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Comprehension challenges in the fourth grade: The roles of text cohesion, text genre, and readers' prior knowledge

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Abstract

We examined young readers' comprehension as a function of text genre (narrative, science), text cohesion (high, low), and readers' abilities (reading decoding skills and world knowledge). The overarching purpose of this study was to contribute to our understanding of the *fourth grade slump*. Children in grade 4 read four texts, including one high and one low cohesion text from each genre. Comprehension of each text was assessed with 12 multiple-choice questions and free and cued recall. Comprehension was enhanced by increased knowledge: high knowledge readers showed better comprehension than low knowledge readers and narratives were comprehended better than science texts. Interactions between readers' knowledge levels and text characteristics indicated that the children showed larger effects of knowledge for science than for narrative texts, and those with more knowledge better understood the low cohesion, narrative texts, showing a reverse cohesion effect. Decoding skill benefited comprehension, but effects of text genre and cohesion depended less on decoding skill than prior knowledge. Overall, the study indicates that the fourth grade slump is at least partially attributable to the emergence of complex dependencies between the nature of the text and the reader's prior knowledge. The results also suggested that simply adding cohesion cues, and not explanatory information, is not likely to be sufficient for young readers as an approach to improving comprehension of challenging texts.

Keywords: Comprehension, fourth grade slump, cohesion, genre, domain knowledge, reading, individual differences, coherence, construction integration

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Introduction

A good deal of research has been conducted and has contributed to our understanding of how children learn to decode words and the factors that influence young readers' ability and inability to decode words (Cain, Oakhill, & Bryant, 2000; Ehri, 1991, Vellutino, Scanlon, & Spearing, 1995). Reading decoding represents the ability to apply letter-sound correspondence rules when reading words and non-words. Scholars have postulated that slow or inaccurate decoding skills tax working memory resources, using up working memory capacity needed for other comprehension processes such as integrating information across sentences (Cain, Oakhill, & Bryant, 2004; Hannon & Daneman, 2001; Perfetti, 1985). Indeed, slow or inaccurate word decoding has a profound impact on the reading comprehension success (Lyon, 2002; Vellutino, 2003).

There has also been a growing realization that children's ability to decode the words in text does not paint a complete picture of children's ability to comprehend text (e.g., Cain et al., 2004; Oakhill, Cain, & Yuill, 1998). The ability to decipher a word is not the same as the ability to interpret a sentence, understand the relationship between sentences, and to interpret the global meaning of a text (Oakhill, Cain, & Bryant, 2003). Successful comprehension also requires the reader to integrate individual word meanings into a coherent sentence level representation and to integrate sentences to create a global understanding. As such, successful reading comprehension requires the efficient coordination and integration of a number of underlying processes. These processes include not only word decoding and parsing sentences, but also integrating information within a text and with prior world knowledge (Kintsch, 1988, 1998; Perfetti, 1985).

More research now turns to developing a better understanding of children's comprehension processes (Cain et al., 2004; Cote & Goldman, 1999; Kendeou, van den Broek, White, & Lynch, 2009) as opposed to decoding processes. This project is intended to contribute to this understanding by examining the effects of both person-related and text-related factors on children's text comprehension. Thus, we examine two factors related to children's abilities (i.e., decoding skill and knowledge) and two factors related to text (i.e., cohesion and genre). Our research targets children in grade 4 because there is some evidence that children at that age are at a critical period in reading development characterized by an emergence of comprehension difficulties. This has been referred to as the *fourth grade slump* (Meichenbaum & Biemiller, 1998; Sweet & Snow, 2003). Our goal here is to examine the relative impact of the four factors related to children's ability and text characteristics so that we can more fully understand the potential problems leading to a fourth grade slump.

The guiding premise of this research is that world knowledge deficits, which are the negative gaps between the reader's actual knowledge and the knowledge demanded by a text to understand the text, are significant contributors to potential problems occurring when children reach the fourth grade. Thus, we examine here effects of knowledge on text comprehension, particularly in concert with characteristics of the text that influence the amount of knowledge required to understand the text. We further assume that genre and cohesion are two aspects of text that principally contribute to the degree of knowledge required to understand texts.

Based on these premises, we expect that readers generally understand (a) narrative text better than science text and (b) text with high cohesion better than text with low cohesion. In addition, we hypothesize the presence of an interaction between level of knowledge and text characteristics such that the benefit of knowledge is more pronounced for text with higher demands on knowledge. Thus, our specific predictions for the interactions are that the benefits of knowledge were expected to be more pronounced for science texts and for texts with more conceptual gaps (i.e., low cohesion texts). We explain these assumptions in greater detail in the following sections.

Text Comprehension

Our expectations are primarily based upon the Construction-Integration (CI) model of text comprehension (Kintsch, 1988, 1998). According to this theory, and indeed most theories of text comprehension (Graesser, Singer, & Trabasso, 1994; van den Broek, Rapp, & Kendeou, 2005), a critical process of successful comprehension is the retrieval of information from knowledge that is not explicitly stated in the text. According to the CI model, text comprehension has multiple levels, including a surface level representation of the words and syntax, and a textbase level that represents the meaning of the text. We hypothesize that, ultimately, the most important level of representation for comprehension that these children often struggle to construct is the situation model, which involves the integration of the textbase with knowledge. Comprehension is assumed to be more successful and deeper if the reader activates relevant knowledge and integrates that knowledge with the information explicitly stated in the text. In essence, text comprehension is more successful when the reader generates inferences while reading (Vidal-Abarca, Martinez, & Gilabert, 2000; Wolfe & Goldman, 2005).

Of course, successful comprehension is also largely dependent on the first two levels of comprehension. If the reader does not successfully form a surface-level representation, then the reader will be highly unlikely to form a coherent textbase. That is, if the reader does not decode the words or parse the sentences, the reader's surface level of comprehension will be deficient, and by consequence, the textbase will likely to be incoherent or malformed. If that is the case, then the activation of relevant knowledge and a coherent situation model representation are unlikely. In sum, the situational model generally builds upon the textbase and surface representations (unless, of course, the reader's understanding comes solely from prior knowledge and not from the text). Thus, the integration of knowledge with the textbase understanding requires sufficient decoding skill for a textbase to be formed. However, what is critical here is the notion that the contribution of decoding skill and knowledge work differently. That is, whereas decoding is fundamental to comprehension of texts across all genres with different features, the contribution of knowledge to comprehension is likely to vary depending on text genre and text features (in particular, text cohesion). Subsequent sections describe how knowledge contributes to comprehension depending on text genre and text cohesion.

Text Genre and World Knowledge

Our focus regarding the influence of text genre is on the distinction between narrative and expository texts, in particular science texts. As discussed in the previous section, world knowledge plays a critical role in deep-level comprehension of texts because readers must use knowledge to integrate meanings of individual sentences into a coherent representation of situations or events depicted by the overall text (Kintsch, 1988, 1998). As such, whether readers can develop a deep-level comprehension of the overall text meaning is likely to be affected by text genre. Narrative texts usually present reoccurring topics (e.g., friendship, love, and parting with a friend) in a specific context involving particular characters, settings, and times. Readers often have extensive experience and knowledge (i.e., schemas) regarding the events and situations described in typical narrative texts. Although narrative texts may contain new information (i.e., unfamiliar location, characters, and specific actions), most children have, from first-hand experience, well-developed schemas about the settings, actions and events described by narrative texts (Nelson, 1996; Olson, 1985). Thus, most children possess adequate event related knowledge to comprehend narrative texts. Moreover, many narrative texts also follow a simple structure—a sequence of casually related events for which many elementary school children are familiar (Williams et al., 2005).

In contrast to narrative texts, expository texts often place greater processing demands on the reader due to their increased structural complexity and increased demands for domain-specific information. Expository texts often contain abstract and logical relations that can be difficult to interpret, especially for children in the third to fifth grades (Kamberelis & Bovino, 1999). Perhaps most importantly, expository texts introduce many concepts that are new or only partially understood by the reader. Indeed, expository texts are used for the purpose of acquiring new information, and thus, they often contain novel content for young school children who are beginning to learn about those content domains, such as science. If children lack previous knowledge about a particular domain, comprehension will be limited because they do not possess the knowledge structures to which the new information can be integrated and assimilated (Langer, 1986).

The link between knowledge and expository text comprehension is well supported by previous research with adolescents and adults (Afflerbach, 1986; Chi, Feltovich, & Glaser, 1981; McNamara & Kintsch, 1996) and elementary school children (Best, Floyd, & McNamara, 2008; Rupley & Wilson, 1996). Thus, one possible interpretation for the emergence of comprehension difficulties around the fourth grade is that children lack sufficient prior knowledge to comprehend expository texts that are introduced during this period. Whereas early elementary school reading instruction focuses on the development of fundamental reading skills (i.e., learning to read), reading goals shift toward *reading to learn* in the third and fourth grades. Thus, up until the fourth grade, children tend to read narrative texts for the purpose of learning to read. However, as they transition from narrative text to expository texts to move to reading to learn during the third and fourth grades, and particularly in the fourth grade, knowledge levels may become the most critical influence on their comprehension.

Text Cohesion and World Knowledge

The effect of world knowledge on reading comprehension is also likely to be regulated by the manner in which reading materials are written. This issue is very important because both narrative and science texts can be written in different ways that might affect comprehension. The notion of text cohesion is one of the most useful concepts to systematically represent text characteristics that affect comprehension in a theoretically meaningful way. Text cohesion represents the extent to which a text explicitly provides background information and cues to help readers relate information distributed across different parts of the text (Britton & Gulgoz, 1991; Graesser, McNamara, & Louwerse, 2003). Cohesive elements in a text are grounded in explicit linguistic elements (i.e., words, features, cues, signals, constituents) and their combinations (Graesser & McNamara, 2010).

Texts are considered to be *low cohesion* when constructing a coherent representation from the text requires many inferences based on reader's knowledge. Texts are considered *high cohesion* when elements within the text provide more explicit clues to relations within and across sentences (McNamara, Louwerse, McCarthy, & Graesser, 2010). As such, low-cohesion texts place greater processing demands on the reader, in particular for readers with low levels of background knowledge. Previous research indicates that many expository materials written for school children have low levels of cohesion. For example, Beck, McKeown, and Gromoll (1989) performed an extensive analysis of four elementary school social studies texts and found that the texts comprised unclear goals and poor explanatory links and assumed too much knowledge on the part of readers. Thus, deficits in prior knowledge are likely compounded by exposure to low-cohesion texts.

In support of that hypothesis, a series of studies conducted by McNamara and colleagues (McNamara, 2001; McNamara & Kintsch, 1996; McNamara, Kintsch, Songer, & Kintsch, 1996; O'Reilly & McNamara, 2007) indicates that the effects of domain knowledge in the comprehension of expository materials are moderated by text cohesion for middle school children and adults. Across these studies, the authors modified texts so that participants either read low-cohesion or high-cohesion versions of the same text. To form the high-cohesion texts, the low-cohesion texts were modified by adding surface-level indicators of relations between ideas in the text. Such modifications range from adding low-level information, such as identifying anaphoric referents, synonymous terms, connective ties, or headers, to supplying background information left unstated in the text (Beck, McKeown, Omason, & Pople, 1984; Beck, McKeown, Sinatra, & Loxterman, 1991; Britton & Gulgoz, 1991; for a review see McNamara et al., 2010). When consecutive sentences overlap conceptually, the reader is more likely to be successful in forming a coherent representation linking the meaning of the two or more sentences. Likewise, when relationships between ideas in the text are explicit by using connectives such as *because, consequently, therefore*, and *likewise*, the reader is more likely to understand the text content better.

These studies (McNamara, 2001; McNamara & Kintsch, 1996; McNamara et al., 1996; O'Reilly & McNamara, 2007) indicated that increased cohesion consistently facilitated comprehension for readers, in particular those with low levels of background knowledge. It was concluded that low-knowledge readers cannot easily fill in gaps in low-cohesion texts because they do not have the knowledge to generate the necessary inferences. Therefore, these readers need high-cohesion text to understand and remember the content. These studies also demonstrated a reverse cohesion effect, showing benefits from low-cohesion text for readers with high level of knowledge. Demonstrations of reverse cohesion supported the assumption that less cohesive texts force high-knowledge readers to generate knowledge-based inferences to bridge cohesion gaps present in the text, thus resulting in further integration of text information with pre-existing knowledge. We would like to emphasize that this gap-filling process can be successful only if readers have the sufficient amount of background knowledge that can be accessed or triggered based on limited textual information.

In this study, this gap-filling inference based on pre-existing knowledge would be most likely to occur for high knowledge readers' reading low cohesion narrative texts. It would be unlikely to occur for low-cohesion science texts because the level of background knowledge is still too low to afford such gap-filling inferences even among relatively high-knowledge students. We hypothesize that (most) grade 4 children will not have a sufficient knowledge base in science to automatically generate inferences when reading low cohesion science text. However, some grade 4 students are expected to have sufficient world knowledge relative to narrative texts. Thus, we expected that high-knowledge students would show a reverse cohesion effect for the narrative texts. In all other cases, we expected to find an advantage for the higher cohesion text.

Present Research

The overarching goal of this research is to further the understanding of the factors that lead to comprehension difficulties among elementary school children entering the period associated with the fourth grade slump. In light of this goal, we examine the roles of reading decoding skill and world knowledge among children in the fourth grade when exposed to texts from different genres (narrative and expository) and different levels of cohesion.

Our study examined elementary-school children's comprehension of narrative and expository texts used in the classroom. We examined separately the effects of knowledge and word decoding skill, and how the effects of text characteristics (i.e., genre and cohesion) depend on knowledge or decoding skill. We expected to find significant effects of both knowledge and decoding skill on comprehension across different texts. We further expected that children would encounter greater difficulty comprehending the science texts and low cohesion texts, both of which are more knowledge demanding.

Most importantly, we hypothesized that comprehension would depend on both knowledge and the characteristics of the text. We predicted that comprehension of science texts, in contrast to narrative text, would depend on world knowledge. In contrast, we did not expect such an interaction between children's decoding skills and text types. Specifically, an interaction was expected between text genre and the readers' level of knowledge, wherein knowledge has a greater effect on expository text comprehension than narrative text comprehension. Decoding skill was expected to benefit comprehension, but a differential effect of decoding skill as a function of text genre was not predicted.

We also hypothesized that the effects of text cohesion would depend on both knowledge and text genre. Specifically, we predicted an advantage for low cohesion texts (i.e., a reverse cohesion effect) when the texts were relatively familiar (i.e., narratives) and when the reader had sufficient knowledge to fill in the cohesion gaps (i.e., high knowledge readers). In all other cases, we expected to find an advantage for higher cohesion text.

Method

Participants

Participants included 65 children enrolled in the fourth grade at four public schools in a large metropolitan school district. Children ranged in age from 9 years, 2 months to 11 years, 2 months (M = 118.30 months, SD = 5.35 months). Girls composed 52.3% of the sample (n = 34), and boys composed 47.7% (n = 31). Of the sample, 54% were Caucasian (n = 35), 40% of the children were African American or Black (n = 26), and 3% were Hispanic (n = 2). All children but two spoke English as their primary language. Using parent education level as an index of socioeconomic status, 2% of fathers did not complete high school; 49% of mothers and 55% of fathers graduated from high school, completed some college, or completed technical school; and 49% of mothers and 35% of fathers obtained at least a college degree.

On two screening measures, children in this sample demonstrated vocabulary knowledge and listening comprehension skills that were somewhat above average for their age. The average performance on the Woodcock–Johnson III (WJ III) Tests of Achievement (ACH) Picture Vocabulary test (Woodcock, McGrew, & Mather, 2001) was 108.2 (SD = 10.7), and average performance on the WJ III ACH Oral Comprehension test was 108.0 (SD = 9.5). Because the population means and standard deviations for these tests are 100 and 15, respectively, these results also indicate that the participating children displayed, on average, somewhat less variability than expected of the population of children this age.

Design

The experimental design of the study was a 2 x 2 within-subjects design. The within-subjects factors were text genre (narrative and expository) and text cohesion (low cohesion and high cohesion).

Materials

Texts. There were eight texts used in this study. Four texts were original texts obtained from basal readers and science textbooks. These texts were considered low-cohesion texts. The four remaining texts were revised versions of the four low-cohesion texts that were manipulated to increase their cohesion (see Appendix 1). The four low-cohesion texts included two science and two narrative texts. They were drawn from a pool of 127 texts collected from elementary-school-age basal readers and science textbooks. These texts included 67 science texts, 53 narrative texts, and 7 science texts written in narrative format. The average number of words per text was 388 (*SD* = 167, Min = 115, Max = 991; Science = 388; Narrative = 399; Mixed Format = 298), and the average Flesch-Kincaid reading level was 3.86 (*SD* = 1.79, Min = 0, Max = 7.8; Science = 4.96; Narrative = 2.52; Mixed format = 3.53). From this pool of 127 texts, we selected two narrative texts and two expository texts. These four texts were chosen because they were representative of the text pool and closely equated in terms of number of words and Flesch–Kincaid grade level. These indices were derived using Coh-Metrix, Version 1.0 (Graesser, McNamara, & Louwerse, & Cai, 2004). Preliminary selection criteria for inclusion in this study were for Flesch–Kincaid grade level to be between 2.0 and 5.0 and text length to be within the range of 304 and 471 words. From the text pool, we selected two science texts, *Heat* (SRA's *Real Science, Grade 2: Elementary Science*) and *Needs of Plants* (McGraw–Hill's *Science, Grade 2*), and two narrative texts, *Moving* (McGraw-Hill *Reading, Grade 3*) and *Orlando* (Addison Wesley's *Phonics Take-Home Reader, Grade 2*).

The cohesion of the four original texts was then manipulated to increase their cohesion. Each of the two texts within each genre included one original, lower-cohesion version and one higher-cohesion version. The aim of the cohesion manipulations for the high-cohesion versions was to increase cohesion between concepts and ideas such that they created a clear situation model for the child. The basic concepts discussed in the low-cohesion and high-cohesion texts were the same (e.g., heat moves through objects). However, the understandability of the high-cohesion versions increased by cohesion cues. There were a number of cohesion manipulations made to the high-cohesion texts that were fitting for each of the four texts. We increased cohesion using methods previously found to enhance comprehension (e.g., Beck et al., 1991; McNamara et al., 1996), including manipulations to referential, temporal, causal and explanatory cohesion. Specifically, there were seven aspects of the text that were modified to increase cohesion: (a) replacing pronouns with noun phrases, (b) adding descriptive elaborations, (c) adding sentence connectives, (d) replacing or inserting words to increase conceptual overlap, (e) adding topic headers, (f) adding theme sentences, and (g) moving or re-arranging sentences to increase temporal or referential cohesion. For example, if events were not presented in chronological order, the presentation of the events was altered to match the chronological order of the events in the world. The aim was to alter the texts so that they approximated equivalent levels of cohesion as measured by the Coh-Metrix, Version 1.1 (Graesser et al., 2004). The tool automatically analyzes texts on over 50 types of cohesion relations and over 200 measures of language and discourse by applying modules that use lexicons, classifiers, syntactic parsers, shallow semantic interpreters, conceptual templates, latent semantic analysis, and other components widely used in computational linguistics.

The high-cohesion versions of the texts included explicit information about the meanings of particular terms, a greater number of noun phrases, and a greater number of causal connections. The following example taken from the plant texts illustrate the ways in which cohesion was added. In this example, the high-cohesion version adds a sentence explaining that a mineral is not a plant or an animal. The third sentence includes a connective term "instead."

Low cohesion. "Plants also need minerals. A mineral is a naturally occurring substance that is neither plant nor animal."

High cohesion. "Plants also need minerals. A mineral is not a plant or an animal. Instead, a mineral is a substance in the ground that occurs naturally."

Cohesion manipulations also involved creating a context so that the child could more easily interpret the situations described in the text. The following example taken from the opening sections of the Orlando texts illustrates an instance in which a context was created for the high-cohesion version of the Orlando text. It is also important to point out that the order in which information was presented was changed for the Orlando text such that the high-cohesion version provided greater temporal cohesion, that is, information was presented in the order in which events occurred; the low-cohesion version on the other hand presented information in a non-temporal order and thus the reader was to infer that information presented at the start of the story was not the first event to occur.

Low cohesion. "Salvador was upset. He told is Mama he was going out. He didn't want to be worried or sad."

High cohesion. "Once upon a time there was a boy. His name was Salvador. Salvador adored his pet pig named Orlando."

A further method for increasing text cohesion was to integrate information across sentences in the low-cohesion text to provide a clearer depiction of the situations described by the text. The following example taken from the Heat texts illustrates an instance in which information was integrated.

Low cohesion. "Most metals are good conductors. Metal pots are used for cooking. Heat from the stove quickly moves through the metal. The heat warms the food."

High cohesion. "Most metals are good conductors. For example, metal pots are used for cooking because heat from the stove quickly moves through the metal pots and the heat from the pot warms the food."

Table 1. *Select Characteristics of the Narrative and Expository Texts*

	Narrative				Expository			
	Orlando		Moving		Plant		Heat	
	Low	High	Low	High	Low	High	Low	High
Argument overlap	0.35	0.62	0.53	0.85	0.78	0.86	0.66	0.84
Number of words	451	547	437	584	466	637	404	521
Average sentence length	6.44	9.77	12.49	14.60	10.13	10.98	7.21	11.33
Grade level	2.20	3.86	4.02	4.82	3.76	3.77	2.67	4.93
Word frequency (min log)	1.85	1.54	1.86	1.83	1.46	1.48	1.50	1.40

Table 1 presents some of the main text characteristics for the eight texts. These features are argument overlap, number of words, average sentence length (i.e., average number of words in a sentence), Flesch-Kincaid Grade Level, and average of word frequency of the lowest word frequency word in each sentence (logarithm). The argument overlap scores, which relate to the proportion of adjacent sentences that share one or more arguments (e.g., pronoun, noun or noun phrase), were higher for the high-cohesion versions of the texts. Incorporating words and phrases to increase cohesion has an effect on text length, such that the high-cohesion versions of the texts comprised more words than the low-cohesion versions. Also, adding cohesion changed the number of sentences and sentence length as indicated in the table. In addition, manipulating texts for cohesion affected the grade level scores, such that the high-cohesion versions were estimated as having higher grade-level scores than low-cohesion versions. Grade level assignments are primarily based on factors such as the number of words in the sentences and the number of letters or syllables per word (i.e., as a reflection of word frequency). Thus, adding words and sentence length (which is generally necessary to increase cohesion), increases grade level scores. However, the cohesion manipulation did not greatly influence content-based difficulty as indicated by word frequency.

Comprehension Measures.

Comprehension was assessed using a combination of recall tasks and multiple-choice questions. Multiple measures have the benefit of providing a more thorough evaluation of the breadth and depth of comprehension.

We collected free recall and cued recall data to assess children's comprehension of the texts. The free recall task required children to report what they remembered about the passage they had just read. Each child was provided the following directive: "Tell me everything you can remember about what you have just read. Give me as many details as possible, like you were trying to tell a friend about what you just read." All responses were recorded on an audiotape and later transcribed.

Cued recall, which assessed major themes in the text, was used to evoke richer content from the children (Zinar, 1990). The cued recall task required children to respond to three directives. The directives were designed to assess comprehension of three major sections of the texts, and they essentially covered the entire text. For example, for the Orlando text, children were directed to (a) "Tell me everything that Salvador did after his mama told him they would have to sell Orlando," (b) Tell me everything that Salvador's mama said at first about what they needed to do with Orlando," and (c) "Tell me everything that happened to Salvador and what he did after the storm began." All responses were audiotaped and later transcribed.

Twelve multiple-choice questions were constructed for each text to assess students' comprehension. Six of the questions were designed to tap local-level comprehension, and the other six were designed to tap global-level comprehension of the text. Whereas local-level questions requested information that was within five or fewer clauses (mostly within 2 sentences), global-level questions requested information that was located across six or more clauses. Each multiple-choice question had four answer options with only one being the correct answer. Examiners read the questions orally while the questions were presented in text form. The children were required to vocalize the correct answer. Comprehension scores for each text were obtained for each child by calculating the proportion of correct responses to total questions (i.e., 12).

Reading Competency Measures

As part of a larger battery of assessment instruments, children completed two tests from the WJ III ACH (Woodcock et al. 2001). The tests from the WJ III ACH included the Word Attack test and the Academic Knowledge test. Word Attack measures reading decoding skills. Examinees must pronounce phonologically regular non-words. The test has a median internal consistency reliability coefficient of .94 for ages 8 to 10 (McGrew & Woodcock, 2001). Academic Knowledge measures knowledge about the biological, physical, and social sciences and the humanities. Examinees must provide information about the biological and physical sciences; about history, geography, government, and economics; and about art, music, and literature. The test has a median internal consistency reliability coefficient of .84 for ages 8 to 10 (McGrew & Woodcock, 2001). For both WJ III tests, age-based standard scores

(*M* = 100, *SD* = 15) were obtained. For Word Attack, the standard score represents decoding skills. The standard score for the Academic Knowledge tests represents world knowledge.

Procedures

Recruitment. Children were recruited by sending letters of invitation to parents through the children's school classrooms. The letters provided information about the study and requested that parents contact researchers to schedule a testing session. Testing sessions were conducted on five Saturdays during fall 2003. After completion of the testing, children were provided a gift card to a department store, coupons from merchants, and school supplies.

Testing. An assessment battery was completed in approximately a 2-hour testing session. Graduate students who had successfully completed a graduate course covering the administration of standardized tests completed all testing. Children first silently read each text within a 5-minute period. After reading the first text, the text was removed from view before answering the free and cued recall questions and 12 multiple-choice questions. This process was repeated with the remaining four texts. The cohesion manipulation was organized such that children either read the high-cohesion or low-cohesion version of each text. The cohesion manipulation was counterbalanced so that an equal number of children read high-cohesion and low-cohesion versions of each of the four texts. The order of texts was counterbalanced using a Latin-square design. Finally, after reading the texts and answering the recall and multiple-choice questions, children completed the battery of reading competency tests.

Coding Recall Data. The analysis focused on the amount of information children recalled about information in the text by counting the number of propositions recalled for each text. It is important to note that we matched all recall to ideas contained in the low-cohesion versions of the texts so we could evaluate whether reading the high cohesion versions of a texts that contained the same ideas in a more understandable way, increased recall for the main ideas contained in the low-cohesion versions of the text. Thus, the number of propositions in the low-cohesion texts provided a benchmark for which we could compare the amount of recall that children generated from the low-cohesion and high-cohesion versions of the texts.

There were two steps to the recall analysis. First, the low-cohesion versions of narrative and expository texts were propositionalized using a conventional method in which the information contained in each sentence was broken into main propositions and sub-propositions (see Kintsch, 1998). Main propositions consisted of the main idea, whereas the sub-propositions contained details pertaining to the main idea. For instance, the main proposition for the sentence "Plants need sunlight, air and water to live" consisted of the notion that plants need things to live. The sub-proposition consisted of the notion that plants need sunlight, and water. The number of main propositions mapped on to the number of sentences contained in each low-cohesion text (e.g., 45 propositions for the plant text). Second, the children's transcribed recall data were divided into idea units. Idea units were classified as utterances that contained a subject, verb, and direct object. Idea units were separated by connectives, such as so, and, but, and because. Every idea unit was matched to the propositions. In cases where children repeated information, each idea unit was counted only once.

Our initial analysis also focused on inferences children generated about information in the text (i.e., information that was extrapolated from but not directly specified in the texts). Using previous research as a guide (e.g., Kintsch, 1993), inferences were classified as text-based, elaborative, global, or irrelevant. However, we did not further analyze inference data because too few inferences were produced (inferences comprised only 3% of cued recall question answers and 1% of free-recall question answers).

All the free recall and cued recall was coded by two trained raters. Half the data was coded by a third trained rater. Inter-rater reliability was evaluated for all dimensions of coding between the third rater and each of the two raters. Simple agreement and Kappa analyses indicated that agreement reached 90% or above on all dimensions, which indicates a high level of agreement. Disagreements were resolved by discussion between raters.

Proposition Analysis. The recall analyses assessed the number of propositions recalled. To account for the completeness of information recalled, a value of 1.0 was assigned to recall that contained the main proposition and more detailed information cited in the sub-proposition. A value of 0.5 was assigned to recall data that contained the main proposition but that did contain the detailed information in the sub-proposition. A value of 0 was assigned when the proposition was not recalled. For example, a value of 0.5 was assigned for the sentence “Plants need sunlight, water, and air to live” when a child stated that plants need water to live. A value of 1 was assigned when the child stated that plants need water, sunlight, and air. Because children’s propositional recall sometimes contained erroneous information, recall that contained such information received a score of 0.5. For example, a child may have erroneously stated, “Plants do not need sunlight.” Once recall scores were totaled for a text, they were transformed into a proportion because there were an unequal number of propositions contained in the four texts.

Free recall and cued recall propositions were summed into separate scores to focus on different dimensions of comprehension across tasks. Thus, it was possible for children to recall the same information in the free recall task and in the cued recall task. For the free recall analysis, proportion scores were calculated by dividing the free recall score by the number of propositions that could potentially be recalled for each text. For the cued recall analysis, the recall scores were summed for each of the free recall questions and divided by the number of directly relevant main propositions that could be potentially recalled (for each question).

To determine which sentences contained directly relevant information, two experimenters identified propositions that directly related to the cued-recall directives from three categories: directly related sentences, indirectly related sentences, and irrelevant sentences. There were 32 main propositions directly relevant to the Plant directives, 52 to the Heat directives, 28 to the Moving directives, and 35 to the Orlando directives. Note that the same proposition was sometimes classified as directly relevant for more than one cued-recall question; in such cases, the same proposition was counted for each of the relevant questions. Kappa analyses showed that there was a high level of agreement between raters across both texts (weighted Kappa = .85 expository texts and .85 for the narrative texts). Disagreements were resolved by discussion.

Results

Preliminary Analyses

Performance on the comprehension questions for the two narrative texts (Orlando and Moving) and for the two expository texts (Plants and Heat) were compared to verify whether there was an effect of text within genre. There were no statistically significant differences in children’s performance comparing the two narrative texts on the multiple-choice, free recall, or cued recall tasks. There were no differences on children’s performance between the two expository texts for the free recall and cued recall tasks. However, on the multiple-choice questions, children performed better on the Plant questions (M = .60, SD = .22) than on the

Heat questions (*M* = .52, *SD* = .21), *t*(64) = 3.96, $p < .01$. We conducted item analyses to examine whether these effects were due to a subset of the multiple-choice questions, but superior performance was evident for the majority of questions for the Plants text. We further confirmed that this effect may have been due to the ease of the questions (and not due to differences between the texts) because the Flesch–Kincaid grade level for the multiple-choice questions for the Heat text (*M* = 2.99, *SD* = 1.77) was somewhat, though not significantly, higher than the Plant text (*M* = 1.94, *SD* = 1.29), $F(1, 22) = 2.751$, $p = .111$, indicating that questions for the Heat text are somewhat more difficult than questions for the Plant text. These effects are unfortunate; however, the results from the recall analyses were not affected by the ease of the questions and thus provide confirmatory validity to the overall results.

Relations between Comprehension Measures, Decoding Skill, and World Knowledge

As can be expected, there was a significant, moderate correlation between decoding skill and world knowledge ($r = .52$, $p < .01$). Among dependent measures, the two recall measures (free and cued) correlated highly ($r = .81$, $p < .01$). By contrast, where the tasks differed more, the correlations between performance on the multiple-choice questions and free recall ($r = .46$, $p < .01$) and cued recall ($r = .50$, $p < .01$) were significant but moderate in magnitude.

Effects of Reader Abilities, Genre, and Cohesion

We performed a median split on the standardized individual difference scores resulting in high and low groups for each knowledge and decoding skill measure. The mean scores for the high and low groups on the two individual difference measures are presented in Table 2.

Table 2. *Mean Scores on Aptitude Measures for Children Assigned to the Low and High Groups*

Individual difference test	Ability group	
	Low *M* (*SD*)	High *M* (*SD*)
WJ III Academic Knowledge	92.97 (5.04)	113.06 (6.80)
WJ III Word Attack	97.39 (4.04)	114.17 (7.86)

We conducted separate mixed ANOVAs on performance on each of the three dependent measures: multiple-choice questions, free recall questions, and cued recall questions. In these ANOVAs, within-subjects factors were genre (narrative vs. expository) and cohesion (low vs. high cohesion). The between-subjects factor was either knowledge level (high vs. low knowledge) or reading decoding skill (high vs. low decoding skill). The ANOVAs were conducted separately for knowledge and decoding skill because including both factors reduced some cell sizes to unacceptably low numbers.

To ensure that the statistically significant effects identified from the ANOVAs were not distorted by entering knowledge or decoding skill as a categorical variable (high or low), we conducted multiple regression analyses in which either knowledge and reading decoding skill was entered as a continuous variable. Children's scores on the Academic Knowledge test or scores on the Word Attack test were entered as a separate independent variable, and scores on the comprehension measures were the dependent variables. We also ran multiple regression analysis with the Academic Knowledge and Word Attack scores as well as the centered interaction between the Academic Knowledge and Word Attack scores as independent variables to assess the robustness of these effects comprehension. Significant main and interaction effects generated from the ANOVAs were replicated in the regression analyses. We report only the ANOVAs because this method mimics prior research on knowledge and cohesion interactions, and is most easily interpreted.

World Knowledge Analysis

We begin by describing the results when knowledge levels are entered as the between-subjects factor. A 2 x 2 x 2 mixed ANOVA was conducted for each of the three dependent measures. These data are presented in Table 3. The first section below describes the effects of genre and knowledge, and the second describes the effects of cohesion.

Table 3. *Proportion Correct for the Three Reading Comprehension Measures as a Function of Knowledge, Genre, and Cohesion*

Knowledge level	Text type	Reading comprehension measure		
	Genre/Cohesion	Multiple-choice	Cued recall	Free recall
		M (*SD*)	*M* (*SD*)	*M* (*SD*)
Low	Narrative/Low	.62 (.16)	.33 (.15)	.16 (.12)
Low	Narrative/High	.70 (.12)	.36 (.15)	.18 (.11)
Low	Expository/Low	.45 (.17)	.06 (.05)	.06 (.05)
Low	Expository/High	.42 (.18)	.06 (.05)	.04 (.03)
High	Narrative/Low	.77 (.14)	.39 (.14)	.22 (.11)
High	Narrative/High	.81 (.11)	.30 (.12)	.19 (.09)
High	Expository/Low	.68 (.17)	.12 (.08)	.08 (.06)
High	Expository/High	.71 (.17)	.15 (.09)	.09 (.07)

Table 4. *Proportion Correct for Three Reading Comprehension Measures for the Narrative and Science Texts*

	Narrative text	Science text	ANOVA	
	M (*SD*)	*M* (*SD*)	*df1, df2*	*F*
Fourth-grade children				
Multiple-choice	.73 (.12)	.57 (20)	1,63	68.20***
Cued recall	.34 (.12)	.10 (.07)	1,50	226.72***
Free recall	.19 (.09)	.07 (.05)	1,52	113.92***

Note. *** = $p < .001$

Table 5. *Proportion Correct for Three Reading Comprehension Measures for Low and High-Knowledge Readers*

	Low Knowledge	High Knowledge	ANOVA	
	M (*SD*)	*M* (*SD*)	*df1, df2*	*F*
Multiple-choice	.34 (.10)	.74 (.10)	1,63	59.27***
Cued recall	.20 (.07)	.24 (.07)	1,50	2.88
Free recall	.11 (.06)	.15 (.07)	1,52	3.68

Note. * = $p < .05$, *** = $p < .001$.

Table 6. *Interaction between Genre and Knowledge*

	Narrative			Expository			
	Low K *M* (*SD*)	High K *M* (*SD*)	*t*	Low K *M* (*SD*)	High K *M* (*SD*)	*t*	Interaction *F*
Multiple-choice	.66 (.12)	.79 (.87)	-5.20***	.43 (.14)	.70 (.15)	-7.36***	11.06**
Cued recall	.34 (.13)	.34 (.11)	-0.50	.04 (.03)	.09 (.05)	-5.21***	2.99
Free recall	.17 (.10)	.20 (.08)	-1.22	.04 (.04)	.08 (.05)	-2.85**	<1

Note. K= knowledge.
** = *p* < .01, *** = *p* < .001.

Genre and knowledge. As shown at the top of Table 4, there was a main effect of genre for all three dependent measures, indicating that children's comprehension was better for the narrative texts than for the expository texts. As shown at the top of Table 5, the effect of knowledge was significant for the multiple-choice questions but marginal for the cued recall and recall measures. Thus, high-knowledge readers showed better comprehension than did low-knowledge readers, and this finding was most apparent on the multiple-choice questions.

As shown in Table 6, there was a significant interaction between genre and knowledge using scores from the multiple-choice questions, and there was a marginal interaction using the cued recall measure. Follow-up tests confirmed that the effect of knowledge was greater for the comprehension of expository texts than for the narrative texts.

Text cohesion. There was a main effect of cohesion on the multiple-choice question performance. As shown in Table 7, children comprehended the high-cohesion texts better than the low-cohesion texts. However, the effects of cohesion were not reliable for the two recall measures.

Table 7. *Proportion Correct for Low and High Cohesion Texts on the Three Dependent Measures*

	Low cohesion *M* (*SD*)	High cohesion *M* (*SD*)	*F*
Multiple-choice	.63 (.15)	.67 (.15)	4.35*
Cued recall	.22 (.09)	.22 (.08)	< 1
Free recall	.13 (.7)	.12 (.7)	< 1

Note. * = *p* < .05.

Table 8. *Interaction between Cohesion and Genre*

	Narrative			Expository			
	Low Coh *M* (*SD*)	High Coh *M* (*SD*)	*t*	Low Coh *M* (*SD*)	High Coh *M* (*SD*)	*t*	Inter-action *F*
Multiple-choice	0.69 (0.16)	0.76 (0.13)	3.09**	0.57 (0.21)	0.57 (0.23)	0.12	5.07*
Cued recall	0.35 (0.15)	0.33 (0.14)	1.36	0.09 (0.06)	0.10 (0.09)	-1.26	5.66*

Note. Coh = cohesion.
** = *p* < .01, *** = *p* < .001.

As shown in Table 8, there was a significant interaction between cohesion and genre on the multiple-choice question and cued recall question performance. Follow-up analyses on the multiple-choice data indicated that for the narrative texts, children comprehended the high-cohesion texts better than the low-cohesion texts, whereas there was no effect of cohesion for the expository texts. The interaction according to the cued recall measure is more difficult to interpret because none of the separate effects were significant. Nonetheless, the trends indicated that there was a slight advantage for low cohesion narrative texts, compared to a slight advantage for high cohesion science texts.

There was also a two-way interaction between cohesion and world knowledge on the cued recall task, $F(1,50) = 5.67$, $p < .05$, but not on the multiple-choice or free recall task (both $F<1$). The interaction indicated that high-knowledge readers recalled more information after reading the low-cohesion texts, $M = 0.26$, $SD = 0.09$, than the high-cohesion texts, $M = 0.22$, $SD = 0.08$; $t(25) = -2.23$, $p < .05$). However, there was no effect of cohesion for low-knowledge readers, $M_{low\ cohesion} = 0.20$, $SD = 0.08$; $M_{high\ cohesion}=0.21$, $SD = 0.08$; $t(25) = 1.10$, $p = .28$.

Most importantly, there was a three-way interaction between genre, cohesion, and knowledge on the cued and free recall measures (cued recall: $F(1,50) = 11.86$, $p < .01$; free recall; $F(1,52) = 6.52$, $p <.05$). This interaction was marginal for the multiple-choice measure, $F(1,63) = 2.61$, $p = .10$. This interaction is displayed for the recall measures in Figure 1 (see also Table 3 for means). As already noted, there is a larger effect of knowledge for the science texts than for the narrative texts. Moreover, we see in Figure 1 that the effect of knowledge depends on cohesion, particularly for the narrative texts, such that there was a reversed cohesion effect for high-knowledge readers and a slight benefit for high cohesion for the low-knowledge readers. High-knowledge students tended to show better comprehension after reading the low-cohesion narrative text than the high cohesion narrative text (multiple choice, $t(33) = -1.51$, $p = .14$, cued recall, $t(26) = -3.88$, $p < .05$, free recall, $t(26) = 1.65$, $p = .11$). In contrast, this pattern did not emerge for the low-knowledge readers. There were trends indicating benefits of cohesion for low-knowledge readers on the narrative text and high-knowledge readers on the science texts, but these effects were not reliable. It is notable that the scores for low-knowledge readers on the measures of expository recall were extremely low (see Figure 1 and Table 3), indicating that low-knowledge readers may not have understood the science text sufficiently in order for us to fully interpret the three-way interaction.

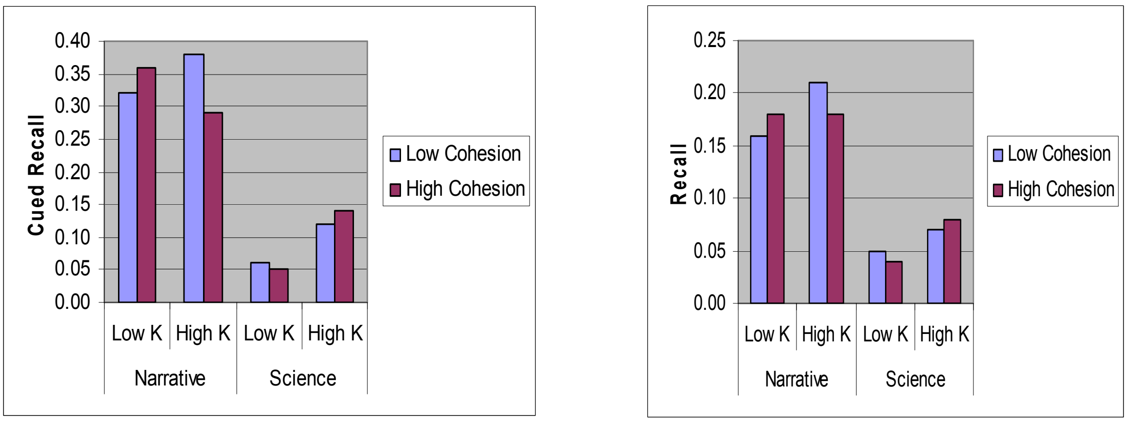

Figure 1. Interaction between knowledge, genre, and cohesion on the cued recall task and the free recall task.

Decoding Skill Analysis

Our second set of analyses examined potential effects of decoding skill for the fourth grade children by conducting the same 2 x 2 x 2 ANOVA as reported above, but this time with decoding skill entered as the dichotomous variable. We only report the effects that are not redundant with the effects reported above, that is, those that involve decoding skills. The mean scores on the comprehension measures are reported in Table 9.

Table 9. *Proportion Correct Scores as a Function of Decoding Skills, Genre, and Cohesion*

Decoding skill	Genre/cohesion	Multiple-choice *M* (*SD*)	Cued recall *M* (*SD*)	Free recall *M* (*SD*)
Low	Narrative low	.65 (.17)	.32 (.14)	.17 (.10)
Low	Narrative high	.72 (.13)	31 (.12)	.18 (.10)
Low	Expository low	.50 (.19)	.08 (.06)	.06 (.04)
Low	Expository high	.51 (.23)	.10 (.07)	.05 (.03)
High	Narrative low	.75 (.15)	.41 (.15)	.22 (.13)
High	Narrative high	.81 (.11)	.35 (.16)	.21 (.11)
High	Expository low	.66 (.20)	.11 (.08)	.09 (.06)
High	Expository high	.65 (.20)	.11 (.10)	.10 (.08)

Table 10. *Proportion Correct for Low and High Decoding Children on the Three Dependent Measures*

	Low decoding *M* (*SD*)	High decoding *M* (*SD*)	*F*
Multiple-choice	.59 (.14)	.72 (.11)	15.54***
Cued recall	.20 (.07)	.25 (.08)	4.28*
Free recall	.11 (.05)	.15 (.07)	5.05*

Note. * = $p < .05$, *** = $p < .001$.

As shown in Table 10, there was a main effect of decoding skill according to all three measures of comprehension indicating that skilled decoders performed better on the comprehension tasks than their less skilled counterparts. However, there were no significant interactions involving decoding skills. Thus, decoding skill affected comprehension, but the effects of text genre and text cohesion did not depend on decoding skill.

Discussion

The purpose of this study was to examine young children's comprehension as a function of the characteristics of the text and the children's knowledge and reading decoding skill levels. Our overarching goal was to more fully understand factors that might contribute to reading problems that seem to emerge in the fourth grade, called the fourth grade slump. The most important prediction made in this study is that at the age when young children are expected to begin *learning from text*, successful comprehension will largely depend on the reader's knowledge about the world and about specific domains. We made this prediction because this educational period is when children are exposed to a wider variety of texts, and moreover, successful comprehension of those texts demands the integration of knowledge with the text. The more that knowledge is required from the text, the more we can expect to see influences of the reader's knowledge level. Thus, we predicted that interactions between levels of world knowledge and characteristics of the text would emerge around grade 4. Indeed, we observed complex interactions between knowledge, text genre, and text cohesion in this study with fourth grade students.

Findings confirmed that text comprehension is influenced by decoding skill as well as the availability of knowledge to the reader. Better decoders showed better comprehension than less skilled decoders and children with more world knowledge performed better on the comprehension measures than did those with less knowledge. Also, children showed better comprehension of narrative than science texts. This result is most likely because narrative texts are more familiar in structure and contain more familiar information than do science texts, and thus readers have more knowledge available to facilitate comprehension.

We also found that the effect of knowledge was greater for science texts than for narrative texts. Thus, knowledge was more important when the text was more knowledge demanding. Further, a three-way interaction was expected between knowledge, text genre, and text cohesion. The children exhibited a reversed cohesion effect when the texts were familiar (i.e., narrative texts) and when they had sufficient knowledge to fill in the cohesion gaps in the text (i.e., high knowledge readers). This result replicates findings with adolescent readers' (McNamara et al., 1996) and adult readers (McNamara, 2001; McNamara & Kintsch, 1996). It confirms that text understanding can be improved when the reader is induced to make more inferences and when those inferences are likely to be successful.

We further predicted that there would be an advantage for high cohesion text. While there was a main effect of cohesion for multiple-choice question performance, the benefits of cohesion were moderate and inconsistent across measures, and did not occur for science texts. To some extent, this result was predicted in the sense that we predicted an interaction of cohesion, genre, and knowledge levels. Nonetheless, the results suggest that our manipulations to the cohesion of these texts may not have been sufficient to fully support the children's understanding of the text. Prior research has clearly established a benefit of cohesion manipulations to texts for children of this age (Beck, McKeown, Omason, & Pople, 1984; Beck, McKeown, Sinatra, & Loxterman, 1991; Loxterman, Beck, & McKeown, 1994). However, the studies that have shown benefits of cohesion included manipulations to the explanatory content in the text. In contrast, in the current study, we were conservative in our approach to avoid adding large amounts of explanatory information to the high cohesion text that could not be inferred in the low cohesion text. This approach is motivated by the goal of not confounding cohesion manipulations with the addition of extra information. However, it seems that the young readers in this study needed more background information in the texts to support their understanding. Simply adding cohesion cues, and not explanatory information, is not likely to be sufficient for young readers as an approach to improving comprehension of challenging texts.

Limitations and Future Directions

The interpretation of these findings should be tempered by at least two limitations. First, although we believe that we selected the two most consistent, powerful, and theoretically valid aptitudes for reading comprehension, other reading aptitudes deemed important in previous research, such as oral language-based abilities (Carver & David, 2001; Storch & Whitehurst, 2002), metacognitive strategy knowledge (Baker, 1985; Wong, 1985), and knowledge of text structure (Williams et al., 2005), were omitted from this study. Second, although our sample was quite diverse in terms of gender, race, and socio-economic status and although they were recruited from four public schools in a large metropolitan school district, these samples do not well demonstrate representativeness of all readers in fourth grades. In fact, the children demonstrated somewhat above average performance and somewhat restricted range on the standardized, norm-based screening measures and on the standardized, norm-based reading decoding and world knowledge measures. Subsequent studies should ensure that there are sufficient readers with low normative levels on such measures.

Conclusions

The results of this study further our understanding of factors that may lead to comprehension problems for children in the fourth grade. Essentially, at this age, children are expected to be and generally are developmentally ready to make inferences while reading text and to learn from text. It is at this age that decoding skills are expected to be largely in place and it is at this age when these young children are increasingly expected to read and learn from expository texts. However, generating inferences depends on prior knowledge. If the reader does not possess sufficient knowledge, inferences are likely to be unsuccessful. Thus, comprehension problems will become more evident (in comparison to their peers), for children in the fourth grade who have not gained sufficient knowledge about the world. Decoding skills are clearly important, but deficits in decoding skills are likely to be evident on all types of texts. Thus, decoding skill problems are likely to be detected far before the fourth grade. In contrast, different problems will occur for readers who are expected to learn from text. When readers are able to make inferences, and the text calls for those inferences, differences in levels of knowledge will be a principle factor contributing to comprehension problems.

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References

Afflerbach, P. (1986). The influence of prior knowledge on expert readers' importance assignment processes. *National Reading Conference Yearbook, 35*, 30-40.

Baker, L. (1985). How do we know when we don't understand? Standards for evaluating text comprehension. In D. L. Forrest-Pressley, G. E. MacKinnon, & T. G. Waller (Eds.), *Metacognition, cognition, and human performance* (Vol. 1, pp. 155-205). Orlando, FL: Academic.

Beck, I., McKeown, M., & Gromoll, E. (1989). Learning from social studies texts. *Cognition and Instruction*, *6*, 99-158.

Beck, I. L., McKeown, M. G., Omason, R. C., & Pople, M. T. (1984). Improving the comprehensibility of stories: The effects of revisions that improve coherence. *Reading Research Quarterly, 19*, 263-277.

Beck, I. L., McKeown, M. G., Sinatra, G. M., & Loxterman, J. A. (1991). Revising social studies text from a text processing perspective: Evidence of improved comprehensibility. *Reading Research Quarterly, 26*, 251-276.

Best, R. M., Floyd, R. G., & McNamara, D. S. (2008). Differential competencies contributing to children's comprehension of narrative and expository texts. *Reading Psychology, 29,* 137-164.

Britton, B. K., & Gulgoz, S. (1991). Using Kintsch's computational model to improve instructional text: Effects of repairing inference calls on recall and cognitive structures. *Journal of Educational Psychology, 83*, 329-345.

Cain, K., Oakhill, J. V. & Bryant, P. E. (2000). Phonological skills and comprehension failure: A test of the phonological processing deficit hypothesis. *Reading and Writing*, *13*, 31-56.

Cain, K., Oakhill, J., & Bryant, P. E. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology*, 96, 31-42.

Carver , R. P., & David, A. H. (2001). Investigating reading achievement using a causal model. *Scientific Studies of Reading, 5*, 107–140.

Chi, M. T. H., Feltovich, P. J., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive Science, 5*, 121-152.

Coté, N., & Goldman, S. R. (1999). Building representations of informational text: Evidence from children's think-aloud protocols. In H. Van Oostendorp & S. R. Goldman (Eds.), *The construction of mental representations during reading* (pp. 169-193). Mahwah, NJ: Erlbaum.

Ehri, L. C. (1991). Development of the ability to read words. In R. Barr, M. L. Kamil, P. B. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. II, pp. 384-417). New York: Longman.

Graesser, A.C. & McNamara, D.S. (2010). Computational analyses of multilevel discourse comprehension. *Topics in Cognitive Science*.

Graesser, A. C., McNamara, D. S., & Louwerse, M. M. (2003). What do readers need to learn in order to process coherence relations in narrative and expository text. In A.P. Sweet and C.E. Snow (Eds.), *Rethinking reading comprehension* (pp. 82-98). New York: Guilford Publications

Graesser, A. C., McNamara, D. S., Louwerse, M. M., & Cai, Z. (2004). Coh-Metrix: Analysis of text on cohesion and language. *Behavioral Research Methods, Instruments and Computers*, *36*, 193-202.

Graesser, A.C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review, 101,* 371-95.

Hannon, B. & Daneman, M. (2001). A new tool for measuring and understanding individual differences in the component process of reading comprehension. *Journal of Educational Psychology, 93*,103-28.

Kamberelis, G., & Bovino, T.D. (1999). Cultural Artifacts as Scaffolds for Genre Development. *Reading Research Quarterly, 34, 138*–170.

Kendeou, P., van den Broek, P., White, M.J., & Lynch, J.S. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. *Journal of Educational Psychology, 101*, 765-778.

Kintsch, W. (1988). The use of knowledge in discourse processing: A construction integration model. *Psychological Review, 95*, 163-182.

Kintsch, W. (1993). Information accretion and reduction in text processing: Inferences. *Discourse Processes, 16,* 193–202

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge, MA: Cambridge University Press.

Langer, J. A. (1986). *Children reading and writing: Structures and Strategies*. Westport, CT: Ablex Publishing.

Loxterman, J. A., Beck, I. L., & McKeown (1994). The effects of thinking aloud during reading on students' comprehension of more or less coherent text. *Reading Research Quarterly, 29*, 353-367.

Lyon, G.R. (2002). Reading development, reading difficulties, and reading instruction: Educational and public health issues. *Journal of School Psychology, 40,* 3‑6.

McGrew, K. S., & Woodcock, R. W. (2001). *Technical Manual. Woodcock-Johnson III*. Itasca, IL: Riverside Publishing.

McNamara, D. S. (2001). Reading both high-coherence and low-coherence texts: Effects of text sequence and prior knowledge. *Canadian Journal of Experimental Psychology, 55*, 51-62.

McNamara, D. S., Louwerse, M. M., McCarthy, P. M., & Graesser, A. C. (2010). Coh-Metrix: Capturing linguistic features of cohesion. *Discourse Processes, 47*, 292-330.

McNamara, D. S., & Kintsch, W. (1996). Learning from texts: Effects of prior knowledge and text coherence. *Discourse Processes, 22*, 247-288.

McNamara, D. S., Kintsch, E., Songer, N., & Kintsch, W. (1996). Are good texts always better? Interactions of text coherence, background knowledge, and levels of understanding in learning from text. *Cognition and Instruction, 14*, 1-43.

Meichenbaum, D., & Biemiller, A. (1998). *Nurturing independent learners: Helping students take charge of their learning.* Cambridge, MA: Brookline.

Nelson, K. (1996). *Language in cognitive development: The emergence of the mediated mind.* New York: Cambridge University Press.

Oakhill, J. V, Cain, K., & Bryant, P. E. (2003). Dissociation of single-word reading and text comprehension skills. *Language and Cognitive Processes*, *18,* 443-468.

Oakhill, J. V., Cain, K., & Yuill, N. M. (1998). Individual differences in children's comprehension skill: Towards an integrated model. In C. Hulme & R. M. Joshi (Eds.), *Reading and spelling: Development and disorder*. Mahwah, NJ: Erlbaum.

Olson, M. W. (1985). Text type and reader ability: The effects on paraphrase and text-based inference questions. *Journal of Reading Behavior, 3*, 199-214.

O'Reilly, T., & McNamara, D. S. (2007). Reversing the reverse cohesion effect: Good texts can be better for strategic, high-knowledge readers. *Discourse Processes, 43,* 121-152.

Perfetti, C. (1985). *Reading ability*. New York: Oxford University Press.

Rupley, H. R., & Wilson, V. L. (1996). Content, domain, and world knowledge: Relationship to comprehension of narrative and expository text. *Reading and Writing, 8*, 419-432.

Storch, S. A., & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology, 6*, 934–947.

Sweet, A. P., & Snow, C. E. (Eds.). (2003). *Rethinking reading comprehension.* New York: Guilford Press.

van den Broek, P., Rapp, D. N., & Kendeou, P. (2005). Integrating memory-based and constructionist processes in accounts of reading comprehension. *Discourse Processes, 39,* 299–316.

Vellutino, F. R. (2003). Individual differences as sources of variability in reading comprehension in elementary school children. In A. P. Sweet & C. E. Snow (Eds.), *Rethinking reading comprehension* (pp. 51-81). New York: Guilford Press.

Vellutino, F. R. Scanlon, D. M., & Spearing, D. (1995). Semantic and phonological coding in poor and normal readers. *Journal of Experimental Child Psychology, 59,* 76 -123.

Vidal-Abarca, E., Martinez, G., & Gilabert, R. (2000). Two procedures to improve instructional text: Effects on memory and learning. *Journal of Educational Psychology*, *92,* 107–116.

Williams, J. P., Hall, K. M., Lauer, K. D., Stafford, K. B., De Sisto, L. A., & deCani, J. S. (2005). Expository text comprehension in the primary grade classroom. *Journal of Educational Psychology, 97*, 538-550.

Wong, B. Y. L. (1985). Issues in cognitive-behavioral interventions in academic skill areas. *Journal of Abnormal Child Psychology, 13*, 425-442.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock–Johnson III*. Itasca, IL: Riverside.

Wolfe, M. B. W. & Goldman, S. (2005). Relations between adolescents' text processing and reasoning. *Cognition and Instruction, 23,* 467-502.

Zinar, S. (1990). Fifth-graders' recall of propositional con- tent and causal relationships from expository prose. *Journal of Reading Behavior, 22*, 181-199.

Appendix A

Eight Texts used in Study

Effects of Heat: Low Cohesion

Moving Heat

Heat can move from one object or place to another. Heat moves from warm objects to cooler ones. You can warm your hands by holding a cup of warm soup. Heat moves from the soup through the cup to your hands. You can feel warm air rising above the cup.

Heat moves through some materials more easily than others. Heat moves easily through conductors. Most metals are good conductors. Metal pots are used for cooking. Heat from the stove quickly moves through the metal. The heat warms the food.

Other materials are not good conductors. But they may be good insulators. Insulators help keep heat from passing through. Most plastics are good insulators. So are clothes you wear, like sweaters and coats. You wear these clothes to keep warm when it is cold outside.

Changing Matter

Adding or taking away heat can change matter. Matter is something that takes up space. Matter can change from one state, or form, to another.

An ice cube is solid water. Solid is one state of matter. Heat can melt an ice cube. The ice cube changes into liquid water. Liquid is another state of matter. When heat is taken away, the water can change back. Liquid water turns into solid water.

Heat can make liquids boil. Water boils when it is heated. When the water boils, it turns into a gas. This gas is called water vapor. Solid, liquid and gas are three states of matter.

Heat from the sun causes liquid water to turn into water vapor. Water vapor mixes with the air. This is called evaporation.

Sometimes heat causes changes that cannot be changed back.

Bread can change into toast when you heat it. Eggs change when you cook them in a pan. You cannot untoast a piece of toast. You cannot uncook an egg.

Changing Air

Heat can warm air, too. A balloon is filled with air. When heat warms the air in the balloon, the air changes. The air takes up more space.

Heat from the sun warms objects all around you, like rocks, streets, and buildings. These objects then warm the air. Warm air is lighter than cold air. Warm air goes up. Cold air takes its place.

You can tell how hot or cold the air is. Temperature is a measure of how hot something is. People use thermometers to measure the temperature.

Effects of Heat on Objects, Matter, and Air: High Cohesion

Heat Moves

Heat can move from one object to another object, or it can move from one place to another place. Heat moves from warm objects to cooler ones. For example, you can warm your cold hands by holding a cup of warm soup. Your hands become warmer because heat moves from the soup, through the cup, to your hands. The heat from the soup also moves above the cup, so you can feel warm air rising above the cup.

Heat moves through some materials more easily than other materials. Conductors are materials through which heat moves easily. Most metals are good conductors. For example, metal pots are used for cooking because heat from the stove quickly moves through the metal pots and the heat in the pot warms the food.

Other materials are not good conductors, but instead are good insulators. Insulators are materials that help keep heat from passing through. For example, most plastics are good insulators. Other good insulators are the clothes you wear, especially sweaters and coats. You wear these insulating clothes in order to keep warm when it is cold outside.

Heat Changes Matter

Adding heat or taking away heat can change matter. Matter is something that takes up space. Matter can change from one state to another state, or from one form to another form. Three states of matter are solid, liquid and gas. For example, an ice cube is solid water. Heat can melt an ice cube, causing the ice cube to change into liquid water. When heat is taken away, the liquid water can change back into solid water (ice).

Heat can make liquids boil and change into a gas state. For example, water boils when it is heated. As the water boils, it turns into a gas state that is called water vapor. Heat from the sun causes liquid water to turn into water vapor. Water vapor then mixes with the air in a process called evaporation.

However, sometimes heat causes changes that cannot be changed back. As one example, bread can change into toast when you heat the bread. However, you cannot untoast a piece of toast by taking away heat. As another example, eggs change when you cook them in a pan, but of course you cannot uncook an egg by taking away the heat.

Heat Changes Air

Just as heat can warm liquids, it can also warm the air. Air is changed when it is heated. For example, if heat warms air in a balloon, the air changes by taking up more space.

Heat from the sun warms objects all around you, including rocks, streets, and buildings. These objects then warm the air. Warm air is lighter than cold air. Therefore, warm air moves upward. When the lighter, warm air goes up, the heavier, cold air moves downward. This cold air takes the place of the air that was warmed.

You can measure how hot or cold the air is by using temperature. Temperature is a measure of how hot something is. People use thermometers to measure temperature.

The Needs of Plants: Low Cohesion

What Are the Needs of Plants?

Like all living things, plants have certain needs. Plants need sunlight, water, and air to live. Plants also need minerals (MIN·uhr·uhlz). A mineral is a naturally occurring substance that is neither plant nor animal.

The parts of plants help them to get or make what they need. All plants get water and minerals from the soil. The root is the part of the plant that grows underground. Roots help hold the plant in the ground. Roots also help take in water and minerals that the plant needs.

The stem is the part that supports the plant. It helps the plant stand upright. It carries minerals and water from the roots. It also carries food from the leaves to other parts of the plant.

Some plants, such as mosses, are simple plants. They don’t have real roots or stems. These plants do not grow tall. Instead, they form low-growing mats in damp places to get water directly from the soil.

Other plants, such as the redwood tree, have many roots and a large stem. They can grow very tall.

Why Does a Plant Need Leaves?

The leaves (singular, *leaf*) are the main food-making part of the plant. Many leaves have broad, flat surfaces that help them take in sunlight. Leaves are green because of *chlorophyll*. Chlorophyll traps the energy (EN·uhr·jee) in sunlight for the plant.

The leaf also helps the plant get the air it needs. Each leaf has tiny holes that take in air for the plant. The leaf uses a gas in the air called *carbon dioxide*. The plant uses the Sun’s energy to combine carbon dioxide and water to make food. The stem then carries the food to the other parts of the plant.

Plants use the food they make to stay alive. When we eat plants or other animals that eat plants, we use this food, too.

When leaves make food for a plant, they give off oxygen (AHK·suh·juhn). Oxygen is a gas that is in air and water. People and animals need oxygen to live. You inhale the oxygen made by a plant with each breath you take.

How Do Plants Respond to Their Environment?

Have you ever seen a plant leaning toward a sunlit window? This is one way that plants respond to their environment. A plant responds to light by growing toward it. Some trees and shrubs drop their leaves as the days grow shorter and colder. These plants respond to the change in seasons from summer to winter.

Plants also respond to other things in the environment. For example, roots may grow toward water. The ability to respond to the environment helps a plant to live, grow, and meet its needs.

The Needs of Plants: High Cohesion

What Plants Need

Plants have certain needs, just like all living things have needs. For example, plants need sunlight, water, and air to live. Plants also need minerals (pronounced as MIN·uhr·uhlz). A mineral is not a plant or an animal. Instead, a mineral is a substance in the ground that occurs naturally. There are three parts of plants that help plants get what they need or help plants make what they need.

The Three Parts of a Plant

The three parts of the plant are the roots, stems, and leaves.

1. The Root

The root is the part of the plant that grows underground. All plants get water and minerals from the ground, which is sometimes called soil. Roots help the plant take in water and minerals that the plant needs from the soil. Roots also help hold the plant in the ground.

2. The Stem

The stem is the part that supports the plant. The stem helps the plant stand upright. It carries minerals and water from the roots of the plant to other parts of the plant. The stem also carries food from the leaves to other parts of the plant.

Some plants, such as the redwood tree, can grow very tall because they have many roots and a large stem. Other plants don't have real roots or stems. These plants are simple plants. An example of these simple plants is mosses. These simple plants do not grow tall. Instead of having roots and stems, they form low-growing mats in damp places. Simple plants get water directly from the soil through these mats.

3. The Leaves

The leaves help the plant make its food. The leaves need sunlight, air, and water to make food. Many leaves have broad, flat surfaces. These surfaces are broad and flat in order to help the leaves take in lots of sunlight. The energy in sunlight is trapped by the leaf by a substance called *chlorophyll* (pronounced KLO ro fill). Leaves are green because of chlorophyll.

The leaf also helps the plant get the air it needs to make food. This process is helped by tiny holes in each leaf. These holes take in air for the plant. The leaf only uses a gas in the air called *carbon dioxide* (CAR bun di OK side). However, the plant needs both carbon dioxide and water to make food. The plant uses the Sun's energy to combine the carbon dioxide and water to make food. The stem then carries this food to the other parts of the plant.

Plants use the food they make to stay alive. When we eat plants or when we eat animals that have eaten plants, we also use this food. That means that the food that keeps the plant alive, keeps us alive too. We also need oxygen (AHK·suh·juhn) to stay alive. The leaves give off oxygen when they make food for the plant. Oxygen is a gas that is in air and in water. All people and animals need oxygen to live. Therefore, we need plants because we inhale oxygen made by plants with each breath that we take.

How Plants Respond to Their Environment

Consider a plant leaning toward a window on which the sun shines. A plant responds to light by growing toward it. This is one way that plants respond to their environment. But plants also respond to other things in the environment. For example, roots may grow toward water. And, some trees and shrubs drop their leaves as the days grow shorter and colder in the fall. These plants are responding to the change in seasons from summer to winter. The ability of a plant to respond to the environment helps a plant to live, to grow, and to meet its needs.

Moving: Low Cohesion

John was very upset when his family moved to another state last month. He knew he would miss all his friends from the neighborhood – the twins, Charlie and Bob; Lisa, Debbie, Mike, and Jimmy. He would miss the playground two blocks from his home where they played baseball. He knew he would also miss the lake where he and his father went fishing, his friends and teachers at school, his Aunt Lucy who lived three blocks away, and the stores where he went shopping with this family. And he knew he would miss his home: the nights in the den watching sports, the barbecue parties in the backyard, his hideout in the attic and, of course, his room.

On moving day, John sat on the steps of his front porch and barely moved. “Come on,” his mother said. “Help us bring some things into the car.”

John could not even hear her. He was thinking of all the good times he had in the neighborhood. When some of his friends came by to say good-bye, tears flowed down his face, and he could barely look at them.

“Are you going to write to me?” he asked.

“Of course,” they said. They each made sure they had the other’s address and telephone number.

John and his dog, Ralph, were the last to get into the car. As his father drove away, John looked back at his house as it got smaller and smaller. When they made a left turn onto another street, he stared out the window at the familiar houses, the same ones he saw when he rode his bicycle through the neighborhood.

“Don’t be upset,” his mother said. “You’ll meet new friends where we are going.”

“Just think of it as an opportunity to meet new people,” his father said. “Life is full of changes.”

“And you can still keep in touch with your old friends,” his mother said.

“I do not want any new friends!” John said.

John was upset for almost a week after he moved. But then he started meeting other children in his neighborhood. His neighbors had two children, Samantha and Tom, that were John’s age. He met them when he played outside with Ralph. They liked a lot of the same things John liked: baseball, bicycle riding, playing tag. They introduced him to other children. In the fall, John met even more children at school. He liked his new teachers. But he still could not wait for Thanksgiving to visit his aunt and uncle in his old neighborhood, where he would see his old friends again.

Moving: High Cohesion

Last month John and his family moved to another state. John was very upset because he knew he would miss all his friends from the neighborhood. He had many friends: the twins, Charlie and Bob; Lisa, Debbie, Mike, and Jimmy. He would miss many other people too: his friends and teachers at school and his Aunt Lucy who lived three blocks away. He would miss places too. He would miss the playground two blocks from his home where he and his friends played baseball. He knew he would also miss the lake where he and his father went fishing and the stores where he went shopping with this family. And he knew he would miss his home: the nights in the den watching sports, the barbecue parties in the backyard, his hideout in the attic and, of course, his own room.

On moving day, John sat on the steps of his front porch and he was so upset that he barely moved. His mother said, "Come on, help us bring some things into the car." But, John could not even hear his mother because he was thinking of all the good times he had in the neighborhood.

Later, when some of his friends came by to say good-bye, tears flowed down John's face. Because he was so sad, he could barely look at them.

John wanted to keep in touch with his friends, so he asked, "Are you going to write to me?"

His friends said: "Of course, we will write to you." He and his friends each made sure they had each other's address and telephone number, so they could write and call.

Then it was time to leave. John and his dog, Ralph, were the last to get into the car. As his father drove away, John looked back at his house. While they were driving away it seemed that the house got smaller and smaller as it got further away. When they made a left turn onto another street, John stared out the window at the familiar houses. They were so familiar because these houses were the same ones he saw when he rode his bicycle through the neighborhood.

His parents knew he was upset and tried to comfort him. His mother said: "Don't be upset, you'll meet new friends where we are going."

His father said: "Just think of this move as an opportunity to meet new people. We know that this move is a change for you. But changes can be good. Life is full of changes."

His mother said: "You can make new friends, and you can still keep in touch with your old friends."

John disagreed, "I do not want any new friends!"

John was upset for almost a week after he moved to the other state. But then he started meeting other children in his neighborhood. His neighbors had two children, Samantha and Tom, who were John's age. He met Samantha and Tom when he played outside with his dog, Ralph. Samantha and Tom liked to do a lot of the same things John liked to do: baseball, bicycle riding, playing tag. John made more friends when Samantha and Tom introduced him to other children. In the fall, when school began, John met even more children at school. He also liked his new teachers. But he still could not wait for Thanksgiving to visit his aunt and uncle in his old neighborhood, where he would see his old friends again.

Orlando: Low Cohesion

Salvador was upset. He told Mama he was going out. He didn't want her to be worried or sad. He just needed to be alone.

He hurried across the cornfield. He turned the corner of the fort and ran through the door. No one would see or hear him cry.

The floor was just dirt, but Salvador liked his fort. He had made it himself the year before. He had brought wood scraps from the old barn behind his house.

Salvador lay down on the dirt floor. He closed his eyes. He had a picture in his mind of his mama. He thought about what happened at home before he left. He cried some more.

“We have to sell Orlando,” Mama had said.

Salvador had put down his fork.

“What did you say, Mama?”

Mama tried to explain. But she could not bring herself to say more. She just looked away.

“Why would we sell Orlando?” Salvador had asked.

“You know we are moving, Salvador. And we will not have room for him in our new place. I know he is a fine pig,” Mama had said.

“Orlando is more than a pig!” Salvador had shouted. “He is family.”

“I know, son,” Mama had said.

“If anyone tries to take poor Orlando, I won't let them!” Salvador had shouted. Then he had hurried from the house to his fort.

Salvador adored Orlando. Orlando was four years old. Salvador had named him after a place in Florida he had read about. There could not be a more perfect pet for Salvador.

As Salvador lay in the fort crying, it began to rain. At first it was only a light rain. Then it began to pour. Next there was lightning and thunder. It was a very bad storm!

Next Salvador heard a loud *crack*! Lightning had struck a tree in the forest. The tree was on fire!

Salvador got up and ran out of the fort. It was dark! He couldn't see.

He did not know which way was home.

Before long Salvador heard a snorting sound. It was Orlando! Orlando had come to find him! Salvador reached out for Orlando. He felt the pig's ear. He held on.

Orlando led Salvador home. They ran through the cornfield as fast as they could go. Mama stood by the door on the porch.

“Oh, Salvador. I was so worried!” she cried.

“Orlando saved me,” Salvador said. “Yes, I know,” said Mama. “He is family! We will just have to find room for him at our next place.”

This brought a smile to Salvador's face. Orlando was saved!

“Now he really is a member of our family!” said Salvador.

Orlando: High Cohesion

Once upon a time, there was a boy. His name was Salvador. Salvador adored his pet pig named Orlando. Orlando was four years old. Salvador had named Orlando after a place in Florida that he had read about. There could not be a more perfect pet for Salvador than his pet pig.

One day, Orlando was eating dinner at home with his Mama. Mama said, "We have to sell Orlando."

Salvador put down his fork. "What did you say, Mama?"

Mama tried to explain, but she could not bring herself to say more. Mama just looked away.

Salvador asked, "Why would we sell Orlando?"

Mama answered, "You know we are moving, Salvador. But we will not have enough room for Orlando in our new place. We cannot take him, even though I know he is a fine pig."

Salvador shouted, "Orlando is more than a pig! He is family."

Mama said, "I know, son."

Salvador shouted, "If anyone tries to take poor Orlando, I won't let them!"

Salvador was upset, so he needed to be alone. Salvador told Mama he was going out because he didn't want her to be worried or sad.

Salvador left the house and hurried across the cornfield. He turned the corner to a fort that he had made and ran through the door. He went to the fort so no one would see him cry or hear him cry.

The floor of the fort was just dirt, but Salvador liked his fort. He had made it by himself one year ago. He had brought wood scraps from an old barn behind his house to build the fort.

After Salvador ran into his fort, he lay down on the dirt floor and closed his eyes. He had a picture in his mind of his mama. He thought about his mama telling him that they had to sell Orlando, and that made him cry some more.

As Salvador lay in the fort crying, it began to rain. At first it was only a light rain. Then it began to pour. Next there was lightning and thunder because it was a very bad storm!

Then lightning struck a tree in the forest, so Salvador heard a loud *crack*! The lightning had caught the tree on fire! Because of the noise and fire, Salvador got up and ran out of the fort. It was dark, so he couldn't see and did not know which way was home. Salvador became lost in the dark.

Before long Salvador heard a snorting sound. The snorting was from Orlando! Orlando had come to find him! When Salvador reached out for Orlando, he felt the pig's ear. Salvador held on to the ear as Orlando led Salvador home. They ran through the cornfield as fast as they could go.

When Salvador and Orlando got home, Mama stood by the door on the porch. Mama cried, "Oh, Salvador. I was so worried!"

Salvador explained, "Orlando saved me."

Mama said, "Yes, I know. Orlando must be family because he saved you! We will just have to find room for him at our next place."

So Orlando was saved, which brought a smile to Salvador's face. Salvador said, "Now Orlando really is a member of our family!"