affect inferences. However, previous research suggests a limited effect for type of top level structure on inferencing. Montanero and Lucero (2012) examined the effect that type of structure had on college readers' responses to inference questions (global and causal) and delayed recall of a short history text. Participants read one of five different structural versions of the same text: causation (with the cause first or last), problem-and-solution, comparison, and collection (Montanero & Lucero, 2012). Inferential comprehension was assessed with multiple choice questions of two types: global inferences, which mostly tested understanding of implied main ideas and causal inferences (Montanero & Lucero, 2012). Montanero and Lucero found that for recall, the causation text (with the cause first) was associated with greater recall; however, there

were no significant differences between text structures in relation to students' answers to inference questions. Durgunoglu and Jheng (1991) found similar results in their comparison of readers' comprehension of structured and unstructured versions of a history text. The structured version consisted of a listing organization with headings, while the unstructured version had no headings and the paragraph order was changed (Durgunoglu & Jheng, 1991). Accuracy on verification of implicit statements was used to examine inferential comprehension (Durgunoglu & Jheng, 1991). Durgunoglu and Jheng found that type of text structure was not associated with performance on the inference verification task.

Although these findings indicate that structure may not influence deep level comprehension as measured by inference tasks, they should be interpreted cautiously. Top-level structure likely influences text-based inferencing by increasing readers' access to text concepts in memory. In relation to the Durgunoglu and Jheng (1991) study, the researchers compared different versions of a listing structure. Listing structures may be the least likely to have a strong effect on memory, and as a result, alternative forms may also have little impact on inferences. Moreover, Montarero and Lucero (2012) relied on multiple choice questions, in which answer choices may have served as retrieval cues. Previous research of text recall (Britton et al., 1980) has found that hierarchical text structure may have less of an influence on recall when readers complete a cued recall task. In a cued recall task readers are provided questions or other guides that are designed to elicit recall of ideas from the text (Britton et al., 1980). It is possible that when inference questions are presented in a multiple choice format, text structure has less of an effect on performance. Additional research is likely needed with alternative formats (i.e. open-ended questions) in order to discern whether the effect of structure is related to the type of assessment used. Finally, with a limited number of studies, it may be difficult to draw definitive conclusions.

In sum, previous research has indicated that texts that are organized according to a causal or comparative structure facilitate memory for text. The benefit for more structured texts likely results from the influence they have on readers' organization of memory. These structures may facilitate the construction of well-organized mental representations in which concepts are linked in terms of comparative and/or causal relations (Meyer & Freedle, 1984). Readers who construct a representation according to these structures may have better memory for text as these relations seem to facilitate access to text ideas. Less is known about the influence of text structure on inferences. It is possible that this facilitative effect on memory extends to the construction of inferences by helping readers to have better access to text information needed to make inferences. However, there is little empirical evidence to suggest that such a relationship exists.

Reader - Structure Interactions

In considering the effect of structure on inferences is it also necessary to consider readers' overall level of comprehension skill and prior knowledge, as these are two important influences on inferencing. Although this study was focused on the effect of type of top-level structure, relatively few studies have investigated how the effect of type top-level structure varies according to readers' knowledge and skill. As a result, in the following section, I have included research of other structural characteristics (text signaling and cohesion) in order to make conclusions about the interaction between reader and top-level structure. Similarly, relatively fewer studies have examined the interaction between structural characteristics and comprehension skill as it relates to inferencing. For that reason where appropriate I have included studies which have focused on readers' memory for text.

Text Structure and Comprehension Skill

The influence of top-level structure on inferencing may vary in relation to reader's overall comprehension skill. In particular, it may vary in relation to readers' need and ability to use text structure to guide their comprehension. Previous research has indicated that text signaling and other revisions to increase the cohesion of text may be more beneficial for less skilled readers (Meyer et al., 1980; Naumann, Richter, Flender, Christmann, & Groeben, 2007). For example, Meyer, Brandt, and Bluth (1980) compared the effect of signaled and unsignaled texts on ninth grade readers' recall. Participants were classified as low ability, high ability, and underachievers. Underachievers were readers who had difficulties with comprehension but not word reading (Meyer et al., 1980). Signaled texts contained topic sentences as well as words and phrases that specifically labeled the structure, such as "the problem of" and "the solution to the problem" (Meyer et al., 1980, pp. 102-103). The researchers found that while there was no significant difference between signaled and unsignaled texts for low and high ability readers; for underachievers, signaled text were associated with a significantly greater number of ideas recall (Meyer et al., 1980). This finding suggests that when signals of the text structure were present, this group of less skilled readers was better able to use the structure of the text.

Naumann, Richter, Flender, Christmann, & Groeben (2007) found similar results with older readers and a longer text. In their study (Experiment1), they examined the effect of signaling by comparing a signaled hypertext to an unsignaled, linear version of the same text. The signaled hypertext version contained overviews that indicated the overall organization and hyperlinks that indicated the conceptual relationships between topics (Naumann et al., 2007). Participants read and studied one version and wrote an essay about the topic from their notes. In examining the number of ideas that readers generated that were related to the general topic of the text, Naumann et al. (2007) found an interaction between signaling and reading skill. While

reading skill was associated with better performance for the linear, unsignaled text, there was no significant effect for reading skill with signaled hypertext (Naumann et al., 2007). This finding indicated that skilled and less skilled readers who read the signaled hypertext had essays of similar quality. Similar performance may have been due to differential benefits of signaling. Less skilled readers benefited from reading the signaled text, while there was no significant effect for signaling for skilled readers (Naumann et al., 2007). Naumann et al. also explored this interaction on readers' inclusion of ideas that indicated integration. These ideas reflected readers' use of ideas not specifically included in the text such as inferences, evaluations, and connections to prior knowledge (Naumann et al., 2007). A similar pattern of results was found for these ideas; however, this interaction between signaling and skill failed to reach significance at the .05 level (Naumann et al., 2007).

However, other researchers have failed to find differential benefits for adult readers. Kardash and Noel (2000) compared the effect of a text containing signaling (overviews, headings, and summaries) to unsignaled text, and explored whether signaling condition interacted with readers' verbal ability (vocabulary test scores). Students read either a signaled or unsignaled version of a text about energy, and completed a recall and sentence verification task (Kardash & Noel, 2000). Kardarsh and Noel found that the signaled text was associated with significantly more topic and total ideas recalled in comparison to the unsignaled text. No significant interaction between signaling and vocabulary test scores was found (Kardash & Noel, 2000). However, for the sentence verification task, a significant interaction between vocabulary score and signaling was found, with the effect of vocabulary score being greater in the unsignaled condition (Kardash & Noel, 2000). The researchers did not provide an explanation as to why an interaction was present with verification (recognition of text sentence) but not recall. Inconsistencies across these two studies may be related to methodological differences. Readers in the Naumann et al. (2007) study read a much longer text (book length) and engaged in a more

complex task (essay construction). Moreover, Naumann et al. compared signaling across modalities (linear vs. hypertext). It is possible that for adult readers, the interaction between signaling and skill is related to the difficulty of the task. Less skilled readers may have more benefits when the task is challenging.

Increases in text cohesion may also be more beneficial to less skilled readers. As discussed in Chapter 1, cohesion typically refers to the degree to which the semantic and organizational relationships are explained (McNamara et al., 1996; O'Reilly & McNamara, 2007). Cohesion is usually considered on continuum from low to high. Linderholm, Everson, G., van den Broek, Mischinski, Crittenden, Samuels (2000) examined the effect of revisions to increase the causal cohesion of social studies texts for college students classified as skill and less skilled. They increased the cohesion of history texts classified as easy or difficult in several ways including reordering concepts so that causes appeared before effects and increasing the clarity of the relationship between causes and effects (Linderholm et al., 2000). Students read both a difficult and easy text, as well as a revised and unrevised version, and then completed a recall and comprehension questions for each text (Linderholm et al., 2000). Although increases in cohesion benefited all readers when reading difficult text, they seemed to have a unique impact on less skilled readers (Linderholm et al. 2000). When reading a revised text, less skilled readers demonstrated performance on comprehension questions that was similar to more skilled readers who had read the unrevised text (Linderholm et al., 2000). This finding suggests that increases in cohesion may not only help less skilled readers to improve their comprehension, but may also provide a compensatory support, helping them to achieve a level of understanding that is similar to skilled readers.

Unfortunately, less is known about how comprehension skill interacts with the type of top-level structure that organizes a text. In general, less skilled readers may have less awareness of the different types of structures used to organize expository texts. Using a rating task, Hiebert,

Englert, and Brennan (1983) found that while both skilled and less skilled readers had similar performance in their ability to recognize description and sequence structures, the skilled readers had better performance on ratings of the comparison and collection structures. Because these structures are on opposite ends of the structure continuum, it is possible that less skilled readers have a general difficulty in being able to recognize expository structures. However, it is unclear how less skilled readers may respond to different structures. It is possible that due to a global deficit in structural knowledge, less skilled readers will not be sensitive to variations in the type of structure used to organize texts. However, like signaling, structures that are more organized may provide more support for less skilled readers.

Previous research suggests that while more structured texts may provide the cognitive supports needed by less skilled readers, they may have less of an influence on skilled readers. Skilled readers may be less sensitive to increases in text organization because they already approach texts trying to establish meaningful relationships between text ideas (Meyer et al., 1980). Less skilled readers, on the other hand, may benefit from signaling because it helps them to better identify the structure of the text. In other words, it encourages readers to engage in a structure strategy, when they might not otherwise (Meyer et al., 1980).

There are three things that are important to consider about this possible interaction between structure and comprehension skill. First, there may be a reading skill threshold readers need to meet in order to take advantage of structural supports. Readers with low reading ability may not benefit from signaling because they have very little knowledge of text structure (Meyer et al., 1980), and/or their comprehension is focused on lower level processing like word recognition (Haenggi & Perfetti, 1994).

Second, even skilled comprehenders may benefit from increases in cohesion and signaling. Numerous studies have found that skilled comprehenders have greater recall and comprehension when reading more cohesive, signaled text (e.g. Lehman & Schraw, 2002; Lorch,

et al., 1993; Loman & Mayer, 1983). While the relative benefits may vary, readers of all skill levels may benefit from increases in text structure. Moreover, some studies of text cohesion, have found that skilled readers had better performance on comprehension questions when reading more cohesive science texts (O'Reilly & McNamara, 2007; Ozuru et al., 2009). However, in these studies, this effect of cohesion was related to the level of comprehension being assessed and the domain knowledge of the reader. It is possible that whether or not readers benefit from increases in text structure depends on the context in which reading occurs.

Finally, these studies have focused primarily on the interaction of structure and skill on readers' abilities to recall text ideas. It is less clear how structural characteristics influence skilled and less skilled readers' ability to generate inferences from text. However, the findings of Naumann et al. (2007), suggest that differential benefits in recall may extend to inferencing.

Text Structure and Prior Knowledge

Readers with higher levels of prior knowledge may respond differently to structural characteristics than readers with low knowledge. With respect to type of rhetorical structure, some researchers have provided evidence that more organized text structures (e.g. comparison) may present a challenge to low knowledge readers. Wylie and McGuinness (2004) examined the effect of five rhetorical forms (classification, compare/contrast, enumeration, sequence, and generalization) on high and low knowledge readers' recall of main ideas from psychology texts. They classified top-level structures on a continuum from most to least structured, with the comparison text being the most structured and the generalization text being the least (Wylie & McGuinness, 2004). Both the high and low knowledge groups recalled fewer ideas when reading the least structured texts (Wylie & McGuinness, 2004).

Wylie and McGuinness (2004) failed to find a significant effect for prior knowledge or a significant knowledge by skilled interaction. However, they found some evidence to suggest that the knowledge groups differed with regard to the effect of type of text structure on recall. In comparing the four more organized text structures, Wylie and McGuinness found that the high knowledge group had higher recall for the most organized text structure (comparison). In contrast, the low knowledge group performed similarly across these four structures (Wylie & McGuinness, 2004). Wylie and McGuiness (2004) concluded that although more structured texts can be beneficial for memory; readers may require some level of prior knowledge in order to use the structure.

Similarly, Armand (2001) found a relationship between degree of structure and prior knowledge by examining sixth grade students' comprehension of a highly structured text to a less structured text. The highly structured text combined a causation structure with a comparison structure ("comparison inserted in cause/effect"), while the less structured text combined a causation structure with a collection structure ("causation inserted in cause/effect") (Armand, 2001, p. 73). After reading, participants answered comprehension question that were categorized in several ways including response type (open vs. closed) and whether an inference was required (text explicit, text implicit, script implicit) (Armand, 2001). With regards to inferences, high knowledge readers had similar performance on text implicit questions across both structures (Armand, 2001). In contrast, low knowledge readers had higher inference scores with the less structured causation-collection text (Armand, 2001). The findings from both of these studies indicate that in order to take advantage of text structure, readers may require a certain level of prior knowledge. Readers with low prior knowledge may struggle to integrate ideas from text because they are unfamiliar with text concepts. Texts that are more structured may also be more complex, and this additional complexity may overburden readers' integration efforts.

Text Cohesion and Prior Knowledge

In contrast, studies of text cohesion have indicated that increases in cohesion may be more beneficial for low knowledge readers. McNamara, Kintsch, Songer, and Kintsch (1996) found an interaction between readers' domain knowledge and level of cohesion (Experiment 2). The researchers examined the influence of domain knowledge by classifying adolescents (age 10-15) into high and low knowledge groups based on their performance on a test of domain knowledge. Participants' read one of four versions of the same scientific text. Each text had a different level of cohesion at local and/or global levels (McNamara et al., 1996). The level of cohesion was increased or decreased through the use of connectives and signals, explanations/ definitions, and repetition of terms (McNamara et al., 1996). In addition to measures of memory, readers answered inference questions that required them to connect information within the text (bridging) and to connect text information to ideas outside of the text (elaboration, problem-solving) (McNamara et al., 1996).

In their comparison of texts with the highest and lowest levels of cohesion, McNamara et al. (1996) found that increases in cohesion had differential effects on high and low knowledge readers' inferences. For low knowledge readers, the high cohesion text was associated with higher scores on bridging and problem-solving questions (McNamara et al., 1996). In contrast, for high knowledge readers, the low cohesion text was associated with higher scores on the bridging and problem-solving questions (McNamara et al., 1996). High cohesion texts may have been more beneficial for low knowledge readers, because increases in cohesion may have provided information that these readers needed in order to be able to construct inferences both during and after reading (McNamara et al., 1996). In contrast, McNamara et al. argued that when the relationships between ideas are clearly explained, high knowledge readers may engage in less inferencing during reading and may not achieve the level of comprehension needed to construct

inferences after reading. This differential effect of text cohesion for low and high knowledge readers is sometimes referred to as a "reverse cohesion effect" (O'Reilly & McNamara, 2007),

McNamara and Kintsch (1996) found similar results regarding the relationship between text cohesion and prior knowledge in their study of adult readers' comprehension of a historical text. However, other researchers have failed to replicate the differential effects for text cohesion found by McNamara et al. (1996). For example, Kamalski, Sanders, and Lentz (2008) found that the interaction between cohesion and knowledge may be related to how readers are classified as having low and high prior knowledge. In a series of studies, they examined the influence of domain knowledge and cohesion on situational level comprehension of expository and persuasive texts. Cohesion was manipulated for two science texts by including headings and connectives, and reducing pronouns (Kamalski, Sanders, & Lentz, 2008). Participants read one high cohesion one low cohesion text and answered either bridging inference questions or completed a sorting task. In the sorting tasks readers were given ideas from the text and were asked to put these ideas into groups based on their relatedness (Kamalski et al., 2008).

Two experiments compared existing knowledge groups: biology vs. history majors (Experiment 1) and medical vs. law students (Experiment 2) (Kamalski et al., 2008). For existing knowledge groups, the reverse cohesion effect was only partially supported for expository texts (Kamalski et al., 2008). Kamalski et al. (2008) found that history majors (low knowledge) had higher scores on bridging questions when reading the high cohesion texts. However, for biology majors (high knowledge) there was no significant difference between cohesion versions (Kamalski et al., 2008). In Experiment 2, there was no effect for the cohesion of expository texts for either high knowledge (medical students) or low knowledge (law school) readers (Kamalski et al., 2008).

In a third study, Kamalski et al. (2008) provided half of the participants with exposure to relevant prior knowledge via video, while the other half of participants received no exposure to

this information. In this study, the researchers found evidence of a reverse cohesion effect. Low knowledge readers (no exposure) had higher scores on a sorting task with the high cohesion text, while high knowledge readers had higher scores with the low cohesion text (Kamalski et al., 2008). Kamalski et al. (2008) proposed that the difference between the experiments was related to knowledge activation. The researchers argued that prior knowledge exposure helped readers to focus on concepts related to the text. However, in studies using existing knowledge groups (participants with either high or low prior knowledge), it was possible that while high knowledge readers possessed more knowledge of concepts, they may not have used this knowledge when reading or answering questions (Kamalski et al., 2008).

In addition, the nature of the cohesion revisions implemented may also explain differences across studies. Gilabert, Martinez, and Vidal-Abarca (2005) examined whether type of cohesion revision influenced the comprehension of high knowledge and low knowledge readers. Specifically, two types of cohesion revisions were applied to a history text: a) increases in argument overlap (like those used by McNamara et al., 1996) and b) causal revisions that provided additional causal information (Gilabert, Martinez, & Vidal-Abarca, 2005). The goal of causal revisions was to ease readers' ability to link cause and effects, without increasing the argument overlap of the text (Gilabert et al., 2005). Gilabert et al. (2005) hypothesized that argument overlap reduces the number of inferences that readers need to make from a text, and that this may contribute to the reverse cohesion effect. In contrast, the researchers hypothesized that revisions that increased the clarity of causal relationships, but did not reduce the inferential load, would be beneficial to both high knowledge and low knowledge readers (Gilabert et al., 2005). In two experiments, Gilabert et al. examined the effect of cohesion, for eighth grade students who either received or did not receive prior knowledge instruction (Experiment 1) and university students who varied in their level of historical knowledge (Experiment 2). In both experiments, students read the text and completed an immediate recall. A week later, participants

completed a delayed recall and answered inference questions with the text present (Gilabert et al., 2005).

Gilabert et al. (2005) found in both experiments that the causal revisions were associated with significantly higher scores on causal inference questions, in comparison to unrevised text. This positive effect for cohesion was present for both high and low knowledge readers (Gilabert et al., 2005). For the argument overlap revision, in Experiment 1, Gilabert et al. found no significant difference in scores between eighth grade students who read the revised text in comparison to those who read the unrevised text. Although prior knowledge was associated with higher inference scores, there was no significant interaction between knowledge and cohesion (Gilabert et al., 2005). For adult readers (Experiment 2) the argument overlap revision was associated with inferencing; readers who read the revised text had higher inference scores than those who read the unrevised text (Gilabert et al., 2005). The researchers' found only partial support for their hypothesis. Causal revisions to improve cohesion were associated with better performance on inference questions for both high and low knowledge readers; however, Gilbert et al. did not find evidence suggesting that cohesion revisions based on argument overlap were associated with the reverse cohesion effect. The findings of Gilabert et al. suggest that when considering the influence of text structure on inferences, it is important to consider the particular characteristic being investigated.

Additionally, methodological differences may have contributed to discrepancies across these studies. In the Gilabert et al. (2005) study readers were able to access the text, while answering questions. In contrast, in McNamara and colleagues' studies the text was unavailable when students answered questions. Ozuru, Best, Bell, Witherspoon, and McNamara, (2007) found that the availability of the text may influence the effect of prior knowledge on comprehension. In their study, prior knowledge was positively correlated with inferential comprehension when text was unavailable. However, when students had access to the text, there

was no significant correlation between knowledge and inferencing (Ozuru et al., 2007). Ozuru et al. (2007) concluded that when readers make inferences without the text, they rely more heavily on their situational models, whereas when the text is present they may rely on other comprehension and test taking strategies. It is possible that the reverse cohesion effect occurs more when readers rely on memory of text to construct inferences. As a result, the lack of a cohesion by knowledge interaction found by Gilabert et al. may have occurred because readers relied less on their situational models of the text.

Taken together, previous research indicates that texts that are more complex, may present a challenge to low knowledge readers. This complexity may be the result of a more elaborate top-level structure or a less cohesive text. Low knowledge readers may benefit from high cohesion texts because these texts often supply the additional information needed to make inferences, information that low knowledge readers are less likely to possess (McNamara et al., 1996; O'Reilly & McNamara, 2007). However, in the case of more structured texts, low knowledge may make it difficult for readers to take advantage of the supports provided by increases in structure (e.g Wylie & McGuinness, 2004). It is less clear how structural characteristics influence high knowledge readers' inferential processes, but increases in cohesion may be detrimental if they encourage more passive processing (McNamara et al., 1996).

Text Structure, Prior Knowledge, and Skill

Studies that have examined the relationship between knowledge, skill, and text structure have focused primarily on the text cohesion element of structure. This research suggests that the effect of structural characteristics is related to both the knowledge and skill of readers. O'Reilly and McNamara (2007) examined this interaction by exploring how high and low cohesion texts affect the comprehension of low- and high-ability readers with high and low domain knowledge.

In this study university students read either a high cohesion or a low cohesion version of a science text. After reading, students answered three types of comprehension questions: textbase questions that required recognition of explicitly stated concepts, local bridging questions that required inferences between adjacent clauses/sentences, and global bridging questions that required the integration of non-adjacent sentences (O'Reilly & McNamara, 2007). Cohesion was varied using the techniques developed by McNamara et al. (1996). Readers were classified into high and low knowledge groups based on their performance on a domain knowledge test. They were also classified into high and low reading ability groups based on their performance on the Nelson Denny Reading Test (O'Reilly & McNamara, 2007).

O' Reilly and McNamara (2007) found that skilled readers benefited from more cohesive texts regardless of their level of prior knowledge. However, increases in scores on comprehension questions were related to the type of questions that readers answered (textbase vs. bridging inference). For high knowledge, high skill readers, those who read the high cohesion texts had significantly higher scores on textbased questions than those who had read the low cohesion text (O'Reilly & McNamara, 2007). For low knowledge, high skill readers, those who read the high cohesion text had higher scores on local bridging questions, but there was no effect for cohesion on their performance on textbase questions (O'Reilly & McNamara, 2007). For less skilled readers, the effect of cohesion was related to readers' prior knowledge. Readers with high knowledge and low skill demonstrated a reverse cohesion effect. O'Reilly and McNamara (2007) found that less skilled, low knowledge readers had higher scores on textbase questions when reading low cohesion texts. In contrast, less skilled, low knowledge readers who read the high cohesion text had higher scores on local bridging inferences than less skilled, low knowledge readers who read the low cohesion text (O'Reilly & McNamara, 2007).

Ozuru et al. (2009) found similar findings using a within-person design in which readers read both a low cohesion and a high cohesion science text. Skilled readers with high and low

knowledge had higher scores on textbase questions when reading high cohesion texts (Ozuru et al., 2009). However, for high skill, low knowledge readers, the difference between high and low cohesion texts was not significant (Ozuru et al., 2009). Like O'Reilly and McNamara (2007), Ozuru et al. found that less skilled, low knowledge readers had significantly higher scores on textbase questions when reading the low cohesion text. Unlike O'Reilly and McNamara, they failed to find a significant effect for text cohesion on less skilled, low knowledge readers' scores on any of the question types (Ozuru et al., 2009). For both studies interactions between knowledge, skill, and cohesion were typically restricted to the textbase questions. With the exception of the low knowledge readers in the O'Reilly and McNamara study, text cohesion did appear to have an impact on readers' performance on inference questions. For both studies, the researchers argued that the reason for no interaction with inference questions was due to the difficulty of the text. When a text presents a challenge to readers, it may be more difficult to establish a situational level model (as measured by bridging inference questions) (O'Reilly & McNamara; Ozuru et al., 2009). It is also possible that for deep level comprehension level, domain knowledge is a stronger predictor of comprehension than cohesion and skill (Ozuru et al., 2009).

O'Reilly and McNamara (2007) argued that when less skilled, high knowledge readers encounter cohesive text, they may engage in more passive processing. However, when the relationships between ideas are more implicit, these readers may rely on their knowledge more and exert more effort in comprehension (O'Reilly & McNamara, 2007). In contrast, skilled readers have a more active approach to text comprehension (O'Reilly & McNamara, 2007). They look for indicators of the relationships between ideas and use these to establish their mental representation. This argument is similar to that proposed by Voss and Silfies (1996) regarding the trade-off between knowledge and skill, when texts are more and less cohesive. Voss and

Silfies argued that when text are cohesive readers rely more on comprehension skill; however, when texts are less cohesive they rely more on prior knowledge.

The findings from these two studies suggest that cohesion affects comprehension particularly through readers' comprehension skill. In order to explore this possibility, Ozuru et al. (2009) conducted a hierarchical regression on the difference in textbase question scores between the high cohesion and the low cohesion texts. The researchers found that for all readers, domain and topic knowledge did not significantly predict the difference in scores (Ozuru et al., 2009). In contrast, comprehension skill did significantly predict the difference in scores and accounted for a significant proportion of the variance, after accounting for readers' level of prior knowledge (Ozuru et al., 2009). However, when they conducted these same analyses on high and low prior knowledge groups separately, comprehension skill was a significant predictor of the differences in scores for only the high knowledge readers (Ozuru et al., 2009). Based on these findings, Ozuru et al. concluded that in order to benefit from increases in cohesion, readers required both knowledge and comprehension skill.

General Conclusions

Although the empirical findings regarding the interaction between knowledge, skill and structure are at times contradictory, some important conclusions can be made from previous research. First, texts that contain highly organized, explicit text structures may benefit readers who have the capacity to use these structures to guide their comprehension. When readers are able to integrate ideas according to these structures, their comprehension may improve as measured by performance on recall tasks (e.g. Meyer & Freedle, 1984). However, less is known about whether use of text structure may facilitate deeper level comprehension, as measured by inference questions.

Increases in text structure may be especially helpful for readers who have difficulties understanding the text as a whole. These difficulties may stem from lower levels of comprehension skill (e.g. Linderholm et al., 2000) or less content knowledge (e.g. McNamara et al., 1996). However, readers may require some level of prior knowledge and comprehension skill in order to be able to take advantage of the supports provided by increases in text structure.

Additionally, readers' domain and topic knowledge play important roles in inferencing after reading. In relation to all three predictors discussed (prior knowledge, text structure, comprehension skill), domain knowledge seems to be the most consistent predictor of deeper level comprehension. Domain knowledge may lessen the benefits of cohesion on comprehension, with high knowledge readers having better comprehension when reading low cohesion texts (McNamara et al., 1996). This relationship between domain knowledge and cohesion may be particularly present for readers with lower comprehension skill (Ozuru et al., 2009). However, this relationship between domain knowledge and cohesion seems to be less likely to occur with deeper level comprehension (Ozuru et al., 2009). It's is not clear why this interaction only seems to occur at the textbase level. Its lack of occurrence may be explained by the primacy of prior knowledge at the situational level. It could also be an artifact of the text, procedures, and measures used in these studies.

Focus of the Current Study

This study examined the influence of top-level structure, comprehension skill, and topic knowledge on readers' ability to construct inferences from expository text. The present study focused on those inferences constructed after reading in response to inference questions. Specifically, it concerned readers' construction of bridging inferences. For the purposes of this study, bridging inferences refer to inferences that require the integration of topics within the text,

and rely on the text as the primary source of information needed to make these inferences (Magliano et al., 2011). These questions measure situational level comprehension because they require readers to make connections between ideas that are not made explicit (McNamara et al., 1996). These connections are more likely to be made when readers establish a situational model for text. In the current study, readers were asked to make these inferences without the text present in order to assess the quality of their situational models, as readers are more likely to use their mental representations to construct inferences when the text is absent (Ozuru et al., 2007).

The primary goal of the study was to examine the extent to which top-level structure has an impact on inferencing. Previous research has indicated that top-level structure may have a significant impact on memory (e.g. Meyer, 1975; Meyer et al., 1980). Although text recall and inferences represent distinct cognitive processes (Hannon & Daneman, 2001), it is unlikely that they are completely exclusive. In the case of text-based inferences, readers must be able to identify and recall those text elements needed to make the inferences. Because text structure may be associated with the nature of the organization of readers' memory for text (Meyer & Rice, 1982), it may also have an influence of readers' ability to make inferences from text. When readers' representations are well-organized, they may be better able to make inferences because they may be better able to recall the relevant text information.

However, previous research has provided little evidence of this influence of text structure on inferences. Studies of variations in type of text structure and overall cohesion have often failed to find an effect of structure on deeper level comprehension, as measured by performance on inference questions (e.g. McNamara, 2001; Montanero & Lucero, 2012). It may be the case that the effect of top-level structure on deep level comprehension is indirect. In this vein, text structure's influence is mediated through the coherence of readers' mental representation of the text. Readers' who establish a more organized, hierarchical mental representation, may be better

able to construct inferences after reading than those with a less organized memory. Thus, one of the goals of the current study was to examine both the direct and indirect effect of structure

The second goal of the study was to examine the influence of readers' comprehension skill and topic knowledge on bridging inferences. Readers, who have higher levels of both knowledge and skill, are better able to construct inferences after reading. However, much of the research on readers' inferencing from expository text uses scientific and historical texts. Although scientific texts are an important domain of inquiry, expository texts come from a variety of domains. One of the goals of this study was to extend the research literature by exploring the influence of reading skill and knowledge when reading from social/behavioral science texts. This text domain was believed to be more ecologically valid for the participants in this study because many of them were education or social science majors. In this vein, by presenting students with a text that was related to their area of interest (major), this study could possibly provide insights into how this group of students read expository texts for studying/learning purposes. Additionally, an education text may have been more relevant to this group of learners, in terms of both their interest and knowledge. This relevancy could have the potential to facilitate participants' motivation to complete study related tasks and possibly produce a greater range in the quality of participants' performance. However, exploring the potential relationship between relevance and performance was not a goal of this study.

The third research goal was to examine the effect comprehension skill and knowledge may have on the influence of text structure. Several studies have indicated that these sources of individual differences may moderate the influence of structural characteristics. As a result, in order to accurately examine the influence of top-level structure on inferential comprehension, it is necessary to consider readers' knowledge and skill.

Research Questions

In relation to the influence of text structure on bridging inferences, the current study addressed the following three questions.

1. Does top-level structure influence readers' construction of bridging inferences?
2. Is the organization of readers' memory for text positively associated with performance on bridging questions?
3. Is the effect of top-level structure on bridging inferences indirect? Does the organization of readers' memory mediate the influences of top-level structure?

These research questions were investigated by comparing two text structures: problem-solution and listing-descriptions. The problem-solution structure is generally considered more structured, as it contains more required components: a problem, its cause, and a solution which directly addresses the problem (Meyer & Freedle, 1984). In contrast, the listing structure is typically considered less structured because it contains a series of concepts that may occur in any order without impairing the comprehensibility of the text (Meyer & Freedle, 1984). A more structured text may be more facilitative for inferences because it may encourage a more organized memory for text. Although the primary purpose of the study was to examine the influence of top-level structure on bridging inferences, the study also examined the relationship between top-level structure and recall. This analysis allowed for the examination of whether the effect of type of top-level structure was present at both a shallow/textbase level and a deeper/situational level.

One of the challenges in studying text structure is distinguishing the content of the text from its organization (Wylie & McGuinness, 2004). Although it is likely impossible to completely separate structure from content (Lemarié, Lorch, Eyrolle, & Virbel, 2008), in order to specifically examine the effect of structure, two structural versions of the same text were generated by reordering paragraphs and varying text signaling.

In order to examine the influence of comprehension skill and topic knowledge as well as the possible interactions between type of text structure, knowledge, and skill, this study addressed the following research questions.

4. Does topic knowledge influence readers' performance on bridging inference questions?
5. Does comprehension skill influence readers' performance on bridging inference questions?
6. Is there evidence of an interaction between knowledge, skill, and top-level structure on inference question performance?

In order to address these research questions, participants' scores on a standardized test of comprehension (The Davis Reading Test), and an experimenter-constructed topic knowledge test were used as indicators of comprehension skill and knowledge respectively.

Chapter 3

Methods

Design

The study utilized a between-participants' experimental design with participants randomly assigned to read either a problem-and-solution or a listing of descriptions version of the same text. During the study, participants were assigned to one of these two text conditions by the survey program (Qualtrics) that was used to conduct the study. Randomization was programed to be balanced to ensure nearly equivalent numbers of participants across the two study conditions. Readers' scores on the Davis Reading Test and topic knowledge test served as between-participants' predictors of comprehension skill and topic knowledge respectively.

Participants

The sample of participants consisted of 168 undergraduate students enrolled in an introduction to educational psychology course at the University Park campus of The Pennsylvania State University. The sample contained 145 female (86 %) and 23 male (14%) students. Academic standing varied across the sample, but the majority of participants, 121 students (72 %), indicated that they had freshman status. Participant ranged in age from 18- 35, with 93 % of students indicating that they were between the ages of 18-20. Most of the participants (152, 91%) indicated that English was their primary/ first language. In terms of their prior coursework in education and psychology, most students reported taking one to two courses in education (M = 1.89, SD = 1.13) and one to two courses in psychology/human development (M = 1.67, SD =

1.75). In calculating previous coursework, participants' current enrollment in the educational psychology course was counted towards the number of education courses taken. In terms of academic majors, 94 (56%) students reported being an education major. Participants were classified as education majors if they reported having a teaching focused major (e.g. elementary education). In order to assess prior teaching experiences, participants were asked whether they had tutored or taught a class. Nearly half of the sample, 88 students, reported having some teaching experience. The mean SAT critical reading score was 580.27 (*SD* = 78.74), with scores ranging from 400 to 750. However, a large number of participants, 64 students (38%) did not report these scores.

Prior to data collection an apriori power analysis was conducted in order to assess the sample size needed, using GPower 3 (Faul, Erdfelder, Lang, & Buchner, 2007). This power analysis was based off a linear, multiple regression model with interaction effects. Estimates of sample size were calculated with power at .80, an alpha level of $\alpha = .05$, and effect sizes (f^2) at .10 and .15. This analysis indicated that a minimum sample size of 103 would be needed for a medium effect size of .15 (see Cohen, 1988), and a minimum size of 151 would have been needed to detect a small-medium effect size of .10. Thus, the sample size met the minimum required to detect a small to medium effect.

Texts

The text used in this study was adapted from an introductory educational psychology text (Eggen & Kauchak, 2006, pp.317-18). Initially two texts were piloted; however, the results of the pilot study indicated differential knowledge and performance across text topics. As a result, only one text was selected for the current study. The text covered topics related to attributions, motivation, and instruction (See Appendix A). Within the text, the authors presented a problem

related to learning and an instructional practice designed to reduce the problem. The original text described attribution theory, learned helplessness (a problem related to attributions), and an intervention associated with a reduction in helplessness. Two stages of text revisions were applied to the text. Before manipulating the structure of the text, the text was adapted to reduce the length and increase its readability. Adaptations to improve the readability of the text included reducing sentence length, decreasing complexity, and substituting low frequency words for more frequent ones. Additional information was also added to describe underdeveloped concepts. Specifically, new information was added to further explain the link between attribution and learned helplessness. The resulting text was 480 words with a Flesch-Kincaid readability grade level of 11.5.

In order to generate the two structures, the structure of the source text was first analyzed using Meyer's (1975, 1985) method of content analysis. This method of propositional analysis parses text into lexical and rhetorical predicates. Lexical predicates primarily describe syntactic relationships within sentences and rhetorical predicates describe structural relationships in the text (Meyer, 1985). The rhetorical organization of the text before the structural revision was primarily a collection of descriptions, consisting of a list of loosely related concepts. Within this list of concepts, the last concepts presented were the problem and its solution. The text underwent two revisions to generate the problem-and-solution and description structures. Revisions consisted primarily of reordering paragraphs and the addition/deletion of text signaling.

To create the problem-and-solution structure, the text was revised to present a description of a problem (learned helplessness) and its cause in the text initial position. The problem was then followed by a description of the solution. The other concepts that were formerly presented initially in the text were revised to provide additional description of the problem. The goal of the reordering was to increase the saliency of the causal relationships between concepts. Finally, problem-and-solution and causal signaling was added to increase the marking of the problem and

solution, as well as causal relationships in the text. This consisted of adding connectives and topic sentences. The final problem-and-solution text contained 533 words and had a Flesch-Kincaid grade level readability of 11.1 (see Appendix A).

In order to generate the listing of description text, the source text was reorganized to decrease the causal relatedness of the concepts in the text and to decrease the saliency of the problem-and-solution structure contained in the text. This involved moving the paragraph which described the solution to occur as the second paragraph in the text, after the presentation of the first concept described in the text. The paragraph describing the problem was moved to occur two paragraphs after the solution. The cause of the problem was presented at the end of the text. Problem-and-solution and causal signaling was removed and descriptive signaling was added to the text. No other content in the text was altered. The listing of descriptions version of the text contained 529 words and had a Flesch-Kincaid grade level readability of 11.4 (see Appendix A).

The cohesion of both the problem-solution and the listing-description texts was also analyzed using Coh-Metrix 3.0. The goal of this analysis was to examine whether the texts varied notably in terms of two aspects of cohesion: argument overlap and latent semantic analysis (LSA) cosine overlap. Argument overlap and LSA cosines indicate the degree of conceptual similarity across adjacent and non-adjacent sentences, with argument overlap representing the degree of repetition of nouns and pronouns and LSA cosines reflecting the degree of shared meaning of content words (Coh-Metrix version 3.0 indices, n.d.; Graesser, McNamara, Louwerse, & Cai, 2004). Scores closer to one indicate high cohesion (Coh-Metrix version 3.0 indices, n.d.; Graesser et al., 2004). Analysis of cohesion indicated that the two texts had similar levels of cohesion. In relation to previous studies of cohesion (Ozuru et al., 2009; Ozuru, Briner, Best, & McNamara, 2010), the cohesion levels of the experimental texts fell between the high and low cohesion texts in these studies. For example, the high cohesion text used by Ozuru, Briner, Best, & McNamara (2010) had an argument overlap adjacent score of .68, and a latent semantic

analysis adjacent cosine of .28 (p. 648). The low cohesion text used in their study had an adjacent argument overlap of .21 and a latent sematic analysis adjacent cosine of .25 (Ozuru et al., 2010, p. 648).

Table 3-1. Cohesion Indices for Experimental Texts

	Problem-Solution	Listing-Description
Argument overlap, adjacent sentences	0.561	0.524
Argument overlap, all sentences	0.419	0.376
LSA overlap, adjacent sentences	0.396	0.39
LSA overlap, all sentences in paragraph	0.296	0.286
LSA overlap, adjacent paragraphs	0.735	0.753

Individual Difference Measures

Comprehension skill. In order to assess students' general comprehension proficiency, participants completed the first half of the Davis Reading Test, Form 1B (Davis & Davis, 1957). This test required participants to read six short passages and answer multiple choice comprehension questions (See Appendix B). The test includes both expository and narrative texts. According to Davis and Davis (1962), it is designed to assess five key comprehension skills: locating information in the text, determining main ideas, making inferences, identifying tone/mood, and recognizing text structure. It consists of 40 questions. The inter-form reliability as measured by the correlation between Form A and B of Series 1 is .80 (AB administration) and .83 (BA administration) (Davis & Davis, 1962). The Davis Reading Test was administered as a timed test, with individuals having 22 minutes to complete the exam. The test was adapted from its original form to a web-based format. One passage was presented per page, with the text appearing at the top of the page and all related questions below the text. Once participants had

read the text and answered questions, they clicked at the bottom of the page to continue to the next passage. Participants were not allowed to go back to passages they had already read.

Participants received two scores, a raw score that indicated the total of number correct answers and an adjusted score. Adjusted scores included a correction for guessing which was equal to the raw score minus one-fourth of the number of incorrect answers (Davis & Davis, 1957; Davis & Davis, 1962). The mean raw score for the sample was 19.18, *SD* = 6.05, with scores ranging from 5 to 34 correct. The mean adjusted scored was 14. 48, *SD* = 7.07, with adjusted scored ranging from -3.25 to 32.5. The internal consistency of the Davis Reading Test for this sample was α =.787. Additionally, the distribution of readers' adjusted Davis Reading Test scores was examined using a histogram and q-q plots (see Figure 3-1 and Figure 3-2) in order to examine possible non-normality. These plots indicated some deviation from normal with some evidence of a positive skew, but it does not appear to be severe. Although there was a range in performance, many participants had lower scores on the reading test.

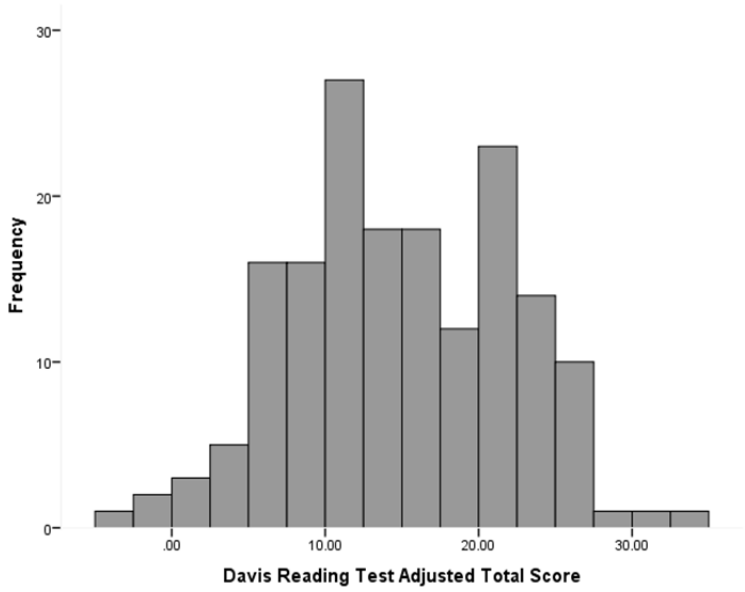


Figure 3-1. Histogram of Davis Reading Test Adjusted Total Scores

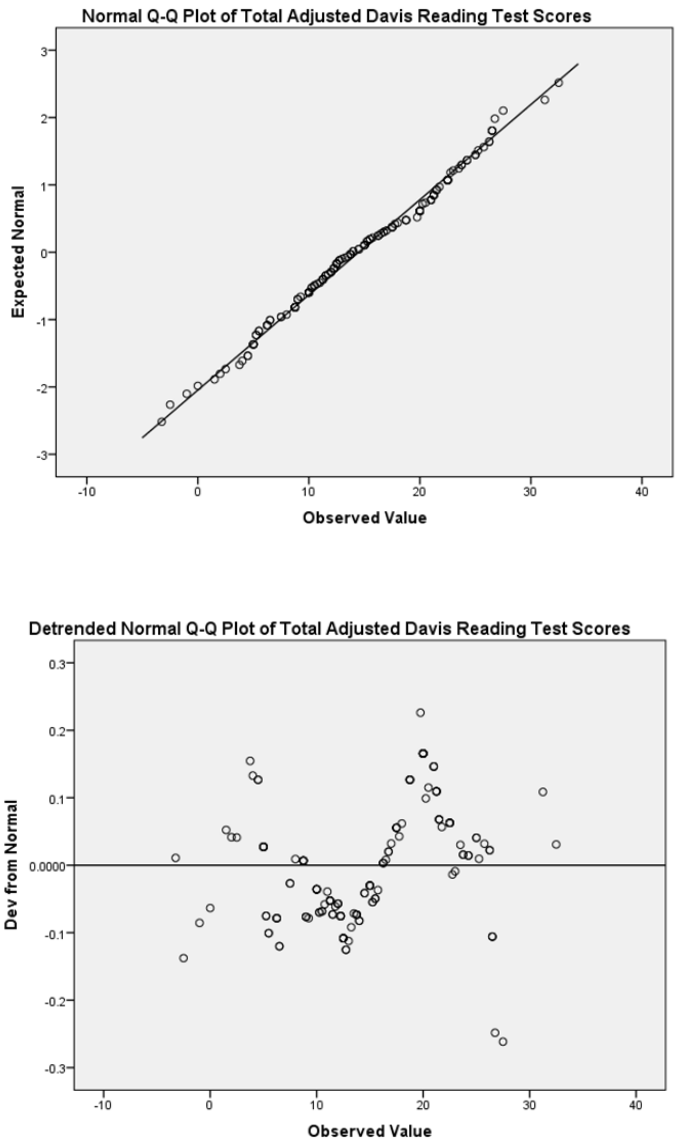


Figure 3-2. Q-Q Plots for Total Adjusted Davis Reading Test Score

Topic knowledge. The topic knowledge test consisted of a 15 item multiple choice test (see Appendix C). The test measured students' knowledge of the major concepts contained in the text (Eggen & Kauchak, 2006). Additionally, the content of the topic knowledge test was developed in consultation with introductory educational psychology texts (Ormrod, 2003; Moreno, 2009/2010, Schunk, 2007; Slavin, 2006) and encyclopedias of education/psychology

(Gill & Martin, 2008; Gordon & Graham, 2006; Krueger, 2007; Summers, 2008). Multiple choice questions covered topics such as attribution theory, learned helplessness, self-efficacy, and motivation. Although topic knowledge questions consisted of the major topics addressed in the text, care was taken to avoid using the exact same wording and content as that contained in the text.

An initial set of 12 topic knowledge questions was piloted with a sample of 27 undergraduate students enrolled in an introductory educational psychology class focused on human development. Pilot testing indicated that the internal consistency of the multiple choice items was low, $\alpha = .34$. An examination of students' responses suggested that some of the questions were likely assessing students' comprehension of the question, rather than their knowledge of the concepts. Questions and answer choices were revised to improve the quality of the questions. Specifically, the questions were revised to increase emphasis on retrieval of concepts and principles and to decrease emphasis on reasoning and application. The mean score on the topic knowledge test was, 5.78, $SD = 1.89$, and scores ranged from 1 to 11. Although there was a large range, most participants demonstrated low knowledge of the topic. The internal consistency of the topic knowledge test was low, $\alpha = .215$ (See Appendix C)

Comprehension Measures

Recall. The purpose of the recall was to capture readers' memory of the text in terms of the amount of text information remembered and the organization of memory. A similar recall procedure was used as the one implemented by Meyer and colleagues (e.g. Meyer et al., 2010; Meyer et al., 2011). Immediately after reading, participants typed a free recall of the text. Instructions for the recall asked participants to write as much as they could remember from the text using complete sentences. Instructions prompted participants to use their own words and/or

words from the passages. Participants were given a full screen window in which to type their recall and were not permitted to view the text.

Inference questions. Inference questions measured readers' situational models and deep level comprehension of the text. Participants completed seven short answer bridging inference questions with the text unavailable (see Appendix D). All inference questions could be classified as text-based, bridging; the essential information needed to answer questions was located in the text. The inference questions required readers to integrate information from at least two sentences in the text. Some questions may also have required readers' to use their general world knowledge. This classification of inference questions is similar to that used by McNamara colleagues (e.g. McNamara & Kintsch 1996; Ozuru et al., 2007; Ozuru et al., 2009) and Magliano et al., 2011. Most of the questions require readers to make a causal inference (six out of seven). Two of these questions related to major causal relationships involving the problem (learned helplessness) and/or the solution (attribution training). One question required readers to link the problem to its cause, and the other required readers to link the solution to the reduction of the problem.

The questions used in this study were revised from an earlier pilot study. The participants in the pilot study were undergraduate students enrolled in an educational psychology course focused on human development. Ten inference questions were piloted. These questions were classified in two groups of inference categories: local inferences that required the integration of adjacent sentences and global inferences that required the integration of information from more than two sentences apart. An examination of readers' responses to local inferences indicated that these questions seemed to prompt recall of information explicitly contained in the text, suggesting that these questions required fairly low level inferences or paraphrases of the text. With the exception of one question, local bridging questions were not included in this study. Global inference questions were revised to clarify the inference readers'

needed to generate and to ensure that the answers required readers to generate an inference. This revision process resulted in one question being dropped and two new questions being added. The classification of global was dropped because not all the inferences required integration of non-adjacent sentences.

Procedures

This study was conducted using small group administration, with no more than thirty students in each session. Study sessions were conducted in computer lab classrooms, and all study related tasks were completed online using a survey website (Qualtrics). At the beginning of the study, participants were given the website for the study, general instructions, and a brief oral description of the tasks they would complete. Students were also given a blank sheet of lined paper to take notes during the Davis Reading Test. With regard to general instructions, participants were told to turn off and put away cell phones for the duration of the study and that they should not go to any websites other than the study site during the study. In providing an overview the study related task, students were told that the study would contain three parts and were given a brief description of each part and reminded to read the instructions contained in the website. Before students began the study they also read and responded to the informed consent page, which was presented as the first page in the study (See Appendix E).

The study materials were presented in three parts. In the first part participants completed the topic knowledge test and answered the background questionnaire. All of the topic knowledge questions were presented on one page. After students finished this page, they were prompted to click to continue to the background questionnaire. The questionnaire consisted of questions primarily about students' educational histories (see Appendix F). Most of the background questions were presented on one page, with the exception of a question about teaching

experience. After they completed both of these tasks, participants arrived at a stop page that prompted them to stop and wait for instructions for part two. During this wait period, participants were not allowed to open any other webpages. Completion of these measures took approximately 10 minutes on average per session.

In the second part of the study session, participants completed the Davis Reading Test. They were told by the administrator that they would have 22 minutes to complete the test, and were told that they could use the note sheet provided to them. Participants were also told that at the end of the test they would see a second stop page and at that time they should take a break and put away any notes. Students were reminded at 5 minute intervals of the time remaining and after 22 minutes were prompted to click through to the second stop page. The second stop page was a timed one minute break, which also contained instructions for participants to put away all paper and writing implements. The page also contained a timer that allowed students to see the time remaining for the break. At the end of one minute, the program automatically moved students onto the experimental text.

In the third part, the program randomly assigned students to read one of the two texts. The full text was presented on one screen. Participants were instructed to read carefully, and that they would be asked questions about their understating. Reading was self-paced and the number of seconds that readers spent on each page was recorded. After students read the text once, they clicked to continue and were prompted to review the text again before answering questions. Participants were also instructed that they would not be able to view the text again after they clicked to continue onto the questions. After reviewing the text, participants' completed the written free recall. Inference questions were completed immediately after the recall. Instructions were presented prior to all of the questions and told students to answer each question based on their understanding of the text they had read. Instructions also prompted participants to use complete sentences. Questions were presented one at a time. The order of inference questions

was randomized; however, the questions appeared in this same random order for all participants. Students were not able to access the text when answering comprehension questions.

Scoring

Recall

Each recall was scored for the number of ideas recalled and its overall organization. In order to score the number of ideas recalled, each text was parsed into idea units using Meyer (1975, 85) method of analysis, resulting in 349 ideas in the listing-description text and 354 in the problem-and-solution text (See Appendix G). Participants' responses were then compared to the content structure of the text that they had read, and participants received credit for each idea from the text that appeared in their recalls. Recalls received several scores. The first score was the proportion of total ideas recalled for the text structure read. The second score was the total number of ideas recalled that were common across both texts. Participants also received a score for the number of high ideas recalled (ideas in the top two levels). The problem-solution text contained 53 high level ideas, and the listing-description text contained 57 high ideas. Proportions scored were used because the number of ideas varied across text structures. Additionally, the number of ideas recalled that were associated with three important concepts from the text: attributions (92), learned helplessness (101), and attribution training (96) were scored. The number of these ideas was the same in both texts. Attribution ideas were those from the paragraph in which the concept of attributions was introduced. In examining the relationship between text structure and recall, only readers' total and high level recall was analyzed.

The organization of each recall was also scored using the top-level structure (TLS) scale developed by Meyer and colleagues (e.g. Meyer et al., 1980; Meyer et al., 2002; Meyer et al., 2010; Meyer et al., 2011). This scale is designed to rate the degree to which the organization of

the students' recalls matches the organization of the text with scores ranging from 1-9 (See Table 3-2). For this study two top-level structure scales were used. The top level structure scale (TLS) for problem-and-solution (see Table 2) captures the extent to which students' recalls reflected a problem-and-solution structure. Scores of 6-9 indicated use of the problem-and-solution structure, with scores of 7-9 indicating use of the structure with problem-and-solution signaling (Meyer et al., 2002; Meyer et al., 2010; Meyer et al., 2011). Scores of 4 and 5 reflected use of an alternative overall structure with at least some inclusion of problem-and-solution; while scores of 1-3 indicate use of others structures with no inclusion of problem-and-solution (Meyer et al., 2002; Meyer et al., 2010; Meyer et al., 2011). All recalls were scored according the problem-and-solution TLS scales, including those participants who read the listing-description text. The TLS scale is primarily concerned with structure rather than accuracy of content (Meyer et al., 2002; Meyer et al., 2010; Meyer et al., 2011). As a result, inaccuracies in the content of the recall do not affect scores; however, in order to receive credit for the problem-and-solution structure readers needed to include a problem and a solution that were based on the text and not prior knowledge or opinion. Moreover the problem and solution had to appear in their typical order, with the problem being presented before the solution.

Table 3-2. Top Level Structure Scale Problem-Solution

Score	Description
1	Recall of concepts unrelated to the topic of text or a recall less than two sentences long.
2	List of ideas with no use of the problem-and-solution structure, and no other structure.
3	A structure other than problem-and-solution (e.g. comparison) with no indication of the problem-and-solution structure
4	A descriptive list of ideas, which contain the problem-and-solution as an element of the list
5	A structure other than problem-and-solution (e.g. comparison) which contains use of the problem-and-solution structure as a component
6	Problem-and-solution structure with no signaling
7	Problem-and-solution with signaling words/phrases to indicate the problem
8	Problem-and-solution with signaling words/phrases to indicate the solution to the problem
9	Problem-and-solution with signaling words/phrases to indicate the problem and the solution

Because the goal of the TLS problem-solution scale is to measure the degree to which recalls matched this structure, low scores on the scale indicate a more list-like organization. As a result, this scale would likely underestimate the level of structure of reader recalls' from the listing-description condition. In order to address this issue, an additional rating scale was developed for the listing-description structure. The description/listing TLS scale indicates the extent to which the structure of readers' recall reflects a well-structured list (see Table 3-3). This scale was adapted from the problem-and-solution TLS scale and contained a range of scores from 1-9. Scores of 6 -9 indicated the use of a well-organized list with the two major concepts contained in the text (attributions and learned helplessness), with scores of 7-9 indicating use of topic signaling. Scores of 3 and 5 indicated use of an alternative overall structure, with a score of

5 indicating inclusion of the two concepts as part of the structure and a score of 3 indicating no description of the concepts. Scores of 2 and 4 reflect a poorly organized list, with scores of 4 indicating inclusion of the two major topics, and a score of 2 indicating that only one topic or neither topic was included. Concepts presented in a listing structure can often have different ordering of topics without disrupting the meaning (Meyer, 1985; Meyer & Freedle, 1984). For that reason, it can be difficult to capture the degree of structure for this particular type of organization. In order to ease scoring and increase the clarity of the rating scale strict scoring criteria were used. For a recall to receive credit for a major topic, all major relevant information for that topic had to be included within the same paragraph and/or adjacent sentences.

The listing-description rating scale was used to rate recalls in both conditions. However, in the problem-solution condition, scoring criteria were relaxed somewhat. In this condition, scores focused on readers' organization of the two major concepts (attributions and learned helplessness) rather than reader's overall organization. Readers could have high scores on the listing-description TLS scale even if they used a problem-solution organization. As a result, listing-description TLS scores have different meanings in the two conditions.

Table 3-3. Top Level Structure Scale Listing-Description

Score	Description
1	Recall of concepts unrelated to the topic of text or a recall less than two sentences long.
2	List of ideas with no inclusion of the two major topics, or minimal to no clustering of topic related information
3	A structure other than a list of description with no inclusion of the two major topics, or minimal to no clustering of topic related information
4	List of ideas which includes the two major topics from the text in one sentence or two adjacent sentences.
5	A structure other than a list of description which includes the two major topics with topic level information clustered together.
6	Listing of descriptions structure organized around the two major topics, with topic information clustered together. Major topics are not signaled.
7	Listing of descriptions structure organized around the two major topics, with topic information clustered together. The first major topic presented is signaled.
8	Listing of descriptions structure organized around the two major topics, with topic information clustered together. The second major topic presented is signaled.
9	Listing of descriptions structure organized around the two major topics, with topic information clustered together. Both major topics are signaled.

In order to obtain inter-rater reliability a subset of approximately 10 % of the sample from each condition (n = 9) was randomly selected and scored by a second rater. The second rater was a graduate student in educational psychology, and was trained in scoring ideas and TLS scales scores for both structures. For the listing-description condition, the inter-rater reliability coefficient for total ideas was .91. For high ideas, those ideas in the top two levels of the content structure, the inter-rater reliability coefficient was .85. For the problem-and-solution condition, the inter-rater reliability coefficient for total ideas was .98 and for high level ideas, the inter-rater reliability coefficient was .88. Across both text conditions, 10% of the total sample, the inter-rater reliability coefficient for those ideas common to both structures was .96. Additionally,

across both conditions the inter-rater reliability coefficient for the problem-solution TLS scale was .93, and the reliability coefficient for the listing-and-description TLS scale was .96.

Inference Questions

Responses to each inference question were rated on their level of accuracy and completeness. A quality of inferencing scale was used, with scores ranging from 1-7 (see Table 3-4). Scores were based on the degree to which the correct inference had been made, and whether readers had included textual information to support their inference. For all inference questions, an answer key was created which contained an ideal answer for each question and a description of the response needed to indicate a correct inference. It also included the information in the text that was relevant to the inference, including the premise information, which was information in the text needed to make the inference (See Appendix H). Scores of 5-7 reflected responses in which the correct inference was made, with scores of 6 and 7 indicating the use of supporting information. A score of a 4 indicated that a partial, incomplete inference had been made. Scores of 1-3 reflected responses in which no inference was made, or incorrect/invalid inferences were made. A score of three indicated that readers had recalled information relevant to the inference, but did not make the correct inference, while a score of 2 indicated that students had recall information from the text that was unrelated to the inference. For both scores, paraphrases of text ideas were included, and at least 50% of the information recalled from the text needed to be accurate. If participants left a question blank, they received a zero. It is important to note that the goal of the rating scale was to capture the degree to which readers constructed the bridging inferences needed to answer the inference questions. In other words, scores were not designed to capture other types of inferences (e.g. connections to prior

knowledge). As a result, scores reflected readers' generation of these bridging inferences rather than overall number of inferences that readers made.

Table 3-4. Quality of Inference Scale

Score	Description
1	Incorrect recall/ extra- textual response OR minimal response
2	Recall of unrelated text information, No inference
3	Recall of related text information, No inference. OR Incorrect inference w/ correct text recall
4	Partial inference
5	Inference, no supporting information
6	Inference with extra-textual support.
7	Inference with correct, text-based support.

In order to obtain inter-rater reliability for the inference rating scale, a second rater was trained in using the rating scale. This rater was a graduate student in educational psychology. After training, an initial subset of 10 % of the sample (n = 17) was randomly selected and scored by this second rater. The inter-rater reliability coefficient for this initial reliability check was .65. To obtain inter-rater reliability, 5 % of the sample was then randomly selected (n = 8) and scored by both raters. Prior to scoring this subsample, the scoring criteria were reviewed, and for two items, (How do attributions lead to giving up without trying? How might attributions influence achievement?) revisions to the scoring criteria were made (See Appendix I). The inter-rater reliability coefficient for the 5 % of the sample was .76. The internal consistency of inference questions was $\alpha = .64$.

Data Analysis

A series of multiple regression analyses were conducted on ideas recalled (total and high), and total inference scores. The goal of these analyses was to examine the influence of text structure and overall comprehension skill on measures of text memory (recall) and bridging inferences. In each of these analyses, structural condition, and adjusted total score on the Davis reading test were included as predictor variables. Text structure condition was entered into equations as a dummy coded variable with 1 = the problem-and-solution condition and 0 = the listing-description text condition. Adjusted total scores were entered into regression equations mean-centered. A coded interaction term representing the interaction between text structure and Davis Reading Test score was also included. Because the internal consistency of the topic knowledge test score was low (α =.215), it was not included in analyses. The inclusion of predictors with low reliability, may introduce additional variance into regression analysis, and as a result may make it more difficult to accurately detect effects (Aiken & West, 1991; Cohen, Cohen, West, Aiken, 2003).

Prior to conducting each analysis, assumptions for ordinary least square regression were examined with a particular focus on the examination of the normality of residuals for outcome variables and homoscedasticity of variance. Violations of homoskedasticity may be important to consider because heteroskedasticity may produce less accurate standard errors, which may influence significance tests (Hayes & Cai, 2007). Similarly, non-normal residuals may also affect significance tests (Cohen et al., 2003). Examinations of assumptions were conducted by examining p-p plots of the residuals (normality) and scatterplots of residual and predicted values (homoscedasticity) (Cohen et al., 2003). If significant interactions were present, additional follow-up testing were to be conducted by examining simple slopes for the Davis Reading Test scores within each condition, as well as plots of the interaction.

Awareness of Text Structure and Inferences

Several analyses were conducted to explore the relationship between structural awareness and total inferences scores. Awareness of text structure, or structural awareness, refers to the extent to which readers recognize and use the organization of the text (Meyer et al., 1980). When readers demonstrate structural awareness they use the same structure as the author to organize their recall (memory). First, within each condition, the bivariate correlations between the TLS scores for that structure and total inference scores were examined. Additional analyses examined whether readers' with high and low structural awareness differed in their performance on inference questions.

For the purposes of this analysis readers were classified into two groups, high structural awareness or low structural awareness based on their performance on the TLS scale that matched the organization of the text read. For the problem-solution condition, readers who had problem-solution TLS scores of 6 and above were classified as high. Participants with scores below a 6 on the problem-solution scale were classified as low. For the listing-description condition, participants with listing-description TLS scores of 6 and above were classified as high, while readers with listing-description TLS scores below 6 were classified low. The TLS score of 6 was used as a cut score to establish the two groups because scores of 6 and above on both scales indicated use of the structure of the text, while scores of 1-5 indicated use of an alternative structure.

Two analysis were conducted which examined the relationship between awareness classification and performance on inference questions. First, a two-factor analysis of variance (ANOVA) was conducted on total inference scores with text structure condition and awareness classification as predictors. The goal of this analysis was to examine the influence of structural awareness on inferencing and whether this influence varied across text conditions. Additionally,

an analysis of covariance (ANCOVA) was conducted on total inference scores with reader's level of structural awareness (high or low) and text structure condition as predictor variables and readers' adjusted total score on the Davis Reading Test as a covariate. This analysis allowed for the examination of differences in inferential performance between high and low awareness groups, while controlling for their overall comprehension skill level.

Finally, the possible indirect effect of text structure on total inferences score was examined. Readers' scores on the problem-solution TLS scale were considered as a mediator because they reflected use of the more organized text structure. Essentially, the regression analysis examined whether text structure condition influenced readers' top-level structure scores, which in turn influenced readers' total inference scores. The model used (Figure 3.1) is derived from those used in simple mediation analysis (Baron & Kenny, 1986; Hayes, 2013).

Figure 3-3 contains the model of direct and indirect effects. The regression coefficients reflect those proposed by Baron and Kenny (1986). The regression coefficient "*a"* reflects the relationship between text structure condition and problem-solution TLS score. The regression coefficient *"b"* reflects the relationship between problem-solution TLS score and total inference score, controlling for condition. The coefficient "*c'"* is the direct effect of text structure condition on total inference scores, when controlling for the indirect effect (through problem-solution TLS). In this model, *ab* reflects the indirect effect of text structure condition through problem-solution TLS score.

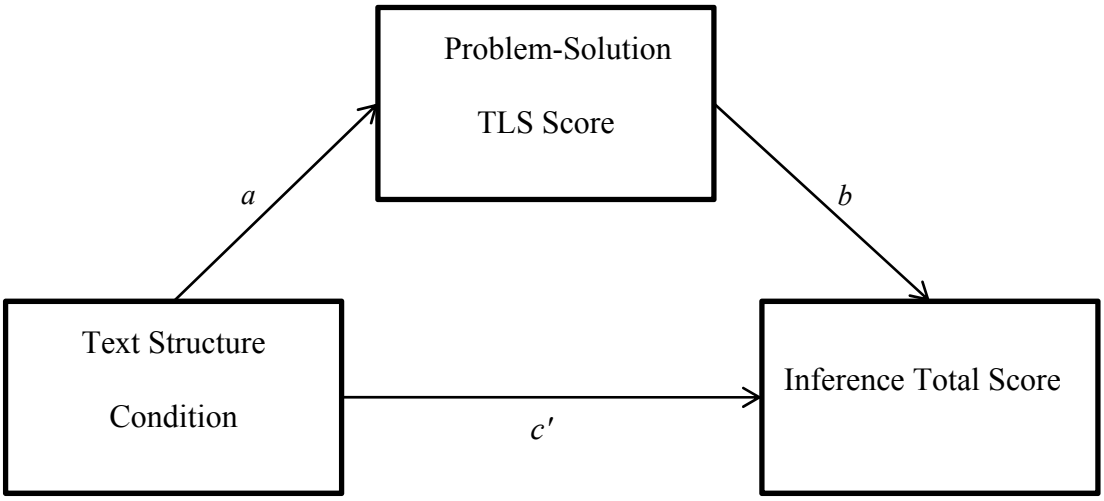


Figure 3-3 Model Representing Possible Direct and Indirect Effect of Text Structure on Inferences.

Although the causal step method of mediation analysis proposed by Barron and Kenny (1986), has been questioned (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Preacher & Hayes, 2004; Shrout & Bolger, 2002), two criteria were established as prerequisites for an examination of the indirect effect of text structure. First, the regression coefficient indicating the relationship between text structure condition and problem-solution TLS score was significant (*a* in Figure 3.1). Second, the regression coefficient, indicating the relationship between problem-solution TLS score and total inference scores was significant (*b* in Figure 3.1). These criteria are similar to Baron and Kenny's approach, which requires a significant relationship between the mediator and the outcome variable and a significant relationship between the predictor variable and the mediator. If these conditions were not met, the analysis of the indirect effect of text structure on inference score was not examined.

If these conditions were met, a test of the indirect effect of text structure on total inference score would be conducted using a macro (PROCESS) created by Hayes (2013). This test for indirect effects is similar to that developed by Preacher and Hayes (2004) and relies on standard errors and confidence intervals derived from a bootstrapping method. Bootstrapping involves repeatedly sampling the data with replacement in order to generate a sampling distribution from which confidence intervals can be derived (Preacher & Hayes, 2004; Shrout & Bolger, 2002). It is important to note that Hayes (2013) does not recommend use of preliminary analysis (e.g. testing the relationship between the mediator and outcome), when testing for indirect effects.

All analyses were conducted using SPSS 21. For all analysis, a significance level with $\alpha = .05$ was used, and exact p-values are reported, unless $p < .0005$. For the primary regression analyses, for each predictor the following is reported: unstandardized partial regression coefficient (b), standardized partial regression coefficient (β), and the semi-partial correlation coefficient (r_p).

Chapter 4
Results

Correlations and Descriptive Statistics

An analysis was conducted to examine the correlations between the predictor and outcome variables as well as descriptive statistics for each variable for the entire sample, $n = 168$ (See Table 4-1). The goal of these correlational analyses was to conduct an initial screening of the strength of the relationships between predictors and outcomes as well as among outcome variables. Correlations between outcome and predictor variables indicated small to moderate, positive correlations among these variables. Scores on the Davis Reading Test were significantly and positively correlated with most of the outcome measures; however, the correlation between Davis Reading Test scores and problem-solution TLS scores was not significant ($r = .09$, $p = 0.265$). However, it is important to note that for these correlations, TLS scores for the entire sample were used. Although the correlation between problem-solution TLS scores and Davis Reading Test scores was low, this low correlation may be related to differences across text structure conditions. Within the problem-solution condition, the correlation between adjusted Davis Test scores and problem-solution TLS scores was $r = .27$, $p = .013$. Additionally, the correlation between scores on problem-solution TLS scale and total inference scores was not significant ($r = .12$, $p = .117$), indicating a weak relationship between these variables when considering the entire sample.

Table 4-1. Correlations and Descriptive Statistics

	1	2	3	4	5	6	7	8	9	10
1. Davis Reading										
2. Topic Knowledge	.23**									
3. Inference Total	.41**	.17*								
4. TLS P-S	0.09	.10	.12							
5. TLS L-D	.24**	.11	.25**	-.22**						
6. High Ideas	.27**	.28**	.36**	.43**	.30**					
7. Total Ideas	.42**	.27**	.45**	.21**	.37**	.70**				
8. Attribution Ideas	.34**	.18*	.40**	-.06	.50**	.36**	.78**			
9. LH Ideas	.21**	.23**	.31**	.27**	.20*	.76**	.55**	.23**		
10. AT Ideas	.23**	.11	.18*	.33**	.06	.43**	.64**	.21**	.19*	
M	14.48	5.78	22.70	3.77	4.43	0.28	0.16	20. 10	17.35	12.75
SD	7.07	1.89	5.77	2.34	2.04	0.12	0.08	15.78	8.33	12.38

** $p < 0.01$ level (2-tailed). *$p < 0.05$ level (2-tailed).

Notes. Davis Reading = Total adjusted score, TLS P-S = Top level structure score, problem-solution scale, TLS L-D = Top level structure score, listing-description scale, High Ideas = proportion of high level ideas, Total Ideas = proportion total number of common ideas recalled, LH Ideas = ideas related to learned helplessness, AT = ideas related to attribution training

In addition, the normality of the distributions of the outcome variables was explored by examining histograms of the three variables (total ideas recalled, high ideas recalled, total inferences scores), as well as q-q plots. Figures 4-1 – 4-5 contain histograms and q-q plots for total inference scores, proportion of total ideas recalled, and proportion of high ideas. For the total inference scores, scores ranged from 8 to 41with a mean of 22.71. (*SD* = 5.77). The histogram and q-q plots indicated that the distribution was near normal with some evidence a positive skew (see Figure 4-1 and 4-2). The proportion of total ideas recalled ranged from 0 to .48 with a mean of .16 (*SD* = .08). The histogram and q-q plots indicated a deviation from normal, with evidence of a positive skew (see Figure 4-3 and Figure 4-4). The proportion of high level ideas recalled ranged from 0 to .58, with a mean of .28 (*SD* = .12). The histogram and q-q plots indicated a near normal distribution (See Figure 4-5 and 4-6).

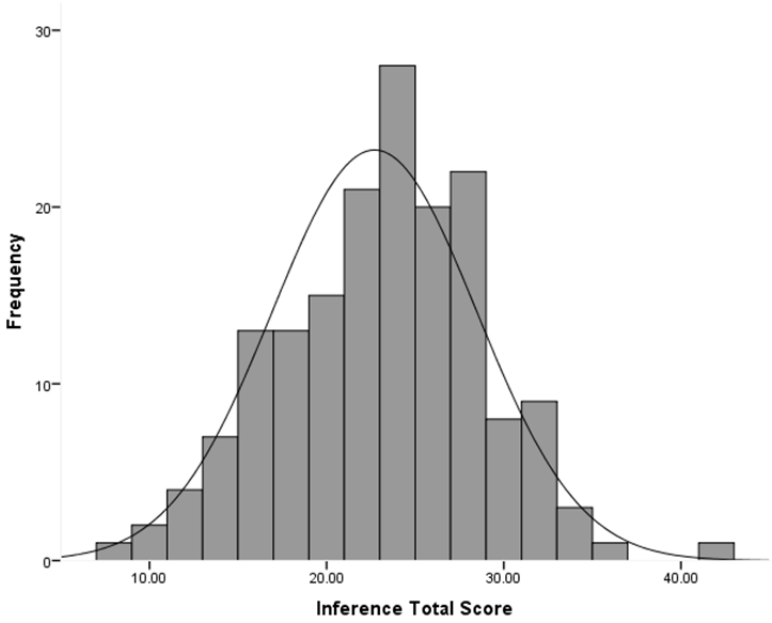


Figure 4-1. Histogram for Total Inference Scores

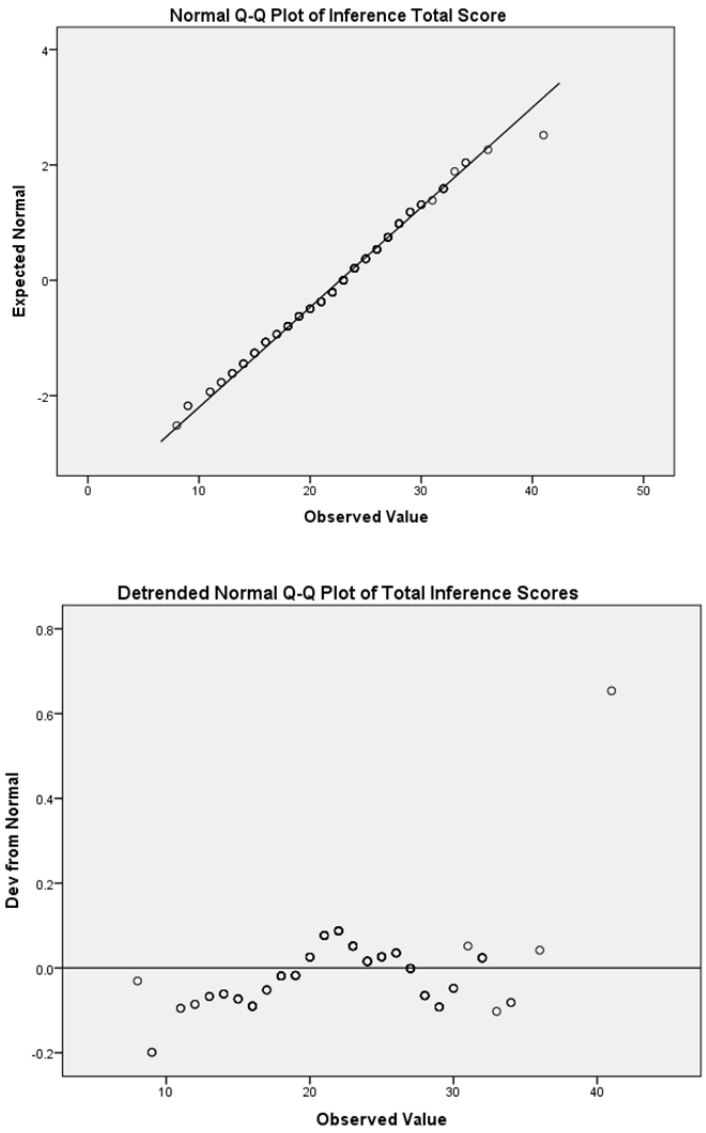


Figure 4-2. Q-Q Plots for Total Inference Scores

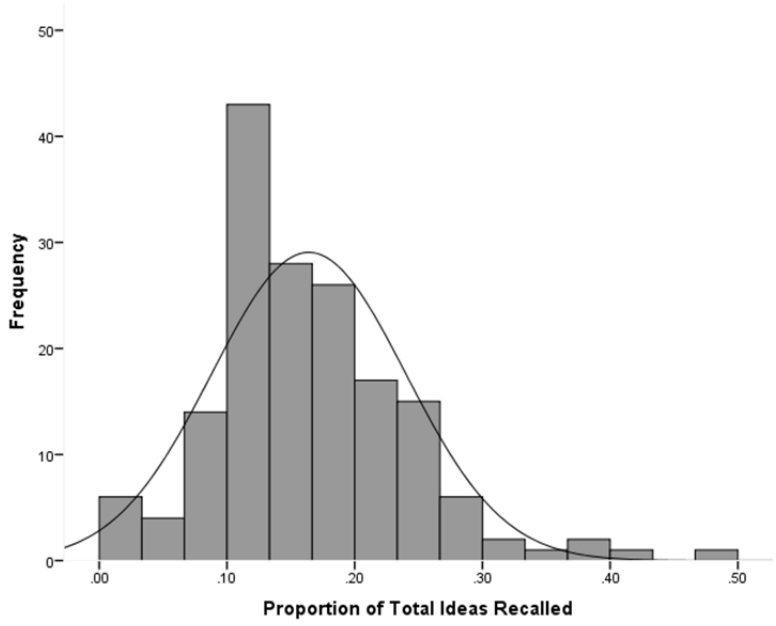
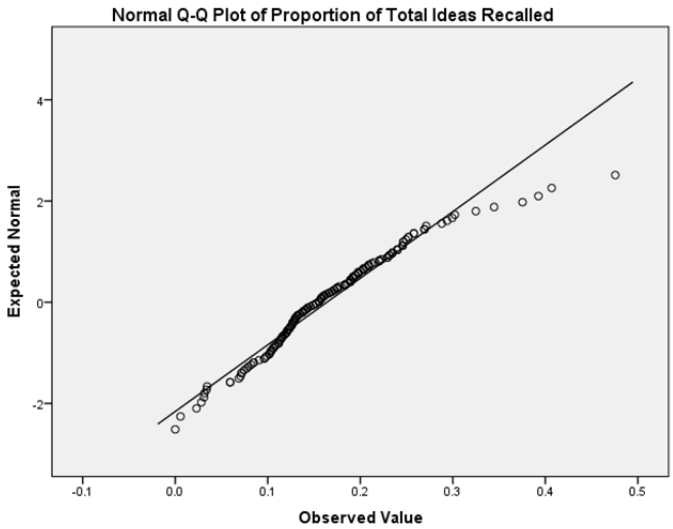


Figure 4-3. Histogram for Total Recall



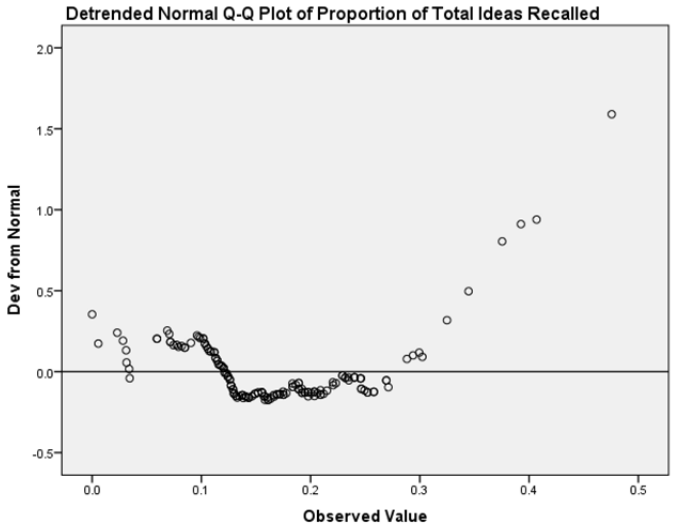


Figure 4-4. Q-Q Plots for Total Recall

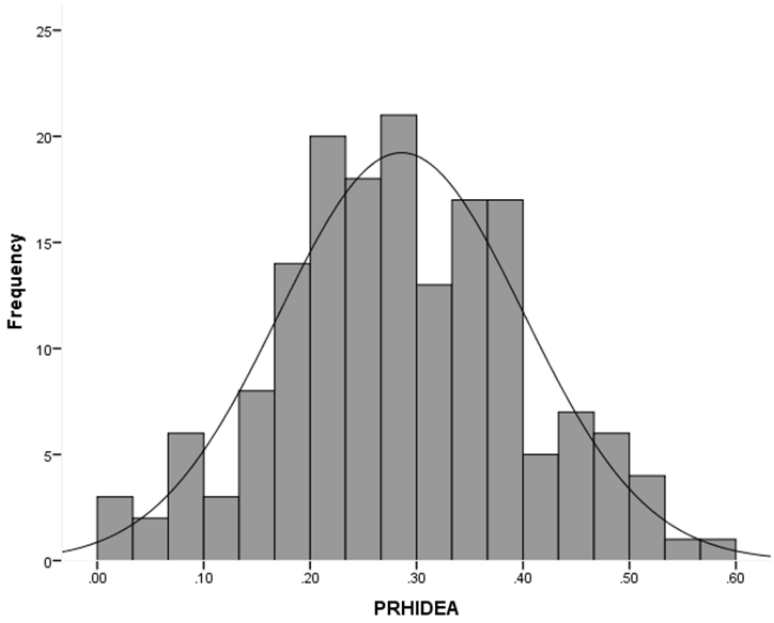


Figure 4-4 Histogram for High Ideas Recalled

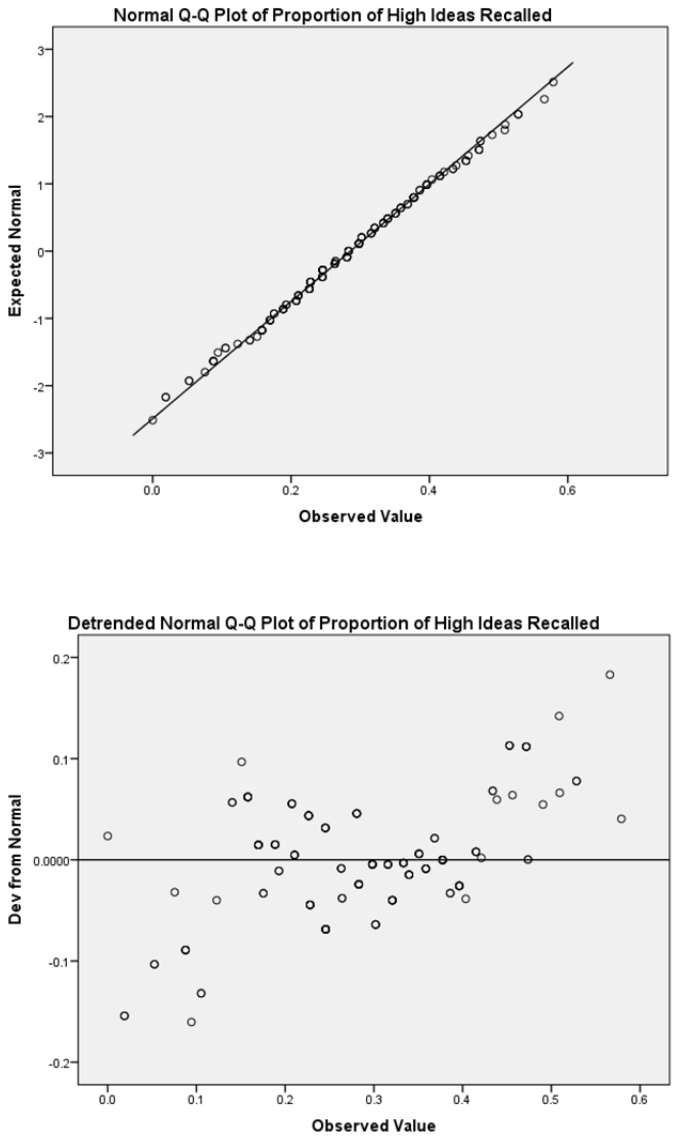


Figure 4-5. Q-Q Plots for High Ideas Recalled

Does Top-Level Structure Influence Bridging Inferences?

The goal of the regression analysis was to examined the influence of top-level structure condition, comprehension skill (as measured by the Davis Reading Test), and their interaction on bridging inferencing. Prior to conducting analysis, assumptions of normality of residuals and homoscedasticity assumptions were examined. With regard to normality, the p-p (probability) plot for residuals indicated a near normal distribution. In relation to homoscedasticity, scatterplots of residuals and predicted values did not indicate notable deviations. Multiple regression analysis indicated that the model significantly predicted total inference scores, with $F(3,164) = 11.215$, $p < .005$. The predictors accounted for approximately 17% of the variance in inference scores ($r^2 = .17$, adjusted $r^2 = 0.16$). Text structure condition did not significantly predict performance on inference questions ($b = .74$, $p = .359$). There was little difference in performance between participants in the listing-description ($M = 22.48$, $SD = 5.76$) and problem-solution conditions ($M = 22.93$, $SD = 5.80$) when the Davis Test score was at the mean. Table 4-2 contains partial regression coefficients, confidence intervals, and semi-partial correlations for total inference scores. The more structured, problem-solution text was not associated with significantly higher scores on bridging inference questions.

Comprehension Skill and Bridging Inferences

The partial regression coefficient for adjusted total score on the Davis Reading Test was significant ($b = .36$, $p <.005$). This coefficient indicated that increases in scores on the Davis Reading Test were associated with increases in total inference scores for

participants in the listing-description condition (See Table 4-2). For participants in the problem-solution condition the partial regression coefficient was similar (b = .31, β = .39, p < .005, r_p =.28). The partial regression coefficient for the interaction between text structure condition and adjusted Davis Reading Test score was not significant (b = -.045, p = .70). More skilled comprehenders demonstrated higher scores on bridging inference questions. This difference between more and less skilled readers did not significantly differ across text structure conditions.

Table 4-2. Partial Regression Coefficients and Semi-partial Correlations for Total Inference Score

	Unstandardized Coefficients		Standardized Coefficients (β)	t	Sig.	95.0% Confidence Interval (B)		Semi-Partial Correlation
	B	Std. Error				Lower Bound	Upper Bound	
(Constant)	22.32	.58		38.48	.000	21.17	23.46	
Condition	.75	.82	.07	.92	.359	-.87	2.37	.07
DRT	.36	.09	.44	4.20	.000	.19	.53	.30
Condition by DRT	-.05	.12	-.04	-.39	.701	-.28	.19	-.03

Note. Condition: 0 = listing-description, 1= problem-solution. DRT = Total Davis Reading Test Score (adjusted).

Does Top-Level Structure Influence Memory for Text?

In order to examine the relationship between top-level structure and memory of the text, a multiple regression analysis was conducted on the total proportion of ideas recalled and the proportion of high levels ideas recalled. For this analysis, a multivariate, general linear multiple regression model (UCLA Statistical Consulting Group ,n.d.) was used

for recall measures due to the high correlation between the proportion of total and high level ideas recalled (r = .70). If readers left the recall blank, providing no response, they were not included in analysis of recall data (n = 2).

The multivariate test indicated a significant effect of condition with Wilks λ (2,161) = 6.39, p = .002, η^2 =.08. Additionally, adjusted total scores on the Davis Reading Test also significantly predicted recall with Wilks λ (2,161) = 5.04, p = .008, η^2 = .06. For the multivariate analysis, the interaction between condition and scores on the Davis Reading Test was not significant, Wilks λ (2,163) = .48, p = .617, η^2 =.006. Table 4-3 contains the mean proportions of ideas recalled for each text structure condition.

Table 4-3. Ideas Recalled and Top-Level Structure Scores by Condition

	Total Ideas		High Ideas		Problem-Solution TLS		Listing-Description TLS	
	M	*SD*	*M*	*SD*	*M*	SD	*M*	*SD*
Problem-Solution	.16	.07	.30	0.12	5.12	2.49	3.55	1.54
Listing-Description	.17	.08	.27	.11	2.38	.96	5.34	2.10
M	.16	.08	0.29	.11	3.77	2.34	4.43	2.04

Note. Total ideas = Proportion of total ideas recalled, High ideas = Proportion of high ideas recalled

Additionally, plots were examined in order to assess whether assumptions of normality and homoscedasticity of variance were met for both the proportion of total and high level ideas recalled. For the proportion of total ideas recalled, p-p plots of residuals indicated some deviation from normal (see Figure 4-6). However, it does not appear to be severe. For the total proportion of ideas recalled, a scatterplot of standardized residuals and predicted values indicated some evidence of heteroscedasticity (see Figure 4-7). For the proportion of high level ideas, the p-p plots for the residuals indicated a

distribution near normal. Additionally, the scatterplot of residuals and predicted values did not appear to indicate a notable violation of homoscedasticity.

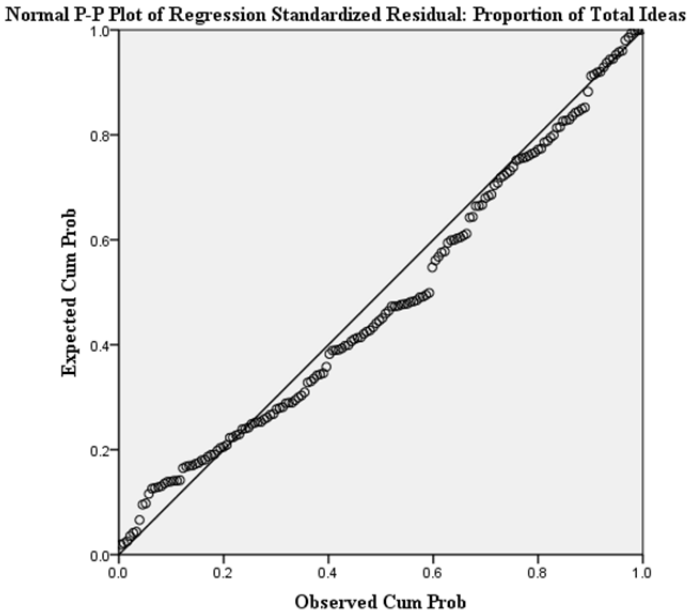


Figure 4-6. Normal P-P Plots for Proportion of Total Ideas Residuals

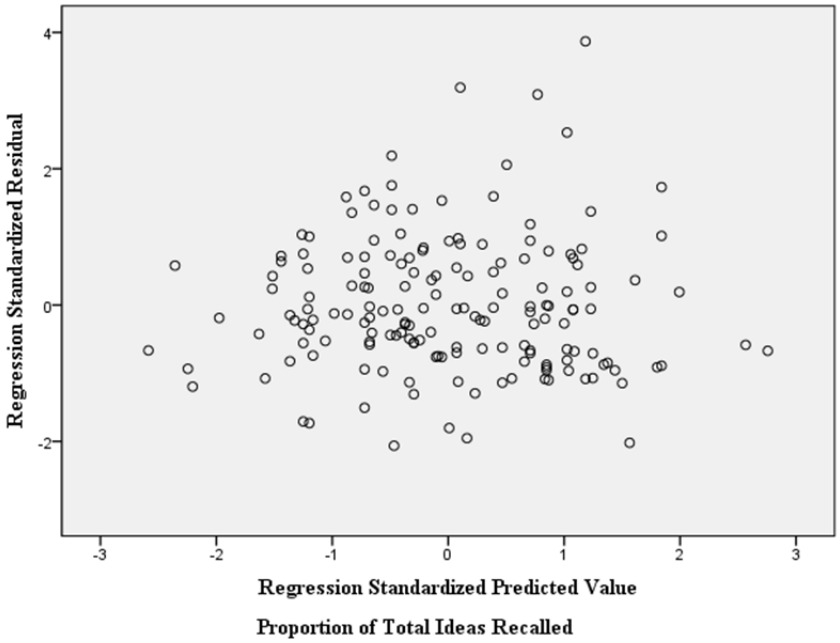


Figure 4-7. Scatterplots for Residuals and Predicted Values: Proportion of Total Ideas

Top-Level Structure and Total Recall

Multiple regression analysis indicated that the overall model was significant with $F(3,162) = 10.90$, $p < .005$. The model accounted for approximately 17 % of the variance in the proportion of total ideas recalled ($r^2 = .17$, adjusted $r^2 = .18$). Text structure condition was not significantly associated with the proportion of total ideas recalled, with $F(2, 162) = .11$, $p = .740$, $\eta^2 = .001$. Table 4-4 contains partial regression coefficients, confidence intervals, and semi-partial correlations for the proportion of total ideas recalled. The regression coefficient of text structure condition was $b = - 0.004$, indicating that when Davis Reading Test score was at the mean, there was little difference between conditions in terms of the total number of ideas recalled (See also Table 4-3). The more organized, problem-solution text structure was not associated with significantly higher total recall.

Comprehension Skill and Total Recall

Adjusted total scores on the Davis Reading Test significantly predicted total recall with $F(1,162) = 9.89$, $p = .002$, $\eta^2 = .06$, and a partial regression coefficient of $b = .004$ (See Table 4-4). This beta weight indicates that increases in adjusted Davis Reading Test scores were associated with small increases in the proportion of total ideas recalled, for students in the listing-description condition. For participants in the problem-solution condition, the partial regression coefficient was similar, $b = .005$, $p < .005$, $r_p = .33$. The interaction between text structure condition and Davis Reading Test score was not significant, with $F(1, 162) = .739$, $p = .391$, $\eta^2 = .005$. More skilled readers recalled more

total ideas than less skilled readers and the two text structure conditions did not significantly differ with regard to differences between more and less skilled readers.

Table 4-4. Partial Regression Coefficients and Semi-partial Correlations for Total Recall

	Unstandardized Coefficients		Standardized Coefficients (β)	t	Sig.	95.0% Confidence Interval (*B*)		Semi-Partial Correlation
	B	Std. Error				Lower Bound	Upper Bound	
(Constant)	0.17	0.01		21.39	.000	0.15	0.18	
Condition	-0.004	0.01	-0.02	-0.33	.740	-0.03	0.02	-0.02
DRT	0.004	0.001	0.33	3.15	.002	0.00	0.01	0.22
Condition by DRT	0.001	0.002	0.06	0.86	.391	-0.002	0.004	0.06

Note. Condition: 0 = listing-description, 1= problem-solution. DRT = Total Davis Reading Test Score (adjusted).

Top-Level Structure and High Level Ideas

Multiple regression analysis indicated that the overall model predicting recall of high level ideas was significant with $F(3, 162) = 6.137$, $p = .001$. The model accounted for approximately 10% of the variance in the proportion of high level ideas recalled ($r^2 = .10$, adjusted $r^2 = .09$). Text structure condition was significantly associated with the proportion of high level ideas recalled with $F(1, 162) = 5.998$, $p = .015$, $\eta^2 = .036$. The partial regression coefficient for text structure condition was $b = .04$, $p = .015$. This coefficient indicated that readers in the problem-solution structure text condition recalled a significantly greater proportion of high level ideas in comparison to participants in the listing-description text condition, when Davis Reading Test score was at its mean (See

Table 4-5). The more organized, problem-solution text structure was associated with significantly greater recall of high level ideas.

Comprehension Skill and High Level Ideas

Additionally, the total adjusted score on the Davis Reading Test was also associated with the proportion of high level ideas recalled, $F(1, 162) = 2.93$, $p = .089$, $\eta^2 = .02$. However, this relationship was not significant. The partial regression coefficient for adjusted Davis Reading Test score, $b = .003$, indicated that increases in reading test scores were associated with a small increase in the proportion of high level ideas recalled, for students in the listing-description condition (See Table 4-5). For participants in the problem-solution condition, the partial regression coefficient was similar ($b = .005$, $\beta = .32$, $p = .002$, $r_p = .23$). The interaction between text condition and Davis Reading Test score was not significant, $F(1, 162) = .872$, $p = .352$, $\eta^2 = .005$. Table 4-5 contains partial regression coefficients, confidence intervals, and semi-partial correlations for recall for high ideas. More skilled readers recalled more high level ideas; however, this difference did not reach significance. Differences between more and less skilled readers' recall of high level ideas did not vary across the two conditions.

Table 4-5. Partial Regression Coefficients and Semi-partial Correlations for High Ideas

	Unstandardized Coefficients		Standardized Coefficients (β)	*t*	Sig.	95.0% Confidence Interval (B)		Semi-Partial Correlation
	B	Std. Error				Lower Bound	Upper Bound	
(Constant)	.26	.01		21.76	.000	.24	.29	
Condition	.0 4	.02	.18	2.45	.015	.008	.08	.18
DRT	.003	.002	.19	1.71	.089	.000	.007	.13
Condition by DRT	.002	.002	.10	.93	.352	-.003	.007	.07

Note. Condition: 0 = listing-description, 1= problem-solution. DRT = total Davis Reading Test Score (adjusted)

Is the Organization of Memory Associated with Bridging Inferences?

An initial examination of the relationship between structural awareness and bridging inferences, examined the correlations between TLS scores and total inference scores within each condition. These correlations reflected the relationship between the degree to which readers' used the same organization as the author and performance on inference questions. Within the listing-description condition, the correlation between listing-description TLS score and total inference score was .20 (p = .07). Within the problem-solution condition, the correlation between problem-solution TLS score and total inference score was .14 (p = .212). These correlations reflect a weak relationship between greater degrees of structural awareness and higher scores on bridging questions.

In addition, an analysis of variance (ANOVA) was conducted to examine whether readers with high and low levels of text structure awareness differed with regards to

performance on bridging inference questions. A two-factor ANOVA on total inference scores, with text structure condition and awareness classification as predictors, indicated that text structure awareness classification (high vs. low) significantly predicted total inferences scores, $F(1, 162) = 6.267$, $p = .013$, $\eta^2 = .037$. Table 4-6 contains mean inference scores for readers with high and low awareness of text structure. The effect for condition was not significant, $F(1, 162) = .085$, $p = .771$, $\eta^2 = .001$. The interaction between condition and awareness classification was not significant, $F(1, 162) = .671$, $p = .414$, $\eta^2 = .004$. However, a t-test comparing readers with high and low awareness in the problem-solution condition indicated that the difference between these groups was not significant, $t(82) = 1.15$ $p = .255$. Readers' with high levels of structural awareness had higher scores on bridging inference questions in comparison to readers' with low awareness. However, in the problem-solution condition, the difference between readers with high and low awareness was small.

Table 4-6. Total Inference Scores for Readers with High and Low Structural Awareness

	High Awareness		Low Awareness	
	M	*SD*	*M*	*SD*
Problem-Solution	23.59	5.50	22.13	6.13
Listing –Description	24.04	5.09	21.17	5.43

An analysis of covariance (ANCOVA) was conducted on total inference scores with structural awareness classification and text condition as predictors and adjusted total score on the Davis Reading Test as a covariate. The results of the ANCOVA indicated that the total adjusted score on the Davis Reading Test was associated with total inference scores, $F(1, 163) = 26.49$, $p < .005$, $\eta^2 = .14$. The main effect for structural awareness was

not significant, $F(1, 163) = 1.186$, $p = .278$, $\eta^2 = .011$. The main effect for text condition was not significant, $F(1, 163) = 1.12$, $p = .291$, $\eta^2 = .007$, nor was the interaction between condition and awareness classification, $F(1, 163) = 1.1922$, $p = .168$, $\eta^2 = .012$. After accounting for readers' overall comprehension skill, as indicated by performance on the Davis Reading Test, the difference between high and low awareness readers' scores on bridging inference questions was not significant.

Is the Effect of Top-level Structure on Bridging Inferences Indirect?

Two preliminary analyses were conducted in examining the possible indirect effect of text structure through readers' structural awareness. First, the effect of top-level structure condition on problem-solution TLS scores was examined through a t-test comparing the problem-solution TLS scores of the two conditions. Overall levels of structural awareness were also compared across conditions. Second, a multiple regression analysis was conducted on total inference scores with problem-solution TLS scores and top-level condition as predictors.

Structural Condition and Structural Awareness

A t-test comparing the mean problem-solution TLS scores of the two text structure conditions, indicated that the difference between structural conditions (2. 74) was significant (t (107.924) = 9.40, $p < .005$). Participants in the problem-solution condition had significantly higher problem-solution TLS scores. In terms of the

mediation model proposed, this finding indicates that the relationship between text structure condition and problem-solution structure TLS scores was significant. Because Levene's test for homogeneity of variance was significant, $F = 124.983$, $p < .005$, test statistics reported are those for which homogeneity was not assumed.

A chi-square test was conducted to examine whether the number of participants demonstrating high and low structural awareness differed across the two conditions. The same classification of high and low structural awareness was used as that used in analysis of the relationship between structural awareness and inferencing. Specifically, readers with high awareness had TLS scores of 6 or greater on the scale which corresponded to their assigned condition, while readers with low awareness had scores less than 6. Text structure conditions did not significantly differ in relation to the number of participants demonstrating structural awareness, X^2 (1) = .11, $p = .740$. Table 4-7 contains the proportion of participants demonstrating structural awareness for each text condition.

Table 4-7. Structural Awareness for Problem-Solution and Listing-Description Conditions

	Low Awareness	High Awareness
Listing-Description	0.43	0.57
Problem-Solution	0.45	0.55
Total	0.44	0.56

Note. Numbers indicate proportion of participants.

Problem-Solution TLS Score and Bridging Inferences

A regression analysis with problem-solution TLS score as a predictor, indicated that the relationship between problem-solution TLS score and total inference scores was not significant, when controlling for condition, $b = .27$, $p = .567$. As a result of this

analysis, the indirect effect of text structure through problem-solution TLS score was not examined because there did not appear to be sufficient evidence that problem-solution TLS score served as a mediator.

Chapter 5

Discussion of Results

Top-level Structure and Bridging Inferences

In relation to performance on inference questions, the two text structure conditions had similar scores. This finding is similar to other researchers who have failed to find a significant relationship between type of structure (Montanero & Lucero, 2012) and level of text cohesion (Ozuru, et al., 2009) on inferencing after reading. Type of text structure did not appear to have a direct influence readers' construction of bridging inferences after reading.

Unlike type of top-level structure, readers' overall level of comprehension skill was associated with performance on bridging inference questions. Higher scores on the Davis Reading Test were associated with higher scores on the inference questions. The lack of a significant interaction between comprehension skill and text structure, indicated that for both structures more skilled readers had higher inference scores. For less skilled readers, the more structured text did not appear to provide the support needed to make bridging inferences.

Across the entire sample, readers did not make very many correct, bridging inferences (M = .96, SD = 1.07). This finding with a social science text is similar to O'Reilly and McNamara (2007) and McNamara (2001) who found that readers made few inferences after reading science texts. It is possible that the lack of an effect for text structure on bridging inferences may be related to readers' overall low inference scores. It is important to note that low levels of inferencing were related to the specific bridging inference questions presented and do not reflect readers' construction of other types of inferences.

Top-Level Structure and Recall of Ideas

In contrast to inferences, there is some evidence that top-level structure influenced readers' recall of text ideas. Readers in the problem-solution condition recalled more high level ideas than readers in the listing-description condition. However, with regard to the total proportion of ideas recalled, the listing-description and problem-solution conditions did not differ significantly. In other words, while readers in the two conditions recalled a similar number of total ideas, the relative height of these ideas may have differed, with readers' in the problem-solution condition recalling more high level ideas. Similar to some studies of text cohesion (O'Reilly & McNamara, 2007; Ozuru et al., 2009), there was some evidence to suggest that while text structure may influence readers' memory of text, it may have less of an influence on readers' deeper level comprehension.. Moreover, the findings provided partial support for previous research that suggests that more organized text structures are associated with greater memory of text (Meyer & Freedle, 1984).

There may be two possible explanations for why the conditions differed in term of high ideas, but not total recall. First, top-level structure may have a stronger effect on the recall of high level ideas than on lower level ideas (Britton et al., 1979). As a result, differences between the structures may be more likely to occur with these ideas. Moreover, it is also possible that lower recall of high level ideas in the listing-description condition was related to text signaling. Meyer and Rice (1982) have found evidence that adult readers use text signaling to organize their recall according to the structure indicated by the signals. In the listing-description text, two major concepts were signaled (attributions and learned helplessness). Other high level ideas (e.g. training in attributions), were not well-signaled. It is possible that in the listing-description condition, readers focused more on the signaled concepts. As a result, their recall of other high level ideas was lower.

The text structure by comprehension skill interaction was not significant. The effect of type of top-level structure did not appear to be greater for less skilled readers than for more skilled readers. For total ideas, this lack of an interaction may have been related to the minimal influence of text structure. Top-level structure did not appear to influence total recall for either more or less skilled readers. For high ideas, this lack of an interaction indicated that both more skilled and less skilled readers recalled more high level ideas if they had read the problem-solution text. When text structure was associated with performance, it did not appear to provide more support for less skilled readers. Moreover, higher levels of comprehension skill, as measured by the Davis Reading Test, were associated with greater recall, particularly total recall. Taken together these findings suggest that more skilled readers may recall more ideas than less skilled readers when reading both more structured and less structured texts.

The lack of a text structure by comprehension skill interaction differs from those studies that have found that signaling (e.g. Meyer et al., 1980; Naumann et al., 2007) and text cohesion (Linderholm et al., 2000) may have differential benefits for more and less skilled readers. In this study although the texts differed in their organization, both texts included text structure signaling and both had similar levels of cohesion. Perhaps when text signaling is present, the effect of type of text structure may not be as large for less skilled readers because the text already contains supports that indicate its organization. In other words, the presence of text signaling may have provided the support that less skilled readers needed, and as a result there was little difference between structure conditions in recall.

The presence of signaling and similar levels of cohesion may also have contributed to minimal differences in performance across the two text structures in terms of both skilled and less skilled readers' total recall and bridging inferences. Although previous research (e.g. Meyer & Freedle, 1984; Sanders & Noordman, 2000) has indicated that more organized structures like problem-solution are associated with greater memory for text, the results of this study do not

provide strong support for this influence of type of structure. It is possible that although the listing-description text may be considered less structured (Meyer & Freedle, 1984), the overall quality of the organization of both texts may not have been substantially different. The listing-description text still contained a clear organization, and this may have contributed to similar performance across the two conditions. It is possible that when texts contain similar degrees of signaling and text cohesion, the type of top-level structure used to organize the text may have less of an impact. Along these same lines, it is also possible that while top-level structure may have an influence on inferencing and recall, its relative impact may be smaller than other aspects of text structure (e.g. signaling, cohesion). Additional research is likely needed to explore the relative benefits of different aspects of text structure (text signaling, top-level structure, text cohesion), particularly for their impact on less skilled readers' comprehension.

Awareness of Text Structure and Bridging Inferences

Awareness of text structure was associated with greater performance on inference questions. However, the influence of structural awareness on bridging inferences appears to depend on which structure readers used to organize their understanding. For readers in the listing-description condition, awareness of text structure was associated with higher inference scores. Readers who were classified as having high awareness had significantly higher scores than those with low awareness. In contrast, within the problem-solution condition, there was little difference in inference scores between readers who demonstrated high awareness and those with low awareness. This small difference in performance between high and low groups in the problem-solution condition, may be because readers in the low awareness group who used an organized listing-description structure (high scores on the listing-description TLS scale with low scores on the problem-solution TLS scale) had higher scores ($M = 26.67$) than high awareness

readers who used only the problem-solution structure (*M* = 23. 78) (high scores on the problem-solution TLS scale, low scores on the listing-description TLS scale) .

Although the difference between these two groups may suggest that using a listing-description structure may be more beneficial, the mean total inference scores of readers with high text structure awareness in the listing-description condition *(M* = 24.04) and high text structure awareness in the problem-solution condition (*M* = 23.59) were similar. In other words, readers who had high awareness in the listing-description condition had slightly higher scores than readers who had high awareness in the problem-solution condition. The research findings suggest that a higher level of structural awareness was associated with greater bridging inferencing, particularly when reading a listing-description text. However, the research findings do not provide strong evidence that using an organized list was more beneficial than using of the problem-solution structure. Alternatively, while using a structure to organize one's memory may facilitate inferencing, using a more organized structure (problem-solution) was not more beneficial than using a less organized structure (listing-description).

It is possible that awareness of the problem-solution structure was not more beneficial for inferencing because of issues related to memory of text. Being able to access textual information stored in memory may improve inferencing (Long et al., 1994; Wiley & Myers, 2003). For example, Wiley and Myers (2003) found that when text premise information (information needed to make the inference) was presented close to those sentences in which an inference needed to be made, readers were better able to generate inferences. A key component of text access is that the information readers are able to recall is needed to construct an inference (e.g. Wiley & Myers, 2003). Using a problem-solution organization may not have been more facilitative because use of this structure may not have promoted access to the ideas from the text needed to answer inference questions. It is possible that the ideas organized within the mental representations of participants

with high awareness of the problem-solution structure did not match those needed to answer the inference questions.

In order to explore this possibility further, an additional regression analysis was conducted that examined the relationship between the types of ideas recalled and inference scores. Specifically, I regressed recall of ideas related to attributions, learned helplessness, and attribution training on total inference scores. The goal of this analysis was to examine whether specific types of ideas were associated with bridging inferences. These concepts were selected because they reflected those concepts that were most important to the two text structures, with attributions and learned helplessness being central to the listing-description text and learned helplessness and attribution training being central to the problem-solution text. While recall of ideas related to attributions ($b = .12$, $p < .005$) and learned helplessness ($b = .13$, $p = .012$) were associated with better performance on bridging inference questions, recall of ideas related to attribution training was not ($b = .04$, $p = .297$).

Moreover, I examined whether readers' structural awareness was associated with the number of ideas readers recalled for each of these concepts. Specifically, I examined whether readers with high awareness in the problem-solution and listing-description conditions differed in the number of ideas related to these concepts that they recalled. The goal of these analyses (t-tests) was to determine whether the use of a particular structure (listing-description vs. problem-solution) was associated with differences in the types of ideas readers recalled. Readers who had high awareness in the listing-description condition recalled more ideas related to attributions ($M = 31.310$, $SD = 15.65$) than readers who demonstrated high awareness in the problem-solution condition ($M = 19.26$, $SD = 13.20$), $t(91) = -4.004$, $p < .005$. Conversely, readers with high awareness in the problem-solution condition recalled more ideas related to attribution training ($M = 18.80$, $SD = 9.73$) than readers with high awareness in the listing-description condition ($M = 11.98$, $SD = 13.58$), $t(83.415) = 2.79$, $p = .007$. The two groups recalled a similar number of

ideas related to learned helplessness (listing-description: $M = 18.17$; $SD = 1.71$; problem-solution: $M = 20.37$, $SD = 6.958$, $p = .152$). Taken together, the findings from the analyses suggest that use of the problem-solution structure may not have promoted memory for attributions, which may have been beneficial in answering inference questions.

Readers using the problem-solution structure may have focused more on the concepts of learned helplessness and attribution training, as these were signaled, high level concepts (at the top of the structure). In other words, these were two concepts that were presented as central to the text. This focus on these two ideas may have contributed to poorer memory for information related to attributions. However, it is important to note that in the problem-solution text the concept of attributions was signaled and occurred higher in the structure. While attributions may not have been the most important concept in the problem-solution text, it was not necessarily a minor detail.

Although these readers used the structure of the text to organize their own memory (recall), being aware of that structure may have been less facilitative for bridging inferences because it may not have encouraged their memory for a key concept needed to answer the inference questions. This finding may suggest that a greater degree of organization may not be as important as the relationship between the nature of that organization and the comprehension task. If readers use a more structured organization (as in the case of problem-solution), but it does not facilitate recall of those concepts needed to answer inference questions, then using this structure may not be more helpful. However, this conclusion regarding awareness and bridging inferences represents one possible explanation. The measures of ideas recalled were general, and do not provide insights into whether the ideas that participants produced on the recall task were the same ones used to answer inference questions. In order to make more definitive conclusions, a closer analysis between the specific ideas recalled and those used to answer inference questions is needed.

Unfortunately, when readers' overall comprehension skill was controlled for, the effect of structural awareness was no longer significant. This may be because the overall influence of structural awareness on inferences was small. The estimate of effect size for structural awareness classification indicated that awareness accounted for only 4% of the variance in inference scores, when not controlling for overall comprehension skill. It is possible that while awareness of text structure has an impact on readers' ability to make inferences after reading, its relative impact is small in comparison to other aspects of comprehension skill. Moreover, overall comprehension skill may exert a greater influence on bridging inferences than readers' structural awareness.

Text Structure, Structural Awareness, and Inferences

The top-level structure of the text appeared to influence how readers organized their memory for text. Readers were more likely to use a problem-solution structure if they had read the problem-solution text. In both conditions, close to 55% of the participants demonstrated awareness of the text structure. This finding suggests that while the type of organization used varied across the two conditions, the two text structures did not differ with regard to whether or not readers recognized the structure and used it to organize their memory. In other words, the problem-solution structure was not associated with higher levels of structural awareness.

Because increases in scores on the problem-solution TLS scale were not associated with better bridging inferential performance, when controlling for condition, the indirect of effect of text structure was not assessed. The weak relationship between use of the problem-solution structure and bridging inferences may help explain the lack of both a direct and indirect effect of top-level structure on these inferences. Although the problem-solution structure was associated with the organization of readers' memory for text, greater use of the more organized structure (problem-solution) was not more beneficial for bridging inferences. It is possible that in order for

top-level structure to have an influence on comprehension, it needs to encourage a memory for that text that in some way facilitates inferencing.

Limitations and Future Research

In addition to those already mentioned, the conclusions made from this study should be interpreted cautiously for several reasons. First, because of the poor reliability of the topic knowledge measure, the study did not address the research questions related to the influence of prior knowledge and its potential interaction with top-level structure and comprehension skill. This is a limitation of the current study, as previous research has consistently provided evidence that prior knowledge is associated with better performance on inference questions (e.g. McNamara, 2001; O'Reilly & McNamara, 2007; Ozuru et al., 2009). Moreover, when text cohesion, comprehension skill, and prior knowledge have been considered together, prior knowledge has been found to be a better predictor of inferencing (Ozuru et al., 2009). By not including a measure of prior content knowledge in analyses, this study has failed to account for an important predictor of deep level comprehension. In relation to inference scores, text structure, comprehension skill, and their interaction only accounted for approximately 17% of the variance in inference scores. It is likely that prior knowledge would account for an important proportion of the unexplained variance.

Moreover, the inclusion of prior knowledge may have altered the research findings. Although the goal of the Davis Reading Test was to assess readers' comprehension skill, there was a significant correlation between performance on this measure and scores on the topic knowledge test ($r = .23$). Because prior knowledge may be associated with performance on comprehension assessments (Cromely & Azevedo, 2007; Haenggi, & Perfetti, 1994; McNamara et al., 2007; O'Reilly & McNamara, 2007), it is possible that by not accounting for readers' prior

knowledge, the analysis may have overestimated the influence of comprehension skill. In order to provide a more accurate picture of the relationship between top-level structure and bridging inferences, future research is needed that includes measures of readers' prior content knowledge.

Second, reader fatigue may have played a role in readers' performance on both the free recall task and bridging inference questions. All of the reading tasks were completed in one study session, with participants completing the Davis Reading Test before reading the experimental text. This reading test may have been challenging for readers and may have contributed to fatigue. Moreover, completing both the reading test and the free recall within the same session may have also increased fatigue, resulting in lower scores on the bridging inference questions. It is possible that if the study had been conducted in multiple sessions, with topic knowledge and comprehension tests being conducted separately, readers may have had better performance on inference questions and increased quality of recall. Improvements in performance on comprehension measures may have led to different results regarding the influence of top-level structure, comprehension skill, and their interaction.

In addition, for the inference questions, the internal consistency of the items was relatively low (.64) and the inter-rater reliability indicated only moderate agreement among raters. Both indices suggest that the reliability of the inference questions was less than ideal. Low reliability on this measure may have made it more difficult to adequately detect the influence of text structure and comprehension skill. Moreover, the scoring criteria for a correct inference were fairly strict, and may have favored those readers who wrote longer responses. Consequently, the scoring may have underestimated the inferential performance of readers who provided shorter responses. Additional research which uses a variety of assessments of inferences, including the use of more reliable measures, is likely needed.

Fourth, the lack of a text structure by reading skill interaction on both recall and inference scores, may have been due to the restricted range of the observed comprehension skill of these

readers. Although the sample of participants had varying levels of comprehension skill, they were all competent readers. For both the proportion of total ideas recalled and total inference score, there was no significant effect for text structure. Although type of text structure was associated with the proportion of high level ideas recalled, this effect was small. It is possible that for this group of readers, text structure did not have a large influence on comprehension because these readers may have relied on other avenues (e.g. used other strategies or prior knowledge) to understand the text. A sample containing a wider range of comprehension skill levels may have yielded a significant interaction between text structure and comprehension skill.

Moreover, only one text was used and only two text structures were compared. As a result, top-level structure scores do not necessarily reflect readers' general ability to recognize text structure. However, they only provide an indicator of readers' awareness for this particular text. In addition, measures of readers' awareness of text structure were derived from their recalls of the same text that served as the basis for inference questions. Because both measures are related to the same text, it is likely that some of the relationship between awareness and inferencing is due to use of the same text.

Finally, the findings regarding the influence of both top-level structure and structural awareness on bridging inferences may be related to the content of the bridging questions. In this study, awareness of text structure appeared to have a stronger influence on inferences when it promoted recall of relevant information. While the inference questions were designed to assess deeper understanding of several different concepts, they seemed to place more emphasis on attributions and learned helplessness. Only one question seemed to directly address attribution training (the solution in the problem-solution text). For readers' with high awareness of the problem-solution structure, attribution training was likely a key concept in their mental representations. By only including one question about this concept, this study may have underestimated these readers' capacity to construct bridging inferences. Moreover, by

emphasizing attributions, the questions may have placed readers' in the problem-solution condition at a disadvantage because they may have had less memory for this concept. Along these same lines, the study may have underestimated the difference between the two text structures, as questions may not have adequately assessed a key concept in which readers may have differed. Consequently, the problem-solution structure could be associated with more bridging inferences, when there is higher degree of similarity between the concepts emphasized in the questions and those emphasized in the text structure. In short, the findings from this study suggest that the relationship between top-level structure and performance on inference questions may be context specific. In order to make more definitive conclusions about the relationship between text structure and inferences, additional research, which incorporates a variety of inference questions is likely needed.

Instructional Implications

The structural characteristics of a text (top-level structure, text signaling, text cohesion) can have an important impact of readers' comprehension. Previous research has indicated that the quality of the organization of the text itself may influence the quality of readers' understanding. When texts are well-organized, readers' may be better able to recognize the relationships between text ideas, which may in turn increase the organization, clarity, and completeness of their understanding (McNamara & Kintsch, 1996; Meyer et al., 1980; Meyer & Rice, 1982). The findings from this study provide some additional support for this relationship between textual organization and comprehension. However, this support is weak, possibly because of the aspect of structure that was examined and/or the characteristics of the sample of participants.

Nevertheless, the findings of this study suggest that teachers should be cognizant of the influence that type of organization has on readers' ability to comprehend. Texts that are loosely organized may increase the difficulty of comprehension tasks that assess recall of text information. It is also important for educators to understand that the comprehension challenges associated with less organized texts may not solely arise from the characteristics of the texts themselves. Previous research suggests that teachers should consider readers' comprehension ability (e.g. Ozuru et al., 2009) and content knowledge (e.g. McNamara et al., 1996) when considering the impact of text organization. Although this study did not find evidence that the influence of top-level structure varied across skilled and less skilled readers, it is still possible that the influence top-level structure depends on the knowledge and skill readers bring to the text. The findings of this study do suggest that when considering the impact that text structure has on readers' comprehension, it may be important to consider how these characteristics influence readers' processing and memory for a text.

Readers may require additional instruction to help them meet the challenges posed by less structured texts. McNamara and colleagues (e.g. McNamara, 2001; O'Reilly & McNamara, 2007; Ozuru et al., 2009) have recommended instruction in comprehension strategies, suggesting that use of strategies may help readers to improve their comprehension of less cohesive text. O'Reilly and McNamara (2007) suggested that strategy instruction presents a more practical alternative to altering texts or only selecting cohesive texts. Comprehension strategy instruction may also help readers when they are confronted with less organized top-level structures. In particular, strategy instruction like the structure strategy training developed by Meyer and colleagues (e.g. Meyer et al., 2011; Meyer et al., 2010; Meyer, Young, & Bartlett, 1989), may help readers when they are faced with less organized texts by helping them to better recognize those structural relationships that may be present. Additionally, structure strategy instruction could be designed to encourage readers to apply text structures to texts in which the structural

relationships have been left implicit, as previous research has found that text structure instruction can improve readers' comprehension of unsignaled texts (Meyer & Poon, 2001).

The findings from this study also provide some evidence that increasing readers' awareness of text structure through structure strategy instruction may also help readers when they are asked to make inferences from the texts that they have read. However, explicit instruction in text structure may not always lead to better inferencing. It is important to keep in mind that awareness of structure may be more beneficial for bridging inferences when there is a clear relationship between the ideas being recalled as part of the structure and those ideas needed to answer inference questions. Consequently, instruction in the use of text structure may have a greater impact on bridging inferences, when readers have a meaningful context in which to apply the text information organized within the structure.

Moreover, if teachers are primarily interested in improving readers' deep level comprehension of text, it may be beneficial to teach text structure in the context of multiple comprehension strategies. While the findings of this study indicate that awareness of text structure may be associated with bridging inferences, its overall influence was small. Awareness of text structure alone may not be enough to help readers make inferences because inferencing may be influenced by several factors, including readers' knowledge of the content. In order to improve readers' deeper level comprehension, teachers may need to incorporate instruction in text structure with other comprehension strategies that promote inferences, such as bridging, logical reasoning, and elaborating (e.g. Magliano, Todaro, Millis, Weimer-Hastings, Kim, & McNamara, 2005; McNamara, 2004).

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Appendix A

Texts

Listing of Descriptions Text

Please read the following text. After you finish reading, you will be asked to answer questions about your understanding. Please take your time and read carefully.

Attributions and learned helplessness are two important concepts relevant to motivation and learning. First, attributions are created explanations (perceived causes) for individuals' successes and failures. Learners attribute success and failures to several factors including: ability, effort, luck, and difficulty of the task. Attributions occur on three dimensions. The first is called locus. Locus refers to the location of the cause, which is either within or outside of the learner. For example, ability and effort are within the learner. In contrast, luck and task difficulty are outside of the learner. The second dimension is stability. Stability refers to whether or not the cause can change. Effort and luck are unstable because they can change, whereas ability is considered stable in attribution theory. The third dimension is control. Control is the extent to which students accept responsibility for their successes or failures, or are in control of the learning situation. Learners can control their efforts, but they cannot control luck or task difficulty.

Students can improve the effectiveness of their attributions through training. In a pioneering study, Dweck (1975) provided students with learned helplessness with both successful and unsuccessful experiences. When students were unsuccessful, the experimenter specifically stated that the failure was caused by a lack of effort or ineffective strategies. Comparable students had similar experiences, but they did not receive training. After 25 sessions, the learners who were counseled about their effort and strategies responded more appropriately to failure. When confronted by failure, they persisted longer and adapted their strategies more effectively. Subsequent research has corroborated Dwecks' findings. This research suggests that teachers can increase students' motivation to learn by teaching them learning strategies and encouraging them to attribute success to effort.

Attributions influence learning in four ways. Attributions impact students' emotional reactions to success and failure, expectations for future success, future effort, and achievement. Motivation tends to increase when students attribute failure to lack of effort because effort can be controlled. It tends to decrease when students attribute failure to uncontrollable causes (e.g. luck, ability if it is viewed as stable).
The second concept, learned helplessness, is closely related to attributions. Students can develop learned helplessness in extreme circumstances. Learned helplessness is the general belief, based on past experiences, that one is incapable of accomplishing tasks and has little control of the environment. This perspective results in overwhelming feelings of shame and self-doubt. Learned helplessness may also cause students to give up without trying, which in turn, may lead to difficulties in learning. Attributing failure to lack of ability, which can be viewed as uncontrollable, could lead to this debilitating strategy. When students frequently experience failure and attribute these failures to lack of ability, they may begin to expect failure in all future attempts.

Learned helplessness has both an emotional and cognitive component. Students with learned helplessness often suffer from anxiety and depression. They may experience feelings of shame and self-doubt. Cognitively, they expect to fail and attribute their failure to lack of ability. As a result, they exert little effort and use ineffective strategies, which results in less success and an even greater expectation for failure. Students who have histories of failure are particularly susceptible to learned helplessness.

Adapted from: *Educational Psychology: Windows on Classrooms, 7th ED*. By P. Eggen and D. Kauchak

Problem-and-Solution Text

Please read the following text. After you finish reading, you will be asked to answer questions about your understanding. Please take your time and read carefully.

Learned helplessness is a serious problem related to students' learning and motivation. Learned helplessness is the general belief, based on past experiences, that one is incapable of accomplishing tasks and has little control of the environment. This perspective results in overwhelming feelings of shame and self-doubt. Learned helplessness may also cause students to give up without trying, which in turn, may lead to difficulties in learning.

Learned helplessness is a problem with both an emotional and a cognitive component. Students with learned helplessness often suffer from anxiety and depression. Cognitively, they expect to fail and attribute their failure to lack of ability. As a result, they exert little effort and use ineffective strategies, which results in less success and an even greater expectation for failure. Students who have histories of failure are particularly susceptible to learned helplessness.

Students' attributions can lead to learned helplessness. Attributions are created explanations (perceived causes) for individuals' successes and failures. Learners attribute success and failures to several factors including: ability, effort, luck, and difficulty of the task. Attributions occur on three dimensions. The first is called locus. Locus refers to the location of the cause, which is either within or outside of the learner. For example, ability and effort are within the learner. In contrast, luck and task difficulty are outside of the learner. The second dimension is stability. Stability refers to whether or not the cause can change. Effort and luck are unstable because they can change, whereas ability is considered stable in attribution theory. The third dimension is control. Control is the extent to which students accept responsibility for their successes or failures, or are in control of the learning situation. Learners can control their efforts, but they cannot control luck or task difficulty.

Attributions influence learning in four ways. Attributions impact students' emotional reactions to success and failure, expectations for future success, future effort, and achievement. Motivation tends to increase when students attribute failure to lack of effort because effort can be controlled. It tends to decrease when students attribute failure to uncontrollable causes (e.g. luck, ability if it is viewed as stable). Attributing failure to lack of ability, which can be viewed as uncontrollable, may lead to learned helplessness. When students frequently experience failure and attribute these failures to lack of ability, they may begin to expect failure in all future attempts.

One possible solution to the problems associated with learned helplessness is attribution training. Through training, students experiencing learned helplessness can improve the effectiveness of their attributions. In a pioneering study, Dweck (1975) provided students with learned helplessness with both successful and unsuccessful experiences. When students were unsuccessful, the experimenter specifically stated that the failure was caused by a lack of effort or ineffective strategies. Comparable students had similar experiences, but they did not receive training. After 25 sessions, the learners who were counseled about their effort and strategies responded more appropriately to failure. When confronted by failure, they persisted longer and adapted their strategies more effectively. Subsequent research has corroborated Dweck's findings. This research suggests that teachers can increase students' motivation to learn and help to eliminate learned helplessness by teaching students learning strategies and encouraging them to attribute success to effort.

Adapted from: *Educational Psychology: Windows on Classrooms, 7th ED*. By P. Eggen and D. Kauchak

Appendix B

Davis Reading Test

DAVIS READING TEST

DIRECTIONS: The passages in this test are taken from textbooks, stories, humorous writings, scientific reports, and other types of reading material. Each passage is followed by one or more multiple-choice items. You are to read each passage carefully as you come to it and then decide, on the basis of the passage, how to answer each item. Select the choice that you think best answers the question or completes the statement. You may go back to the passage as many times as you wish. Feel free to underline, notate, etc. in the test booklet, but be sure that your answer is clearly indicated.

It pays to answer items even when you are not sure that your answers are correct, but it is better to omit an item than to guess wildly among the choices since there is a penalty for incorrectly marked responses. Work as rapidly as you can without making careless mistakes.

You will have 22 minutes to complete this test.

Please raise your hand to indicate that you have read the directions above.

Click the button below to continue.

By Frederick B. Davis and Charlotte Croon Davis

It is likely that the second way man told time was by fire. Very early in history the Chinese knotted grass ropes, dampened them, and calculated the time by marking each knot as it burned off by slow fire. Alfred the Great devised a system using candle clocks. He divided every day into three equal periods, to be devoted to religion, public affairs, and rest. At the rate of one inch burning every twenty minutes, one candle lasted four hours. The next development was probably water clocks; these were basins from which water trickled drop by drop into receiving glasses having marks to indicate hours. The Greeks used them to time their orators. Water clocks were an improvement over sundials for they told how long rather than merely when.

About how tall were the candles used by Alfred the Great?

- ○ 8 inches
- ○ 12 inches
- ○ 16 inches
- ○ 18 inches
- ○ 20 inches

If Alfred kept a candle clock burning during all the time he devoted to religion and public affairs, how many would he use in a week?

○ 21

○

24

○ 28

○

36

○ 42

If the Greeks wished to improve the accuracy of their water clocks by increasing the distance between the hour marks, they could do so by

○ Reducing the trickle of water.

○ Making the sides of the basin steeper.

○ Increasing the capacity of the basin.

○ Increasing the diameter of the receiving glass.

○ Decreasing the diameter of the receiving glass.

What disadvantage do the various timing devices described in the passage all have?

○ They vary with the seasons.

○ They vary markedly with the weather.

○ They require considerable attention.

○ They are not transportable.

○ They cannot be used at night

In the article from which the passage was taken, the paragraph immediately preceding this one probably described

○ The discovery of fire.

○ Sundials.

○ Early methods of making rope.

○ The early history of the Chinese.

○ Prehistoric inventions, such as the wheel.

The summer visitors spent hours on end in the graveyard, looking at the inscriptions. "Did you see this one?" They would call, reading it out loud. "Isn't it quaint and frightful?"

Stranger, pause as you pass by.
As you are now, so once was I.
As I am now, so shall you be,

Prepare for death and follow me.
We "natives" saw nothing quaint or frightful about a man's wanting to pass on the lessons he had learned. Moreover, we honored our dead and never raised our voices about them.

The visitors found the inscriptions

- ○ Entertaining.
- ○ Frightening.
- ○ Undignified.
- ○ Stilted.
- ○ Dull.

How did the "natives" feel towards the visitors?

- ○ Amused
- ○ Curious
- ○ Humbled
- ○ Resentful
- ○ Grateful

The inscription quoted advises the reader to

- ○ Make merry while he can, for tomorrow he may die.
- ○ Live so that he will be ready for death.
- ○ Lead the same sort of life as the man whose grave it marked.
- ○ Prepared for everlasting life.
- ○ Remember that he will be dead a long, long time.

The writer uses quotation marks around "natives" because

- ○ It is an unusual word.
- ○ He felt superior to them.
- ○ They were so referred to by the visitors.
- ○ They were not really natives.
- ○ That was what they called themselves.

"Them" (last word in the passage) means the

- ○ Inscription.
- ○ Voices of the visitors.
- ○ Voices of the "natives".
- ○ Voices of the dead.
- ○ Graves of the dead.

(1) There has never been such mastery over matter as
(2) Morel's. Like the great humorous artist that he is, he
(3) has deliberately set himself the most difficult tasks.
(4) What, for example, is less tractable than a billiard
(5) ball – a hard, round, polished thing, full of
(6) independence and original sin, that scarcely affords
(7) foothold for a fly, and often refuses to obey even on
(8) a level table?
(9) But Morel will not only balance a billiard ball on a
(10) cue but will balance another ball on that, and will
(11) even run two together, one resting on the other,
(12) backwards and forwards between two parallel
(13) cues.
(14) This feat, I am convinced, is as much a miracle as
(15) many of the things in which none of us believe.
(16) It is perfectly ridiculous, after seeing it performed by
(17) Morel, to come away with petty doubts as to the
(18) unseen world. Everything has become possible.

Morel appears to be a

- ○ Juggler.
- ○ Quack.
- ○ Painter of humorous pictures.
- ○ Hypnotist.
- ○ Spiritual medium.

What answer does the writer expect to the question, "What, for example…?" (lines 4-8)

- A great many things
- Everything
- Nothing
- Two billiard balls
- A billiard ball and a cue

The writer expresses

- Envy.
- Deep religious feeling.
- Contempt.
- Admiration.
- Uncertainty

He attributes human qualities to

- A fly.
- A cue.
- A billiard table.
- A billiard ball.
- The unseen world.

His style is

- Informal.
- Extremely serious.
- Matter-of-fact.
- Careless.
- Awkward.

In the last two sentences (lines 16-18), he

- Is sarcastic.
- Exaggerates.
- Contradicts himself.
- Uses figurative language.
- Loses emphasis by repetition.

How many pieces of equipment does Morel use in the most difficult feat described?

- Six
- Two
- Three
- Four
- Five

The second "it" in line 16 refers directly to

- Feat (line 14).
- Miracle (line 14).
- The first "it" in line 16.
- Unseen world (line 18).
- Everything (line 18).

Our wagonette topped a rise and before us lay a vast expanse of moor, mottled with gnarled and craggy cairns and tors. A cold wind swept over us. The road grew bleaker and wilder over huge russet and olive slopes sprinkled with giant boulders. We saw no one nor any human habitation.

The atmosphere of this region was one of

- Supernatural beauty.
- Wearisome monotony.
- Suppressed excitement.
- Hopeless despair.
- Desolation.

The passage suggest that the travelers

- Still had a considerable distance to go.
- Had reached their destination.
- Were lost.
- Were going over a familiar road.
- Had been overtaken by a storm.

(1) Most sponges are able to produce new
(2) individuals by regeneration, from pieces cut
(3) out of the old sponge. A biologist tried to find out just how
(4) much cutting up a sponge will stand and still be
(5) able to produce a normal individual. To break up
(6) the sponge as completely as possible without
(7) killing it, he tried to pull it apart with needles. This
(8) was not thorough enough, so he put about a gram
(9) of clean fresh sponge tissue in a small cloth bag
(10) under water and squeezed it. The structure of the
(11) sponge was completely masked and the softer
(12) portions were pushed out through the cloth's tiny
(13) pores. This sieve was so fine that to pass it the
(14) tissue had to break up into single cells. As they
(15) came through the bottom of the bag and fell
(16) through the water down to the surface of a glass
(17) plate, they looked like a small reddish cloud. Surely
(18) this was the ultimate in disintegration.

(19) But these cells were not dead they began to
(20) glide about and send out questing filaments. And
(21) now comes the most remarkable part. They did not
(22) cherish their new independence. When two
(23) approached and their filaments touched, they
(24) promptly fused. The two fused cells soon added a
(25) third, and then another and another, until the
(26) host of separate cells formed small round masses.
(27) Adjacent masses now fused, and finally the whole
(28) body of cells formed a single group.

(29) Soon in the mass the characteristic cellular
(30) differences appeared- outer layer, a middle layer,
(31) skeletal cells, etc. Whether, as a result of their
(32) drastic separation, all the cells revert to a
(33) primitive form from which any type of cell may later
(34) arise or whether they keep their original
(35) characters and assume their proper places in the new
(36) sponge is not certain. But the new whole is built
(37) by the spontaneous assembling of individual units,
(38) each of which develops into a cell characteristic
(39) of the particular place it happens to occupy. Like
(40) soldiers in a well-drilled company, when the bugle
(41) blows they assemble in orderly formation. In

(42) some way the structure of the whole sponge, with its
(43) specific pattern and cellular variety, is inherent in
(44) each individual cell.

The biologist (line 3) was investigating

- ○ Into how small bits a sponge can be separated.
- ○ From how small bits of a sponge tissue a new sponge will form.
- ○ Whether sponges formed by regeneration are like the parent sponge.
- ○ How quickly a new sponge will form from old tissue.
- ○ Whether single sponge cells can live.

According to the passage, an important conclusion from this experiment is that individual sponge cells.

- ○ Differ from one another.
- ○ Do not differ from one another.
- ○ Cannot be destroyed.
- ○ Have inherent in them the structure of the whole organism.
- ○ Can take on the characteristics of other types of cells.

It is not known whether when sponge cells are separated, they

- ○ Can still move about.
- ○ Maintain a spherical shape.
- ○ Lose their color.
- ○ Remain independent one-celled organisms
- ○ Retain their original character

The passage indicates that, if a sponge is pulled apart with needles,

- ○ It will disintegrate into a reddish cloud.
- ○ The bits of sponge will die.
- ○ New sponges will form by regeneration.
- ○ The cells will live as separate units.
- ○ The cells will lose their special characters.

In this experiment which of the steps listed below occurred first?

- ○ Passage of a reddish cloud through the water.
- ○ Fusing of masses of cells.
- ○ Appearance of cellular differences.
- ○ Sending out of filaments.
- ○ Separation into single cells.

Of the steps listed in the item above, which one occurred last?

- ○ Passage of a reddish cloud through the water.
- ○ Fusing of masses of cells.
- ○ Appearance of cellular differences.
- ○ Sending out of filaments.
- ○ Separation into single cells.

The writer likens an individual sponge cell to a

- ○ Tiny pore.
- ○ Small cloud.
- ○ Filament.
- ○ Soldier.
- ○ Well-drilled company.

Which of the following words suggests that he is for the moment, giving sponge-cells human attributes?

- ○ Produce (line 5)
- ○ Cherish (ling 22)
- ○ Touched (line 23)
- ○ Body (line 28)
- ○ Characters (lines 34-35)

(1) Greek and Roman societies were built on the
(2) concept of the subordination of the individual to
(3) the community, of the obligation of the citizen to
(4) the state; it set the safety of the commonwealth
(5) above the safety of individuals. Trained from

(6) infancy to these unselfish ideals, the citizens devoted
(7) their lives to public services and were ready to lay
(8) them down for the common good; or if they shrank
(9) from this it never occurred to them that they acted
(10) otherwise than basely in preferring their personal
(11) existence to the interests of their country.

(12) All of this was changed by the spread of Oriental
(13) religions that inculcated the communion of the soul
(14) with God and its eternal salvation as the only objects
(15) worth living for. The inevitable results of this
(16) selfish and immoral doctrine was to withdraw the
(17) devotee more and more from public service. A
(18) disintegration of the body politic set in; the ties of
(19) the state and the family were loosened and society
(20) tended to relapse into barbarism.

Which one of the following goals did Greek and Roman societies regard as most important?

- ○ Individual freedom
- ○ Eternal salvation
- ○ Personal welfare
- ○ Welfare of the state
- ○ Devotion to the gods

The writer criticizes

- ○ Greek and Roman Societies.
- ○ Public service.
- ○ Family ties.
- ○ Oriental religions.
- ○ Pagans ideals.

He regards the idea that eternal salvation for the soul is man's only objective as

- Praiseworthy.
- Unimportant.
- Unselfish
- Inevitable.
- Immoral.

"It" in line 4 refers to

- Concept (line 2).
- Subordination (line 2).
- Community (line 3).
- Obligation (line 3).
- State (line 4).

"Them" in line 8 refers to

- Individuals (line 5).
- Ideals (line 6).
- Citizens (line 6).
- Lives (line 7).
- Public services (line 7).

The "devotee" (line 17) was devoted to

- The safety of the commonwealth.
- Worldly pleasures.
- Religion.
- His family.
- Unselfish ideals.

One of the best-known Southern poets of the post-Civil War period was Sidney Lanier. Although excited by the intellectual ferment of the time, he never did any hard thinking about the philosophic problems raised by science and the machine. His plastic mind entertained all the faith-doubt conflicts of the nineteenth century; and, in contrast to Emily Dickinson, he had a lot to say about them. Whether he had anything important to say is another matter. Like Carlyle, whom he followed devotedly, he romanticized the conclusions of thinkers whom he could neither supplement nor contradict. He wailed a lot about "trade" but what does he offer as a cure except his misty personifications, his jargon of Love and Art?

Even his finest poem. "The Symphony," ends:

Any yet shall Love himself be heard,
Though long deferred, though long deferred;
O'er the modern waste a dove hath whirred.
Music is Love in search of a word.

Very pretty, but not worthy of a student of Wordsworth. Lanier's reactions toward the thinking of his time were always emotional. Only in his special fields of music and the craftsmanship of verse was he a constructive thinker.

The central thought of this passage is that Lanier

- ○ Was a great poet.
- ○ Lived in a world of his own.
- ○ Was not a great thinker.
- ○ Had something important to say.
- ○ Understood the relationship between poetry and music.

A reader disagreeing with the general tone of the passage might best point out that

- ○ Lanier had never met Emily Dickinson.
- ○ Lanier wrote other fine poems besides "The Symphony."
- ○ Lanier had no wish to contradict Carlyle.
- ○ Faith, doubt, love, and art are actually important subjects.
- ○ Thinking constructively in two important fields is a considerable achievement.

Which one of the following words would *not* be applied to Lanier by the writer of the passage?

- ○ Emotional
- ○ Independent
- ○ Vague
- ○ Romantic
- ○ Impressionable

The writer regards the lines he quotes from "The Symphony" as

- Among Lanier's finest.

Not very good.

- Inspiring.

Penetrating.

- Symbolic.

The passage indicates that Lanier wrote extensively about

- Religious problems.
- Southern poetry.
- Education.
- Carlyle.
- His own life.

A phrase used ironically is

- "Hard thinking."
- "Plastic mind."
- "Wailed a lot."
- "Misty personifications."
- "Very pretty."

STOP

Take a short break. You will continue to read and answer questions in 1 minute. Please do not leave your seat. Do not view any other web pages during this time. Laptops, cell phones, and other electronic devices should remain put away at this time.

Please put away any note sheets.

The page will advance when it is time to continue.

Appendix C

Topic Knowledge Test

Read each question and select the best answer.

What are attributions?

- ○ Feelings about current problems
- ○ Descriptions of the causes of past events
- ○ Predictions for future outcomes
- ○ Explanations of the motives for one's behavior

According to attribution theory, what influences students' desire to complete a task?

- ○ Their beliefs about the causes of previous successes and failures
- ○ Their estimations of the probability that they will be successful
- ○ Their beliefs about the potential benefits of completing the task
- ○ Their desires to be viewed as competent by their peers

Attributions are typically described in terms of three characteristics. Which of the following is one of the three characteristics used to describe attributions?

- ○ Utility
- ○ Locus
- ○ Strength
- ○ Accuracy

According to the expectancy-value theory, how do learners' expectancies influence behavior?

- ○ Students are more likely to complete a task when they feel confident in their abilities.
- ○ Students are more likely to complete a task when they believe it is worthwhile.
- ○ Students are more likely to complete a task if it presents a unique challenge.
- ○ Students are more likely to complete a task if they have been successful in previous attempts.

Which theory asserts that motivation is influenced by students' beliefs about their competencies and their attitudes toward a given task?

- ○ Achievement goal theory
- ○ Attribution theory
- ○ Self-determination theory
- ○ Expectancy-value theory

Which of the following is one of the four common attributions that students use?

- ○ Likelihood of success
- ○ Need for mastery
- ○ Difficulty of the task
- ○ Importance of the activity

According to the expectancy-value theory, which of the following values will predict motivation?

- ○ Mastery
- ○ Stability
- ○ Utility
- ○ Approval

What is self-efficacy?

- ○ Attitudes about one's self-image in relation to others
- ○ Feelings about one's capabilities and self-worth
- ○ Thoughts about one's capacity to manage his/her emotions
- ○ Beliefs about one's ability to carry out a specific task

Which of the following best describes students' with low self-efficacy in math?

- ○ They have difficulty solving math problems.
- ○ They do not believe that they are good students.
- ○ They think math is a challenging subject.
- ○ They do not feel confident about their math skills.

What is a student's self-efficacy most likely to influence?

- ○ Persistence on tasks
- ○ Level of self-esteem
- ○ Attitude towards school
- ○ Quality of task performance

Which of the following is most likely to cause low levels of self-efficacy in English?

- ○ Frequently receiving low grades on assignments and papers
- ○ Having few friends and difficulty working on group projects
- ○ Experiencing frequent difficulties in learning other subjects
- ○ Believing that English is boring and uninteresting

Which of the following statements best describes learned helplessness?

- ○ Students feel that they are failures in comparison to their peers
- ○ Students believe their successes and failures are determined by fate
- ○ Students think that they can only succeed with the help of others
- ○ Students assume they will fail in all future attempts

Students with learned helplessness are most likely to attribute failure on an exam to which of the following?

- ○ Poor study habits
- ○ Lack of ability
- ○ Fear of failure
- ○ Lack of effort

Which of the following views of ability is associated with learned helplessness?

- ○ Only talented people can improve their abilities.
- ○ With hard work and effort abilities can increase.
- ○ Abilities cannot be changed because they are innate.
- ○ Abilities are usually stable, but small increases can be made.

What do students with learned helplessness believe about their efforts?

- ○ That their efforts are connected to their successes and failures
- ○ That their efforts will have little impact on future success or failure
- ○ That their efforts are fixed and cannot change
- ○ That their efforts will decrease their likelihood for success

Appendix D

Inference Questions

Write an answer to each of the following questions. Answer the questions based upon your understanding of the text. Use complete sentences.

How do attributions cause students to give up without trying?

Why are students with histories of failure particularly susceptible to learned helplessness?

Why does training include counseling about students' effort?

Why do students with learned helplessness experience a decrease in motivation?

Why does motivation increase when student attribute failure to controllable causes like effort?

How might attributions influence achievement?

On which dimensions can effort and ability differ?

Appendix E

Informed Consent

Informed Consent

Informed Consent Form for Social Science Research
The Pennsylvania State University

Title of Project: Individual Differences in Deep Level Comprehension: Contributions of Reader and Text Characteristics

Principal Investigator: Melissa Ray, Graduate Student
225 CEDAR BUILDING
University Park, PA 16802
Email: mnr128@ psu.edu
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Advisor: Dr. Robert Stevens
202 CEDAR BUILDING (Mailing Location)
University Park, PA 16802
224 S. Allen Street (Physical Location)
State College, PA 16801
Email: rjs15@psu.edu
Phone: 814-863-2417

1. Purpose of the Study: The purpose of this research study is to examine college students' comprehension of education texts. It explores how students draw conclusions from text and how textual features impact student's ability to make inferences.

2. Procedures to be Followed: You will be asked to read texts and answer questions about your understanding. You will also be asked to answer questions about your knowledge of topics related to what you have read.

3. Duration/Time: It will take 60 minutes to read and answer questions.

4. Statement of Confidentiality: Confidentiality will be maintained to the degree permitted by the technology used. Specifically, no guarantees can be made regarding the interception of data sent via the Internet by any third parties. Your responses will be stored on a password protected database on the qualtrics.com site. Only the investigators will have access to them. You will be asked to supply your name at the end of the study. Your name will only be used to inform your instructor of your participation, so that you may receive extra credit. Your name will be stored separately from your answers to questions. Questions will not ask for any other information that would identify who the response belongs to. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared because your name is in no way linked to your responses.

5. Right to Ask Questions: Please contact Melissa Ray by emailing mnr128@psu.edu with questions or concerns about this research

6. Payment for Participation: For students in EDPSY 014, you will receive 6 extra credit points as compensation for your participation in this study. If you do not wish to participate, but would like to earn extra credit points, there is an alternative opportunity available. You can write a short response paper related to the content of the course. Please see your instructor for more specific information about this opportunity.

7. Voluntary Participation: Your decision to be in this research is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer.

You must be 18 years of age or older to take part in this research study. If you agree to take part in this research study and the information outlined above, please click on the "Yes" button below to indicate your consent to participate in this study.

Please print off this form to keep for your records.

Do you consent to participate in the study described above?

- ○ Yes
- ○ No

PENNSTATE

Vice President for Research
Office for Research Protections

The Pennsylvania State University
The 330 Building, Suite 205

Phone : (814) 865-1775
Fax: (814) 863-8699
Email : orprotections@psu.edu
Web : www.research.psu.edu/orp

Date:	November 09, 2012
From:	The Office for Research Protections - FWA#: FWA00001534 Stephanie L. Krout, Compliance Coordinator
To:	Melissa N. Ray
Re:	Determination of Exemption

IRB Protocol ID:	41517
Follow-up Date:	November 8, 2017
Title of Protocol:	Individual differences in deep level comprehension: The influence of text structure and reader characteristics

The Office for Research Protections (ORP) has received and reviewed the above referenced eSubmission application. It has been determined that your research is exempt from IRB initial and ongoing review, as currently described in the application. You may begin your research. The category within the federal regulations under which your research is exempt is:

45 CFR 46.101(b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Given that the IRB is not involved in the initial and ongoing review of this research, it is the investigator's responsibility to review IRB Policy III "Exempt Review Process and Determination" which outlines:

- What it means to be exempt and how determinations are made
- What changes to the research protocol are and are not required to be reported to the ORP
- Ongoing actions post-exemption determination including addressing problems and complaints, reporting closed research to the ORP and research audits
- What occurs at the time of follow-up

Please do not hesitate to contact the Office for Research Protections (ORP) if you have any questions or concerns. Thank you for your continued efforts in protecting human participants in research.

This correspondence should be maintained with your research records.

Appendix F

Background Questionnaire

Please answer each question to the best of your ability. You may skip any questions that you do not wish to answer.

Sex/Gender:

- ○ Male
- ○ Female

Age:

- ○ 17 and younger
- ○ 18-20
- ○ 21-25
- ○ 26-35
- ○ 36-45
- ○ 46-55
- ○ 56 and older

Year at Penn State:

- ○ 1st
- ○ 2nd
- ○ 3rd
- ○ 4th
- ○ 5th
- ○ Other

Academic Status at Penn State:

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior

Is English your primary/first language?

- ○ Yes
- ○ No

College/Department:

Major:

SAT Total Score:

SAT Critical Reading Score:

College GPA:

Education courses you are taking/have previously taken:

Psychology/Human Development courses you are taking/have previously taken:

Have you ever taught a class or tutored before?

- ○ Yes
- ○ No

If you answered yes, please describe.

Appendix G

Content Structures

Problem-and-Solution Content Structure

```
1   response
2   problem
3   causation: covariance, consequent
4   causation: covariance, antecedent
5   LEARNED HELPLESSNESS
6     description: equivalent
7     IS THE GENERAL BELIEF
8                 description: attribute
9                 collection
10                IS INCAPALE OF ACCOMPLISHING
11                  agent
12                  ONE
13                  patient
14                  TASKS
15                HAS LITTLE CONTROL
16                  patient
17                  ENVIRONMENT
18                causation: explanation
19                BASED ON PAST EXPERIENCES
20    description: attribute
21    collection
22    RELEVANT
23                patient
24                collection
25                LEARNING
26                MOTIVATION
27    HAS
28                patient
29                COMPONENT
30                  description: attribute
31                  collection
32                  EMOTIONAL
33                        description: attribute
34                        SUFFER
```

35 patient
36 collection
37 ANXIETY
38 DEPRESSION
39 description: manner
40 OFTEN
41 COGNITIVE
42 description: attribute
43 causation: covariance, antecendent
44 collection
45 EXPECT TO FAIL
46 ATTRIBUTE FAILURE
47 range
48 TO LACK OF ABILITY
49 causation: covariance, consequent
50 causation: covariance, antecendent
51 collection
52 EXERT
53 patient
54 LITTLE EFFORT
55 USE
56 patient
57 INEFFECTIVE STRATEGIES
58 causation: covariance, consequent
59 RESULTS IN
60 patient
61 collection
62 LESS SUCCESS
63 EXPECTATION OF FAUILRE
64 description: attribute
65 EVEN GREATER
66 ARE PARTICULARLY SUSCEPTIBLE
67 range
68 TO LEARNED HELPLESSNESS
69 agent
70 STUDENT
71 description: attribute
72 HAVE
73 patient
74 HISTORIES OF FAILURE
75 causation: covariance, consequent

```
76  RESULTS
77     force
78     THIS PERSPECTIVE
79     patient
80     collection
81     OVERWHELMING FEELINGS OF SHAME
82     SELF- DOUBT
83     causation: covariance, antecedent
84     GIVING UP
85                 range
86                 WITHOUT TRYING
87     causation: covariance, consequent
88     LEAD TO DIFFICULTIES
89                 range
90                 IN LEARNING
91  causation: covariance, antecedent
92  collection
93  CAN LEAD TO
94     patient
95     LEARNED HELPLESSNESS
96     agent
97     STUDENTS' ATTRIBUTIONS
98                 description: equivalent
99                 ARE CREATED EXPLANATIONS (PERCEIVED CAUSES)
100                   description:  attribute
101                   collection
102                   SUCESSES
103                   FAILURES
104                description: attribute
105                collection
106                ATTRIBUTE
107                   agent
108                   LEARNERS
109                   patient
110                   collection
111                   SUCCESS
112                   FAILURE
113                   range
114                   TO SEVERAL FACTORS
115                         description: constituency identification
116                         collection
```

```
117                 ABILITY
118                 EFFORT
119                 LUCK
120                 DIFFICULTY OF TASK
121         OCCUR
122           range
123           ON THREE DIMENSIONS
124           description: constituency identification
125           collection
126           LOCUS
127                 description: equivalent
128                 REFERS
129                       patient
130                       LOCATION OF CAUSE
131                                 description: location
132                                 collection
133                                 WITHIN
134                                 OUTSIDE THE LEARNER
135                 description: specific
136                 comparison: alternative
137                 ARE WITHIN THE LEARNER
138                       patient
139                       collection
140                       ABILITY
141                       EFFORT
142                 comparison: alternative
143                 ARE OUTSIDE of the LEARNER
144                       patient
145                       collection
146                       LUCK
147                       TASK DIFFICULTY
148           STABILITY
149                 description: equivalent
150                 REFERS TO
151                       patient
152                       WHETHER CAUSE CAN CHANGE
153                 description: specific
154                 ARE UNSTABLE
155                       patient
156                       collection
157                       EFFORT
```

158 LUCK
159 causation: explanation
160 CAN CHANGE
161 comparison: adversative
162 IS CONSIDERED STABLE
163 patient
164 ABILITY
165 CONTROL
166 description: equivalent
167 IS THE EXENT TO WHICH ACCEPT
168 agent
169 STUDENTS
170 patient
171 RESPONSIBILITY
172 range
173 FOR SUCESSES OR FAILURES
174 ARE IN CONTROL
175 patient
176 LEARNING SITUATION
177 description: attribute
178 CONTROL
179 agent
180 LEARNERS
181 patient
182 EFFORTS
183 comparison: adversative
184 CANNOT CONTROL
185 patient
186 collection
187 LUCK
188 TASK DIFFICULTY
189 INFLUENCE
190 force
191 ATTRIBUTIONS
192 patient
193 LEARNING
194 description: manner
195 FOUR WAYS
196 description: constituency indentification
197 IMPACT
198 patient

```
                                collection
                                 STUDENTS EMOTIONAL REACTIONS TO
                                SUCCESS and FAILURE
                                EXPECTATIONS FOR FUTURE SUCCESS
                                FUTURE EFFORT
                                ACHIEVEMENT
                    description: specific
                    comparison: alternative
                    TENDS TO INCREASE
                        agent
                        MOTIVATION
                        description: time
                        ATTRIBUTE
                                agent
                                STUDENT
                                patient
                                FAILURE
                                range
                                TO LACK OF EFFORT
                        causation: explanation
                        CONTROL
                                patient
                                EFFORT
                    comparison: alternative
                    TENDS TO DECREASE
                        description: time
                        ATTRIBUTE
                                agent
                                STUDENT
                                patient
                                FAILURE
                                range
                                TO UNCONTROLLABLE CAUSES
                                        description: specific
                                        collection
                                        LUCK
                                        STABLE ABILITY
ATTRIBUTING
  patient
  FAILURE
  range
```

```
    LACK OF ABILITY
                description: attribute
                VIEWED AS UNCONTROLLABLE
    description: specific
    BEGIN TO EXPECT FAILURE
                range
                IN ALL FUTURE ATTEMPTS
                description: time
                collection
                EXPERIENCE FAILURE
                   desciption: manner
                   FREQUENTLY
                ATTRIBUTE TO LACK OF ABILITY
                   patient
                   THESE FAILURES
solution
ATTRIBUTION TRAINING
    description: attribute
    CAN IMPROVE
                agent
                STUDENTS EXPERIENCING LEARNED HELPLESSNESS
                patient
                EFFECTIVENESS OF THEIR ATTRIBUTIONS
    description: specific
    causation: covariance, antecedent
    PROVIDED
                agent
                collection
                DWECK (1975)
                PIONEERING STUDY
                benafactive
                STUDENTS
                   description: attribute
                   WITH LEARNED HELPLESSNESS
                patient
                EXPERIENCES
                   description: attribution
                   collection
                   SUCCESSFUL
                   UNSUCCESSFUL
                description: manner
```

```
                SPECIFICALLY STATED
                  description: attribute
                  WAS CAUSED BY
                        patient
                        FAILURE
                        agent
                        collection
                        LACK OF EFFORT
                        INEFFECTIVE STRATEGIES
                  description: time
                  WERE UNSUCESSFUL
                        patient
                        STUDENTS
                  comparison: adversative
                  DID NOT RECEIVE TRAINING
                        patient
                        COMPARABLE STUDENTS
                              description: attribute
                              HAD
                                          patient
                                          SIMILAR EXPERIENCE
causation: covariance, consequent
collection
RESPONDED MORE APPROPRIATELY
              range
              TO FAILURE
              agent
              LEARNERS
                description: attribute
                COUNSELED ABOUT
                      description :attribute
                      collection
                      EFFORT
                      STRATEGIES
              description: time
              AFTER 25 SESSIONS
PERSISTED LONGER
ADAPTED MORE EFFECTIVELY
              patient
              THEIR STRATEGIES
comparative: alternative
```

```
CORROBORATED
        agent
        SUBSEQUENT RESEARCH
        patient
        DWECK'S FINDINGS
SUGGESTS
        patient
        RESEARCH
        description: attribute
        collection
        ELIMINATE
          patient
          LEARNED HELPLESSNESS
        CAN INCREASE
          agent
          TEACHERS
          patient
          STUDENTS' MOTIVATIONTO LEARN
          description: manner
          collection
          TEACHING
              benefactive
              THEM
              patient
              LEARNING STRATEGIES
          ENCOURAGING
              benefactive
              THEM
              patient
              TO ATTRIBUTE
                  patient
                  SUCCESS
                  range
                  TO EFFORT
```

Listing of Description Content Structure

```
1   description
2   ATTRIBUTIONS
3       description: equivalent
4       ARE CREATED EXPLANATIONS (PERCEIVED CAUSES)
5           description: attribute
6           collection
7           SUCESSES
8           FAILURES
9       description: attribute
10      collection
11      RELEVANT
12          patient
13          collection
14          LEARNING
15          MOTIVATION
16      ATTRIBUTE
17          agent
18          LEARNERS
19          patient
20          collection
21          SUCCESS
22          FAILURE
23          range
24          TO SEVERAL FACTORS
25              description: constituency identification
26              collection
27              ABILITY
28              EFFORT
29              LUCK
30              DIFFICULTY OF TASK
31      OCCUR
32          range
33          ON THREE DIMENSION
34          description: constituency identification
35          collection
36          LOCUS
37              description: equivalent
38              REFERS
39                  patient
40                  LOCATION OF CAUSE
```

```
41                          description: location
42                          collection
43                          WITHIN
44                          OUTSIDE THE LEARNER
45                  description: specific
46                  comparison: alternative
47                  ARE WITHIN THE LEARNER
48                      patient
49                      collection
50                      ABILITY
51                      EFFORT
52                  comparison: alternative
53                  ARE OUTSIDE OF THE LEARNER
54                      patient
55                      collection
56                      LUCK
57                      TASK DIFFICULTY
58              STABILITY
59                  description: equivalent
60                  REFERS TO
61                      patient
62                      WHETHER CAUSE CAN CHANGE
63                  description: specific
64                  ARE UNSTABLE
65                      patient
66                      collection
67                      EFFORT
68                      LUCK
69                      causation: explanation
70                      CAN CHANGE
71                      comparison: adversative
72                      IS CONSIDERED STABLE
73                          patient
74                          ABILITY
75              CONTROL
76                  description: equivalent
77                  IS THE EXENT TO WHICH ACCEPT
78                      agent
79                      STUDENTS
80                      patient
81                      RESPONSIBILITY
```

```
82                          range
83                          FOR SUCESSES OR FAILURES
84                  ARE IN CONTROL
85                          patient
86                          LEARNING SITUATION
87                  description: attribute
88                  CONTROL
89                          agent
90                          LEARNERS
91                          patient
92                          EFFORTS
93                          comparison: adversative
94                          CANNOT CONTROL
95                                  patient
96                                  collection
97                                  LUCK
98                                  TASK DIFFICULTY
99  TRAINING
100     description: attribute
101     CAN IMPROVE
102         agent
103         LEARNERS
104         patient
105         EFFECTIVENESS OF THEIR ATTRIBUTIONS
106     description: specific
107     causation: covariance, antecedent
108     PROVIDED
109         agent
110         collection
111         DWECK (1975)
112         PIONEERING STUDY
113         benafactive
114         STUDENTS
115             description: attribute
116             WITH LEARNED HELPLESSNESS
117         patient
118         EXPERIENCE
119             description: attribution
120             collection
121             SUCCESSFUL
122             UNSUCCESSFUL
```

```
123             description: manner
124             SPECIFICALLY STATED
125                 description: attribute
126                 WAS CAUSED BY
127                     patient
128                     FAILURE
129                     agent
130                     collection
131                     LACK OF EFFORT
132                     INEFFECTIVE STRATEGIES
133                 description: time
134                 WERE UNSUCESSFUL
135                     patient
136                     STUDENTS
137                 comparison: adversative
138                 DID NOT RECEIVE TRAINING
139                     patient
140                     COMPARABLE STUDENTS
141                         description: attribute
142                         HAD
143                             patient
144                             SIMILAR EXPERIENCE
145         causation: covariance, consequent
146         collection
147         RESPONDED MORE APPROPRIATELY
148             range
149             TO FAILURE
150             agent
151             LEARNERS
152                 description: attribute
153                 COUNSELED ABOUT
154                     description: attribute
155                     collection
156                     EFFORT
157                     STRATEGIES
158             description: time
159             AFTER 25 SESSIONS
160         PERSISTED LONGER
161         ADAPTED MORE EFFECTIVELY
162             patient
163             THEIR STRATEGIES
```

```
164         comparative: alternative
165         CORROBORATED
166             agent
167             SUBSEQUENT RESEARCH
168             patient
169             DWECK'S FINDINGS
170         SUGGESTS
171             patient
172             RESEARCH
173             description: attribute
174             CAN INCREASE
175                 agent
176                 TEACHERS
177                 patient
178                 STUDENTS' MOTIVATION TO LEARN
179                 description: manner
180                 collection
181                 TEACHING
182                     benefactive
183                     THEM
184                     patient
185                     LEARNING STRATEGIES
186                 ENCOURAGING
187                     benefactive
188                     THEM
189                     patient
190                     TO ATTRIBUTE
191                         patient
192                         SUCCESS
193                         range
194                         TO EFFORT
195 ATTRIBUTIONS
196         description: attribution
197         INFLUENCE
198             patient
199             LEARNING
200             description: manner
201             FOUR WAYS
202                 description: constituency identification
203                 IMPACT
204                     patient
```

```
                    collection
                    STUDENTS 'EMOTIONAL REACTIONS TO SUCCESS
                    and FAILURE
                    EXPECTATIONS FOR FUTURE SUCCESS
                    FUTURE EFFORT
                    ACHIEVEMENT
          description: specific
          comparison: alternative
          TENDS TO INCREASE
               agent
               MOTIVATION
               description: time
               ATTRIBUTE
                    agent
                    STUDENT
                    patient
                    FAILURE
                    range
                    TO LACK OF EFFORT
               causation: explanation
               CONTROL
                    patient
                    EFFORT
          comparison: alternative
          TENDS TO DECREASE
               description: time
               ATTRIBUTE
                    agent
                    STUDENT
                    patient
                    FAILURE
                    range
                    TO UNCONTROLLABLE CAUSES
                         description: specific
                         collection
                         LUCK
                         STABLE ABILITY
causation: covariance, antecedent
causation: covariance, consequent
LEARNED HELPLESSNESS
     description: equivalent
     IS THE GENERAL BELIEF
```

```
246             description: attribute
247             collection
248             IS INCAPALE of ACCOMPLISHING
249                 agent
250                 ONE
251                 patient
252                 TASKS
253             HAS LITTLE CONTROL
254                 patient
255                 ENVIRONMENT
256             causation: explanation
257             BASED ON PAST EXPERIENCES
258 causation: covariance, consequent
259 RESULTS
260     force
261     THIS PERSPECTIVE
262     patient
263     collection
264     OVERWHELMING FEELINGS OF SHAME
265     SELF- DOUBT
266     causation: covariance, antecedent
267     GIVING UP
268         range
269         WITHOUT TRYING
270     causation: covariance, consequent
271     LEAD TO DIFFICULTIES
272         range
273         IN LEARNING
274 causation: covariance, antecedent
275 ATTRIBUTING
276     patient
277     FAILURE
278     range
279     LACK OF ABILITY
280         description: attribute
281         VIEWED AS UNCONTROLLABLE
282     description: specific
283     BEGIN to EXPECT FAILURE
284         range
285         IN ALL FUTURE ATTEMPTS
286         description: time
```

```
287             collection
288             EXPERIENCE FAILURE
289                 description: manner
290                 FREQUENTLY
291             ATTRIBUTE TO LACK OF ABILITY
292                 patient
293                 THESE FAILURES
294         description: attribute
295         collection
296         CLOSELY RELATED
297             range
298             ATTRIBUTIONS
299         DEVELOP
300             range
301             IN EXTREME CIRCUMSTANCES
302         HAS
303             patient
304             COMPONENT
305                 description: attribute
306                 collection
307                 EMOTIONAL
308                     description: attribute
309                     SUFFER
310                         patient
311                         collection
312                         ANXIETY
313                         DEPRESSION
314                         description: manner
315                         OFTEN
316                 COGNITIVE
317                     description: attribute
318                     causation: covariance, antecedent
319                     collection
320                     EXPECT TO FAIL
321                     ATTRIBUTE FAILURE
322                         range
323                         TO LACK OF ABILITY
324                     causation: covariance, consequent
325                     causation: covariance, antecedent
326                     collection
327                     EXERT
```

```
                                patient
                                LITTLE EFFORT
                        USE
                                patient
                                INEFFECTIVE STRATEGIES
                        causation: covariance, consequent
                        RESULTS IN
                                patient
                                collection
                                LESS SUCCESS
                                EXPECTATION OF FAUILRE
                                        description: attribute
                                        EVEN GREATER
ARE PARTICULARLY SUSCEPTIBLE
    range
    TO LEARNED HELPLESSNESS
    agent
    STUDENT
        description :attribute
        HAVE
            patient
            HISTORIES OF FAILURE
```

Appendix H

Scoring Rubric Inferences

Question #	Question	Key Answer (must contain bolded portions)	Text Premise	Additional Text Support
1	How do attributions cause students to give up without trying?	Attributions cause students to giving up without trying **(1) because they affect students' expectations for failure.** Specifically (2) **attributing failure to lack of ability causes learned helplessness**. Students with **learned helplessness** (3) **give up without trying because they feel expect that they won't succeed/ or will** fail. *uncontrollable, internal cause **Also accept the specific definition of helplessness as a substitutions (one is incapable of accomplishing tasks) Need 1 + 3 or 2 + 3	Learned helplessness may also cause students to give up without trying, Cognitively, they expect to fail and attribute their failure to lack of ability. As a result, they exert little effort and use ineffective strategies, which results in less success and an even greater expectation for failure **Students' attributions can lead to learned helplessness* Attributing failure to lack of ability, which can be viewed as uncontrollable, may lead to learned	Motivation tends to increase when students attribute failure to lack of effort because effort can be controlled. It tends to decrease when students attribute failure to uncontrollable causes (e.g. luck, ability if it is viewed as stable).

			helplessness. When students frequently experience failure and attribute these failures to lack of ability, they may begin to expect failure in all future attempts.	

Scoring Notes for Question 1:

1. In order to get full credit for the inference, they need to have **low expectancy for success/ high expectancy for failure/ learned helplessness** leads to **giving up without trying** AND one of the following
    a. Attributions affect students' expectancies for failure
    b. Attributions can lead to learned helplessness
    c. Attributing failure to lack of ability leads to learned helplessness
2. If they have only one part, score as 4.
3. If they just mention learned helplessness (feeling incapable/can't do anything) with no link to giving up, then score as 3.

Question #	Question	Key Answer (must contain bolded portions)	Text Premise	Additional Text Support
2	Why are students with histories of failure particularly susceptible to learned helplessness?	Learned helplessness is associated with (1) **past repeated failure**. Students with histories of failure may (2a) **experience frequent failure** and as a result are (2b) **more likely to believe that their failure is related to lack of ability**, which may place them at a greater risk for developing learned helplessness (2a and 2b) Must have 1 +2a or 2a +2b	Learned helplessness is the general belief, based on past experiences, that one is incapable of accomplishing tasks and has little control of the environment. Students who have histories of failure are particularly susceptible to learned helplessness. Attributing failure to lack of ability, which can be viewed as uncontrollable, may lead to learned helplessness. When students frequently experience failure and attribute these failures to lack of ability, they may begin to expect failure in all future attempts.	Cognitively, they expect to fail and attribute their failure to lack of ability. As a result, they exert little effort and use ineffective strategies, which results in less success and an even greater expectation for failure.

Score Notes for Question 2:

1. In order to get credit for the inference need to mention:
    a. Learned helplessness is cause by past failure + people with history of failure have repeated failures
    b. People with history of failure have experience have repeated failure + more likely to attribute failure to lack of ability
2. If they have only one in the pair score as 4.
3. If the student just mentions that the person thinks he/she won't succeed (expect to fail) score as 3.
4. Need to mention something about lack of ability to get a 4.
5. If they just mention that ability can't be changed, score as 3
6. If they just mention anxiety and depression alone, score as 2.

Question #	Question	Key Answer (must contain bolded portions unless stated otherwise)	Text Premise	Additional Text Support
3	Why does training include counseling about students' effort?	The goal of training is (1) to **change students' attributions from a detrimental attribution to a beneficial attribution (OR** *change from ability to effort***)**. (2a)**Effort is a more beneficial attribution** because it is associated with increases in motivation/persistence/strategy use, (2b) **while ability is a detrimental attribution** because it is associated with learned helplessness/decreases in motivation. Training in efforts is needed because students with (3) **learned helplessness are less likely to attribute failure to lack of effort (OR** *training in effort can reduce learned helplessness***s)**. (must contain either 1& 3 1& 2a & 2b 2a&3	Students can improve the effectiveness of their attributions through training. When students were unsuccessful, the experimenter specifically stated that the failure was caused by a lack of effort or ineffective strategies. After 25 sessions, the learners who were counseled about their effort and strategies responded more appropriately to failure. When confronted by failure, they persisted longer and adapted their strategies	In a pioneering study, Dweck (1975) provided students with learned helplessness with both successful and unsuccessful experiences. Comparable students had similar experiences, but they did not receive training. Subsequent research has corroborated Dwecks' findings. This research suggests that teachers can increase students' motivation to learn by teaching them learning strategies and encouraging them to attribute success to

			more effectively. Motivation tends to increase when students attribute failure to lack of effort because effort can be controlled. It tends to decrease when students attribute failure to uncontrollable causes (e.g. luck, ability if it is viewed as stable). Attributing failure to lack of ability, which can be viewed as uncontrollable, could lead to this debilitating strategy (learned helplessness).	effort. Learned helplessness is the general belief, based on past experiences, that one is incapable of accomplishing tasks and has little control of the environment. When students frequently experience failure and attribute these failures to lack of ability, they may begin to expect failure in all future attempts. Cognitively, they expect to fail and attribute their failure to lack of ability. As a result, they exert little effort and use ineffective strategies, which results in less success and an even greater expectation

				for failure.

Scoring Notes Question 3:

1. In order to get credit for the inference, the student must include the following combination
   a. 1 & 3 (change from ability to effort + students' with learned helpless less likely to attribute to effort)
   b. 1 & 2a & 2b (change from ability to effort + effort is associated with increases in motivation+ ability associated with decreases in motivation)
   c. 2a &3 (effort is associated with increases in motivation + students' with learned helplessness less likely to attribute to effort)

   The basic idea is that by changing from attributions from ability to effort, you reduce learned helplessness

2. Description of attributes with no mention of motivation, score as 2.
3. If they talk about the benefits of training (increase motivation/decreasing learned helplessness) without mentioning effort/ability, score as 3
4. Students can receive partial credit (4) for
   a. Changing from ability to effort
   b. Attributing to effort decreases learned helplessness
   c. Attributing to effort increases motivation/persistence

Question #	Question	Key Answer (must contain bolded unless stated otherwise)	Text Premise	Additional Text Support
4	Why do students with learned helplessness experience a decrease in motivation?	(1) Students with learned helplessness experience a decrease in motivation because they often **attribute failure to a lack of ability**. (2a) **Attributing failure to lack of ability may be associated with decreases** in motivation when ability is seen as **uncontrollable**. (2b) Students with learned helplessness **do not belief that they can control their abilities**. (3) **They believe that all of their attempts will result in failure, as a result,** their motivation decreases (desire to put in effort/try harder). Must have 1 & 3 (a or b) 2& 3	Learned helplessness is the general belief, based on past experiences, that one is incapable of accomplishing tasks and has little control of the environment. Learned helplessness may also cause students to give up without trying Cognitively, they expect to fail and attribute their failure to lack of ability. As a result, they exert little effort and use ineffective strategies… Attributing failure to lack of ability, which can be viewed as uncontrollable, may lead to learned helplessness (this debilitating strategy). (Motivation) tends to decrease	This perspective (learned helplessness) results in overwhelming feelings of self-doubt. …, which in turn, may lead to difficulties in learning. … which results in less success and an even greater expectation for failure. When students frequently experience failure and attribute these failures to lack of ability, they may begin to expect failure in all future attempts. Effort and luck are unstable because they can change, whereas ability is considered stable in attribution

			when students attribute failure to uncontrollable causes (e.g. ~~luck,~~ ability if it is viewed as stable).	theory

Scoring Notes Question 4:

1. In order to get full credit for the inference, the reader has to have 1) attributing failure to lack of ability AND expect to fail, 2) belief that ability is uncontrollable AND expect failure in all future attempts.
2. In order to get partial credit (4), the student has to have either
    a. Expectation of failure
    b. Ability is uncontrollable
    c. **Attribute failure** to lack of ability
3. If they mention uncontrollable factors lead to expectancies of failure, with not mention of ability, score as 3.
4. If the response is primarily about external attribution of luck, score as a 2.
5. If a student response is primarily about actively trying to avoid failure, score as a 1.
6. If depression, anxiety, self-esteem are presented as the cause of low motivation, score as 2

Question #	Question	Key Answer (must contain bolded unless stated otherwise)	Text Premise	Additional Text Support
5	Why does motivation increase when student attribute failure to controllable causes like effort?	Motivation increases when students attribute failure to controllable causes like effort because **(1) students believe that they can change their outcomes (success/failure) by managing their efforts.** **(2) If students believe that they can change their efforts, then may be more likely to try hard the next time**. This may in turn lead to greater motivation. Must have 1 and 2.	Control is the extent to which students accept responsibility for their successes or failures, or are in control of the learning situation. Learners can control their efforts, but they cannot control luck or task difficulty. Attributions influence learning in four ways. Attributions impact students' emotional reactions to success and failure, expectations for future success, future effort, and achievement. Motivation tends to increase when students attribute failure to lack of effort because effort can be controlled. After 25 sessions, the learners who	Stability refers to whether or not the cause can change. Effort and luck are unstable because they can change, whereas ability is considered stable in attribution theory. The third dimension is control. It tends to decrease when students attribute failure to uncontrollable causes (e.g. luck, ability if it is viewed as stable).

			were counseled about their effort and strategies responded more appropriately to failure. When confronted by failure, they persisted longer and adapted their strategies more effectively.	

Scoring Notes for Questions 5

1. In order to get credit for inference, students need to mention 1) that they believe can control the outcome (success/failure/results) preferable by something they can do (efforts), AND 2) that they are more likely to try harder (or increase their efforts)
2. If students just talk about learned helplessness, score as 2.
3. If they just describe what a controllable attribution is, score as 3.
4. If they just mention that effort (or controlling effort) attributions increase motivation, score as 3.

Question #	Question	Key Answer (must contain bolded unless stated otherwise)	Text Premise	Additional Text Support
6	How might attributions influence achievement?	Attributions may affect learning and achievement (1) **through motivation and strategy use**. If students (2) **attribute failures/success to their efforts, they may try harder (increase motivation)/ try to adapt their strategies** because effort is often viewed as a **controllable** attribution. Increases **(3) persistence and strategy use may be associated with increases in learning and achievement**. OR Attributions may affect learning and achievement (1) **through motivation and strategy use**. If students (2) **attribute failures/success to their lack of ability, they may not try hard (decrease motivation) and may use less**	Attributions influence learning in four ways. Attributions impact students' emotional reactions to success and failure, expectations for future success, future effort, and achievement. Motivation tends to increase when students attribute failure to lack of effort because effort can be controlled. It tends to decrease when students attribute failure to uncontrollable causes (e.g. luck, ability if it is viewed as stable). After 25 sessions, the learners who were counseled about their effort and strategies responded more appropriately to failure… they persisted longer	Control is the extent to which students accept responsibility for their successes or failures, or are in control of the learning situation. Learners can control their efforts, but they cannot control luck or task difficulty. Attributing failure to lack of ability, which can be viewed as uncontrollable, Cognitively, they expect to fail and attribute their failure to lack of ability. As a result, they exert little effort and use ineffective strategies, which results in less success and an even greater expectation for failure. When students frequently experience failure and attribute these failures to lack of ability, they may

		effective strategies when facing difficulty. This is because ability is often viewed as an **uncontrollable** attribution, which can lead to learned helplessness. Decreases in **(3) persistence and strategy use may be associated with decreases in learning and achievement**. Must have 1 & 3 or 2 & 3	… research suggests that teachers can increase students' motivation to learn by teaching them learning strategies and encouraging them attribute success to effort	begin to expect failure in all future attempts.

Scoring Question 6 Notes:

1. In order to get a 5 or above, the student must have the attribution influence motivation (trying) AND that increase in motivation/trying/persistence are associated with increases in achievement. If only one is present, score as 4.
2. If students refer to a specific attribution and increases in trying (working hard, putting in more effort, increases in motivation), they must have **one** of the following to get credit towards the inference:
    a. Attributing failure/success to effort can increase trying
    b. Attributing failure/success to ability can decrease trying
    c. Attributing failure/success to controllable causes can increase trying
    d. Attributing failure/success to uncontrollable causes can decrease trying
3. If a student mentions attribution to luck and difficulty but doesn't mention that these are uncontrollable attribution, do not towards inference.
4. If students just define what attribution are score as 2
5. If students basically restate the questions, score as 3.
6. If they mention attributing to efforts (or controllable causes) increases achievement but don't mention changes motivation, score as 3.
7. If the student mentions good/positive or bad/negative attribution with no further correct explanation, count as incorrect.

Question #	Question	Key Answer (must contain bolded unless stated otherwise)	Text Premise	Additional Text Support
7	On which dimensions can effort and ability differ?	Effort and ability **differ on two dimension, (1) stability and (2) control**. Ability is considered stable and uncontrollable, while effort is considered unstable and controllable.	Stability refers to whether or not the cause can change. Effort and luck are unstable because they can change, whereas ability is considered stable in attribution theory. Control is the extent to which students accept responsibility for their successes or failures, or are in control of the learning situation. Learners can control their efforts, but they cannot control luck or task difficulty.	Attributions occur on three dimensions. Attributions occur on three dimensions. Locus refers to the location of the cause, which is either within or outside of the learner. For example, ability and effort are within the learner. Attributions are created explanations (perceived causes) for individuals' successes and failures. Learners attribute success and failures to several factors including: ability, effort, luck, and difficulty of the task.

Scoring Question 7 Notes:

1. If just mention what ability is (talent, skills) and what efforts are (actions people take) score as 2. They need to provide a clear definition about what they are (either ability and/ or efforts).
2. If they mention the correct answer, but don't include them as phrase/sentence, score as 1.
3. If they just discuss the inverse relationship between ability and effort (e.g. more ability- need less effort), or mention that effort increases (or doesn't increase) ability score as 1.
4. Incomplete comparisons, in which one a characteristics of one (ability and effort) is describe but not really compared to the other attribute are 3
5. If only one dimension of contrast is mentioned, score as a 4 (need indicate that the two attribute are different)

Appendix I
Revised Rubrics: Questions 1 and 6

Questions 1: How do attributions lead to students giving up without trying?

Ideal Answer:
Attributions cause students to giving up without trying because **attributing failure to lack of ability causes learned helplessness****. Students with learned helplessness (3) **give up without trying because they feel that they can't succeed/ or will fail**.

Score	Description	Acceptable Paraphrases/Notes
7	Score of 7 with additional text-based explanation	
6	Score of 5 with additional explanation	
5	1. Attributions in general lead to learned helplessness, and that the feelings of helplessness** lead students to give up. 2. Attributing failure to lack of ability causes helplessness, and the feelings of helplessness** cause students to give up	****Learned helplessness**: believe that they are incapable, think they can't be successful, believe they will fail, expect that they will fail, don't think they will succeed, don't think they can complete. **Attributions/attribute:** blame failure on, think failure was caused by, think failure comes from, think they failed because, believe failure was caused by, believe success is caused by
4	1. Attributions in general lead to students feel learned helplessness. 2. Attributing failure to lack of ability leads to learned helplessness. 3. Students who have learned helplessness (see paraphrases) give up without trying.	
3	Recalls or paraphrases one of the following: 1. Ability can be viewed as uncontrollable or stable 2. Students with learned helplessness exert little effort, and use ineffective strategies. 3. Student with learned helplessness feel like they have no	**Score when it's not linked to attributions or giving up without trying (if they don't mention giving up in the response) *score if not linked to a feeling of helplessness

	control of the environment. 4. **Students with learning helplessness feel like they are incapable of accomplishing a task 5. Students frequently experience failure/ have less success. 6. Motivation tends to increase when students **attribute** failure to lack of effort. 7. Effort is viewed as controllable. 8. Motivation tends to decrease when students **attribute** failure to uncontrollable causes. 9. Attribute to uncontrollable causes 10. **They expect to fail 11. Attribute their failure to lack of ability 12. *Giving up without trying	
2	Recalls something else from text (not in 3). Should be a verbatim recall or close paraphrase. Mentions that attributing failure to luck or task difficulty of external causes, leads to giving up without trying	

	(doesn't mention helplessness).	
1	Incorrect response that does not contain a correct recall of text information	

Question 6: How might attributions influence achievement?

Answer Key

Attributions may affect learning and achievement (1) **through motivation**. If students (2) **attribute failures/success to their efforts, they may try harder (increase in motivation).** Increases **(3) in trying and may be associated with increases in learning and achievement**.

OR

Attributions may affect learning and achievement (1) **through motivation**. If students (2) **attribute failures/success to their lack of ability, they may not try hard (decrease motivation)**. This is because ability is often viewed as an uncontrollable attribution, which can lead to learned helplessness. Decreases in **(3) trying may be associated with decreases in learning and achievement**.

Score	Description	Paraphrases/ Notes
7	Score of 5 with additional text-based support	
6	Score of 5 with additional extra-text support	
5	Attributions affect motivation, and increases or decreases in motivation may affect achievement Attributing failure to effort (controllable cause) is associated with increases in trying, and increases in trying may lead to higher achievement Attributing failure to ability (uncontrollable cause) may be associated with decreases in trying, decreases in trying may lead to lower achievement	**Increases in trying:** put forth more effort, try harder, increase efforts, persistent longer, keep working, work harder, change efforts, change strategies **Decreases in trying:** exert little effort, give up without trying, don't try as hard **Motivation:** reason to try, desire to try **Achievement:** doing well, success, getting good grades **Attributions/attribute:** blame failure on, think failure was caused by, think failure comes from, think they failed because, believe failure was caused by, believe success is caused by
4	1. Attributions affect motivation 2. Attributing failure to effort (controllable causes) increases motivation or **increases trying** 3. Attributing failure to ability (uncontrollable decrease motivation or **decreases trying**	Can also say increases/decreases in motivation are associated with achievement, or the Attributions are associated with how much a person tries

	4. **Increases in trying** are associating with increases in achievement 5. **Decreases in trying** are associated with decreases in achievement	
3	Person has nothing from 4 and recalls verbatim or a close paraphrase of the following. 1. Attributions influence learning. 2. Attributions impact students' emotional reactions to success and failure, expectations for future success, future effort, and *achievement.* 3. Effort can be controlled 4. Ability can be viewed as uncontrollable 5. The learners who were counseled about their effort and strategies responded more appropriately to failure… they persisted longer 6. Research suggests that teachers can increase students' motivation to learn by teaching them learning strategies and encouraging them *attribute success to effort* 7. (Students with learned helplessness) expect to fail and attribute their failure to lack of ability.* 9. As a result, they exert little effort and use ineffective strategies 8. Learned helplessness may also cause students to give up without trying. 9. When students frequently experience failure and attribute these failures to lack of ability, they may begin to expect failure in all future attempts. 10. Students attribute failure to lack of effort* 11. Students attribute failure to controllable uncontrollable causes* 12. Motivation tends to increase/decrease* 13. Control is the extent to which students accept responsibility for their successes or failures, or are in control of the learning situation	*score as 3 when not connected to motivation or trying
2	Anything from the text not in 3-5 If mentions attributing failure to	

	luck/difficulty but doesn't describe as uncontrollable.	
1	If the student mentions good/positive or bad/negative attribution with no further correct explanation, count as incorrect	

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Meyer, B.J.F., Ray, M.N, & Middlemiss (2012). Children's use of comparative text signals: The relationship between age and comprehension ability. *Discours, 10*. doi:10.4000/discours.8637

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Ray, M.N. & Meyer, B.J.F. (2011). Individual differences in children's knowledge of expository text structures: A review of literature. *International Electronic Journal of Elementary Education, 4(1),* 67-82

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Stevens, R.J., Ray, M.N., Eckert, S. A. (2011). *The cognitive complexity of reading comprehension tasks: Changes over the past century.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

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