

ABSTRACT

Title of Document

CLARIFYING LINGUISTIC COMPREHENSION
IN THE SIMPLE VIEW OF READING: THE
INFLUENCE OF WORD-, SENTENCE-, AND
DISCOURSE-LEVEL LINGUISTIC SKILLS ON
READING COMPREHENSION.

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There are a high number of students who struggle with reading comprehension beyond the primary grades and understanding the skills involved in successful reading comprehension continues to be a topic of investigation. The Simple View of Reading (SVR) is a viable theory of reading that suggests reading comprehension results from developing skills in the areas of decoding and linguistic comprehension. This study examined the role of linguistic comprehension in reading comprehension within the SVR framework concurrently and over time in a sample of fourth-, fifth-, and sixth-grade students. I organized linguistic comprehension into word-, sentence-, and discourse-level skills. Linguistic comprehension is poorly defined in the extant literature and although results consistently support a relationship between linguistic and reading comprehension, no inference can be made regarding which specific linguistic comprehension skills are most influential in reading comprehension, concurrently or longitudinally. Through the use of hierarchical regression, results suggest that there are differential effects of the linguistic comprehension variable(s) on reading comprehension at all grades. Namely, word-level linguistic skills were significant positive predictors of reading comprehension

at all grades. Similarly, discourse-level linguistic skills significantly predicted fourth- and fifth-grade, though not sixth-grade reading comprehension. Finally, sentence-level linguistic skills did not emerge as significant predictors of reading comprehension at any grade. Additional hierarchical regression analyses revealed that over time the influence of linguistic comprehension on reading comprehension was stable from fourth to sixth grade. These results are discussed in light of the limitations of the study and areas of future research are suggested.

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READING: THE INFLUENCE OF WORD-, SENTENCE-, AND DISCOURSE-LEVEL
LINGUISTIC SKILLS ON READING COMPREHENSION

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Chapter 1

Statement of the Problem

Successful readers comprehend text. Reading comprehension is defined as “the process of simultaneously extracting and constructing meaning through interaction and involvement with written language” (RAND Reading Study Group, 2002, p. 11). It involves the reader who does the comprehending, the text that is to be comprehended, and the cognitive activity in which comprehension is a part. Instructional methods and materials are more easily controlled and manipulated with regards to managing the text and activity components of reading comprehension. It is the reader who presents more of a challenge when assessing and teaching reading comprehension.

Since there are a high percentage of students who struggle with reading beyond the primary grades, more focus is needed on addressing the needs of older students struggling with reading comprehension. In fact, 36% - 46% of children who “develop” late emerging reading disabilities were not identified in earlier grades (Badian, 1999; Compton, Fuchs, Fuchs, Elleman, & Gilbert, 2008; Leach, Scarborough, & Rescorla, 2003; Lipka, Lesaux, & Siegel, 2006). Fourth-grade reading scores from the 2009 National Assessment of Educational Progress remained the same from 2007 and have only increased slightly from 1992 (NCES, 2009). Fourth graders are required to make the transition from “learning to read” to “reading to learn” (Chall, 1983), therefore academic success is more related to reading comprehension than decoding. Additionally, texts in upper elementary school become more linguistically complex, and reading comprehension relies on vocabulary and other linguistic skills (Verhoeven, van Leeuwe, & Vermeer, 2011). Given the need to identify the specific aspects of the linguistic

components influencing reading comprehension in upper elementary students the remainder of the chapter will (a) introduce the Simple View of Reading (SVR) as a viable theoretical framework in which the relationships between linguistic and reading comprehension can be investigated, (b) briefly review the varying definitions of linguistic comprehension in the extant literature, and (c) present some of the methodological challenges associated with examining the relationship between linguistic comprehension and reading comprehension.

The Simple View of Reading

Gough and Tunmer (1986) attempted to clarify the role of decoding in reading by proposing a simple model of reading where reading equals the product of decoding and comprehension. The Simple View of Reading (SVR), is now a viable theory of reading (Kirby & Savage, 2008), and is centered around the premise that reading comprehension (RC) results from developing skills in the areas of decoding (D) and linguistic comprehension (LC) and is characterized by the following equation: $D \times LC = RC$.

Gough and Tunmer's (1986) original definition of the components included (a) *decoding* as the ability to pronounce nonwords using an understanding of alphabetic principle, as well as the ability to read isolated words quickly and accurately, and (b) *linguistic comprehension* as the process of interpreting spoken words, sentences, and discourse.

The multiplicative relationship between decoding and linguistic comprehension implies that it is the interaction between the two that is important, or when there is no linguistic comprehension or decoding then there is no reading comprehension. The additive relationship between decoding and linguistic comprehension is considered more appropriate when investigating SVR in a typically developing sample because reading

comprehension could possibly be attained without either decoding or linguistic comprehension (Chen & Vellutino, 1997; Savage, 2006; Silverman et al. in press). Given this consensus, the additive model will be used in the current study since a threshold of linguistic comprehension and decoding skills would be expected given that this normally distributed sample includes older (fourth- through sixth-grade) students.

The SVR framework provides researchers a mechanism to investigate skills the reader needs to comprehend text. Decoding and linguistic comprehension contribute significantly and uniquely to reading comprehension in younger children (de Jong & van der Leij, 2002; Kendeou, Savage, & van den Broek, 2009; Storch & Whitehurst, 2002) with the relationship between linguistic comprehension and reading comprehension becoming stronger as children get older (Adlof, Catts, & Little, 2006; Kendeou, van den Broek, White, & Lynch, 2009; Ouellette & Beers, 2010; Tilstra, McMaster, van den Broek, Kendeou, & Rapp, 2009). In the Adlof et al. study, fourth-grade word recognition and listening comprehension contributed 62.2% shared variance to explain reading comprehension, and listening comprehension uniquely accounted for 17% of that variance where as all of the variance in eighth-grade reading comprehension was explained by listening comprehension, which was an increase from fourth grade. Similarly, the amount of reading comprehension variance explained by listening comprehension, beyond decoding, increased from fourth- (6%) to seventh-grade (13%) in the Tilstra et al. (2009) study.

Measurement of the decoding component of SVR included including real word reading (Verhoeven & van Leeuwe, 2008), nonword reading (Hoover & Gough, 1990; Joshi & Aaron, 2000; Ricketts, Nation, & Bishop, 2007) and a combination of the two

(Adlof et al., 2006; Cutting & Scarborough, 2006; Silverman, Speece, Harring, & Ritchey, in press). Studies of linguistic comprehension as one of the components of SVR have investigated a wide range of variables including listening comprehension (Georgiou, Das, & Hayward, 2009; Johnston & Kirby, 2006), language comprehension (Catts, Adlof, & Weismer, 2006), and verbal proficiency (Tilstra et al., 2009). There is also variability in defining the construct of reading comprehension in this literature base. Researchers have often measured reading comprehension through one test or subtest (Berninger & Abbott, 2010; Chen & Vellutino, 1997; Nation & Snowling, 2004; Ouellette & Beers, 2010; Ouellette, 2006; Ricketts et al., 2007; Tilstra et al., 2009; Verhoeven & van Leeuwe, 2008). This may limit interpretation of findings since studies have shown that different tests with different formats measure SVR components differently (Cutting & Scarborough, 2006; Keenan, Betjemann, & Olson, 2008; Spear-Swerling, 2004). For example, question-answering formats correlate more with the linguistic comprehension component than cloze formats (i.e., sentences with blanks to be filled in with a word to complete the sentence) (Nation & Snowling, 1997).

Although SVR is accepted as an adequate framework for explaining and investigating reading comprehension, there are gaps in the literature related to inconsistent definitions of the linguistic comprehension as well as which oral language skills are most related to reading comprehension within the linguistic comprehension construct. The study of linguistic comprehension depends on measuring oral language skills, but across studies the rationale for selecting measures is not consistent. Traditionally, oral language is described by at least five parameters including: phonology (concerned with rules governing speech sounds and combinations), semantics (concerned

with meaning of words and word combinations and/or relationships), syntax (concerned with the rule system for how words are related within and combined into larger, meaningful units), morphology (concerned with words and inflections that convey subtle meaning and serve specific grammatical function, and pragmatics (concerned with the use of language in context) (ASHA, 1982). Measurement of linguistic comprehension did not consistently include all of these parameters. The parameters assessed most often were semantics, syntax, and morphology while phonology was often captured in the decoding component as phonological awareness. No studies explicitly measured pragmatics, most likely due to the limited number of reliable standardized measures available for use.

Gough and Tunmer (1986) viewed linguistic comprehension as “the process by which, given lexical (i.e., word) information, sentences and discourses are interpreted” thereby suggesting a general framework organizing oral language skills in an effort to determine which are most important to reading comprehension. Adlof, Catts, and Lee (2010) found that different combinations of oral language variables in kindergarten, including expressive measures such as sentence imitation, oral vocabulary, and grammatical completion, predicted reading comprehension in later grades. Since the sole use of receptive oral language measures might present an incomplete representation of the relationship between linguistic comprehension and reading comprehension, both receptive and expressive measures of oral language will be used to represent linguistic comprehension in the current study. Additionally, Scarborough (2001) suggested that there are many strands of linguistic skills that are “woven together” (p. 97) resulting in skilled reading. See Figure 1 for an illustration of the component skills underlying

linguistic comprehension. Consistent with Gough and Tunmer (1986), word-, sentence-, and discourse-level skills, both receptive and expressive, within the parameters of vocabulary/semantics, syntax and morphology will be measured.

Given the varying terms and measures in the study of linguistic comprehension, the next three sections of this chapter present overviews of the three main types of studies investigating linguistic comprehension and reading comprehension organized by terms and measures used in the studies. Although the studies used a variety of terms, linguistic comprehension will be the term used in the proposed study to represent oral language skills at the word-, sentence-, and discourse-level. This term will also be used in the description of studies.

Listening Comprehension and Reading Comprehension

Although Gough and Tunmer's (1986) model used linguistic comprehension as the component term in the original equation to predict reading comprehension, it began to be commonly defined as listening comprehension. This is aligned with the original SVR presumption that once printed text is decoded, the reader applies the same mechanisms used in understanding its spoken equivalent. Researchers used listening comprehension measures to investigate the relationship with reading comprehension in upper elementary students (Chen & Vellutino, 1997; Keenan, et al., 2008; Verhoeven & van Leeuwe, 2008). There was a significant relationship between listening and reading comprehension, beyond the ability to decode, in older elementary students concurrently and longitudinally.

Listening Comprehension, Oral Language, and Reading Comprehension

Since linguistic comprehension is a broad and difficult to define construct (Kirby & Savage, 2008), researchers attempted to capture the complexity of it by including additional measures of oral language beside or combined with listening comprehension to investigate the relationship with reading comprehension. The majority of these studies examined this relationship within the SVR framework, therefore controlling for decoding as the other influential component in the model (Adlof et al., 2006; Harlaar et al., 2010; Ouellette & Beers, 2010; Silverman et al., in press; Spear-Swerling, 2004; Tilstra et al., 2009). The definitions and measures used varied for each study and included terms such as listening comprehension (measured by a different test in each study), oral language, vocabulary, linguistic comprehension, language comprehension, and verbal proficiency. Similar to the findings when defined only as listening comprehension, when decoding was controlled, a significant relationship between linguistic comprehension and reading comprehension in the upper elementary samples existed. Linguistic and reading comprehension, investigated within frameworks other than SVR, were also significantly related (Berninger & Abbott, 2010; Nation & Snowling, 2004).

Oral Language and Reading Comprehension

Interestingly, studies examined linguistic comprehension constructs that did not include specific measures of listening comprehension and each was related to reading comprehension in older elementary students (Cutting & Scarborough, 2006; Goff, Pratt, & Ong, 2005; Nagy, Berninger, & Abbott, 2006; Ouellette, 2006; Ricketts et al., 2007). The most frequent predictor of reading comprehension measured was vocabulary (word-level semantics). Additional areas investigated included receptive grammar combined with receptive vocabulary to create a composite variable (Goff, et al., 2005), and

morphological awareness explored independent of other oral language skills (Nagy et al., 2006). Cutting and Scarborough (2006) organized measures of semantics, syntax and morphology into two composite variables representing linguistic comprehension: lexical skills (including vocabulary) and sentence processing skills. Inconsistency of measurement, as well as definition of construct, continued to be a problem in this group of studies as well. Similar to the other groups of studies, a relationship between linguistic comprehension, most frequently including vocabulary, and reading comprehension existed regardless of the measurement and definition inconsistencies. Although vocabulary was found to be significant, it fails to capture the breadth of linguistic comprehension.

Conceptual and Methodological Issues

It is clear that a relationship exists between linguistic comprehension, variously defined, and reading comprehension in students in upper elementary grades. However, what is not clear is how oral language variables are organized under the umbrella of linguistic comprehension. Shadish, Cook, and Campbell (2002) consider this a threat to construct validity. That is, linguistic comprehension means many different things and depends on the researchers' perspective. Researchers have investigated an array of oral language variables as predictors of reading comprehension but not in an organized conceptual framework. Using vocabulary (one aspect of semantics) as an example, the linguistic comprehension construct has included: (a) single measures (i.e., observed variables) of vocabulary (Ouellette, 2006), (b) composite variables that include vocabulary and listening comprehension (Spear-Swerling, 2004), and (c) a latent variable including one measure of vocabulary. Although the importance of vocabulary in reading

comprehension has been established, it is unclear how it interacts with the other parameters of oral language (e.g., syntax or sentence-level semantics) within SVR. Cutting and Scarborough (2006) used composite variables labeled at the lexical and sentence processing levels, which provided a different organizational model in which oral language skills could be measured and compared. This was the only study found in the existing literature that described the oral language variables by level rather than by parameter. This framework is sensible as it matches up with the demands of the reading task. Currently, there is no clear conceptual framework guiding the selection of oral language variables for linguistic comprehension. Additionally, the presence of mono-operation bias for linguistic comprehension and mono-method bias for reading comprehension threatens construct validity as well. As will be reviewed in Chapter 2, unreliability of measures is a threat to statistical conclusion validity due to researchers not reporting reliability or using author-made tests with no reported reliability. Finally, external validity is a problem resulting from limited information about the sample characteristics.

Purpose

The use of SVR as the foundation for investigating the relationship between linguistic comprehension and reading comprehension is supported by the extant literature in this area. Research to this point indicates a relationship between linguistic comprehension (regardless of how it is defined) and reading comprehension. The ambiguity of the construct of linguistic comprehension calls for further investigation of the oral language skills encompassed in the construct and how they relate to reading comprehension. Within the extant literature, it is most common to measure linguistic

comprehension by some oral language parameter (e.g., semantics/vocabulary) although the researchers do not typically provide a clear conceptual framework for choosing the oral language skills important in linguistic comprehension. Within a limited framework of linguistic comprehension measures, I propose to examine the relationship between language at the word-, sentence- and discourse-level and reading comprehension in fourth, fifth and sixth grades. This framework is consistent with Gough and Tunmer's (1986) original definition of linguistic comprehension. Using levels (i.e., word-, sentence-, and discourse-) of oral language creates a template for understanding linguistic comprehension by encompassing the parameters of language within a framework and extends the work of Cutting and Scarborough (2006) by investigating discourse-level linguistic skills in addition to word- and sentence-level linguistic skills. It is relevant to further investigate these areas in upper elementary students, both concurrently and longitudinally, given the problems at that age range including: reading failure, the increasing relationship between linguistic and reading comprehension, and the significant number of students identified with late-emerging reading comprehension deficits. One longitudinal study addressing this area suggested an increasing relationship between linguistic comprehension and reading comprehension from fourth- to eighth-grade (Adlof, Catts, & Little, 2006). A cross-grade comparison conducted by Tilstra et al. (2009) also supported an increasing relationship between linguistic comprehension (measured by listening comprehension) and reading comprehension from fourth- to seventh-grade. The authors also found that the relationship between linguistic comprehension (as measured by verbal proficiency) and reading comprehension increased from fourth- to seventh-grade and from seventh- to ninth-grade. Since the

studies investigating this area of research are limited and the extant literature addressing the relationship of linguistic and reading comprehension over time are limited to timeframes of three to four years, the following research questions are posed.

Research Questions

To further inform the field on the relationship between linguistic comprehension and reading comprehension in SVR, this study addressed the following questions in fourth-through sixth-grade students:

1. Beyond the influence of decoding and phonological processing skills, what is the unique impact of each (word-, sentence-, and discourse-level) linguistic comprehension skill in fourth grade on reading comprehension, measured in fourth, fifth, and sixth grades?

I hypothesized that linguistic comprehension (i.e., word-, sentence-, and discourse-level skills) will contribute to reading comprehension beyond the control variables (i.e., decoding and phonological processing) in fourth, fifth, and sixth grades (Adlof et al., 2006; Chen & Vellutino, 1997; Harlaar et al., 2010; Nation & Snowling, 2004; Ouellette, 2006; Ricketts et al., 2007; Silverman et al., in press; Spear-Swerling, 2004; Tilstra et al., 2009). Beyond the control variables, word-, and sentence-level linguistic skills, discourse-level linguistic skills will contribute uniquely to reading comprehension at all grade levels (Adlof et al., 2006; Harlaar et al., 2010; Nation & Snowling, 2004; Silverman et al., in press; Spear-Swerling, 2004; Verhoeven & van Leeuwe, 2008). Beyond the control variables, sentence-level, and discourse-level linguistic skills, word-level linguistic skills will also contribute uniquely to reading comprehension at all grade levels (Nation & Snowling, 2004; Ouellette & Beers, 2010; Tilstra et al., 2009). The

impact of sentence-level linguistic skills will not be significant beyond the control variables, word-, and discourse-level linguistic skills since all of the variance in reading comprehension will be accounted for by those variables at all grade levels.

2. Beyond the influence of decoding and phonological processing skills, does linguistic comprehension (word-, sentence-, and discourse-level skills) have an increasing impact on reading comprehension across fourth, fifth, and sixth grades?

I hypothesized that the impact from linguistic comprehension on reading comprehension will be difficult to detect from fourth to fifth grade then fifth to sixth grade. There will be an increasing impact of linguistic comprehension on reading comprehension from fourth to sixth grade (Adlof et al., 2006; Tilstra et al., 2009; Verhoeven & van Leeuwe, 2008)

Implications

Students in upper elementary school continue to struggle with reading comprehension and a relationship between linguistic and reading comprehension has been established. However, linguistic comprehension does not enjoy a uniform interpretation or operationalization making the relationship between linguistic and reading comprehension unclear. Clarification of the linguistic comprehension construct will provide an improved understanding of the oral language skills most related to reading comprehension, which is important in the accurate assessment and treatment of reading comprehension problems. The use of a more explicit framework (i.e., word-, sentence, and discourse-level linguistic skills) to investigate the linguistic component of SVR informs the literature and provides a replicable conceptual framework for future research. Investigating the relationship of linguistic and reading comprehension

longitudinally attempts to replicate and inform the findings of the few studies that found the relationship of linguistic comprehension and reading comprehension becomes stronger in upper elementary grades (Adlof et al., 2006; Tilstra et al., 2009; Verhoeven & van Leeuwe, 2008).

Definitions of Key Terms

Oral language – The understanding and use of verbal skills comprised of at least five parameters including phonology, semantics, syntax, morphology, and pragmatics (ASHA, 1982).

Semantics – The understanding and use of meanings and associations of words individually and in sentences, including vocabulary (ASHA, 1993)

Syntax – The understanding and use of the rules that order and combine words to form sentences, and the relationships among the elements within a sentence (ASHA, 1993).

Morphology - The understanding and use of the system that governs the structure of words and the construction of word forms (ASHA, 1993).

Simple View of Reading (SVR) – A viable and accepted theoretical framework, on which this study is based, explaining reading comprehension as the additive combination of decoding and linguistic comprehension (Gough & Tunmer, 1986; Kirby & Savage, 2008).

Linguistic comprehension – The oral language construct in SVR defined in this study by word-, sentence-, and discourse-level linguistic skills.

Word-level linguistic skills – An independent variable in this study measured by scores from the Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF-4)

Word Classes subtest (Semel, Wiig, & Secord, 2003) and the Weschler Intelligence Scale for Children-Fourth Edition (WISC-IV) Vocabulary subtest (Weschler, 2003)

Sentence-level linguistic skills – An independent variable in this study measured by scores from the CELF-4 Formulated Sentences subtest (Semel et al., 2003)

Discourse-level linguistic skills – An independent variable in this study defined by scores from the Listening Comprehension Test, a researcher-developed test of oral comprehension of passages based on the Gates MacGinite Reading Comprehension (GMRC) subtest (MacGinite, MacGinite, Maria, & Dreyer, 2000).

Decoding – The ability to read isolated real words and pseudowords. An independent variable in this study measured by scores on the Letter Word Identification and Word Attack subtests of the Woodcock Johnson Tests of Achievement, Third Edition (WJ III) (Woodcock, McGrew, Mather, & Schrank, 2001).

Phonological Processing – The awareness of the phonological (sound) segments of speech most commonly the segments represented by the letters of the alphabet (Blachman, Ball, Black, & Tangel, 2000) and the encoding and storage of phonological information in memory (Catts & Kamhi, 2005). An independent variable in this study measured by scores on the Elision and Nonword Repetition subtests of the Comprehensive Test of Phonological Processing (CTOPP) (Wagner, Torgesen, & Rashotte, 1999).

Reading comprehension – The process of reading and extracting meaning from text. The dependent variable in this study measured by the GMRC (MacGinite, et al., 2000) and the Maze (D. Fuchs & Fuchs, 1992; L. S. Fuchs, n.d.).

Chapter 2

Review of the Literature

The purpose of this chapter is to summarize the literature investigating the relationship between linguistic comprehension and reading comprehension within, but not limited to, the theoretical framework of SVR. This chapter begins with a review of the framework and components of SVR. Next, content and methodological reviews of studies examining SVR are presented specifically investigating (a) listening comprehension as a predictor of reading comprehension, (b) listening comprehension and an additional component of oral language as predictors of reading comprehension, and (c) any component of oral language (i.e., oral vocabulary) as a predictor of reading comprehension. Lastly, a summary of the review will be provided along with a listing of the research questions guiding this study.

The Simple View of Reading

In an effort to create a framework providing clarity to educators regarding reading instruction, Gough and Tunmer (1986) developed the Simple View of Reading. Within SVR, reading comprehension is the end goal of reading and is the product of decoding and linguistic comprehension. Since that time, researchers who have investigated SVR have generally supported the framework and its components (Catts et al., 2006; Georgiou et al., 2009; Hoover & Gough, 1990; Kendeou, Savage, et al., 2009). Researchers have also indicated that the term *simple* in SVR may be just that and suggested that the model may require modification (Johnston & Kirby, 2006; Joshi & Aaron, 2000; Silverman et al., in press; Tilstra et al., 2009). The components within SVR are complex in nature given the issues of definition, assessment, and development impacting the framework.

Decoding. Gough and Tunmer (1986) discuss decoding as the ability to pronounce pseudowords that requires an understanding of alphabetic principle along with developed phonemic awareness and phonics skills. They also explained “the skilled decoder is exactly the reader who can read isolated words quickly, accurately, and silently” (p. 7). There has been much learned about decoding since Gough and Tunmer discussed it in 1986 and the ambiguity between decoding defined as phonic analysis or as successful word recognition has been examined and assumed to be the latter (Kirby & Savage, 2008). Johnston and Kirby (2006) addressed this issue by examining two separate measures of decoding as predictors of reading comprehension in SVR: (a) pseudoword reading, and (b) word identification. They found that when each was combined with listening comprehension, word recognition was a better predictor accounting for more unique variance in reading comprehension than pseudoword reading (57.3 – 72.7%; 51.0 – 66.4 %, respectively). Pseudoword reading provided a clearer indication of one aspect of the decoding process related to the reliance on the sounding out of smaller units (i.e., letters and syllables) rather than whole-unit recognition. Silverman et al. (in press) determined through exploratory factor analysis that measures of phonological awareness, including pseudoword reading, and measures of decoding loaded on the same factor representing decoding skills. This indicates that decoding consists of earlier developing skills including phonological awareness in addition to the more traditional skills associated with decoding. These results suggested that it is important to consider how decoding is defined and that SVR may be incomplete if decoding is defined solely by real word identification, especially for “less able readers” still reliant on the earlier developmental skills of decoding.

Linguistic comprehension. Gough and Tunmer's (1986) original framework defined the comprehension component (LC) in the equation $R = D \times LC$ as "*linguistic* comprehension, that is, the process by which, given lexical (i.e., word) information, sentences and discourses are interpreted" (p. 7). Consistency is lacking in the literature about how to define and measure linguistic comprehension. Many different measures were used, with no general consensus, in defining the construct. Construct terminology has included listening comprehension, language comprehension, linguistic comprehension, oral language, and language. Eventually, the C in Gough and Tunmer's equation morphed into LC and is commonly referred to as listening comprehension. Many researchers have used only measures of listening comprehension as predictors of reading comprehension (Chen & Vellutino, 1997; Georgiou et al., 2009; Johnston & Kirby, 2006; Ouellette & Beers, 2010; Tilstra et al., 2009). Others have viewed LC in a broader sense, either as linguistic or language comprehension, and used composite scores from a combination of assessments including receptive and expressive vocabulary and receptive and expressive grammar as predictors of reading comprehension (Adlof, Catts, & Lee, 2010; Catts et al., 2006; Cutting, Materek, Cole, Levine, & Mahone, 2009; Cutting & Scarborough, 2006).

Regardless of the definition which included the use of expressive and receptive oral language measures, the relationship between linguistic comprehension and reading comprehension was significant not only in typically developing students but in students with poor comprehension skills as well (Cain & Oakhill, 2006; Catts et al., 2006; Kelso, Fletcher, & Lee, 2007; Nation, Clarke, Marshall, & Durand, 2004; Wise, Sevcik, Morris, Lovett, & Wolf, 2007).

The use of both receptive and expressive measures to operationalize linguistic comprehension is prevalent in the extant literature but there were no attempts to discuss the rationale for selecting the measures. Although linguistic comprehension denotes receptive ability, there is evidence that expressive oral language skills influenced reading comprehension therefore should be included in the operationalization of the construct. Scarborough (2001) reported results based on a meta-analysis of findings from studies examining kindergarten predictor variables and later reading scores. Results indicated that oral language skills, both receptive and expressive, are correlated with later reading skills, including reading comprehension. Additionally, Adlof, Catts, and Lee (2010) also found significant relationships between both receptive and expressive oral language skills in kindergarten and later reading comprehension ability. Given that early expressive, along with receptive oral language skills are predictive of reading comprehension in later grades, the use of both receptive and expressive measures to operationalize linguistic comprehension is warranted and both types of measures will be used in this study. The challenges of defining linguistic comprehension continue in this study although organizing the oral language variables according to Gough and Tunmer's (1986) framework (i.e., word-, sentence-, and discourse-level skills) along with clear, detailed descriptions of how each variable is operationalized will help to disentangle the relationship between linguistic and reading comprehension.

Product term. The original framework used a multiplicative term to explain the role of linguistic comprehension in SVR. This is significant because it means that it is the interaction of the two components that is important (Kirby & Savage, 2008). Given this interpretation, in an extreme case of no decoding or linguistic comprehension there

would be no reading comprehension. The scenario of no linguistic comprehension is more difficult to imagine which is one of the reasons alternative models (i.e., additive) were investigated, especially in samples of typically developing students where extreme cases of no decoding or linguistic comprehension are less likely. The current general consensus emerging is that if there are any linguistic comprehension skills present, as would be the case in a typically developing sample in upper elementary school, then an additive term is more appropriate within SVR (Chen & Vellutino, 1997; Georgiou et al., 2009; Silverman et al., in press).

Reading comprehension. Similar to linguistic comprehension, reading comprehension is also a broad construct that has definition and measurement issues as well. Given the number of assessment formats available to evaluate reading comprehension, it cannot be assumed that they all assess the same thing (Cutting & Scarborough, 2006; Hagtvet, 2003; Keenan, et al., 2008). Because of this variation, one approach is to define reading comprehension by using several measures that vary in format. The most common formats include: (a) reading passages (that vary in length and type) then responding to questions (open ended or multiple choice), (b) cloze, where passages are read and correct words are chosen and inserted to complete a sentence, and (c) reading sentences and pointing to pictures that describe the sentence. Often, reading comprehension is operationalized by only one measure that limits the definition of the construct. Using two or more measures or forming a latent variable may provide a more robust and reliable construct (Adlof et al., 2006; Harlaar et al., 2010; Silverman et al., in press). Additionally, researchers including Keenan et al. (2008) and Spear-Swerling (2004) reported that different tests also measured different skills depending on the

developmental level of the student (i.e., a reading comprehension test that depended more on decoding/word recognition skills would measure reading comprehension differently for a younger versus an older student).

Summary. Given the ambiguity of defining and measuring both linguistic comprehension and reading comprehension within SVR, continued efforts to disentangle the relationships within these constructs are important, especially for older elementary students where reading comprehension is the primary medium by which they access academic information. It is apparent that there are differing interpretations on the definitions of the components within Gough and Tunmer's (1986) original model, but most researchers are accepting of the general framework as a way to conceptualize reading comprehension while recognizing the need for continued investigation to clarify and expand the model (Kirby & Savage, 2008).

Method of Literature Review

To identify the relevant extant literature to frame this study, an electronic search of peer reviewed journals from 1986 - 2011 in Education Research Complete, ERIC, and PsycInfo was conducted using the descriptors *reading comprehension* as the first term and *oral language* then *listening comprehension* as second terms. Additionally, a separate search of the same databases was completed using the term "*simple view of reading*". The abstracts of all the articles were read to determine participants' age or grade level at the time of the study. Studies with participants in fourth, fifth, or sixth grade were retained for review. An ancestral search of these articles was completed along with a hand search of the *Journal of Educational Psychology*, *Scientific Studies of Reading*, *Journal of Learning Disabilities*, and *Reading Research Quarterly*. The

selection criteria for inclusion in this review were applied to the articles obtained to this point: (a) age, participants who were in fourth, fifth, or sixth grade or nine through twelve years of age; (b) unselected sample; (c) reading comprehension was the dependent variable; (d) listening comprehension or any component of oral language was an independent variable. A total of 16 studies met the selection criteria and were included in the final review of literature. Specific information about participants and measurements used as independent and dependent variables as well as research questions and results are included in Table 1.

Results

Content review. This section contains a content review of the selected studies. Three studies examined listening comprehension alone as an independent predictor variable of reading comprehension. Eight studies examined linguistic comprehension defined by listening comprehension and at least one other measure of oral language as an independent variable(s) and reading comprehension as a dependent variable. The remaining five studies investigated at least one component of oral language (not including listening comprehension) as an independent variable(s) and reading comprehension as a dependent variable. Thirteen of the 16 studies accounted for the influence of decoding on reading comprehension when analyzing the relationship between linguistic and reading comprehension. Ten of the studies were conducted in the United States, two in Canada, two in England, one in the Netherlands, and one in Australia.

In order to clarify and organize terms and measures for this study, I will use the term linguistic comprehension to define oral language skills at the word-, sentence-, and

discourse-level regardless of the terms used by the authors in the selected studies.

Additionally, oral language measures are at the word-level and listening comprehension measures are at the discourse-level unless otherwise indicated.

Listening comprehension and reading comprehension. Three studies examined the relationship between listening comprehension and reading comprehension (Chen & Vellutino, 1997; Keenan, et al., 2008; Verhoeven & van Leeuwe, 2008). Chen and Vellutino's study focused on cross-validating the SVR model in a group of poor and normal readers in second, third, sixth, and seventh grades to extend the Hoover and Gough's (1990) findings based on a sample of bilingual children. They analyzed the relationships between the observed variables of decoding (measured both by phonetic decoding and by word identification), listening comprehension, and reading comprehension in both an additive ($RC = D + LC$) and multiplicative ($RC + D + LC + D \times LC$) model. Regardless of whether the product term was entered into the equation before or after the additive terms, the interaction of decoding and listening comprehension did not add significant variance. Both decoding and listening comprehension, as additive terms, accounted for significant variance in reading comprehension at all grades (R^2 ranging from .59 to .76). Descriptive statistics results revealed correlations between listening and reading comprehension that increased with age.

Keenan, Betjemann, and Olson (2008) also examined the relationships between the composite variables of word decoding and listening comprehension, the observed variable non-word decoding, and reading comprehension. Reading comprehension was measured with four tests varying in format to determine if they measured different skills.

Results from paired hierarchical regression analyses for each comprehension test revealed that listening comprehension accounted for significant variance (R^2 ranging from .047 to .171) in each reading comprehension test when entered after decoding, as did decoding when entered after listening comprehension (R^2 ranging from .033 to .341). These relationships depended on what measure of reading comprehension was used in the analysis. The Peabody Individual Achievement Test and Woodcock Johnson Passage Comprehension test (picture selection and cloze formats, respectively) were less sensitive to individual differences in listening comprehension than were the Gray Oral Reading Test and Qualitative Reading Inventory (multiple choice and short answer/retell, respectively). The authors summarized by stressing the importance of acknowledging that different reading comprehension tests measure different skills and that the variables used to “carve up” (p. 298) the variance in reading comprehension, such as global measures of listening comprehension versus a single component of oral language, could also affect what reading comprehension is measuring.

Verhoeven and van Leeuwe (2008) examined the effects of listening comprehension along with word decoding and vocabulary on the development of reading comprehension in a longitudinal study on students from first through sixth grade. It is important to note that for fourth grade, vocabulary was measured as reading vocabulary therefore is not included in this review as an oral vocabulary skill. Analyses of variance with repeated measures examined the development of word decoding, vocabulary, listening comprehension, and reading comprehension across grades. There was a significant main effect for Grade found for listening comprehension indicating that progress was made from one grade to the next. Structural equation modeling (SEM) was

used to investigate the relationships between word decoding, vocabulary, listening comprehension, and reading comprehension over time. First-grade listening comprehension strongly influenced second-grade reading comprehension but in the grades following, there were reciprocal relationships between listening and reading comprehension. Data supported Hoover and Gough's SVR that the development of reading comprehension is closely related to the development of listening comprehension as well as the development of word decoding skills, although the relationship between listening and reading comprehension appeared to be more complicated in this model. The authors noted that the use of shorter texts with multiple choice questions may have affected the results since such tests may rely more heavily on word decoding and vocabulary rather than on higher level language skills.

Results from these three studies revealed a significant relationship between listening comprehension (measured by listening comprehension tests) and reading comprehension in upper elementary students both concurrently and longitudinally. No additional oral language measures were used in defining the construct and findings were based on discourse-level linguistic comprehension skills. Additionally, the use of different measures to define reading comprehension appeared to influence the relationship between listening comprehension and reading comprehension. Multiple measurements of each listening and reading comprehension may be needed to encompass the complexity of each construct.

Listening comprehension, oral language, and reading comprehension. Eight studies examined the relationships between listening comprehension, at least one oral language skill, and reading comprehension. Six of the studies specifically investigated

these variables within the context of SVR (Adlof et al., 2006; Harlaar et al., 2010; Ouellette & Beers, 2010; Silverman et al., in press; Spear-Swerling, 2004; Tilstra et al., 2009). The remaining two studies (Berninger & Abbott, 2010; Nation & Snowling, 2004) investigated oral language variables, including listening comprehension, within alternative theoretical frameworks.

Ouellette and Beers (2010) were interested in clarifying the relationships of non-word decoding, irregular word recognition, listening comprehension, oral vocabulary (breadth and depth), and reading comprehension. Hierarchical regression analyses were conducted on the observed variables and resulted in the following findings specific to the older students (sixth grade) given the focus of this review: (a) vocabulary breadth (i.e. quantity of known words in lexicon) and depth (i.e., extent of semantic knowledge measured by a definitions task) predicted reading comprehension when the other variables were controlled (phonological awareness, decoding, irregular word recognition, and listening comprehension) in sixth-grade students ($R^2 = .55$ and $.56$, respectively); (b) the contribution of oral vocabulary increased from first grade to sixth grade supporting a hypothesis of the study “that oral vocabulary would contribute to reading comprehension beyond measures of the constructs specified within the *simple view of reading*: decoding and listening comprehension” (p. 202).

Three studies looked specifically at one specific age group, 9 years (Harlaar et al., 2010) and fourth grade (Silverman et al., in press; Spear-Swerling, 2004) to investigate the relationships between linguistic comprehension and reading comprehension within the SVR framework. Each of these studies also included at least one measure of listening comprehension as a part of linguistic comprehension. The study conducted by Harlaar et

al. (2010) involved a sample of twins who participated in an ongoing study of reading and related cognitive skills. The purpose of the study was to contribute to the research studying genetic and environmental influences but the findings are relevant to the focus of this review as well. Phonological decoding and word recognition (both defined by composite scores from two measures in each area) indexed word decoding. Linguistic comprehension was defined by vocabulary and listening comprehension. Vocabulary and listening comprehension were each defined by a composite score from results on two vocabulary tests and two listening comprehension tests (see Table 1). Reading comprehension was also defined by a composite score from two reading comprehension measures, both of which assessed the literal interpretation of the text as reading comprehension. The phonological decoding, word recognition, vocabulary, listening comprehension and reading comprehension measure composites were all used as indicators of latent factors in structural equation models (SEM). The authors were interested in determining if each subcomponent made a significant unique contribution to reading comprehension. The results indicated that all of the variance in reading comprehension could be explained by two factors: (a) one reflecting the common variance among phonological decoding and the remaining factors and, (b) one reflecting the effects of oral language skills. The correlations among latent phonological decoding, word reading, listening comprehension, and vocabulary factors with the reading comprehension factor were substantial (.80, .93, .87, and .94, respectively).

Spear-Swerling (2004) investigated single word reading, receptive vocabulary, listening comprehension, and rapid naming as possible predictors (SVR component reading measures) of reading comprehension in a group of fourth graders. Students'

scores on two reading subtests of a state mandated test measured reading comprehension. The Degrees of Reading Power (DRP) used a cloze format with multiple-choice options and the Reading Comprehension (RC) subtest used a question-answering format and is criterion-referenced. Since the two subtests differ in format, Spear-Swerling was interested in whether the differences would impact reading comprehension performance and/or how component reading abilities (e.g., word identification and language comprehension) are influenced by the different formats. A composite score from scores on a listening comprehension subtest and vocabulary test represented the linguistic comprehension variable. Two sets of hierarchical regressions, varying the order of entry on word accuracy and language comprehension, revealed that language comprehension accounted for 56.2% of the variance on the DRP and 51.9% on RC when it was entered first. When it was entered second, it accounted for an additional 14% of the variance on the DRP and 20.5% on RC after word accuracy. Findings differed from an earlier study where oral language was more highly correlated with a question-answer format than a cloze measure (Nation & Snowling, 1997). Differences in the age of the sample, with this sample being older, may explain the variation in findings since linguistic comprehension becomes more important in reading comprehension once students have developed strong decoding/word recognition skills (Diakidoy, Stylianou, Karefillidou, & Papageorgiou, 2005; Vellutino, Tunmer, Jaccard, & Chen, 2007).

The primary aim of the Silverman et al. (in press) study was to determine the viability of fluency as an additional component in SVR. They used a broad definition of linguistic comprehension that included syntax, semantic (at the word- and sentence-levels) and listening comprehension measures as indicators of the latent variable and two

measures of reading comprehension as indicators of reading comprehension: passage reading/question answering; and a maze task requiring students to select one of three possible words to complete sentences in connected text. Although Gough and Tunmer's (1986) original SVR model is multiplicative, a comparison between an additive model and the original was conducted and no significant difference was found, with the amount of variance between the two models being almost the same (88.2% vs. 88.6%, respectively). Therefore, the analyses were done with an additive SVR model. Latent variable regression was conducted and the model testing SVR with the original components found that decoding and linguistic comprehension are significant predictors of reading comprehension accounting for 88.2% of the variance in reading comprehension. A second model examined fluency as a unique contributor to reading comprehension beyond decoding and linguistic comprehension. In this model decoding was not significant and fluency and linguistic comprehension accounted for 95.5% of the reading comprehension variance. Fluency mediated the relationship between decoding and reading comprehension.

Adlof et al. (2006) and Tilstra et al. (2009) added to the SVR research by examining the original model and possible additions to the model using longitudinal and cross sectional designs. Similar to Silverman et al. (in press), the purpose of the Adlof et al. study was to determine if fluency should be added as a component in SVR. Word recognition accuracy, fluency, listening comprehension, and reading comprehension measures were administered to students in second, fourth, and eighth grades. Of interest to the current review were the results specific to fourth-grade students but since eighth grade results in a longitudinal comparison could contribute to the understanding of skill

development beyond fourth grade, eighth grade results are included. Structural equation modeling was used to examine relationships within and across grades between the latent constructs of listening comprehension (composed of vocabulary, sentence-level semantic and syntax, and listening comprehension measures), word recognition accuracy (composed of real word, nonword, and connected text reading measures), fluency (composed of two word-level fluency measures and a connected text fluency measure) and reading comprehension (composed of a cloze task, passage reading/multiple choice response, and passage reading/open-ended response measures). Word recognition accuracy and listening comprehension accounted for 62.2% of the variance explaining reading comprehension in the concurrent model for fourth grade. Listening comprehension uniquely accounted for 17% of the variance. In eighth grade, confirmatory factor analysis revealed that all the variance between listening and reading comprehension was shared, therefore adjustments were made and demonstrated that listening and reading comprehension should be combined as a single construct. A predictive model was run with fourth-grade variables predicting eighth-grade reading comprehension. Word recognition and listening comprehension shared 48.9% of the variance in reading comprehension and listening comprehension accounted for 45.2% unique variance. Findings supported the importance of listening comprehension to reading comprehension later in the reading development continuum.

Tilstra et al. (2009) also examined fluency, as well as verbal proficiency, as additional components in SVR. The sample of students, in fourth, seventh, and ninth grades, was selected from a subset of students from the screening process of a larger study investigating reading comprehension processes of good, average, and struggling

readers. There were an equal number of struggling, good, and average readers at each grade within the sample based on review of scores from a CBM maze task. The cross-grade comparisons were an important component to this study since it would add to the limited base of SVR studies completed across multiple grades, especially older grades. In contrast to the last two studies reviewed, there was only one measure used to define each observed variable investigated. Multiple regression analyses were used to examine the relationships between listening comprehension, verbal proficiency (measured by expressive vocabulary), decoding, fluency and reading comprehension. Regarding the contributions of SVR components to reading comprehension, listening comprehension accounted for an additional 19% in fourth grade, 35 % in seventh grade, and 21% in ninth grade after decoding was controlled. The proportion of variance in reading comprehension explained by listening comprehension was compared between grades and was significantly greater in seventh grade (35%) than in fourth grade (19%) and approached a significant difference in seventh grade versus ninth grade (21%). After decoding and listening comprehension, verbal proficiency accounted for additional unique variance (5%) in fourth grade reading comprehension, an additional 8% in seventh grade, and an additional 12 % in ninth grade. Listening comprehension also explained a significant portion of variance in reading comprehension at each grade when entered after decoding and verbal proficiency (fourth grade, 6%; seventh grade, 13%; ninth grade, 4%). The findings of this study suggested the need for modification to SVR framework, specifically adding additional cognitive linguistic measures so that linguistic comprehension is assessed by receptive and expressive linguistic tasks rather than by listening comprehension alone.

The remaining two studies investigated relationships between oral language (including listening comprehension) and reading comprehension unrelated to the SVR framework. Nation and Snowling (2004) explored predictors of reading in a normally developing sample by using a longitudinal data set. Participants were assessed at age 8.5 years and again at 13 years. One of the areas examined included the relationship of oral language, separate from phonological skills, and reading comprehension. Oral language, also defined as broader language, included assessments of vocabulary, listening comprehension, and word-level semantic association skills. A series of hierarchical regressions were completed on the observed variables. After age and nonverbal ability were entered as control variables on step 1 (12% of variance), and nonword reading and phonological skills were entered on step 2 (additional 20% of variance), listening comprehension, vocabulary, and semantic association skills each predicted a significant portion of unique variance in reading comprehension (30.8%, 25.2%, 15.1%, respectively). Another set of hierarchical regressions examined the longitudinal predictors of reading comprehension. First, age, nonverbal IQ, and the autoregressive effect of previous reading comprehension were entered on step 1 and accounted for 32% of the variance in later reading comprehension. Concurrent and previous nonword reading and previous phonological skills entered in step 2 accounted for an additional 16% of variance. Listening comprehension, vocabulary, and semantic skills all accounted for unique variance when entered on the last step (14.1%, 4.9%, 4.5%, respectively). Results revealed that linguistic comprehension skills predicted reading comprehension concurrently and longitudinally.

Berninger and Abbott (2010) conducted a broader investigation of the four language systems: listening comprehension, oral expression, reading comprehension and written expression. Assessments in these areas were administered to two cohorts of students in first, third, and fifth grades (Cohort 1) and third, fifth, and seventh grades (Cohort 2). The Listening Comprehension and Oral Expression (including word- and sentence-level semantic and syntax skills) subtests of the Weschler Individual Achievement Test (WIAT)-2 were administered to the students yielding a composite score for each observed variable for use in multiple regression analyses. The WIAT-2 reading comprehension subtest measured reading comprehension and the standard score for that subtest served as the observed reading comprehension variable in the analyses. One multiple regression analysis was conducted with each oral expression, listening comprehension and written expression as predictor variables of reading comprehension. Oral expression and listening comprehension contributed uniquely to reading comprehension in 3rd grade in Cohort 1 ($\beta = .27$ and $.18$, respectively), Cohort 2 ($\beta = .16$ and $.36$, respectively), and in 5th grade in Cohort 1 ($\beta = .16$ and $.59$, respectively). Listening comprehension also contributed unique variance in 5th and 7th grades in Cohort 2 ($\beta = .55$ and $.42$, respectively). Although percentage of unique variance was not reported for the variables, standardized betas, measured in standard deviation units, were provided to indicate which variables had more impact in the model.

To summarize this section, terms defining the linguistic comprehension component varied in the six SVR studies reviewed. Listening comprehension was used twice, paired with vocabulary (receptive, breadth, and depth), as observed variables representing the oral language component in the framework. Adlof et al. (2006) used

listening comprehension as a latent construct indicated by three different oral language measures including a listening comprehension subtest providing a more reliable (but complicated) variable in the analyses. Two additional studies also used latent variables in their analyses defined as oral language (indicated by listening comprehension and vocabulary) and linguistic comprehension (indicated by four oral language measures at the word, sentence, and paragraph level). In the final two SVR studies, linguistic comprehension was used as a composite variable (listening comprehension and receptive vocabulary) and the observed variables of verbal proficiency and listening comprehension were investigated within SVR. Findings from this study suggested that the linguistic comprehension component might need to be expanded beyond listening comprehension to include additional measures word- and sentence-level linguistic comprehension skills. The two studies not framed in SVR investigated the constructs of listening comprehension and oral expression (each represented by a corresponding measure) (Berninger & Abbott, 2010) and broad oral language beyond phonological skills (Nation & Snowling, 2004). Nation and Snowling defined oral language with the observed variables of vocabulary and listening comprehension and a composite semantic variable each analyzed separately in relation to reading comprehension. In regards to the examining the relationship between linguistic comprehension and reading comprehension, no two studies were alike in their definitions or use of measures to define the construct.

When the measures are organized as word-level, sentence-level, and discourse-level linguistic comprehension, three of the studies examined word-level and discourse-level skills separately finding that each area contributed uniquely to the variance in

reading comprehension. Sentence-level linguistic skills were not investigated independent of word- and discourse-level skills. Although the latent variables encompassed more of the complexity in the linguistic comprehension construct, they did not provide specific information about the influence of word-, sentence-, and discourse-level linguistic comprehension on reading comprehension. Overall, there is an indication that word- and discourse-level linguistic skills are important in reading comprehension but no clear consensus emerged regarding which oral language skills are most important.

Oral language (not including listening comprehension) and reading comprehension. Five studies investigated the role of at least one oral language skill, not including listening comprehension, in literacy skills where reading comprehension was the dependent variable in at least one of the analyses (Cutting & Scarborough, 2006; Goff, et al., 2005; Nagy et al., 2006; Ouellette, 2006; Ricketts et al., 2007). These studies differed from previous studies in that the linguistic comprehension component was defined in a broader linguistic sense and did not include any traditional listening comprehension measures (i.e., tests that paralleled reading comprehension measures). The specific purpose of the Goff et al. study was to identify the strongest predictors of reading comprehension from word identification, language, and memory skills. Language skills were measured by tests of receptive vocabulary (word-level semantic skills) and receptive grammar (sentence-level syntax skills). Scores from a normed Australian reading comprehension test measured reading comprehension. Results from exploratory hierarchical regression analyses revealed the strongest predictors of reading comprehension for each set of language, word reading, and memory variables. After age and general intellectual ability, both language measures (receptive vocabulary and

receptive grammar) together accounted for an additional 35% of the variance in reading comprehension. In summary, the general framework of SVR was supported in this study although the component skills did not include any measures of listening comprehension.

Cutting and Scarborough (2006) asked a similar question regarding variables beyond word recognition/decoding and oral language, contributing to additional variance in reading comprehension, specifically reading speed, verbal working memory, serial naming speed, IQ, or attention. They also investigated whether the contributions of word recognition/decoding and oral language are affected by the comprehension measure used to assess reading comprehension. Oral language was measured at two levels: lexical and sentence processing. Principal component analyses were completed to create a lexical composite score from the three lexical measures and a sentence-processing composite score from the four other oral language measures. Reading comprehension was measured separately by three different widely used tests: the Gates-MacGinite Reading Test-Revised (GMRC), the Gray Oral Reading Test (GORT-3), and the Weschler Individual Achievement Test (WIAT). Pairs of hierarchical multiple regression analyses were conducted on each comprehension measure entering the word reading composite at the first step, and the lexical and sentence-processing composites second. The shared contributions of linguistic comprehension (only at the word- and sentence-levels) and decoding to reading comprehension on the different measures ranged from 33% - 46%. Linguistic comprehension accounted for unique variance on the GMRC, WIAT and the GORT-3 (15%, 9%, 9%, respectively). Separate contributions of lexical and sentence-processing skills were investigated in another pair of regression analyses. Both aspects of linguistic comprehension made unique contributions to GMRC scores (4.5% by lexical

and 1.8% by sentence-processing) but only lexical skills accounted for unique variance on the GORT-3 (5.3%) and when predicting the WIAT, only sentence-processing did (3.4%). Findings suggested that different demands might be placed on vocabulary knowledge and sentence-processing ability depending on which reading comprehension measure is being used. Results further suggested that organizing linguistic comprehension by word- and sentence-levels might be a productive approach.

The remaining three studies examined, at least in part, at one aspect of oral language and its relationship with reading comprehension (Nagy et al., 2006; Ouellette, 2006; Ricketts et al., 2007). Ouellette (2006) and Ricketts et al. (2007) focused on the relationship between vocabulary and reading. Ricketts et al. by investigating which reading skills are predicted by oral vocabulary and Ouellette by distinguishing between breadth (receptive and expressive) and depth of oral vocabulary knowledge, measured by word definitions and synonyms tasks, when measuring vocabulary and reading skills. Scores on one reading comprehension measure represented the observed reading comprehension variable in the analyses of both studies. Ouellette conducted fixed order hierarchical regression analyses to evaluate the influence of the vocabulary breadth and depth on reading comprehension. After the control variables (age, non-verbal IQ, decoding, and visual word recognition) accounted for 42.9% of the total variance in reading comprehension, receptive vocabulary breadth explained an additional 6.1% of significant unique variance while expressive vocabulary breadth accounted for no unique variance. In that same model, vocabulary depth was entered last and added 8% unique variance. In the second regression, the order of receptive and expressive vocabulary breadth measures were changed and expressive vocabulary breadth accounted for 4.2% of

the significant variance in reading comprehension but receptive vocabulary breadth did not when entered next. The variance predicted by receptive and expressive vocabulary breadth is shared while vocabulary depth contributes significantly (8%) beyond these measures. When entered into the third model, before the breadth measures and after the control variables, vocabulary depth predicts 12.1% of the significant variance leaving receptive and expressive depth as non-significant variables. The findings suggested that both oral vocabulary breadth and depth are related to reading comprehension as defined in this study. Given that reading comprehension is predicted by shared contributions of vocabulary breadth and depth and that there is a significant role of vocabulary depth beyond vocabulary breadth, findings further suggest that semantic knowledge and organization are more relevant to reading comprehension in this age range. In a less detailed investigation, Ricketts et al. (2007) conducted hierarchical regressions to predict reading comprehension and text reading accuracy. After chronological age, nonverbal reasoning, decoding, regular word reading, and exception word reading had been entered into the models, oral vocabulary accounted for a significant portion (17.8%) of the variance in reading comprehension. Results revealed that oral vocabulary skills predicted concurrent reading comprehension, which is consistent with the findings from Ouellette (2006).

Less investigated is the role of morphology in literacy, but Nagy, Berninger, and Abbott (2006) examined morphology through the contributions of morphological awareness to literacy outcomes (including reading comprehension). Structural equation modeling (SEM) was applied to determine if the contribution of morphological awareness, along with phonological memory and phonological decoding, as predictors of

reading comprehension was unique. Morphological awareness made a significant, unique contribution at all grade levels to reading comprehension. Additional SES analyses of relationships among morphological awareness, reading vocabulary, and reading comprehension revealed that the contribution of morphological awareness to reading comprehension is through its impact on vocabulary growth but it also shows that morphological awareness makes a significant contribution to comprehension above vocabulary. Findings suggest that the significant unique impact morphological awareness had on reading vocabulary, spelling, decoding accuracy, and decoding rate in grades 4 through 9 may explain the consistent relationship between morphological awareness and reading comprehension.

To summarize, although none of these studies included measures of listening comprehension (discourse-level linguistic skills) to define linguistic comprehension in relation to reading comprehension, all studies concluded that there is a significant relationship between the variables investigated and reading comprehension in upper elementary students. The variables were primarily at the word-level, however sentence-level linguistic skills were included in two studies, but only investigated alone as an independent variable in one and was then found to contribute uniquely to reading comprehension. This suggests that expanding the definition of linguistic comprehension in Gough and Tunmer's (1986) SVR framework should be investigated beyond listening comprehension. The following terms were used to define the variables in the studies: Oral language (lexical and sentence level composite variables), language (receptive vocabulary and grammar observed variables), oral vocabulary (receptive and expressive breadth, and depth), and morphological awareness (latent variable). As in previous

studies, there was little consistency or agreement in how to define the oral language component in relation to reading comprehension.

Summary of content review. Overall, there was a consensus that the general framework of SVR is solid but a number of issues lack clarity, especially concerning the measurement of linguistic comprehension as a predictor variable of reading comprehension. Definitions of the oral language component in relation to reading comprehension were confusing and overlapped which confounded the construct within the extant literature. An explicit conceptual framework in which to harness the oral language variables within the linguistic comprehension component of SVR was absent. The current study uses a framework to investigate linguistic comprehension at the word-, sentence-, and discourse-level providing a more systematic process for determining which linguistic skills have the most impact on reading comprehension. Additionally, it will provide information at all three levels within one study, which has not occurred to this point. Regardless of this lack of clarity, results from this review suggested a clear relationship between linguistic comprehension and reading comprehension in upper elementary students. Less clear was which specific subcomponents are most important in predicting reading comprehension in this age group. Listening comprehension (as defined by listening comprehension measures) was important in reading comprehension especially in the older grades. A broader construct of linguistic comprehension was measured by a combination of latent, composite, and observed variables that included listening comprehension, linguistic comprehension, language, oral expression, vocabulary, and verbal proficiency. Studies not focused on the SVR framework also found relationships between oral language variables and reading comprehension. Only

six studies (Harlaar et al., 2010; Ouellette, 2006; Ricketts et al., 2007; Silverman et al., in press; Spear-Swerling, 2004; Tilstra et al., 2009) investigated the relationship of oral language and reading comprehension variables specifically in fourth-grade students (independent of samples collapsing fourth-grade with other grades for analyses). Longitudinal designs were used in four studies (Adlof et al., 2006; Berninger & Abbott, 2010; Nation & Snowling, 2004; Verhoeven & van Leeuwe, 2008) and cross-grade comparisons in two studies (Chen & Vellutino, 1997; Tilstra et al., 2009) to investigate these relationships over time. The current study will inform the current longitudinal studies by investigating the relationship of linguistic and reading comprehension over shorter time periods (one to two years vs. three to four years). Regardless of the inconsistent and overlapping definitions of linguistic comprehension/oral language, findings were consistent that linguistic comprehension and reading comprehension are related. Information about these relationships in the fourth grade, concurrently and longitudinally, was limited but generally the results suggested that the relationship grows stronger in upper elementary ages.

Methodological review. This section discusses concerns regarding the validity of the studies included in this review. Threats to internal validity, statistical conclusion validity, construct validity, and external validity as defined by Shadish, Cook, and Campbell (2002) are reported. Given that “validity judgments are not absolute” (Shadish, Cook, & Campbell, 2002, p. 34), establishing clear boundaries for each type of validity in social science research is an ongoing challenge. Additionally, discussions of these design issues are in the context of experimental and quasi-experimental studies without a clear exposition of determining which threats are most germane to nonexperimental studies

such as the proposed investigation. Therefore, the selection of the most relevant threats and decisions to assign observed threats to certain validity types will be made with the understanding that a threat may overlap in more than one area but will be assigned only to one (i.e., internal validity vs. construct validity). Threats relevant to this review are defined in Table 2.

Internal validity. Internal validity is concerned with the extent to which causal inferences are justified and that the researcher has evidence that the independent variables caused what was observed to happen in a dependent variable measured within a specific setting and time with the sample selected for the study (Shadish, Cook, & Campbell, 2002; Trochim). Non-experimental designs do not correlate precisely to Shadish, Cook, and Campbell's defined threats given that causal relationships are not the subject of these investigations. However, it is still possible to examine the truth of relationships within non-experimental studies by evaluating the studies for the threats that apply. The threats pertinent to this review are selection bias and ambiguous temporal precedence (uncontrolled third variable).

Selection bias. Selection bias occurs when there are group differences in the sample that could interfere with the outcome of the dependent variable, separate from the influence of the independent variable(s). Efforts to clearly define the sampling procedures and describe the sample characteristics were evaluated to determine the level of threat of selection bias in each study. Adlof et al. (2006) selected their participants ($n=604$) from a larger epidemiologic investigation that used a stratified cluster sample of 7218 children. The large number of participants, the sampling procedures, and the detailed description of the sample characteristics separated this study from the rest in

terms of controlling selection bias. Thirteen studies (81%) defined the samples with sufficient detail so that selection bias was not considered a threat to the internal validity of the studies (Adlof et al., 2006; Berninger & Abbott, 2010; Cutting & Scarborough, 2006; Goff, et al., 2005; Harlaar et al., 2010; Keenan, et al., 2008; Nagy et al., 2006; Ouellette & Beers, 2010; Ouellette, 2006; Ricketts et al., 2007; Silverman et al., in press; Spear-Swerling, 2004; Tilstra et al., 2009; Verhoeven & van Leeuwe, 2008). Limited information was provided on the selection procedures and the sample characteristics for the remaining two studies (Chen & Vellutino, 1997; Nation & Snowling, 2004). Chen and Vellutino used an existing data set and referred the reader to a previous study containing more detailed information about the sample, however access to this article proved to be a challenge and required significant effort to obtain. Nation and Snowling conducted their study using a sample described in a previous paper and also referenced the article for sample details rather than providing the information in the paper reviewed here. Overall, selection bias was not a threat to internal validity in the majority of studies reviewed.

Uncontrolled third variable. To demonstrate that the dependent variable (reading comprehension) was related only to the independent variable(s) (e.g., linguistic comprehension), the influence of a possible third uncontrolled variable on reading comprehension required ruling out. Although controlling for all unknown variables influencing reading comprehension in upper elementary students is not possible, there is a general consensus that decoding is one known influential factor therefore should be controlled in the statistical analyses.

All but one study controlled decoding skill in the statistical analyses investigating the relationship between oral language variables and reading comprehension. The exception was (Berninger & Abbott, 2010). Although this study did not specifically investigate these variables within the SVR framework, decoding would have continued to influence reading comprehension therefore required attention as an influential variable in the study. In addition to decoding, four studies controlled for the influence of age and IQ, defined as nonverbal reasoning, non-verbal IQ, or general IQ (Goff, et al., 2005; Nation & Snowling, 2004; Ouellette, 2006; Ricketts et al., 2007). The results of age and IQ accounting for significant variance in reading comprehension was inconsistent ranging from accounting for 20% of reading comprehension variance to not contributing significantly in any analyses. Nation and Snowling (2004), in addition to age and IQ, and Verhoeven and van Leeuwe (2008) controlled for previous reading comprehension in their analyses, which is a valid approach to control for a third variable. Nation and Snowling reported that the effect of prior reading comprehension (time 1) accounted for 32% of the variance in reading comprehension (time 2). Reciprocal relationships were found between reading and listening comprehension in Verhoeven and van Leeuwe's longitudinal SEM study. The threat of a third variable influencing reading comprehension was generally controlled allowing for conclusions to be made that the relationships found between linguistic comprehension and reading comprehension are valid.

Statistical conclusion validity. Statistical conclusion validity is concerned with the degree to which the conclusions that are reached about relationships in the data are reasonable (Trochim). Failure to consider threats can cause researchers to make false

assumptions that linguistic comprehension and reading comprehension variables are related when in fact they are not (Type I error), or that they are unrelated when a relationship exists (Type II error). The threats to statistical conclusion validity relevant to this review include unreliability of measurement, number of participants (statistical power), and data analyses (violated assumptions of statistical tests).

Unreliability of measurement. Reliable measures of oral language and reading comprehension variables are needed to determine the presence of a relationship. Measures that are unreliable weaken the ability to find a significant relationship due to the fact that the test may not be assessing the target area adequately or completely. Assessing and reporting the reliability of the measures along with using latent variables in analyses are “remedies for unreliability” (Shadish et al., 2002, p. 49). For the purpose of this review, reported reliability of .70 was considered acceptable. Seven of the studies (44%) reported at least acceptable reliability on all the standardized measures (published norm-referenced and curriculum-based measurements – CBM) used in the studies to assess oral language and reading comprehension skills (Berninger & Abbott, 2010; Harlaar et al., 2010; Ouellette & Beers, 2010; Silverman et al., in press; Spear-Swerling, 2004; Tilstra et al., 2009; Verhoeven & van Leeuwe, 2008). Internal consistency (Cronbach’s alpha and split half) reliability and test-retest reliability were used most frequently across the studies that reported it. In addition to reporting reliability, Harlaar et al. (2010), Silverman et al. (in press), and Verhoeven and van Leeuwe (2008) used latent variables in their analyses increasing the likelihood of measuring the intended variable rather than error variance (Shadish, et al., 2002). Some authors were uneven in their reporting of reliability, supplying estimates for some measures but not all. (Adlof et

al., 2006; Cutting & Scarborough, 2006; Nagy et al., 2006; Nation & Snowling, 2004; Ouellette, 2006). The remaining five studies (31%) used published, norm-referenced measures in assessing oral language and reading comprehension but did not include information on reliability. Although most standardized measures are assumed to be generally reliable, this information should be reported.

In order to control for Type II error probability, there should be a sufficient number of participants for each independent variable. Troia (1999) suggested a conservative heuristic estimate of a 10 to 1 ratio that was used as the criteria for evaluating sample sizes in the selected studies. The researchers controlled for the threats associated with number of participants and data analyses with the exception of one study that reported a small sample size given the number of independent variables in the multiple regression analyses conducted (Ouellette, 2006). Overall, setting aside measure reliability, statistical conclusion validity was strength of the studies reviewed.

Construct validity. Trochim explains construct validity as the degree to which researchers can make legitimate inferences from the measured variables to the constructs that they represent. It is an assessment of how well the ideas/constructs of linguistic comprehension and reading comprehension were translated into the actual measures. Threats to construct validity relevant to the selected studies included inadequate explication of constructs (adequate theoretical framework and defining constructs), mono-operation bias, and mono-method bias.

Inadequate explication of constructs. The constructs investigated need to be operationally defined in a manner reflective of the construct. When several definitions of a construct are reasonable, the direction of future research is impacted (Shadish, et al.,

2002). The linguistic comprehension definition in the selected studies was inconsistent and no clear framework for defining the construct emerged. Several studies used latent variables to capture the complexity of the construct and create more reliable variables but even these variables were indicated with varying oral language measures (Adlof et al., 2006; Harlaar et al., 2010; Nagy et al., 2006; Silverman et al., in press; Verhoeven & van Leeuwe, 2008). Studies using composite and observed variables defined the construct with a variety of terms including language comprehension, listening comprehension, oral expression, oral language, vocabulary, verbal proficiency, and language. No two studies operationalized linguistic comprehension (i.e., the oral language construct) in the same manner.

Mono-operation bias. The use of only one operationalization of an independent variable will underrepresent the construct therefore lowering the construct validity of the study (Shadish, et al., 2002). Seven studies (44%) used only one measure to operationalize linguistic comprehension prohibiting them from capturing the breadth and depth of the construct (Berninger & Abbott, 2010; Chen & Vellutino, 1997; Nation & Snowling, 2004; Ouellette & Beers, 2010; Ricketts et al., 2007; Tilstra et al., 2009; Verhoeven & van Leeuwe, 2008).

Mono-method bias. Similar to mono-operation bias, mono-method bias is the threat that a single measure of the dependent variable might call into question if the entire construct is being measured or just a part of it. This was identified as a threat in 10 studies (63%) after evaluating the measures defining reading comprehension (Berninger & Abbott, 2010; Chen & Vellutino, 1997; Goff, et al., 2005; Nagy et al., 2006; Nation &

Snowling, 2004; Ouellette & Beers, 2010; Ouellette, 2006; Ricketts et al., 2007; Tilstra et al., 2009; Verhoeven & van Leeuwe, 2008).

External validity. External validity is concerned with the degree to which the findings from a study generalize to other students in other locations at another time (Trochim). It is often difficult to draw from an unselected, representative sample in educational research, which makes the generalization of results more challenging. Providing a detailed description of the sample and setting counters the possibility that an inference about the findings is a result of an interaction between any of the variables and a characteristic of the sample. See Table 3 for a summary of external validity criteria met by the selected studies. Three of 16 studies met all of the criteria (7/7) for external validity (Berninger & Abbott, 2010; Silverman et al., in press; Verhoeven & van Leeuwe, 2008) and another eight studies met more than half of the criteria (Cutting & Scarborough, 2006; Goff, et al., 2005; Harlaar et al., 2010; Nagy et al., 2006; Ouellette & Beers, 2010; Ouellette, 2006; Spear-Swerling, 2004; Tilstra et al., 2009). The remaining five studies reported on less than half of the criteria needing to be met to establish external validity of their results (Adlof et al., 2006; Chen & Vellutino, 1997; Keenan, et al., 2008; Nation & Snowling, 2004; Ricketts et al., 2007) compromising the ability to confidently know to whom the results would generalize. All of the studies provided information on the grade or age of the student and all but two (Adlof et al., 2006; Cutting & Scarborough, 2006) reported the location of the study. Of the studies that did not meet all of the criteria for external validity (Adlof et al., 2006; Chen & Vellutino, 1997; Cutting & Scarborough, 2006; Goff, et al., 2005; Harlaar et al., 2010; Keenan, et al., 2008; Nagy et al., 2006; Nation & Snowling, 2004; Ouellette & Beers, 2010; Ouellette,

2006; Ricketts et al., 2007; Spear-Swerling, 2004; Tilstra et al., 2009) information on the other characteristics (gender, race, SES, disability) was reported inconsistently prohibiting the generalization of results from any of those studies (see Table 3).

Summary. The findings from this review revealed methodological concerns in the following areas: (a) statistical conclusion validity, specifically unreliability or unreported reliability of measures; (b) construct validity; and (c) external validity. Out of the 16 studies selected for this review, three met or exceeded 90% of the criteria for internal, statistical conclusion, construct, and external validity combined (Cutting & Scarborough, 2006; Silverman et al., in press; Verhoeven & van Leeuwe, 2008). An additional five studies met or exceeded 75% of the total criteria (Berninger & Abbott, 2010; Harlaar et al., 2010; Nagy et al., 2006; Spear-Swerling, 2004; Tilstra et al., 2009). The remainder of the studies met less than 70% of the total criteria. The strongest aspect of the corpus was internal validity and the weakest design element was construct validity. Clearly defining the linguistic comprehension construct within an explicit conceptual framework is a significant gap in this body of research. Future research should also include the use of multiple measures in operationalizing both the linguistic and reading comprehension to capture the breadth of the constructs. It is possible to draw the conclusion that linguistic and reading comprehension are related in typically developing students in upper elementary grades. At this time, no inference can be made regarding the specific oral language skills encompassed in linguistic comprehension and which are most influential in reading comprehension, especially over time. The current study seeks to inform the literature on both counts by (a) using a framework of word-, sentence-, and discourse-level linguistic skills to operationalize linguistic comprehension allowing for

clearer comparisons of measures across studies, and (b) comparing the impact of linguistic comprehension on reading comprehension in fourth-, fifth-, and sixth-grade to provide information at those grade-levels not available from previous studies.

Conclusion

There is general agreement that SVR is a solid framework in which to study and understand the relationship between linguistic and reading comprehension. Although there is agreement on the basic architecture of the framework, the extant literature is not in agreement about how to define linguistic comprehension, especially in older students. There is no explicit framework for investigating linguistic comprehension and specifically which linguistic skills are most important in reading comprehension. The extant literature shows that the relationship between linguistic and reading comprehension increases with development but the number of longitudinal studies investigating this phenomenon is limited. Continued SVR research on fourth-grade students both concurrently and longitudinally is needed to more clearly understand how linguistic and reading comprehension are related and how the relationship changes as students get older.

Organizing the selection of oral language variables in a more explicit framework is needed to clarify the definition of linguistic comprehension and its relationship with reading comprehension. The use of word-, sentence-, and discourse-level linguistic skills provides a structure in which to insert oral language measures targeting a variety of parameters (e.g., semantic, syntactic). Word-level linguistic measures will focus on linguistic skills requiring a response demonstrating understanding at the single word level. Sentence-level linguistic skills will require linguistic understanding or formulation

at the sentence level. Discourse-level linguistic skills will encompass linguistic understanding at the level of connected speech (i.e., paragraph-length information). The use of this framework is consistent with the original framework of Gough and Tunmer (1986). It is similar to Cutting and Scarborough's (2006) use of lexical and sentence processing variables and extends it through the addition of discourse-level linguistic skills. This study seeks to disentangle the relationships within linguistic comprehension to determine, more specifically, its relationship to reading comprehension within SVR in fourth-through sixth-grade students after controlling for decoding and phonological awareness.

Chapter 3

Method

Overview

The purpose of this study was to explore the relationship between linguistic and reading comprehension within the SVR framework in a longitudinal sample of fourth-grade children followed through sixth-grade. This relationship has been investigated in previous research and found to be significant, especially in upper elementary students, but there is no consistent conceptual framework for operationalizing linguistic comprehension and limited information on the relationship over time. Therefore, understanding is limited about which oral language skills are most important in linguistic comprehension and how those skills change over time in relation to reading comprehension.

In an effort to make this conceptualization more explicit and further explore the changes in the linguistic and reading comprehension relationship over time, I analyzed data from a sample of participants who were part of a larger longitudinal study (Speece, Ritchey, & Silverman, 2006-2012) investigating Response to Instruction (RTI) and designed to: (a) develop a screening battery to identify fourth-grade students at risk for reading problems, and (b) develop and validate a reading comprehension intervention to ameliorate the reading problems of at risk fourth-grade students. Scores from the decoding, linguistic comprehension, and reading comprehension measures from the battery administered to fourth-, fifth-, and sixth-grade students were obtained and analyzed using hierarchical regression analyses. The current study builds specifically on the Silverman et al. (in press) investigation of SVR where linguistic comprehension was

studied as a latent variable. In the current study, the various components of linguistic comprehension were investigated to determine their relationships to reading comprehension. This chapter outlines the (a) participants, (b) setting, (c) measures, and (d) data collection and analyses procedures used in the study.

Participants

The participants were 227 fourth-grade students who have complete data on the variables of interest. The sample included students referred for special education or with an Individual Education Plan. English was the primary language for all students. No additional screenings or assessments were administered to the students beyond the measures of interest as described in the Measures section of this chapter. In the absence of IQ information, standard scores from fourth-, fifth-, and sixth-grade reading comprehension measures were reviewed and the mean score for each grade was within the average range ($M = 100$; $SD = \pm 15$), therefore normal distribution of the sample was assumed. Mother's level of education was used as an indicator of socio-economic status. Table 4 presents the demographic information of the participants in this sample. The longitudinal sample size was determined by (a) the number of students who have complete data in fourth and fifth grades ($n = 211$) and (b) the number of students who have complete data in fourth and sixth grades ($n = 183$). The sample for this study was used to identify a screening battery and did not receive reading intervention from the researchers.

Setting

The participants attended 15 parochial schools in a large, mid-Atlantic city and surrounding suburban communities. There were 20 classrooms where students remained

as a cohort for the year. Some students had the same teacher for instruction throughout the day while others had different teachers for different subjects. Fourth, fifth, and sixth grades were contained in the same school unless a participant moved to a different school for personal reasons.

Measures

Students were assessed using measures of decoding, phonological processing, linguistic comprehension, and reading comprehension. Table 5 summarizes the administration schedule for the measures for fourth-, fifth-, and sixth-grade students.

Independent variables. Assessments of decoding, phonological processing, and linguistic comprehension were used as independent variables. Decoding and phonological processing measures were used as control variables. Based on results from the preliminary analyses, significant correlations were found between both gender and mother's level of education and the study variables therefore they were added as control variables in subsequent analyses. Linguistic comprehension measures were labeled as a word-, sentence-, or discourse-level linguistic skill, and represented three separate independent variables for research question one and were combined for research question two. The criteria for assigning measures to the different levels of linguistic skills are as follows: (a) word-level linguistic skills were operationalized by measures including tasks requiring comprehension or use of single words; (b) sentence-level linguistic skills were operationalized by measures requiring comprehension or response at the sentence level; and (c) discourse-level linguistic skills were operationalized by tasks requiring comprehension or response at the discourse level.

Decoding. The Woodcock-Johnson Tests of Achievement, Third Edition (WJ III; Woodcock et al., 2001) is an individually administered and norm-referenced test. The Letter-Word Identification (a measure of real word recognition skills) and Word Attack (a measure of pseudoword reading ability) subtests were administered to assess decoding skills. The split-half reliability coefficients for 9-year old children are .94 for Letter-Word Identification and .89 for Word Attack. Good concurrent validity is reported for the entire battery, including Letter-Word Identification and Word Attack given correlations with corresponding tests on the Kaufman Test of Educational Achievement and the Weschler Individual Achievement Test (Sandoval, 2010).

Phonological processing. The Elision and Nonword Repetition subtests from the Comprehensive Test of Phonological Processing (CTOPP; Wagner, et al., 1999) were individually administered to assess phonological processing skills. Research suggests that rapid automatized naming (RAN) tasks assess not only phonological processing skills, but also a wide range of additional cognitive processes in skilled readers (Arnell, Joanisse, Klein, Busseri, & Tannock, 2009). Given the focus of the current study to control only decoding and phonological processing skills, RAN tasks were not included as a measure of phonological processing. The Elision subtest is a phoneme deletion task where the students are required to orally delete syllables and phonemes in a word and then pronounce the remaining word. The Nonword Repetition subtest is a phonological memory task that requires the student to repeat orally presented nonwords. Reliability estimates for both the Elision and Nonword Repetition subtests are acceptable ($r = .79$ and $.75$, respectively). Both subtests have strong criterion-related predictive validity ($r = .67$ -. 68 for Elision and $r = .52$ for Nonword Repetition).

Linguistic comprehension. In an effort to capture which oral language skills are important in linguistic comprehension in relation to reading comprehension, the construct was organized by the following levels: word-, sentence-, and discourse-level linguistic skills. Although the term linguistic comprehension suggests that all measures might be receptive, findings from Adlof, Catts, and Lee (2010) and Scarborough (2001) suggest that expressive skills in kindergarten are predictive of later reading comprehension therefore a combination of receptive and expressive measures will be used. Subtests from the following tests were used to measure linguistic comprehension skills: (a) The Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF-4; Semel et al., 2003) is an individually administered, norm-referenced assessment of language abilities, and (b) The Weschler Intelligence Scale for Children-Fourth Edition (WISC-IV; Weschler, 2003) is an individually administered assessment of cognitive ability.

Word-level linguistic skills. Two measures operationalized linguistic comprehension at the word level: the CELF-4 Word Classes subtest and the WISC-IV Vocabulary subtest. Both of these measures addressed vocabulary breadth (the quantity of words known) as well as depth by investigating the student's semantic knowledge of words. The Word Classes subtest of the CELF-4 requires students to identify which word from an array of words presented orally are semantically related. Responses are scored as 0 for incorrect and 1 for correct. Test-retest reliability for this subtest is high ($r = .81$). Validity evidence of scores is well documented, item content is appropriate and the language and cognitive response processes are well documented, and comprehensive intercorrelational and factor analyses confirmed the basic construct validity of this test (Samar, 2010)

The Vocabulary subtest of the WISC-IV was used to assess vocabulary and semantic knowledge, and requires the student to listen to a target word presented orally then adequately define it. Completeness and accuracy of the definitions are scored using criteria yielding scores of 0 (not defined), 1 (partially defined), and 2 (defined completely and accurately). Internal consistency using the split half method ($r = .89$) and test-retest ($r = .92$) estimates on the vocabulary subtest are adequate to excellent. Overall, the WISC-IV, including the Vocabulary subtest, is judged to have strong validity based on evidence of extensive literature reviews and input from panels, consultants, and psychologists for content validity, exploratory and confirmatory factor analysis of internal structure, and reported correlations with several other tests (Thompson, 2010).

Sentence-level linguistic skills. Sentence-level linguistic skills were operationalized by the Formulated Sentences subtest of the CELF-4. This subtest requires students to listen to target words, presented orally and in most cases with corresponding illustrations. The student is then asked to orally construct semantically and syntactically correct sentences containing the target words. Responses were scored as 0 (incorrect), 1 (partially correct), and 2 (fully correct). Test-retest reliability for this subtest is high ($r = .86$). The CELF-4 Examiner's Manual presents extensive evidence of validity based on test content, response processes, internal structure, relationships with other variables, and consequences of testing.

Discourse-level linguistic skills. Discourse-level linguistic skills were operationalized by the Listening Comprehension Test, which was developed for the larger investigation (Speece, Ritchey, & Silverman, 2006 – 2012) to evaluate oral comprehension of passages read aloud. This is an individually administered passage-

level comprehension task that is designed to be comparable to measures typically used to assess reading comprehension in which children read passages and answer multiple-choice questions about the passages. The investigators developed this test based on the Gates MacGinite Reading Comprehension (GMRC) subtest (MacGinite, et al., 2000). Examiners read three passages (including narrative and expository texts) from Form T of the GMRC and ask 16 multiple-choice questions, presented orally and in print, after each passage had been read. Cronbach's alpha was .73 in the current sample. The Listening Comprehension Test is correlated with the GMRC subtest at .59 and further correlated with CELF Formulated Sentences at .35, CELF Word Classes at .54, and WISC Vocabulary at .73 providing evidence of criterion-related validity.

Dependent variable. Reading comprehension was assessed by two measures. The Reading Comprehension subtest of the Gates MacGinite Reading Test, Fourth Edition – GMRC (MacGinite, et al., 2000) is a group administered, norm-referenced measure in which students are asked to silently read short narrative and expository passages and answer multiple-choice questions. Students have 35 minutes to complete the test. Examiners reported that most finished the test well before the time limit and that few required the full amount of time to finish the test. Internal consistency coefficients for the subtest are at or above .90 for grades 4 through 6. The authors report adequate concurrent validity but no actual data are provided in the technical manual (Johnson, 2010).

Maze (D. Fuchs & Fuchs, 1992; L. S. Fuchs, n.d.) is a group-administered CBM that incorporates a modified cloze technique. Students are presented with a narrative passage in which the first and last sentences remain intact but every seventh word

thereafter is deleted and replaced with three choices. Students are asked to select the choice that is most appropriate in context. Students are given 2 minutes to complete as many choices as possible. Two probes were administered and the mean of the number of correct items per minute was calculated. The fourth-grade level of this CBM was administered to all grades (fourth, fifth, and sixth) to more accurately compare progress overtime. Median test-retest reliability is .89 and criterion validity with the Reading Comprehension subtest of the Stanford Achievement Test is adequate ($r = .77$; Fuchs and Fuchs, 1992).

Procedure

Parent permission was obtained and the study has University of Maryland Institutional Review Board (IRB) approval. The data for this study were based on (a) assessments given to fourth grade students in individual and group sessions in the fall and another individual session in the early spring and (b) group assessments given each spring to students in fourth, fifth, and sixth grade. Graduate research assistants, who were trained to a 90% accuracy criterion for administration and scoring before testing began, administered the measures. Measures administered in the fall of fourth grade will be used to predict reading comprehension measured in the spring of fourth, fifth, and sixth grade. Information about measures and the schedule on which they were administered can be found in Table 5.

The data analysis included descriptive statistics (means, ranges, standard deviations, skewness, and kurtosis) and correlations for independent and dependent variables and hierarchical multiple regression analyses of the relationships between

linguistic comprehension and reading comprehension. Scaled scores and transformed z scores were used in the regression analyses.

Multiple regression analysis is used to relate a set of independent or predictor variables to a dependent variable for purposes of explanation and/or prediction with an equation linear in its parameters (Kelley & Maxwell, 2010). For the purposes of this study, hierarchical regression models were used to investigate the relationship of linguistic comprehension and reading comprehension while controlling for decoding and phonological processing. Multiple regression relies on four assumptions being met in order to control for Type I or Type II error and/or not to over- or under-estimate significance or effect size(s) (Osborne & Waters, 2002). Descriptive statistics (See Table 6) and correlations (See Table 7) were run and assumptions checked as follows: (a) data independence, the assumption that study variables are independent; (b) normality, the assumption that errors follow a normal distribution, will be confirmed by visually comparing the distribution of the observed errors, on a histogram or various plots, mapped against a normal curve as well as checking for violations by skewness and kurtosis values; (c) homoscedasticity, the assumption that error variance is homogeneous across all values of the regressors, will be checked by visual examination of a residual versus predictor plot (residual plot); (d) linearity, the assumption that the relationship between the independent and dependent variables is linear, will be confirmed with examination of a conditioning plot (coplot) or residual plot; and (e) any outliers will be identified by visual inspection of a matrix scatterplot (Kelley & Maxwell, 2010).

Attrition analysis. Finally, an attrition analysis was examined using a one-way analysis of variance to analyze the mean differences in scores for linguistic

comprehension variables and reading comprehension variables, comparing fourth-grade mean scores to fifth- and sixth- grade scores, respectively (see Table 8). Chi-Square tests were used to analyze the differences in the frequency of categorical variables (race, gender, and mother's level of education). Due to small cell size, Asian and mixed race were collapsed into one category (Other) prior to analysis. Non-significant results of the resulting F -tests and χ^2 -tests indicated that there was no effect of attrition on linguistic and reading comprehension scores. Because no significant effects of attrition were found, missing data techniques were not explored further (i.e., variable/participant deletion, imputation, or maximum likelihood techniques).

Data Analyses. The research questions guiding this study were explored through hierarchical regression analyses.

1. Beyond the influence of decoding and phonological processing skills, what is the unique impact of each (word-, sentence-, and discourse-level) linguistic comprehension skill in fourth grade on reading comprehension, measured in fourth, fifth, and sixth grades?

In order to answer this question, a series of hierarchical regressions were conducted for each grade level investigating the contribution of linguistic skills to reading comprehension. A composite score for reading comprehension was created for use in all research questions. The standardization of each reading comprehension variable (resulting in z scores with $M = 0$ and $SD = 1$) and then averaging the z scores together created the composite score for reading comprehension. A z-score is a measure of distance from the mean, using standard deviation units.

A basic regression equation can be written as

$$y = \alpha + \beta_1x_1 + \beta_2x_2 + \dots + \beta_px_p + \varepsilon$$

where Y is the value of the dependent variable which is being regressed upon the independent variable (x), α (α) is a constant which is equal to y when the value of x is zero, and β is the beta coefficient or slope of the independent variable which explains the change in y for each one-unit change in x . The error term is represented by ε and p represents the number of independent variables in the model. In the proposed analyses, the regression equation is represented by Y , a composite score for reading comprehension for either fourth, fifth, or sixth grade, which will be predicted by the independent variables of decoding (x_1), phonological processing (x_2), and the linguistic comprehension variable of interest (x_3) (i.e., word-, sentence-, or discourse-level) such that $y = \alpha + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \varepsilon$.

In the first block of each regression, demographic variables of maternal education and child gender, as well as decoding and phonological processing were entered to control for the known influence those skills have on reading comprehension. Silverman et al. (in press) found that decoding and phonological awareness factored together therefore it is warranted to control for both. In the second block, two of the three linguistic comprehension variables were entered, and in the third block, the third specific variable representing linguistic comprehension (or variables in the case of word-level) was entered, with separate analyses conducted for word-, sentence-, and discourse-level as the final variable entered. The reading comprehension composite score was used as the dependent variable in the model, with separate analyses for fourth-, fifth-, and sixth-grade reading comprehension variables. The amount of variance in reading comprehension

explained by each block of the model was reported for each model in addition to the unique variance accounted for by the particular block including the linguistic comprehension variable of interest (word-, sentence-, or discourse- level) beyond the other variables in the model (see Tables 9, 10, and 11).

This analysis was repeated for the prediction of fourth-, fifth-, and sixth-grade reading comprehension, and for each linguistic comprehension variable, therefore a total of nine hierarchical regression models were conducted.

2. Beyond the influence of decoding and phonological processing skills, does linguistic comprehension (word-, sentence-, and discourse-level skills) have an increasing impact on reading comprehension across fourth-, fifth-, and sixth-grades?

The second research question was explored by examining three additional hierarchical regressions. In the first regression, decoding and phonological processing variables were entered into the first block of the analyses, and the three linguistic comprehension variables measured in fourth grade were entered together into a second block to determine the variance they contribute to fourth-grade reading comprehension. The second regression analysis included the same blocks of independent variables, but predicted fifth grade reading comprehension. Finally, the third analysis again included the same independent variable blocks, but predicted variance in sixth-grade reading comprehension. These analyses assisted in determining the joint influence of word-, sentence-, and discourse-level linguistic comprehension on children's fourth-, fifth-, and sixth- grade reading comprehension, respectively, beyond what is predicted by decoding and phonological processing variables. The regression equation was written as a function of the dependent variable Y, a composite score for reading comprehension for either

fourth, fifth, or sixth grade, which was predicted by the joint influence of decoding (X_1) and phonological processing (x_2), and the joint contribution of the linguistic comprehension variables [i.e., word- (x_3), sentence- (x_4), and discourse-level (x_5)] such that $y = \alpha + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5 + \varepsilon$.

Chapter 4

Results

In this study, the relationship between linguistic and reading comprehension within the SVR framework was examined in an effort to clarify which specific linguistic comprehension skills are influential in reading comprehension beyond decoding and phonological processing. Results from the preliminary analyses and hierarchical regression analyses are summarized in this chapter.

Preliminary Analyses

Before the main study analyses were conducted, several preliminary analyses were conducted including tests of data independence, normality, homoscedasticity and linearity, and an inspection of potential outliers. Each preliminary analysis is described in detail below.

Independence. The assumption that study variables were independent was estimated in several ways. First, a correlation matrix was produced to assess the zero-order correlations among the independent study variables as well as demographic variables of child gender and maternal education level (see Table 7) in order to determine whether the assumption of data independence was met and determine whether any variables needed to be controlled for in subsequent analyses. Next, multicollinearity was addressed by inspecting the bivariate correlations among independent variables as well as their tolerance levels. Tabachnick and Fidel (2007) suggest that correlations greater than .70 among independent variables may signify a problem with multicollinearity. WJIII Word Identification and Word Attack scores were significantly correlated at .76, which exceeded .70 and indicated a potential issue with multicollinearity; however, it was

decided to retain both variables as it was expected they would each offer unique predictive value to the outcomes. Although bivariate correlations among independent variables above .70 are not optimal, a more critical issue occurs for correlations at or above .90 (Tabachnick & Fidell, 2007). Correlations this high can indicate redundant information and cause instability in the statistical analysis, or in a more severe case, not allow computation of the analysis at all (i.e., in the case of a perfect correlation).

Finally, with regard to multivariate correlations, tolerance values did not fall below the predetermined threshold of .10, which suggests there was not an issue with multicollinearity at the multivariate level (Cohen, Cohen, West, and Aiken, 2003). Given that the bivariate correlations did not reach critical values of .90 and because multivariate correlations were within acceptable ranges (i.e., tolerance < .10), it was decided to retain variables with correlations above .70 (but below .90) in the analysis. Additionally, several significant correlations were found between child gender, maternal education level, and the study variables, therefore these demographic variables were controlled for in subsequent hierarchical regression analyses.

Normality. An analysis of data normality was conducted to test the assumption that the study variables follow a normal distribution. Visual inspection of the descriptive statistics (including skewness and kurtosis), observed errors, and histograms (i.e., a distribution plot for each variable plotted against a normal curve) suggested that the assumption of normality was met.

Results of the descriptive statistics analysis are presented in Table 8 and include means, standard deviations, and minimum and maximum values of the study variables as well as skewness and kurtosis values. The skewness and kurtosis values were used to

identify any variables that were significantly skewed or kurtotic, which would suggest departure from normality. To estimate skewness and kurtosis, first, the standard error of skewness was calculated by using the formula $\sqrt{6/N}$, where N indicates the number of subjects (Tabachnick & Fidell, 2007). Any variable with a skewness statistic over two standard errors of the calculated skew was considered skewed. According to the recommended procedures set forth by Tabachnick and Fidell (2007), transformations on any skewed variables were employed in an attempt to normalize the distribution. Similar procedures were used to determine kurtosis values. The standard error of kurtosis was calculated using the formula $\sqrt{24/N}$, where N is the sample size, and any kurtosis statistic greater than two standard errors over its calculated kurtosis was transformed.

Indices of skewness and kurtosis indicated that scores on the CTOPP Elision were negatively skewed and kurtotic, and the CELF-4 Formulated Sentences scaled scores were negatively skewed according to Tabachnick and Fidell's (2007) recommended procedures. Specifically, calculations of twice the value of the standard error of skewness for the CTOPP Elision (.33) and CELF-4 Formulated Sentences (.33) scores exceeded their skew statistics (-.39 and -.57, respectively). In addition, a kurtosis statistic of -1.09 exceeded the calculation of twice the calculated standard error of kurtosis (.65) for the CELF-4 Formulated Sentences measure. Therefore, standardized (z) scores for these two variables were calculated for use in subsequent analyses.

Although the z-score transformations did improve skew and kurtosis, they were not effective in fully normalizing these variables. Tabachnick and Fidell (1996) suggest that for larger samples, such as the one in the current study, significant skewness and kurtosis values tend not to meaningfully impact analyses because although the values do deviate

from normal, that deviation is rarely substantial. Therefore, the decision was made to use the z -score transformations, but to interpret the results with some caution.

Finally, inspection of observed errors and histograms also confirmed data normality. Specifically, a normal probability plot of the standardized residuals was created, plotting the fixed values of the current sample against those in a normal distribution. An approximately straight line was obtained, suggesting that the data in the current sample is normally distributed. Further, a histogram was created by plotting the observed values in the current sample with those of a normal distribution. The data from the current study followed an approximate bell curve, which also suggested data normality.

Homoscedasticity and linearity. Homoscedasticity, the assumption that error variance is homogeneous across all values of the regressors, was checked by visual examination of a scatterplot of the standardized residual versus predictor plot (residual plot). Visual inspections of residual plots suggested no issues with heteroscedasticity, such that the response variables all had similar variance. Specifically, the spread of the residuals were approximately evenly distributed throughout the plot.

Linearity, the assumption that the relationship between the independent and dependent variables is linear, was confirmed with examination of a conditioning plot (coplot), which plots the relation between each explanatory variable and the outcome, taking into account all other explanatory variables. Plots suggested a general linear trend in the regression lines, with no clear departures from a linear relationship (i.e., no quadratic or cubic trends were present).

Outliers. Outliers were identified by visual inspection of a matrix scatterplot (Kelley & Maxwell, 2010). Outliers were examined to determine whether any observations had a clear departure from the general data trend (i.e., extreme high or low values). No extreme outliers were identified from the scatterplots.

Summary. Based on all preliminary analyses, the assumptions of data independence, normality, linearity, and homoscedasticity were met, and the absence of outliers was also confirmed. Given that the assumptions were met, the regression analyses for the main research questions were conducted next.

Research Question One

Results of the first research question suggest that, after controlling for decoding and phonological processing skills, there were differential effects of the linguistic comprehension variable(s) on reading comprehension at fourth, fifth, and sixth grades.

A series of hierarchical regressions were conducted for each grade level investigating the contribution of linguistic skills to reading comprehension. Control variables (maternal education, child gender, and decoding and phonological processing variables) were entered into the first block of the equation. In the second and third blocks, the specific variable(s) representing linguistic comprehension were entered, with separate analyses being conducted where the third block alternated between word-, sentence-, or discourse-level variables, and with the remaining two variables being entered in block two. Reading comprehension was used as the dependent variable in the model, with separate analyses for fourth-, fifth-, and sixth-grade reading comprehension variables.

Tables 9, 10, and 11 present the amount of reading comprehension variance explained by each step of the model in addition to the unique variance accounted for by the particular linguistic comprehension variable(s) entered in the last block (word-, sentence-, or discourse- level) beyond the other variables in the model. Results suggest that there were differential effects of the linguistic comprehension variable(s) on reading comprehension at fourth, fifth, and sixth grades. Namely, word-level linguistic skills variables together were significant positive predictors of fourth-, fifth-, and sixth-grade reading comprehension scores, after accounting for control variables and sentence- and discourse-level linguistic skills. Specifically, 66%, 61%, and 62% of the variance in reading comprehension at fourth, fifth, and sixth grades, respectively, was predicted by word-level linguistic skills. Sentence-level skills did not emerge as significant predictors of reading comprehension at any grade level after accounting for control variables and word- and discourse-level linguistic skills, however, these models explained 65%, 61%, and 62% of the variance in reading comprehension at fourth, fifth, and sixth grades, respectively. Finally, discourse-level linguistic skills significantly predicted fourth- and fifth-grade, though not sixth-grade reading comprehension scores, after accounting for control variables and word- and sentence-level linguistic skills. In these models, 65%, 61%, and 61% of the variance in reading comprehension at fourth, fifth, and sixth grades, respectively, was accounted for. Specific findings for each analysis are presented below.

First, three analyses were conducted where fourth-grade reading comprehension was used as an outcome variable in the analysis. In the first of these analyses, word-level linguistic skills (CELF-4 Word Classes and WISC IV Vocabulary) together predicted 3% of the variance in reading comprehension skills after accounting for the control variables

and sentence- and discourse-level linguistic skills. An inspection of the beta statistics reveals that CELF-4 Word Classes scores, but not WISC IV Vocabulary scores, were unique (and significant) positive predictors of reading comprehension scores in fourth grade, even after accounting for control variables as well as sentence- and discourse-level linguistic skills (β s = .18 and .12, p s = .007 and .07, respectively). In the next analysis, sentence-level linguistic comprehension ($\beta = -.002$) was not a significant predictor of fourth grade reading comprehension skills, and predicted 0% of the variance in fourth grade reading outcomes. Finally, in the third analysis, discourse-level linguistic comprehension ($\beta = .25$, $p < .0001$) significantly and positively predicted 4% of the variance in fourth grade reading outcomes over and above the variance accounted for by control variables and word- and sentence-level linguistic skills.

Similarly, three analyses were conducted to examine the variance accounted for in fifth grade reading comprehension by word-level, sentence-level, and discourse-level skills. Word-level skills (β s = .31 and .14, p s = .0001 and .07, for CELF-4 Word Classes and WISC IV Vocabulary, respectively) together significantly and positively predicted fifth grade reading comprehension, accounting for 7% of the variance in scores beyond the variance accounted for by controls and sentence- and discourse-level linguistic skills. In a second analysis, a nonsignificant and marginal percent (0.3) of the variance in fifth grade reading comprehension was accounted for by sentence-level skills ($\beta = .06$, $p = .30$) after accounting for control and word- and discourse-level skills. In the third analysis, discourse-level linguistic skills accounted for a significant percent of the variance in reading comprehension scores at fifth grade scores (1%) even after accounting for control variables and word- and sentence-level linguistic skills ($\beta = .15$, $p = .02$).

The last set of analyses included word-, sentence-, and discourse-level linguistic skills predicting sixth grade reading comprehension. CELF-4 Word Classes and WISC IV Vocabulary together predicted 6% of the variance in reading comprehension in sixth grade and also were found to be significant unique predictors above and beyond control variables and sentence- and discourse-level skills, with β s = .25 and .17, p s = .001 and .03, respectively. In contrast, sentence-level linguistic comprehension (β = .08, p = .19) was not a significant predictor of later reading comprehension at sixth grade, after accounting for control variables and word- and discourse-level linguistic skills, accounting for only 1% of the variance. Finally, discourse-level linguistic comprehension was not a significant predictor of the variance (1%) in sixth grade reading comprehension scores (β = .12, p = .09) after accounting for control variables as well as word- and sentence-level linguistic skills.

Research Question Two

Results for the second research question indicate that there was a significant joint influence of word-, sentence-, and discourse-level linguistic comprehension on children's fourth-, fifth-, and sixth-grade reading comprehension scores, respectively, beyond what was predicted by decoding and phonological processing variables.

These results were discovered using three hierarchical regressions. In all regression analyses, control variables (maternal education, child gender, and decoding and phonological processing variables) were entered into the first block of the analyses and the linguistic comprehension variables measured in fourth grade were entered together into a second block to determine the variance they contributed to reading comprehension either at fourth, fifth, or sixth grade. In the first analysis, the independent

variables were used to predict fourth grade reading comprehension. The second regression analysis included the same blocks of independent variables, but predicted fifth grade reading comprehension. Finally, the third analysis again included the same independent variable blocks, but predicted variance in sixth-grade reading comprehension scores. Results are presented in Table 12.

Results suggest that there was a significant effect of the control variables on reading comprehension in the separate analyses, accounting for 51%, 44%, and 46% of the variance in reading comprehension during fourth, fifth, and sixth grades, respectively. Further, after accounting for the significant effect of the control variables, linguistic comprehension at fourth grade continued to be a significant predictor of fourth-, fifth-, and sixth-grade reading comprehension in their respective analyses, representing an additional 14%, 17%, and 15% of the variance, respectively. Inspection of standardized beta statistics in the final model suggested that CELF-4 Word Classes and the Listening Comprehension Test were significant and positive predictors of reading comprehension in fourth grade, as well as in fifth grade, in their respective analyses. Students' CELF-4 Word Classes scores were also significant contributors of sixth grade reading comprehension; however, Listening Comprehension Test scores were not significant predictors of sixth grade reading comprehension. As indicated by a significant standardized beta, the WISC-IV Vocabulary measure also was a significant and positive predictor of sixth grade reading comprehension. These results, their potential implications, and further areas of study will be discussed in the following chapter.

Chapter 5

Discussion and Conclusion

Clarifying the role of linguistic comprehension in reading comprehension, specifically within the SVR framework is an area of need since the extant literature is in want for a consistent definition of linguistic comprehension. Using a framework in this study, that operationalized linguistic comprehension with word-, sentence-, and discourse-level variables informs the current literature base with a foundation of evidence and supports the findings that linguistic comprehension is important in reading comprehension in upper elementary students. Gough and Tunmer's (1986) SVR theory suggests that reading comprehension results from developing skills in the areas of decoding and linguistic comprehension. Linguistic comprehension is a poorly defined construct in the extant literature and requires clarification to increase understanding about the specific linguistic skills that are important in reading comprehension, specifically in upper elementary school. In an effort to inform the SVR theory, specifically by clarifying the role of linguistic comprehension in reading comprehension, my two main questions and hypotheses of the current study were:

1. Beyond the influence of decoding and phonological processing skills, what is the unique impact of each (word-, sentence-, and discourse-level) linguistic comprehension skill in fourth grade on reading comprehension, measured in fourth, fifth, and sixth grades?

I hypothesized that word- and discourse-level linguistic skills would significantly predict reading comprehension beyond the control variables (i.e., decoding and phonological

processing) in all grades and that the impact of sentence-level linguistic skills would not be significant beyond the control variables and other linguistic skills.

2. Beyond the influence of decoding and phonological processing skills, does linguistic comprehension (word-, sentence-, and discourse-level skills) have an increasing impact on reading comprehension across fourth-, fifth-, and sixth-grades?

I hypothesized that there will be an increasing impact of linguistic comprehension on reading comprehension from fourth- to sixth grade.

This chapter will present an overview of the findings for each research question, including an interpretation and discussion of the results in relation to my hypotheses.

Contributions and limitations of this study will also be discussed along with suggestions for future research.

Research Question One

This question focused on investigating a more explicit conceptualization of linguistic comprehension within SVR. Gough and Tunmer (1986) defined linguistic comprehension as the process by which information at the word level, as well as sentences and discourse are interpreted. Consistent with their definition, linguistic comprehension was organized into a framework of word-, sentence-, and discourse-level linguistic comprehension variables to explore the influence of each beyond the other two linguistic comprehension variables and the control variables (i.e., decoding and phonological processing). Since past studies have not used this conceptualization fully, the use of the word-, sentence-, and discourse-level linguistic skills framework in the current study contributes to the literature in a unique way and establishes a foundation for future use of Gough and Tunmer's conceptualization of linguistic comprehension within

SVR. Results from this study are generally consistent with the hypothesis presented prior to the analyses.

Control variables. The combination of decoding, phonological processing, child gender, and mother's level of education predicted 51% of the variance in fourth-grade reading comprehension, 44% in fifth-grade, and 46% in sixth-grade. The influence of decoding and phonological processing on reading comprehension is well established in the literature (Silverman et al., in press; Tilstra et al., 2009; Adlof et al., 2006; Cutting & Scarborough, 2006) and the results of the current study add to that body of research. Less investigated within SVR is the influence of child gender and mother's level of education (used as an indicator of SES) on reading comprehension. This is the first study in the extant literature that examined the influence of gender and mother's level of education concurrently and longitudinally. Child gender significantly predicted reading comprehension in fourth, fifth, and sixth grade (β s = -.14, -.10, -.20, respectively) and in general, a significant effect favored girls over boys. These findings are consistent with other studies that have investigated the influence of gender on reading comprehension (Logan & Johnston, 2009).

Mother's level of education was a significant predictor in fourth-grade reading comprehension ($\beta = .13$) where students with mothers having higher levels of education had higher reading comprehension. Given the strong relationship between vocabulary and reading comprehension, the findings from the current study support the research suggesting that students from a higher SES category have larger vocabularies than students from a lower SES category (Hoff, 2003; Huttenlocher, Haight, Bryk, Selzer, & Lyons, 1991). Further investigation of the impact of gender and level of mother's

education is warranted given the current findings. Likewise, missing data on mothers' education may have impacted the results of this analysis.

The current study, consistent with the other longitudinal studies with the exception of one, did not control for influence of prior reading comprehension on later reading comprehension. Nation and Snowling (2004) controlled for the autoregressive effect of earlier reading comprehension and although it accounted for unique variance in outcome reading comprehension (32%), linguistic comprehension skills accounted for significant variance (ranging from 4% - 14%) beyond prior reading comprehension as well as age, non-verbal IQ, decoding, and phonological processing skills. Given the consistency in the findings across studies, whether prior reading comprehension was controlled or not, it was not entered as a control variable. Future longitudinal studies should consider using the autoregressive effect of prior reading comprehension as a control variable to further clarify the influence of linguistic and reading comprehension.

Word-level linguistic skills. Word-level linguistic skills predicted reading comprehension in fourth, fifth, and sixth grades beyond the influence of the control variables, sentence-level, and discourse-level linguistic skills. This finding is consistent with previous research suggesting that word-level linguistic skills predict reading comprehension in upper elementary grades beyond the influence of decoding (Ouellette & Beers, 2010; Ricketts et al., 2007; Cutting & Scarborough, 2006; Ouellette, 2006).

Measuring word-level linguistic skills. In the extant literature, word-level linguistic comprehension observed variables were most often measured by receptive or expressive vocabulary tests (Nation & Snowling, 2004; Ouellette, 2006; Ouellette & Beers, 2010; Ricketts et al., 2007; Spear-Swerling, 2004). Two researchers used a

combination of measures involving tasks requiring semantic knowledge along with vocabulary breadth (i.e., quantity of known words in a lexicon) to create latent word-level linguistic comprehension variables that also predicted reading comprehension beyond decoding (Cutting & Scarborough, 2006; Harlaar et al., 2010). In this study, the use of the WISC IV Vocabulary subtest (expressive vocabulary) along with the CELF-4 Word Classes (knowledge of semantic relationships) encompassed both vocabulary breadth and semantic knowledge. The tasks involved in both measures required students to understand semantic relationships between words, such as words that are synonyms, antonyms, or related by attribute (CELF-4 Word Classes) as well as comprehend a word well enough to define it sufficiently (WISC IV Vocabulary). The findings in the current study are consistent with previous research suggesting vocabulary breadth (i.e. quantity of known words in lexicon) and depth (i.e., extent of semantic knowledge) are important in reading comprehension.

Influence of semantic knowledge on reading comprehension. Tilstra et al. (2009) used an expressive vocabulary test, similar in task to the WISC Vocabulary subtest used in this study, to operationalize verbal proficiency. They found that verbal proficiency uniquely contributed to reading comprehension in fourth, seventh, and ninth grades beyond decoding and discourse-level linguistic comprehension. In the current study, the CELF-4 Word Classes and the WISC IV Vocabulary together predicted reading comprehension in all grades. The CELF-4 Word Classes predicted reading comprehension in all grades but the WISC IV Vocabulary was significant alone in only sixth grade. Since the CELF-4 Word Classes requires an understanding of how words are related to each other, these results seem to suggest that semantic knowledge may be more

important in reading comprehension than vocabulary breadth. One possible explanation for the discrepancy between these results and the results from Tilstra et al. (2009) is that the use of the CELF-4 Word Classes, which specifically assesses semantic knowledge, may have weakened the effect of WISC IV Vocabulary on reading comprehension because any variance attributed to semantic knowledge would have been accounted for before WISC IV Vocabulary was entered into the analysis. An expressive vocabulary task encompasses semantic knowledge that requires not only recognition of a word but the knowledge of related words to define it, such as attributes, antonyms, and synonyms. Tilstra et al. (2009) only used one expressive vocabulary measure to represent verbal proficiency, their finding that verbal proficiency predicts reading comprehension supports the premise that semantic knowledge is an important linguistic skill in reading comprehension. Overall, my findings suggest that a deep understanding of vocabulary (i.e., semantic knowledge) combined with vocabulary breadth play an important role in reading comprehension.

Influence of word-level linguistic skills longitudinally. Also important in this study, is the evidence that beyond decoding, phonological processing, and the other linguistic comprehension variables, word-level linguistic skills are not only important in fourth-grade reading comprehension but in fifth- and sixth grade reading comprehension as well, with the amount of variance accounted for increasing from 3% to 7% and 6%, respectively. Similarly, Tilstra et al. found that the influence of word-level linguistic skills (i.e., verbal proficiency) on reading comprehension increased significantly from fourth grade (5%) to seventh grade (8%). The findings of the current study, consistent with Tilstra et al., is in line with previous longitudinal or cross-grade comparison

research suggesting that the role of linguistic comprehension increases, as elementary students get older. These results inform the gaps in the literature resulting from a scarcity of longitudinal studies investigating the significance of word-level linguistic skills and their influence on reading comprehension across consecutive elementary grades (Harlaar et al., 2010; Tilstra et al., 2009).

The importance of word-level linguistic skills in fourth-, fifth-, and sixth-grade reading comprehension is most likely related to the fact that understanding word meanings and their use (i.e. vocabulary knowledge) contributes to reading comprehension and knowledge building (Linan-Thompson & Vaughn, 2007). Initially, oral vocabulary links to the printed word when students are learning to read and the quantity of words they know drives how well they comprehend text. As students get older and their lexicon gets broader and deeper, they gain vocabulary knowledge orally and through print. By the time students are in fourth, fifth, and sixth grade, reading comprehension would rely not only on the quantity of words they know but their semantic knowledge of the words in relation to other words in the text. This most likely explains the predictive relationship between word-level linguistic skills and reading comprehension as measured in the current study.

Sentence-level linguistic skills. Consistent with my hypothesis, sentence-level linguistic skills, beyond the control variables, word- and discourse-level linguistic skills, had no significant influence on reading comprehension at any grade. Although in previous research sentence-level linguistic skills were included as indicators of latent linguistic comprehension variables (Cutting & Scarborough, 2006; Silverman et al., in press), it is difficult to determine the impact they have on reading comprehension because

the specific influence of sentence-level linguistic skills on reading comprehension was not analyzed.

Contrary to the findings in the current study, Goff et al. (2005) found that sentence-level linguistic skills, measured by a receptive grammar test, were a significant predictor of reading comprehension in a group of students (third – fifth grades). The receptive grammar test required students to listen to a phrase or a sentence then choose the corresponding picture from a choice of four. Although they also controlled for decoding, the only other linguistic variable was measured by a receptive vocabulary test, which required students to listen to a word then choose the correct picture from a choice of four. The more narrow definition of word-level linguistic comprehension (i.e., receptive vocabulary) in the Goff et al. study may not have accounted for as much variance as both word- and discourse-level linguistic comprehension variables did in the current study resulting in findings that differed from the ones in this study.

Another possible reason for the results of this analysis is that the influence of sentence-level linguistic skills in the current study was subsumed by discourse-level linguistic skills yielding a non-significant result. It is also possible that results were not significant because the CELF-4 Formulated Sentences subtest, used to operationalize sentence-level linguistic comprehension in this study, is primarily an expressive task requiring less interpretation of linguistic information than the receptive grammar measure used in the Goff et al. study. Additionally, given the negative skew of the CELF-4 scores and the fact that the z-score transformations did not normalize the variables, results may have been impacted. It is important to note, per the limitations discussed below, that the use of more than one measure to operationalize sentence-level linguistic comprehension

would have created a more representative sentence-level linguistic comprehension variable and may have yielded a significant result.

Discourse-level linguistic skills. Discourse-level linguistic skills, as measured in this study, were a significant predictor of reading comprehension in fourth and fifth grades but not in sixth grade. My hypothesis held for the results for fourth and fifth grade but not for sixth. Prior research has shown that the relationship between linguistic comprehension, measured by discourse-level linguistic skills and reading comprehension increases in upper elementary grades beyond decoding (Tilstra et al., 2009; Adlof et al., 2006; Nation & Snowling, 2004). Tilstra et al. is the only other study that investigated discourse-level linguistic comprehension skills as a predictor of reading comprehension beyond decoding and another linguistic skill (i.e., verbal proficiency measured by an expressive vocabulary test). They found that discourse-level linguistic comprehension skills significantly predicted reading comprehension in fourth (6%), seventh (13%), and ninth (4%) grades. In the current study, discourse-level linguistic comprehension skills significantly predicted 4 % of the variance in fourth-grade reading comprehension and 1% of the variance in fifth-grade reading comprehension beyond the control variables, word-level, and sentence-level linguistic skills. However, discourse-level linguistic skills did not predict reading comprehension in sixth grade differing from the findings of Tilstra et al (2009). It is possible that the use of the Listening Test, a non-standardized researcher developed test, limited the representation of the discourse-level variable in the current study. Although the measure was generally reliable and correlated with other listening comprehension tests, it did not encompass the complexity and have the reliability that other listening comprehension tests possess.

Another explanation of the discrepancy in findings is related to the other linguistic comprehension variables entered into the analysis before the discourse-level linguistic variable in the current study compared to the one measure in Tilstra et al. In the current study, the word-level linguistic skills variable was operationalized by two measures (CELF-4 Word Classes and WISC IV Vocabulary) compared to only one measure (WASI Vocabulary). Variables that are operationalized with more than one measure are more representative and may account for more variance than a less representative variable leaving less variance available for the discourse-level linguistic variable. Since the variance accounted for in fourth grade were similar in both studies (4% and 6%), it is possible that the measures used to represent the word-level linguistic skills variable in the current study were more influential in the older grades compared to the single variable used in Tilstra et al. This concept is consistent with Ouellette and Beers (2010) suggesting that vocabulary depth and breadth (semantic knowledge and quantity of words known, respectively) is a significant predictor of reading comprehension in upper elementary grades beyond decoding. Therefore, investigating the influence of discourse-level linguistic skills on reading comprehension may be impacted by the type and quantity of measures used to operationalize word-level as well as discourse-level linguistic comprehension in regard to which measures contain tasks most related to vocabulary breadth and depth. Given that both word- and discourse-level linguistic skills were predictive of reading comprehension in fourth and fifth grades but only word-level linguistic skills were significant in sixth grade supports Tilstra et al.'s (2009) suggestion that defining linguistic comprehension by discourse-level skills (i.e. a listening comprehension measure) alone may not be sufficient in SVR. Their finding that verbal

proficiency (i.e., expressive vocabulary) is a predictor of reading comprehension beyond discourse-level linguistic skills, operationalized by a listening comprehension test, is similar to the findings in the current study that word-level linguistic skills predict reading comprehension beyond discourse-level linguistic skills. This provides foundational evidence that the definition of linguistic comprehension should include measures that assess word-level linguistic skills in addition to discourse-level linguistic skills. Future research focusing on investigating different measures of discourse-level linguistic comprehension would help clarify the influence of discourse-level linguistic skills on reading comprehension which has some variation in the literature.

Research Question Two

This question focused on the relationships between linguistic comprehension, defined by word-, sentence-, and discourse-level linguistic skills, and reading comprehension over time (fourth to sixth grade). Results are not consistent with my hypothesis made before the analysis that there would be an increase in the role of linguistic comprehension in reading comprehension from fourth to sixth grade.

The findings from the current study are inconsistent with other research including studies by Adlof et al. (2006), Tilstra et al. (2009), Harlaar et al. (2010), and Silverman et al. (in press) that linguistic comprehension, measured by word-, sentence-, and discourse-level skills, contribute significantly to reading comprehension in fourth grade. Research is limited regarding the relationship of linguistic and reading comprehension longitudinally therefore the findings from the current study add to the literature base, specifically for these grade levels. Both Adlof et al. and Tilstra et al. found increasing relationships between linguistic and reading comprehension from fourth (17%) to eighth

(45.2%), and fourth (19%) to seventh (35%) grades, respectively. Nation and Snowling (2004) found that each variable: a) semantic skills, b) vocabulary, and c) listening comprehension significantly predicted reading comprehension beyond decoding in a sample of 8.5 year old students (15%, 25%, 31%, respectively) and again when they were 13 years old (4.5%, 5%, 14%, respectively). In the current study, the influence of linguistic comprehension on reading comprehension persisted over time where linguistic comprehension significantly predicted reading comprehension in fourth (14%), fifth (17%), and sixth grades (15%) beyond the control variables. There is no way to test for any significance in the changes across grades but the magnitude of unique variance is similar for the three models. Across time, both word-level and discourse-level linguistic skills are influential in reading comprehension and the variance accounted for is fairly stable as well. Nation and Snowling did not find that the relationship between any of the linguistic skills variables increased from time 1 to time 2, which differed from the results of Adlof et al. (2006), Tilstra et al. (2009), and the current study. In addition to the impact of varying measures across studies, Nation and Snowling's results may have been impacted by the consideration of the effects of time 1 reading comprehension on time 2 reading comprehension. None of the other longitudinal or cross-grade comparison studies controlled for previous reading comprehension, which should be an important consideration in future research in order to consider the influence of an uncontrolled variable.

Given that previous cross-grade comparison and longitudinal research (Tilstra et al., 2009; Adlof et al. 2006; Nation & Snowling, 2004) investigating the relationship between linguistic and reading comprehension beyond decoding collected data in time

frames of three to five years, the current findings provide information on the relationships between linguistic and reading comprehension in annual time increments in grades that have not been included in previous research. Results of the current study suggest that the role of linguistic comprehension in reading comprehension from fourth to sixth grade is stable over that time frame. The results of this study inform the longitudinal literature base suggesting that the role of linguistic comprehension in reading comprehension remains constant from fourth to sixth grade.

Given that it appears there is a differential impact of word-, sentence-, and discourse-level linguistic skills variables on reading comprehension at fourth, fifth, and sixth grades, the amount of variance accounted for by linguistic comprehension across grades may vary depending on the linguistic measures used. Additionally, it is important to consider which measures are used to operationalize reading comprehension since not all reading comprehension tests measure the same thing (Cutting & Scarborough, 2006). Further exploration of the specific linguistic skills most influential in reading comprehension through the use of a variety of linguistic and reading comprehension measurements is warranted. This will add to the foundation of evidence that measurements of at least word-level and discourse level skills together should be used to operationalize linguistic comprehension when investigating its relationship to reading comprehension in SVR.

The findings of the current study provide new information beyond the findings of Tilstra et al. (2009) and Adlof et al. (2006). The influence of linguistic comprehension on reading comprehension beyond decoding is stable from fourth to sixth grade, which is foundational information in this literature base.

Summary of Findings

Consistent with previous research, linguistic comprehension is a significant predictor of reading comprehension, beyond decoding and phonological processing, adding to the support for an additive model of Gough and Tunmer's (1986) SVR (Ouellette & Beers, 2010; Tilstra et al., 2010; Adlof et al., 2006; Cutting & Scarborough, 2006; Ouellette, 2006; Chen & Vellutino, 1997; Silverman et al., in press). The issue of more clearly defining linguistic comprehension was addressed by investigating the influence of each word-level, sentence-level, and discourse-level linguistic skills beyond the other two variables. Findings suggest that word-level linguistic skills, specifically when measuring semantic knowledge, are most predictive of reading comprehension concurrently and longitudinally. Discourse-level linguistic skills are also important in reading comprehension although it appears to work in concert with word-level linguistic comprehension skills, especially in sixth grade. Sentence-level linguistic skills, as measured in this study, do not appear to be independently influential in reading comprehension concurrently or longitudinally but may work together with word- and discourse-level linguistic skills to predict reading comprehension. These findings inform the literature base in more clearly defining linguistic comprehension and that word-, sentence-, and discourse-level linguistic skills differentially influence reading comprehension concurrently and longitudinally. This is also consistent with Gough and Tunmer's (1986) framework, which suggests that linguistic comprehension is the interpretation of information at the word-, sentence-, and discourse-level.

Longitudinally, the predictive relationship between linguistic and reading comprehension was relatively constant from fourth to sixth grade (14%, 17%, 15%,

respectively). The inclusion of word- and discourse-level linguistic measures in defining linguistic comprehension was found to be important in determining whether relationships with reading comprehension persisted over time. Consistent with other studies, word-level linguistic comprehension, including measures of semantic knowledge, appears to be one of the influential linguistic skills related to reading comprehension over time (Ouellette & Beers, 2010; Tilstra et al., 2010; Ouellette, 2006; Cutting & Scarborough, 2006).

Limitations

Examining the role of linguistic comprehension in reading comprehension within the SVR framework has presented researchers with certain challenges, especially in the defining and measurement of the linguistic comprehension construct. The current study also has limitations that require consideration. First, the non-experimental design of this study limits the ability to make assumptions that any of the significant relationships between linguistic and reading comprehension are causal. Given the complex constructs of linguistic and reading comprehension in older students, identifying and controlling confounding variables continued to be a challenge as in previous research. Specifically, prior reading comprehension was not considered and may have contributed to the findings. Evaluating related areas such as memory, attention, executive functioning, as has been done in previous research, then investigating the relationship between word-, sentence-, and discourse-level linguistic comprehension and reading comprehension beyond those related variables would create a more rigorous study investigating linguistic and reading comprehension. Additionally, extraneous variables in the environment may also have been unknowingly at play therefore caution should be exercised when

interpreting the results. Although the measurements used to operationalize the independent and dependent variables were valid and reliable, the variables represented by only one measure were not captured as fully as if more than two measurements were used. The use of two or more measurements more accurately represents the variable thereby controlling the threat of mono-operation and mono-method bias, which compromises the construct validity of the study. For the purposes of this study, the use of hierarchical regression was appropriate given the sample size and goals of the study. However, the use of latent variables within a structural equation model may provide more robust variables yielding more informative results.

Strengths and Contributions

Although limited by some of the same issues found in the previous research, there are several strengths of the study that position the study to add to the research base. The word-, sentence-, and discourse-level framework is informed by Gough and Tunmer's (1986) original definition of linguistic comprehension, extends the framework used by Cutting and Scarborough (2006) and provides a foundation to further investigate which specific linguistic skills are most influential in reading comprehension. Given the high number of students in upper elementary school that struggle with reading comprehension, advancing our understanding about the role that linguistic comprehension plays beyond decoding and phonological processing in reading comprehension is important for developing and administering appropriate assessments and intervention techniques.

The finding that word- and discourse-level linguistic comprehension skills are predictors of reading comprehension across fourth, fifth, and sixth grade provides information that begins to clarify which specific linguistic skills are important in reading

comprehension. Specifically both receptive and expressive measures of vocabulary depth (i.e., semantic knowledge) breadth (i.e., quantity of words known in a lexicon), and listening comprehension appear to be important in predicting reading comprehension. This finding is consistent with previous research (Ouellette & Beers, 2010; Tilstra et al., 2009; Adlof et al., 2006; Nation & Snowling, 2004; Spear-Swerling, 2004; Silverman et al., in press) and offers consideration for a foundational operationalization of linguistic comprehension in SVR that includes word-level linguistic skills operationalized by at least vocabulary breadth and depth and discourse-level linguistic skills operationalized by at least listening comprehension.

All of the measures used to operationalize the independent and dependent variables had at least adequate reliability estimates therefore strengthening the statistical conclusion validity of the study. The longitudinal design adds to an extremely small base of literature investigating these relationships over time and extends the current information available on the influence of linguistic comprehension on reading comprehension in upper elementary grade students.

Implications for Practice

The influence of vocabulary, specifically vocabulary depth, on reading comprehension was a significant finding in the current study for parents and educators. Although it is important to teach students a quantity of words at certain grade levels (i.e., sight words, content vocabulary), it seems more important that students gain semantic knowledge of words in order to improve their reading comprehension. Some activities that build semantic knowledge of words include work on multiple meaning words, generating synonyms and antonyms, and defining or describing words with a variety of

attributes. The use of mapping and graphic organizers is an effective tool and provides visual support during the process of learning and extending their knowledge of new and known words. Activities to build broad and deep vocabularies should begin in the early elementary grades and continue into upper elementary grades to strengthen reading comprehension skills. Given the limitation of this study, use of instructional implications should be used with caution.

Future Directions for Research

Consistent with previous research (Tilstra et al., 2010; Adlof et al., 2006; Nation & Snowling, 2004), the findings from this study support a significant relationship between linguistic and reading comprehension in upper elementary students concurrently and over time. This was the first study that organized linguistic comprehension by word-, sentence-, and discourse-level linguistic skills in an attempt to clarify which specific linguistic comprehension skills are most influential in reading comprehension. Future research using this framework should include multiple measures of each variable to create variables that more accurately represent the construct. Measures at the word-level should include both receptive and expressive tests that continue to focus on semantic knowledge (i.e., vocabulary depth) as well as vocabulary breadth, sentence-level measures should focus on comprehension of semantic and syntactic information, and discourse-level measures should include more than one type of listening comprehension measure. In addition to investigating linguistic and reading comprehension beyond decoding and phonological processing, future research should include areas shown to be influential in reading comprehension, such as fluency, memory, attention, and previous reading comprehension, to more specifically detail the significance of linguistic

comprehension in reading comprehension. This study did not examine specifically at the relationship of linguistic and reading comprehension in students who struggle with reading comprehension compared to students who do not. Future studies should investigate the influence of word-, sentence-, and discourse-level linguistic comprehension on reading comprehension in upper elementary students who struggle with reading comprehension in comparison to the students whose reading comprehension is grade level or above.

Conclusion

Within the original SVR framework (Gough & Tunmer, 1986), this study sought to clarify the relationships between linguistic and reading comprehension, concurrently and longitudinally, by organizing linguistic comprehension into word-, sentence-, and discourse-level linguistic skills. Examining the influence of linguistic comprehension on reading comprehension in fourth, fifth, and sixth grades provided information on those relationships in smaller longitudinal increments than in previous research (Tilstra et al., 2010; Adlof et al., 2006; Nation & Snowling, 2004). The use of this framework was supported given that the variables differentially predicted reading comprehension at each grade with word-level linguistic skills being significant at all grade levels and discourse-level linguistic skills only not significant in sixth grade. Future research is warranted to further clarify the specific linguistic skills important to reading comprehension as well as to determine if these relationships change in students who struggle with reading comprehension. Given the lack of longitudinal research in this area, future studies should focus on investigating the relationship of word-, sentence-, and discourse-level linguistic comprehension over time.

Table 1

Summary of Studies: Content Review

Author	Research Questions	Participants	Constructs	Independent Variable(s)	Dependent Variable(s)	Data Analysis Method	Results
<u>Studies Examining Listening Comprehension and Reading Comprehension</u>							
Chen & Vellutino (1997)	In SVR, what impacts RC more, decoding or LC and do these relationships change with development? ^a	129 6 th grade and 37 7 th grade students Poor and normal readers from schools in suburban areas near Albany, NY Middle- and upper-class families English as first language	LC RC	Spache Diagnostic Reading Scales LC subtest ^f	Spache Diagnostic Reading Scales RC subtest	Multiple regression	Decoding is a moderator variable for LC and RC. At low levels of decoding, LC and RC are weakly related but the relationship becomes stronger as decoding is mastered.
Keenan, Betjemann, & Olson (2008)	Do RC measures that differ in format assess decoding and LC differently?	510 children from larger twin study (470 twins, 40 siblings) ranging in age from 8 –	LC RC	Composite score ^f from Woodcock-Johnson (WJ) Oral Comp subtest, Qualitative	WJ Passage Comp QRI Gray Oral	Hierarchical regression	Different RC tests measure different skills variables used to “carve up” the variance in RC, such as global measures of

	Does the age of testing or decoding ability influence the results?	18 years (median at 10.5 years) ^b From 27 school districts in Colorado English as first language; Full scale IQ greater than 85; no sensory deficits		Reading Inventory (QRI), & KNOW-IT Test	Reading Test (GORT) Peabody Individual Achievement Test (PIAT)		LC versus a single component of OL, could also affect what RC is measuring. The same RC test can measure different skills depending on age and ability
Verhoeven & van Leeuwe (2008)	To what extent can RC be explained by LC skills across grades ^a	2384 children in longitudinal study of 1 st – 6 th grades with a final sample of 2143 children Representative sample from 118 elementary schools in the Netherlands including linguistically diverse learners	LC RC	LC standardized test constructed by the Dutch National Institute for Educational Measurement ^f	RC standardized test constructed by the Dutch National Institute for Educational Measurement	Analyses of variance with repeated measures Structural equation modeling	In 3 rd – 6 th grades, LC and RC relationships are reciprocal showing the development of these skills are highly interdependent

Author	Research Questions	Participants	Constructs	Independent Variable(s)	Dependent Variable(s)	Data Analysis Method	Results
<u>Studies Examining Listening Comprehension, Oral Language, and Reading Comprehension</u>							
Adlof, Catts, & Little (2006)	Should a fluency component be added to SVR?	604 children followed from 2 nd – 8 th grade initially from a larger epidemiologic study (328 children met criteria for language or nonverbal cognitive impairments in kindergarten; 276 non-impaired children) ^c	LC RC	LC indicators: Peabody Picture Vocabulary Test-Revised (PPVT-R) ^d Clinical Evaluation of Language Fundamentals-3 (CELF-3) Concepts and Directions subtest ^e CELF-3 Listening to Paragraphs subtest ^f	RC indicators: Woodcock Reading Mastery Test-Revised (WRMT-R) Passage Comp subtest GORT-3 Comp subtest Diagnostic Achievement Battery-2 (DAB-2)	Structural equation modeling	Fluency does not predict RC independent from word recognition and LC. LC abilities are important for RC, especially in later grades
Berninger & Abbott (2010)	What are the relationships among oral expression, LC and RC? ^a	113 3 rd graders followed longitudinally through 7 th grade (<i>n</i> = 99) Representative	LC Oral Expression RC	Weschler Individual Achievement Test (WIAT)-2 Listening comp subtest ^f	WIAT-2 Reading comp subtest	Multiple regressions	Oral expression and LC contributed uniquely to RC in 3 rd and 5 th grades while only LC contributed unique variance in 5 th and 7 th grades.

		sample of the school system and Pacific Rim region of the northwest US		WIAT-2 Oral expression subtest ^{d,e,f}			
Harlaar et al. (2010)	Do the subcomponents of OL (LC and vocabulary) account for unique variance in RC and how do they relate to RC? ^a	440 9 year old twins (89 identical pairs and 131 fraternal pairs) who were part of an ongoing twin study of reading and cognitive skills Sample recruited from Ohio and Pennsylvania	OL ability defined by LC and vocabulary RC	LC indicators: Test of Narrative Language Narrative Comp subtest ^f CELF Understanding Spoken Paragraphs subtest ^f Vocabulary indicators: CELF Word Classes ^d Boston Naming Test ^d	RC indicator: WRMT-R Passage Comp subtest PIAT Reading Comp subtest	Structural equation modeling	All of the variance in RC was explained by factors reflecting word decoding and OL skills regardless of the order of the factors consistent with SVR that word decoding and OL skills are independent predictors of RC
Nation & Snowling (2004)	What is the relationship between OL skills and RC? ^a	Sample of 72 children assessed at ages 8.5 and 13 years Attended schools in working class	OL skills RC	Vocabulary: Weschler Intelligence Scale for Children (WISC-III) Vocabulary	Neale Analysis of Reading Ability-Revised	Hierarchical regressions	OL skills predicted RC concurrently and longitudinally

		areas of York, England		subtest ^d			
		English as first language		LC: % correct on questions corresponding to short stories presented on audio-tape ^f			
				Semantics: Composite score of CELF-R Word association subtest and synonym judgment task ^d			
Ouellette & Beers (2010)	Does oral vocabulary (breadth and depth) contribute to RC beyond components of SVR? ^a	56 6 th graders Sample recruited from 3 English schools in eastern Canada English as first language	LC Vocabulary breadth Vocabulary depth RC	CELF-4 Understanding Spoken Paragraphs subtest ^f PPVT-4 ^d Definitions task ^d	WRMT-R Passage Comp subtest	Hierarchical regressions	Oral vocabulary predicted RC after accounting for the components of SVR
Silverman, Speece, Harring, & Ritchey (in press)	Does fluency uniquely contribute to RC beyond decoding and	284 4 th grade students Sample from parochial schools	Linguistic comp RC	Ling comp indicators: CELF-4 Formulated	RC indicators: Gates MacGinitie	Latent variable regressions	Fluency added unique variance beyond decoding and linguistic comp

linguistic comp? in a large city and surrounding suburbs in the mid-Atlantic region of the US

English as first language

sentences^c and word classes^d subtests

WISC-IV Vocabulary subtest^d

Listening Comp Test (developed and based on Gates MacGinite Reading Comp subtest)^f

Reading Test (GMRC) Reading comp subtest

Maze (group administered CBM using modified cloze technique)

Spear-Swerling (2004)

Are there differences in how two RC measure formats (cloze and question-answering) tap SVR components including language comp?

95 4th graders

Sample from 3 different schools in separate school districts in Connecticut 1 school was suburban ($n = 33$), 1 was urban ($n = 29$), and the other an interdistrict magnet ($n = 33$)

Fluent speakers of English

Language comp defined by LC and vocabulary RC

Composite score from: WJ-R LC^f subtest and PPVT^d

The Connecticut Mastery test: The Degrees of Reading Power subtest

Reading Comp subtest

Hierarchical regressions

Language comp skills were strongly related to RC on both RC formats

Tilstra, McMaster, Van den Broek, Kendeou, & Rapp (2009)	What is the contribution of SVR components to RC in 4 th , 7 th , and 9 th grade? Does verbal proficiency contribute to RC beyond decoding and LC? ^a	89 4 th graders 89 7 th graders 93 9 th graders Total of 271 struggling, average, and good readers from the screening phase of a larger study of RC processes. Sample from suburban schools in a large metropolitan area in Midwestern region of US English as first language	Verbal proficiency LC RC	Weschler Abbreviated Scale of Intelligence (WASI) Vocabulary definitions subtest ^d Iowa Test of Basic Skills LC subtest ^f	Gates-MacGinite Reading Comprehension test	Multiple regressions	After decoding, LC contributed uniquely to RC in all 3 grades The proportion of variance held by LC increased from 4 th to 7 th grade Verbal proficiency also accounted for additional variance in RC after decoding and LC in all 3 grades
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Author	Research Questions	Participants	Constructs	Independent Variable(s)	Dependent Variable(s)	Data Analysis Method	Results
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Studies Examining Oral Language and Reading Comprehension

Cutting & Scarborough (2006)	Do the contributions of word recognition/decoding and OL skills to RC depend on the	97 children ranging in age from 7 years to 15 years ($M = 9.7$) Sample from a	OL: Lexical and sentence processing skills	Lexical composite score: PPVT-3 ^d Boston Naming Test ^d	Gates-MacGinite Reading Test-Revised GORT-3	Hierarchical regressions	Regardless of what RC measure was used, OL uniquely predicted RC
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	RC measure used? ^a	comparison sample for ongoing study of reading and language deficits associated with Neurofibromatosis Type 1 (NF-1)	RC	CELF-3 Word classes subtest ^d	WIAT		Different tests might place different demands on vocabulary knowledge or sentence processing ability
		IQ of 80 or higher		Sentence Processing composite score: CELF-3 Concepts and directions subtest ^e			
		English as first language		CELF-3 Formulated sentences subtest ^e			
				CELF-3 Recalling sentences subtest ^e			
				Experimental syntactic comprehension measure ^e			
Goff, Pratt, & Ong (2005)	What are the strongest predictors of RC from word reading, language, and	180 primary school children from 3 rd (<i>n</i> = 54), 4 th (<i>n</i> = 80), and 5 th (<i>n</i> = 46) grades	Language RC	PPVT-3 ^d Test for Reception of Grammar ^e (TROG)	The Progressive Achievement Test in RC (normed Australian test)	Exploratory hierarchical regressions	After controlling for age and IQ, both language measures accounted for unique variance

memory variables?

Recruited from two representative primary schools in Melbourne, Australia

IQ 85 or higher

English as first language

in RC

After controlling for age, IQ, and word reading, language continued to account for unique variance in RC

Ouellette (2006)

What is the relationship of vocabulary (breadth and depth) to RC?

60 4th grade students

Sample recruited from 6 English schools in an urban area of Canada

English preferred language spoken

Oral vocabulary (breadth and depth)

RC

The Test of Word Knowledge subtests:

Receptive vocabulary^d

Expressive vocabulary^d

Word definitions^d

Synonyms^d

WRMT-R Passage comp subtest

Hierarchical regressions

After controlling for age, non-verbal IQ, decoding, and visual word recognition, oral vocabulary made a significant contribution to RC

RC was better predicted by vocabulary depth than by vocabulary breadth

Nagy, Berninger, & Abbott (2006)	Does morphological awareness make significant contributions to RC when shared variance between morphological and phonological abilities is controlled? ^a	607 4 th – 9 th graders 96 in 4 th 86 in 5 th 116 in 6 th 102 in 7 th 105 in 8 th 102 in 9 th Sample from a small suburban school district near a large metropolitan area in the northwestern US	Morphological awareness RC	Indicators: Suffix Choice Test ^{d,e} Morphological Relatedness Test ^d	Stanford Diagnostic Reading Test Comp subtest	Structural equation modeling	Morphological awareness contributed significantly at all grade levels to RC when the shared variance among morphological awareness, phonological working memory, and phonological decoding were controlled for statistically
Ricketts, Nation, & Bishop (2007)	Does oral vocabulary predict RC? ^a	81 students between 9 – 10 years old ($M = 9.21$ years) Sample from schools in a variety of economical environments in Middlegender and Oxford, England	Vocabulary ability RC	WASI Vocabulary subtest ^d	Neale Analysis of Reading Ability-II RC subtest	Hierarchical regressions	After chronological age, nonverbal reasoning, decoding, regular word reading, and exception word reading were controlled, oral vocabulary predicted additional variance in RC

Note. LC = listening comprehension; RC = reading comprehension; OL = oral language; comp = comprehension.

^aAdditional research questions addressed in study. ^bNonindependence of data controlled by additional analyses yielding identical results.

^cWeighted scores used in all analyses to reduce potential bias from sample characteristics. ^dWord level language measure. ^eSentence level language measure. ^fDiscourse level language measure.

Table 2.

Definitions of Threats to Validity

Criterion	Definition
Internal validity criteria	
Unbiased selection	Sample was randomly selected and reflected the participants regularly found in the described learning environments. Students were not purposely included or excluded. Information about the sampling procedures was provided.
Control for third variable	The correlation between the oral language variable(s) and reading comprehension variable(s) cannot be explained by a third, uncontrolled for, variable not represented in the statistical analysis. For the purposes of this review, variables should have included at least decoding since it is established in the research as an influential factor in reading comprehension.
Statistical conclusion validity	
Measure reliability	Reliability coefficients (most commonly internal consistency, test-retest, split-half) for the measures used in the study were provided.
Number of participants	The specific number of initial and final participants was provided and was sufficient to control for Type II error. Ten participants per independent variable was used as the standard in this review.
Data analyses	The form(s) of data analysis were listed, appropriate, and supported therefore minimizing the probability of Type I error.
Construct validity	
Adequate theoretical framework	The study was situated in a theoretical framework that was explained and justified.
Constructs defined	Constructs were clearly defined.
Confounding constructs	Relationships between or among constructs were delineated and explained.
Control for mono-method bias	More than one measure was used to evaluate each variable or construct of interest.

External validity criteria

Grade	The grade level(s) of the participants was provided.
Age	The mean age of the participants was provided.
Gender	The number of male and female participants was provided.
Race/Ethnicity	The race/ethnicity of the participants was provided.
Socio-economic status	The socio-economic status of the participants was disclosed.
Disability inclusion	If students with special education needs were included, their disability information was provided.
Location	The physical location (country, urbanization, school district size) of where the study was conducted was provided

Note. Definitions adapted from Troia (1999)

Table 3.
Studies Cross-referenced with External Validity Criteria

Author	Grade	Age	Gender	Race	SES	Disability	Location
<u>Studies Examining Listening Comprehension and Reading Comprehension</u>							
Chen & Vellutino (1997)	Y	N	N	N	N	N	Y
Keenan, Betjemann, & Olson (2008)	N	Y	N	N	N	N	Y
Verhoeven & van Leeuwe (2008)	Y	Y	Y	Y	Y	Y	Y
<u>Studies Examining Listening Comprehension, Oral Language, and Reading Comprehension</u>							
Adlof, Catts, & Little (2006)	Y	N	N	N	N	Y	N
Berninger & Abbott (2010) ***	Y	Y	Y	Y	Y	Y	Y
Harlaar et al. (2010)	N	Y	Y	Y	Y	N	Y
Nation & Snowling (2004)	Y	Y	N	N	N	N	Y
Ouellette & Beers (2010)	Y	Y	Y	N	N	N	Y

Silverman, Speece, Harring, & Ritchey (in press)	Y	Y	Y	Y	Y	Y	Y
Spear-Swerling (2004)	Y	Y	Y	N	N	N	Y
Tilstra, McMaster, Van den Broek, Kendeou, & Rapp (2009)	Y	Y	Y	Y	N	Y	Y

Studies Examining Oral Language and Reading Comprehension

Cutting & Scarborough (2006)	Y	Y	Y	Y	Y	Y	N
Goff, Pratt, & Ong (2005)	Y	Y	N	N	Y	N	Y
Ouellette (2006)	Y	Y	Y	N	N	Y	Y
Nagy, Berninger, & Abbott (2006)	Y	N	Y	Y	Y	Y	Y
Ricketts, Nation, & Bishop (2007)	N	Y	N	N	N	Y	Y

Table 4.

Demographic Information for Fourth-grade Sample

Fourth-grade participants (<i>n</i> = 227)		
	Frequency	Percent
Gender		
Male	104	46.0
Female	123	54.0
Race		
White	164	72.2
Black	39	17.2
Other	11	4.9
Unavailable	13	5.7
Mother's level of education ^a		
Some high school	4	1.8
High school graduate	27	11.9
Some college	60	26.4
College graduate	50	22.0
Professional/graduate degree	39	17.2
No information provided	47	20.7

Note: Mother's education was coded as 1 = some high school, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = professional/graduate school. ^aMother's level of education was used as an indicator of socio-economic status.

Table 5.

Schedule for Administration of Measures

Measure	Fall – Grade 4		Spring – Grade 4		Spring – Grade 5		Spring – Grade 6	
	Ind.	Group	Ind.	Group	Ind.	Group	Ind.	Group
Decoding								
WJIII Letter-Word Identification	x		x					
WJIII Word Attack	x		x					
Phonological Processing								
CTOPP Elision	x							
CTOPP Pseudoword Repetition	x							
Linguistic Comprehension								
CELF-4 Word Classes	x							
WISC-IV Vocabulary	x ^a							
CELF-4 Formulated Sentences	x							
Listening Comprehension Test	x							
Reading Comprehension								
GMRC		x		x		x		x
Maze		x		x		x		x

Note. Ind. = Individually administered assessment; Group = Group administered assessment; WJIII = Woodcock-Johnson Tests of Achievement, Third Edition; CTOPP = Comprehensive Test of Phonological Processing; CELF-4 = Clinical Evaluation of Language Fundamentals, Fourth Edition; WISC-IV = Weschler Intelligence Scale for Children, Fourth Edition; GMRC = Reading Comprehension subtest of the Gates MacGinitie Reading Test, Fourth Edition; ^aadministered in the fall during a separate session.

Table 6.

Descriptive Statistics of Study Variables for Fourth, Fifth, and Sixth Grades (Maximum Possible N=227)

Measure	Mean	SD	Minimum	Maximum	Skewness		Kurtosis	
					Statistic	Std. Error	Statistic	Std. Error
WJIII Letter-Word Identification ^a	104.45	9.90	73.00	129.00	-.10	.16	-.45	.32
WJIII Word Attack ^a	104.94	9.92	73.00	135.00	.04	.16	.38	.32
CTOPP Elision ^a	.00	1.00	-2.52	1.59	-.39	.16	-1.09	.32
CTOPP Pseudoword Repetition ^a	10.47	2.61	3.00	17.00	-.10	.16	.33	.32
CELF-4 Word Classes ^a	10.49	2.64	4.00	17.00	.22	.16	-.45	.32
WISC-IV Vocabulary ^a	10.72	2.54	4.00	16.00	-.25	.16	-.42	.32
CELF-4 Formulated Sentences ^a	.00	1.00	-2.94	2.12	-.57	.16	.17	.32
Listening Comprehension Test ^a	8.63	3.38	.00	16.00	.09	.16	-.70	.32
Fourth Grade Reading Comprehension Composite Score ^a	.00	.89	-2.18	2.25	-.05	.16	-.43	.32
GMRC	102.10	2.60	71.51	134.90	-.01	.16	-.35	.32
Maze	8.96	2.60	2.50	16.50	.16	.16	-.00	.32
Fifth Grade Reading Comprehension Composite Score ^b	.00	.86	-2.68	.40	.08	.17	.09	.33
GMRC	101.14	13.24	65.10	134.90	-.01	.17	.08	.34
Maze	9.27	2.56	2.50	16.25	.37	.17	.18	.33

Sixth Grade Reading	.00	.85	-2.57	2.11	-.07	.18	-.24	.36
Comprehension Composite Score ^c								
GMRC	103.31	12.93	69.37	134.90	.06	.18	-.20	.36
Maze	11.06	3.09	3.25	21.00	.22	.18	.35	.36

Note: WJIII = Woodcock-Johnson Tests of Achievement, Third Edition; CTOPP = Comprehensive Test of Phonological Processing; CELF-4 = Clinical Evaluation of Language Fundamentals, Fourth Edition; WISC-IV = Weschler Intelligence Scale for Children, Fourth Edition; GMRC = Reading Comprehension subtest of the Gates MacGinitie Reading Test. ^aN=227. ^bN=211. ^cN=183.

Table 7.

Bivariate Correlations between Study Variables for Fourth, Fifth, and Sixth Grades (Maximum Possible N=227)

Measure	1	2	3	4	5	6	7	8	9	10	11	12
1. Child Gender ^{ac}	-											
2. Maternal Education ^{bc}	.06	-										
3. WJIII Letter-Word Identification ^c	.05	.16*	-									
4. WJIII Word Attack ^c	.07	.04	.76**	-								
5. CTOPP Elision ^c	.13*	.11	.58**	.57**	-							
6. CTOPP Pseudoword Repetition ^c	-.06	.06	.42**	.34**	.36**	-						
7. CELF-4 Word Classes ^c	.03	.21**	.59**	.43**	.47**	.36**	-					
8. WISC-IV Vocabulary ^c	-.01	.25**	.54**	.31**	.37**	.31**	.58**	-				
9. CELF-4 Formulated Sentences ^c	-.03	.07	.37**	.34**	.40**	.29**	.47**	.43**	-			
10. Listening Comprehension Test ^c	.04	.24**	.38**	.24**	.33**	.26**	.53**	.58**	.36**	-		

11. Fourth Grade Reading Comprehension Composite ^c	-.11	.31**	.64**	.45**	.51**	.37**	.62**	.60**	.37**	.59**	-	
GMRC			.57**	.38**	.46**	.32**	.61**	.61**	.36**	.64**	-	
Maze			.58**	.42**	.45**	.34**	.50**	.46**	.31**	.41**	-	
12. Fifth Grade Reading Comprehension Composite ^d	-.11	.25**	.58**	.43**	.48**	.40**	.64**	.56**	.40**	.57**	.87**	-
GMRC			.50**	.34**	.41**	.38**	.62**	.52**	.42**	.57**	.73**	-
Maze			.50**	.40**	.42**	.31**	.49**	.45**	.29**	.41**	.78**	-
13. Sixth Grade Reading Comprehension Composite ^e	-.17*	.17*	.60**	.43**	.46**	.39**	.61**	.56**	.41**	.52**	.82**	.86**
GMRC			.54**	.40**	.42**	.30**	.55**	.52**	.39**	.48**	.65**	.67**
Maze			.48**	.33**	.36**	.36**	.48**	.43**	.30**	.41**	.74**	.79**

Note: Correlations for CELF-4 Formulated Sentences and CTOPP Elision are based on transformed scores. WJIII = Woodcock-Johnson Tests of Achievement, Third Edition. CTOPP = Comprehensive Test of Phonological Processing. CELF-4 = Clinical Evaluation of Language Fundamentals, Fourth Edition. WISC-IV = Weschler Intelligence Scale for Children, Fourth Edition. GMRC = Reading Comprehension subtest of the Gates MacGinitie Reading Test. ^a0 = Female, 1 = Male. ^bMother's education was coded as 1 = some high school, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = professional/graduate school. ^cN=227. ^dN=210. ^eN=182.

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

Table 8.

Analyses of Attrition Effects of Demographic and Study Variables

Chi-Square Analyses			<i>df</i>		X^2	<i>p</i> -value
Race			2		3.28	.19
Child Gender ^a			1		.01	.91
Mother's Education ^b			5		8.27	.14
One-Way Analysis of Variance		Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i> -value
Child Age	Between Groups	.00	1	.00	.01	.92
	Within Groups	25.14	225	.11		
	Total	25.14	226			
WJIII Letter-Word Identification	Between Groups	210.50	1	210.50	2.16	.14
	Within Groups	21961.67	225	97.61		
	Total	22172.17	226			
WJIII Word Attack	Between Groups	109.63	1	109.63	1.11	.29
	Within Groups	22152.62	225	98.46		
	Total	22262.26	226			
CTOPP Elision	Between Groups	.96	1	.96	.96	.33
	Within Groups	225.04	225	1.00		
	Total	226.00	226			
CTOPP Pseudoword Repetition	Between Groups	1.58	1	1.58	.23	.63
	Within Groups	1536.98	225	6.83		
	Total	1538.56	226			

CELF-4 Word Classes	Between Groups	.13	1	.13	.02	.89
	Within Groups	1572.59	225	6.99		
	Total	1572.72	226			
WISC-IV Vocabulary	Between Groups	.00	1	.00	.00	1.00
	Within Groups	1453.52	225	6.46		
	Total	1453.52	226			
CELF-4 Formulated Sentences	Between Groups	.42	1	.42	.42	.52
	Within Groups	225.58	225	1.00		
	Total	226.00	226			
Listening Comprehension Test	Between Groups	35.92	1	35.92	3.17	.08
	Within Groups	2551.26	225	11.34		
	Total	2587.17	226			
Reading Comprehension (Fourth Grade)	Between Groups	.04	1	.04	.05	.83
	Within Groups	180.85	225	.80		
	Total	180.89	226			
Reading Comprehension (Fifth Grade)	Between Groups	.33	1	.33	.44	.51
	Within Groups	156.51	209	.75		
	Total	156.84	210			

Note: WJIII = Woodcock-Johnson Tests of Achievement, Third Edition. CTOPP = Comprehensive Test of Phonological Processing. CELF-4 = Clinical Evaluation of Language Fundamentals, Fourth Edition. WISC-IV = Weschler Intelligence Scale for Children, Fourth Edition. ^a Child gender was coded 0 = Female, 1 = Male. ^b Mother's education was coded as 1 = some high school, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = professional/graduate school.

Table 9.

Hierarchical Regression Analysis for Word-Level Linguistic Skills Predicting Fourth-, Fifth-, and Sixth-Grade Reading Comprehension (Maximum N = 227)

Variable	Fourth Grade Reading Comprehension			Fifth Grade Reading Comprehension			Sixth Grade Reading Comprehension		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
	<hr/>								
Block 1: Control Variables									
Child Gender ^a	-.26	.09	-.14**	-.18	.09	-.10*	-.33	.09	-.20***
Maternal Education ^b	.11	.04	.13**	.07	.04	.08	.01	.04	.02
WJIII Letter-Word Identification	.03	.01	.28**	.01	.01	.10	.02	.01	.21*
WJIII Word Attack	-.00	.01	-.01	.01	.01	.06	.00	.01	.01
CTOPP Elision ^c	.13	.06	.14*	.10	.06	.11	.06	.06	.07
CTOPP Pseudoword Repetition	.02	.02	.05	.04	.02	.12*	.06	.02	.17**
<i>Block 1 R² Change</i>		.51			.44			.46	
<i>Block 1 F Change</i>		30.18***			20.79***			19.50***	
<hr/>									
Block 2: Sentence- and Discourse-level Linguistic Skills Variables									
CELF-4 Formulated	-.00	.05	-.00	.05	.05	.06	.07	.05	.08

Sentences ^c									
Listening Comprehension Test	.07	.02	.25***	.04	.02	.15*	.03	.02	.12
<i>Block 2 R² Change</i>		.11			.10			.10	
<i>Block 2 F Change</i>		25.33***			18.04***			13.75***	
<hr/>									
Block 3: Independent Variables									
CELF-4 Word Classes	.06	.02	.18**	.10	.02	.31***	.08	.02	.25**
WISC-IV Vocabulary	.05	.03	.12	.05	.03	.14	.06	.03	.17*
<i>Block 3 R² Change</i>		.03			.07			.06	
<i>Block 3 F Change</i>		6.65***			13.42***			10.23***	

Note: Standardized (β) betas are presented for the last step in the analysis. WJIII = Woodcock-Johnson Tests of Achievement, Third Edition. CTOPP = Comprehensive Test of Phonological Processing. CELF-4 = Clinical Evaluation of Language Fundamentals, Fourth Edition. WISC-IV = Weschler Intelligence Scale for Children, Fourth Edition.

^aChild Gender was coded where 0 = Female and 1 = Male.

^bMother's education was coded as 1 = some high school, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = professional/graduate school.

^cTransformed z scores used.

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

Table 10.

Summary of Hierarchical Regression Analysis for Sentence-level Linguistic Skills Predicting Fourth-, Fifth-, and Sixth-Grade Reading Comprehension (Maximum N = 227)

Variable	Fourth Grade Reading Comprehension			Fifth Grade Reading Comprehension			Sixth Grade Reading Comprehension		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
	<hr/>								
Block 1: Control Variables									
Child Gender ^a	-.26	.09	-.14**	-.18	.09	-.10*	-.33	.09	-.20***
Maternal Education ^b	.11	.04	.13**	.07	.04	.08	.01	.04	.02
WJIII Letter-Word Identification	.03	.01	.28**	.01	.01	.10	.02	.01	.21*
WJIII Word Attack	-.00	.01	-.01	.01	.01	.06	.00	.01	.01
CTOPP Elision ^c	.13	.06	.14*	.10	.06	.11	.06	.06	.07
CTOPP Pseudoword Repetition	.02	.02	.05	.04	.02	.12*	.06	.02	.17**
<i>Block 1 R² Change</i>		.51			.44			.46	
<i>Block 1 F Change</i>		30.18***			20.79***			19.50***	
<hr/>									
Block 2: Sentence- and Discourse-level Linguistic Skills Variables									
CELF-4 Word Classes	.06	.02	.18**	.10	.02	.31***	.08	.02	.25**

WISC-IV Vocabulary	.05	.03	.12	.05	.03	.14	.06	.03	.17*
Listening Comprehension Test	.07	.02	.25***	.04	.02	.15*	.03	.02	.12
<i>Block 2 R² Change</i>		.14			.17			.15	
<i>Block 2 F Change</i>		22.57***			22.46***			16.55***	
<hr/>									
Block 3: Independent Variable									
CELF-4 Formulated Sentences ^c	-.00	.05	-.00	.05	.05	.06	.07	.05	.08
<i>Block 3 R² Change</i>		.00			.003			.01	
<i>Block 3 F Change</i>		0.001			1.11			1.73	

Note: Standardized (β) betas are presented for the last step in the analysis. WJIII = Woodcock-Johnson Tests of Achievement, Third Edition. CTOPP = Comprehensive Test of Phonological Processing. CELF-4 = Clinical Evaluation of Language Fundamentals, Fourth Edition.

^aChild Gender was coded where 0 = Female and 1 = Male.

^bMother's education was coded as 1 = some high school, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = professional/graduate school.

^cTransformed z scores used.

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

Table 11.

Summary of Hierarchical Regression Analysis for Discourse-level Linguistic Skills Predicting Fourth-, Fifth-, and Sixth-Grade Reading Comprehension (Maximum N = 227)

Variable	Fourth Grade Reading Comprehension			Fifth Grade Reading Comprehension			Sixth Grade Reading Comprehension		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
	<hr/>								
Block 1: Control Variables									
Child Gender ^a	-.26	.09	-.14**	-.18	.09	-.10*	-.33	.09	-.20***
Maternal Education ^b	.11	.04	.13**	.07	.04	.08	.01	.04	.02
WJIII Letter-Word Identification	.03	.01	.28**	.01	.01	.10	.02	.01	.21*
WJIII Word Attack	-.00	.01	-.01	.01	.01	.06	.00	.01	.01
CTOPP Elision ^c	.13	.06	.14*	.10	.06	.11	.06	.06	.07
CTOPP Pseudoword Repetition	.02	.02	.05	.04	.02	.12*	.06	.02	.17**
<i>Block 1 R² Change</i>		.51			.44			.46	
<i>Block 1 F Change</i>		30.18***			20.79***			19.50***	

Block 2: Sentence- and Discourse-level Linguistic Skills Variables									
CELF-4 Word Classes	.06	.02	.18**	.10	.02	.31***	.08	.02	.25**
WISC-IV Vocabulary	.05	.03	.12	.05	.03	.14	.06	.03	.17*
CELF-4 Formulated Sentences ^c	-.00	.05	-.00	.05	.05	.06	.07	.05	.08
<i>Block 2 R² Change</i>		.10			.16			.14	
<i>Block 2 F Change</i>		15.19***			20.57***			15.98***	

Block 3: Independent Variable									
Listening Comprehension Test	.07	.02	.25***	.04	.02	.15*	.03	.02	.12
<i>Block 3 R² Change</i>		.04			.01			.01	
<i>Block 3 F Change</i>		17.36***			5.19*			2.99	

Note: Standardized (β) betas are presented for the last step in the analysis. WJIII = Woodcock-Johnson Tests of Achievement, Third Edition. CTOPP = Comprehensive Test of Phonological Processing. CELF-4 = Clinical Evaluation of Language Fundamentals, Fourth Edition.

^aChild Gender was coded where 0 = Female and 1 = Male.

^bMother's education was coded as 1 = some high school, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = professional/graduate school.

^cTransformed z scores used.

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

Table 12.

Summary of Hierarchical Regression Analysis for Variables Predicting Fourth-, Fifth-, and Sixth-Grade Reading Comprehension (Maximum N = 227)

Variable	Fourth Grade Reading Comprehension			Fifth Grade Reading Comprehension			Sixth Grade Reading Comprehension		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Block 1: Control Variables									
Child Gender ^a	-.26	.09	-.14**	-.18	.09	-.10*	-.33	.09	-.20***
Maternal Education ^b	.11	.04	.13**	.07	.04	.08	.01	.04	.02
WJIII Letter-Word Identification	.03	.01	.27**	.01	.01	.10	.02	.01	.21*
WJIII Word Attack	.00	.01	-.01	.01	.01	.06	.00	.01	.01
CTOPP Elision ^c	.13	.06	.14*	.10	.06	.11	.06	.06	.07
CTOPP Pseudoword Repetition	.02	.02	.05	.04	.02	.12*	.06	.02	.17**
<i>Block 1 R² Change</i>		.51			.44			.46	
<i>Block 1 F Change</i>		30.18***			20.79***			19.50***	
Block 2: Independent Variables									
CELF-4 Word Classes	.06	.02	.18**	.10	.02	.31***	.08	.02	.25**
WISC-IV Vocabulary	.04	.02	.12	.05	.03	.14	.06	.03	.17*

CELF-4 Formulated Sentences ^c	.00	.05	.00	.05	.05	.06	.07	.05	.08
Listening Comprehension Test	.07	.02	.25***	.04	.02	.15*	.03	.02	.12
<i>Block 2 R² Change</i>		.14			.17			.15	
<i>Block 2 F Change</i>		16.83***			17.13***			12.91***	

Note: Standardized (β) betas are presented for the last step in the analysis. WJIII = Woodcock-Johnson Tests of Achievement, Third Edition. CTOPP = Comprehensive Test of Phonological Processing. CELF-4 = Clinical Evaluation of Language Fundamentals, Fourth Edition. WISC-IV = Weschler Intelligence Scale for Children, Fourth Edition.

^aChild Gender was coded where 0 = Female and 1 = Male.

^bMother's education was coded as 1 = some high school, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = professional/graduate school.

^cTransformed z scores used.

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

Figure 1. *Illustration of areas underlying linguistic comprehension within the Simple View of Reading*

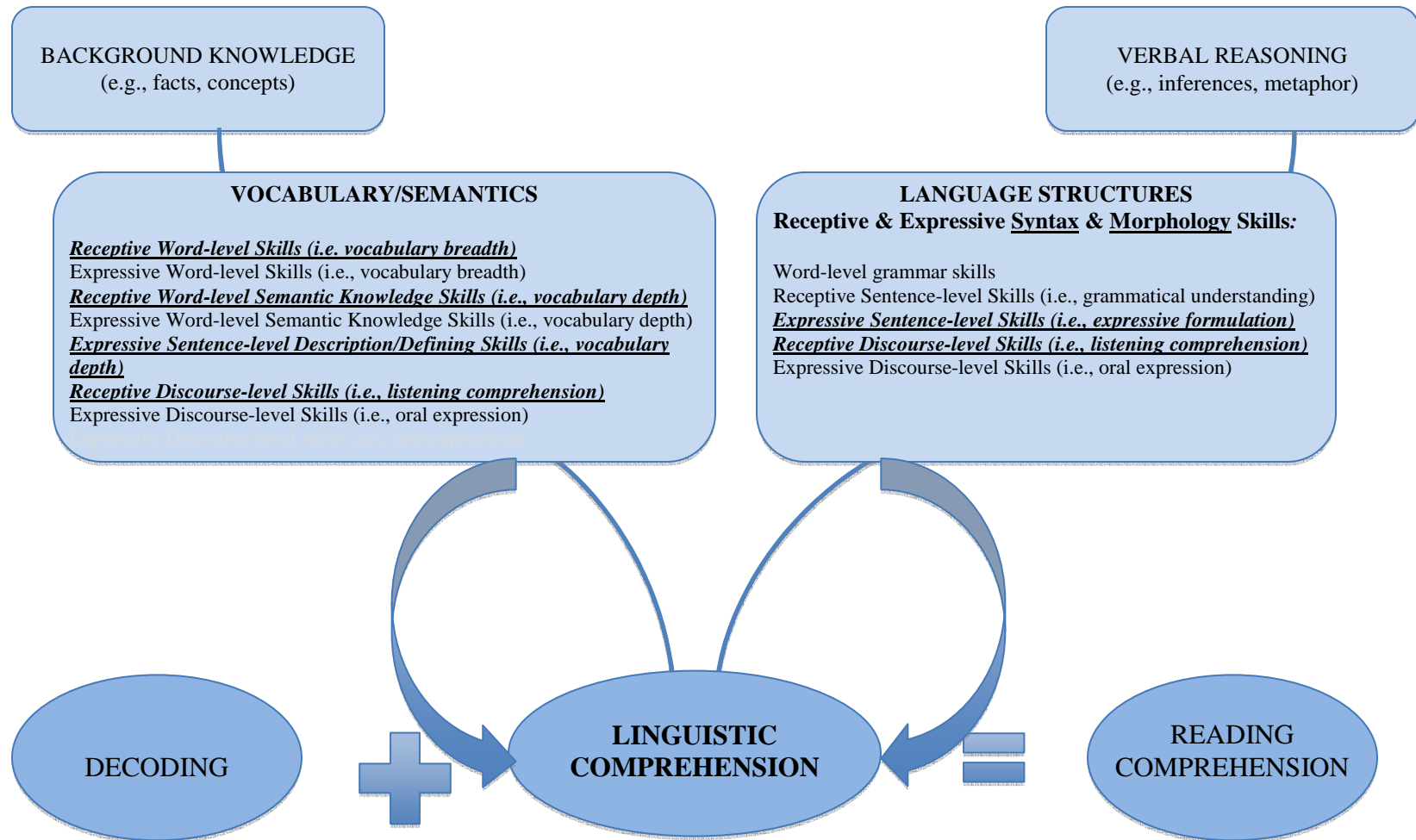


Figure 1. For the purpose of this study, the underlined areas of vocabulary and language structures will be used in defining linguistic comprehension. Adapted from Scarborough (2001).

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