The Relationship Among Receptive and Expressive Vocabulary, Listening Comprehension, Pre-Reading Skills, Word Identification Skills, and Reading Comprehension by Children With Reading Disabilities

Justin C. Wise
Rose A. Sevcik
Robin D. Morris
Georgia State University

Maureen W. Lovett
Hospital for Sick University/
University of Toronto

Maryanne Wolf
Tufts University

Purpose: Some researchers (F. R. Vellutino, F. M. Scanlon, & M. S. Tanzman, 1994) have argued that the different domains comprising language (e.g., phonology, semantics, and grammar) may influence reading development in a differential manner and at different developmental periods. The purpose of this study was to examine proposed causal relationships among different linguistic subsystems and different measures of reading achievement in a group of children with reading disabilities.
Methods: Participants were 279 students in 2nd to 3rd grade who met research criteria for reading disability. Of those students, 108 were girls and 171 were boys. In terms of heritage, 135 were African and 144 were Caucasian. Measures assessing pre-reading skills, word identification, reading comprehension, and general oral language skills were administered.
Results: Structural equation modeling analyses indicated receptive and expressive vocabulary knowledge was independently related to pre-reading skills. Additionally, expressive vocabulary knowledge and listening comprehension skills were found to be independently related to word identification abilities.
Conclusion: Results are consistent with previous research indicating that oral language skills are related to reading achievement (e.g., A. Olofsson & J. Niedersoe, 1999; H. S. Scarborough, 1990). Results from this study suggest that receptive and expressive vocabulary knowledge influence pre-reading skills in differential ways. Further, results suggest that expressive vocabulary knowledge and listening comprehension skills facilitate word identification skills.

KEY WORDS: dyslexia, phonology, written comprehension disorders, elementary school pupils, receptive language

Research suggests that early oral language skills are influential in later reading achievement outcomes (Cooper, Roth, Speece, & Schatschneider, 2002; Olofsson & Niedersoe, 1999; Scarborough, 1990). Some have argued (Vellutino, Scanlon, & Tanzman, 1994) that the different domains comprising language (e.g., phonology, semantics, and grammar) may influence the development of different reading achievement skills in a differential manner and at different developmental

periods. In support of this argument, some research suggests that vocabulary knowledge is strongly related to pre-reading (i.e., phonological awareness and orthographic knowledge) and word identification skills (Chiappe, Chiappe, & Gottardo, 2004; Lindsey, Manis, & Bailey, 2003; McBride-Chang, Wagner, & Chang, 1997), whereas listening comprehension skills are strongly related to reading comprehension skills (Diakidoy, Stylliannou, Karefillidou, & Papageorgiou, 2005; Hagtvet, 2003; Nation & Snowling, 2004). However, because of confounds associated with these studies, the exact nature of the relationship between oral language skills and reading achievement has not yet been fully specified.

Many studies examining the relationship between oral language skills and reading achievement fail to include multiple measures of oral language skills (i.e., measures of receptive vocabulary, expressive vocabulary, and listening comprehension). Without contrasting measures of oral language skills, it is not possible to draw firm conclusions concerning the nature of the relationship between different linguistic skills and different aspects of reading achievement. Similarly, studies that do not include multiple measures of reading achievement (i.e., pre-reading skills, word identification, and reading comprehension) cannot accurately assess the relations that exist between different linguistic skills and different aspects of reading achievement.

When multiple measures are included, many studies incorporate global composite measures of oral linguistic skills and reading achievement. For example, studies may combine measures of receptive and expressive language into a single score to represent linguistic skill. Although using global composite scores may provide for a more comprehensive assessment of a child's linguistic and reading skills, analyzing this relationship in such a manner does not allow researchers to examine the potentially unique relationships that may exist between different aspects of oral language skills and reading achievement.

Finally, many studies fail to take into account the developmental nature of reading achievement. Reading achievement can be assessed either in terms of pre-reading and word identification skills or in terms of reading comprehension. Early in the reading process, reading principally is confined to pre-reading and word identification skills. It is not until around the 3rd grade that children begin to read for meaning as a result of pre-reading skills becoming more fluent and automatized (Adams, 1990). Collapsing across groups of children who are at various developmental levels in the learning-to-read process can cause misleading results.

Given these confounds associated with previous research, conclusions concerning how oral language skills relate to reading achievement remain unclear. Therefore, the purpose of this study was to attempt to minimize the confounds associated with previous research to better explain the relationships that exist between oral language skills and reading achievement.

Theoretical Links Between Linguistic Knowledge and Reading Achievement

Vocabulary knowledge and pre-reading skills. A theoretical explanation offered for the influence of vocabulary knowledge on pre-reading skills has been put forth by Metsala and Walley (1998). According to their *lexical restructuring model (LRM),* the understanding that the speech stream is composed of increasingly smaller phonetic elements is a developmental process driven largely by vocabulary growth. The LRM assumes that words are represented holistically in older infants and toddlers. Over time, growth of their lexical base allows children to make comparisons between internally represented words to eventually allow children to recognize words at the syllable level and, ultimately, at the level of the phoneme. Walley, Metsala, and Garlock (2003) argue that this is not a system-wide process, but rather, it is a word-by-word process influenced by neighborhood density, age of acquisition, and word frequency. Words that have a greater neighborhood density (i.e., those words that differ by one phoneme; *bar, bat, bag*) will afford greater comparison, and those words that are acquired early and used more frequently will provide more opportunities for comparison between words. Once children begin to recognize the phonemic elements of spoken words, they then can begin to establish grapheme–phoneme correspondences that provide the basis for word identification skills. Therefore, the size and the nature of a child's developing lexical base is responsible for the establishment and acquisition of pre-reading skills.

Vocabulary knowledge and word identification skills. It has been speculated that in addition to being important for the development of pre-reading skills, vocabulary knowledge is important for word identification performance. Because vocabulary knowledge is composed of both stored phonological and semantic representations (Levelt, Roelofs, & Meyer, 1999), vocabulary knowledge may aid in word identification through two routes. The first route may reflect a link between stored phonological representations and specific orthographic patterns. Therefore, students with smaller vocabularies may have difficulty identifying words because they do not have well-established, internalized phonological representations of words to map onto written words. The second route may involve depth of vocabulary knowledge. It has been speculated that word meanings that are conceptually represented in more

detail will be easier to access in the lexicon because greater depth of vocabulary knowledge may reflect greater speed in the encoding, organizing, and retrieving of phonological representations of words (Ouellette, 2006). Thus, children with deeper vocabulary knowledge should be able to access and retrieve word-specific phonological representations with more efficiency, which should lead to greater word identification performance.

These two routes of vocabulary influence suggest that receptive and expressive vocabulary may relate to measures of reading achievement in a differential manner. Because expressive vocabulary knowledge includes accessing semantic knowledge in addition to phonological representations, expressive vocabulary knowledge may be more strongly related to word identification performance than is receptive vocabulary knowledge.

Listening comprehension skills and reading comprehension. Difficulties with word identification and deficits in pre-reading skills are generally associated with the definition of dyslexia, whereas difficulties in reading comprehension are associated with weak comprehension skills in the presence of adequate pre-reading skills (Fletcher et al., 2002). With respect to reading comprehension, it is obvious that a larger semantic store can facilitate comprehension skills. However, only successful readers use contextual information to identify unfamiliar words (Adams, 1990). In terms of reading comprehension, it appears that once fluent and automatized pre-reading skills are in place, the ability to comprehend a written sentence is dictated by the ability to comprehend the same sentence when it is spoken. This relationship is evidenced in studies indicating strong and significant correlations between oral and written language comprehension in adults (e.g., Bell & Perfetti, 1994; Gernsbacher, Varner, & Faust, 1990).

Empirical Evidence Suggesting a Relationship Between Linguistic Skills and Reading Achievement

Pre-reading and word identification skills. Studies attempting to examine the relationship between vocabulary knowledge and word identification skills have produced mixed results. For example, Lindsey et al. (2003) examined a sample of 249 Latino children who were Spanish-speaking English language learners. The children in this study were participating in a transitional bilingual curriculum and were followed from the beginning of kindergarten through the end of the 1st grade. Lindsey and colleagues found that expressive vocabulary measured at the beginning of kindergarten accounted for a significant amount of unique variance in word identification skills measured at the end of the 1st grade. Results from this study suggest that early expressive vocabulary knowledge is influential in later word identification abilities. It is important to note that this pattern of results was found when predicting from English to Spanish and from Spanish to English. This indicates a cross-linguistic transfer of reading skills and suggests that the influence of expressive vocabulary knowledge is common across the two languages.

In support of the Lindsey et al. (2003) study, Chiappe, Chiappe, and Gottardo (2004) examined two groups of students representing Grades 1 through 3: poor readers and good readers. Poor readers (n = 13) were defined as those students who exhibited word identification scores that were below the 26th percentile, whereas good readers (n = 49) evidenced word identification scores that were above the 29th percentile. For analyses conducted with the entire sample, Chiappe et al. found that expressive vocabulary skill correlated more strongly with measures of phoneme blending (r = .35) and phoneme deletion (r = .48) and measures of word (r = .44) and nonword identification (r = .41) than did receptive vocabulary (r = .22, r = .11, r = .19, and r = .22, respectively) when controlling for age. It was also found that the poor readers evidenced significantly lower expressive vocabulary scores than the good readers; however, the two groups did not differ significantly with respect to their receptive vocabulary scores. The authors interpreted these findings to suggest that expressive vocabulary skills are more strongly related to reading and pre-reading skills than are receptive vocabulary skills. Chiappe et al. argue that because expressive vocabulary tasks are oral and productive in nature, they require the use of more fully specified phonological representations than a receptive vocabulary task, which is a recognition task. This interpretation is problematic in that the authors failed to take into account the developmental nature of reading achievement by combining students across 1st, 2nd, and 3rd grades. The relationship between oral language skills and reading achievement may be different across these grades because of the developmental nature of reading achievement. Additionally, results of the correlation analyses may be misleading because they were conducted on the combined group of poor and good readers. Combining poor readers who may be more developmentally similar to younger readers with good readers could produce misleading findings. Therefore, it is important for research examining reading skills across different ages and across different reading levels to remain cognizant of the developmental nature of reading.

In contrast to the Chiappe et al. (2004) study, Metsala (1997) examined a sample of 100 children representing the ages of 6–8 years. Thirty-one of these students were classified as having a reading disability. Using the youngest one third of the combined sample, Metsala found that receptive vocabulary did not

significantly predict word identification skills. Pre-reading skills measured by phoneme deletion tasks, however, significantly correlated with receptive vocabulary scores and significantly predicted both word and nonword identification scores. Although not directly assessed, these findings suggest that pre-reading skills mediate the relationship between receptive vocabulary knowledge and word identification skills.

In support of this suggestion, Catts (1993) examined a sample of children classified with speech-language impairments (n = 56) and found that global composite measures of receptive language (i.e., Peabody Picture Vocabulary Test–Revised, Dunn & Dunn, 1981; The Token Test for Children, DiSimoni, 1978; and the Grammatical Understanding subtest of the Test of Language Development–2, Newcomer & Hammill, 1988) and expressive language (Expressive One-Word Picture Vocabulary Test, Gardner, 1979; Structured Photographic Expressive Language Test–II, Werner & Krescheck, 1983; and combined performance on the Sentence Imitation and Grammatical Closure subtests of the Test of Language Development-2) measured in kindergarten significantly correlated with word identification ability measured in the 1st grade (r = .31 and r = .42, respectively). However, kindergarten receptive and expressive language skills did not account for a significant amount of unique variance in 1st grade word identification scores after phoneme deletion and blending skills were entered into the regression equation. This pattern of results was also seen when using kindergarten receptive and expressive language scores to predict 2nd grade word identification skills. These results support the idea that receptive and expressive language skills influence the development of pre-reading skills, which in turn influence single word identification accuracy. However, because corelational analyses and global composite measures of receptive and expressive language were used, effects that are attributed specifically to vocabulary knowledge cannot be determined.

Further support that vocabulary knowledge is influential in the development of pre-reading skills comes from McBride-Chang et al. (1997) who used hierarchical linear modeling techniques to model the growth of 128 students' performance on a phoneme deletion task from the beginning of kindergarten to the winter of their 1st grade year. The authors found that a measure of expressive vocabulary predicted both the initial performance on the phoneme deletion task and the rate at which this performance grew. These findings are in line with the LRM (Metsala & Walley, 1998), which suggests that a child's developing lexicon drives the development of pre-reading skills.

Although the literature suggests that receptive and expressive vocabulary knowledge is significantly related to pre-reading and word identification skills, the exact nature of the relationship still remains unclear. Few studies have included both measures of receptive and expressive linguistic skills in addition to both measures of pre-reading and word identification skills. Without including all of these variables simultaneously, it is not possible to determine the exact relationships that exist between vocabulary knowledge, pre-reading skills, and word identification skills. Further, some studies have found that vocabulary knowledge is related to word identification performance (e.g., Chiappe et al., 2004; Lindsey et al., 2003), whereas other studies have failed to find this relationship (e.g., Metsala, 1997). This discrepancy in findings may be related to the possibility that pre-reading skills mediate the relationship between vocabulary knowledge and word identification skills.

Turning to the issue of the relationship between listening comprehension and pre-reading and word identification skills, research indicates that listening comprehension skills are only weakly related to pre-reading and word identification skills. For example, Nation and Snowling (2004) examined 72 students at two time points: at 8.5 years of age and at 13 years of age. At Time 1, results indicated that listening comprehension skills accounted for only 3% of unique variance in word identification ability once pre-reading skills (i.e., measures of rhyme fluency and rhyme judgment; 71.8%) and expressive vocabulary knowledge (3.8%) were accounted for.

As with Time 1, at Time 2, pre-reading skills accounted for the largest amount of unique variance (58.9%) in word recognition skills, whereas expressive vocabulary knowledge (1.9%) and listening comprehension skills (2.4%) accounted for significant but small amounts of unique variance.

Reading comprehension. Compared with research exploring the relationships between linguistic skills and pre-reading and word identification skills, few studies have examined the relationship between linguistic skills and reading comprehension. The limited research in this area suggests that listening comprehension skills are more strongly related to reading comprehension than is vocabulary knowledge.

Some research indicates that vocabulary knowledge is important for reading comprehension. However, because measures of word identification have not been included in the analyses, it is difficult to interpret these findings. For example, the previously outlined study by Lindsey et al. (2003), which examined a large sample of Spanish-speaking English language learners, indicated that receptive vocabulary measured at the beginning of kindergarten accounted for a significant amount of unique variance in reading comprehension (i.e., the

Passage Comprehension subtests of the Woodcock–Johnson Psycho-Educational Battery–Revised [Woodcock & Johnson, 1989] and the Woodcock Language Proficiency Battery–Revised, Spanish Form [Woodcock & Munoz-Sandoval, 1995]) measured at the end of the 1st grade. Again, this was seen when predicting English to Spanish and Spanish to English. However, because listening comprehension and word identification skills were not entered into the regression equation, it is not clear whether the strength of this relationship would be reduced if word identification ability had been accounted for.

As seen with the Nation and Snowling (2004) study that examined 72 students at 8.5 and at 13 years of age, when both measures of vocabulary knowledge and listening comprehension skills are accounted for, listening comprehension skills appear to be the most important factor in predicting reading comprehension that was assessed by aloud passage reading followed by questions intended to assess understanding of the read passage. At Time 1, results indicated that pre-reading skills (i.e., nonword reading and phonological awareness skills) and expressive vocabulary knowledge significantly predicted reading comprehension scores (r^2 = 20.4 and r^2 = 25.2, respectively). Listening comprehension skills, however, were the strongest predictor of reading comprehension (r^2 = 30.8), even after controlling for pre-reading skills and expressive vocabulary knowledge. At Time 2, listening comprehension skills accounted for 14% of the unique variance in reading comprehension scores after controlling for pre-reading skills (15.7%) and expressive vocabulary knowledge (4.9%).

Further evidence that listening comprehension skills make larger contributions to reading comprehension than vocabulary knowledge comes from Hagtvet (2003), who examined a group of 70 second-grade Norwegian children randomly selected from a larger standardization study of the Norwegian version of the Reynell Developmental Language Scales (Hagtvet & Lillestolen, 1985). A written cloze task was used in this study to assess reading comprehension; this cloze task involved presenting children with a set of sentences in which some sentences were missing a word. Children were then required to provide the word that would appropriately complete the sentence. Results indicated that phoneme blending and segmenting skills in concordance with listening comprehension skills independently and significantly predicted the written cloze task (r^2 = .09 and r^2 = .05, respectively); however, expressive vocabulary was not found to be a significant predictor. Consistent with the Nation and Snowling (2004) study, this Norwegian study indicates that listening comprehension skills are importantly related to reading comprehension, whereas vocabulary knowledge makes noticeably smaller contributions to reading comprehension abilities.

It is important to point out that results concerning the relationship among vocabulary knowledge, listening comprehension skills, and reading comprehension remained consistent across these two studies in light of the different reading comprehension measures used. The Nation and Snowling (2004) study used a reading comprehension measure that requires significant memory, processing, and response-generating demands, whereas the Hagtvet (2003) study used a more simple reading comprehension task that relies on semantic and syntactic judgments. Although similar findings were found across the two studies, the nature of the reading comprehension measures used may explain the different findings concerning the strength of relationship between listening comprehension skills and reading comprehension found between the two studies. The more complicated reading comprehension task used in the Nation and Snowling study may be more directly associated with listening comprehension skills that rely on high levels of memory and processing performance in contrast to the more simple cloze task used by Hagtvet.

Reading comprehension and automaticity. For children who are learning to read and those who continue to struggle with the learning process, most resources available to the child will be devoted to single word identification. Therefore, there is less opportunity for the child to incorporate lexical information into a more global and meaningful interpretation. It may be that once pre-reading skills have been mastered and a high degree of fluency and automaticity are present in the processing of orthographic-phoneme correspondences, the same basic processes underlie all comprehension regardless of linguistic mode (i.e., written or oral; Sinatra, 1990).

In support of this assertion, there is evidence to suggest the relationship between reading comprehension and listening comprehension becomes stronger as children develop and continue to gain experience with connected text. Diakidoy et al. (2005) conducted a cross-sectional study of a large sample of Greek-speaking students (n = 612) from the island of Cyprus who represented the 2nd, 4th, 6th, and 8th grades. The purpose of the study was to determine how, or if, the relationship between listening comprehension and reading comprehension skills changed with increasing grade levels. Results indicated that the correlation between listening comprehension skills and reading comprehension were significantly correlated at all grades; however, the strength of the correlation coefficients increased with increasing grade levels. Further, the correlation coefficient evidenced in Grade 2 was significantly lower than the correlation coefficients evidenced in Grades 4, 6, and 8.

Conclusions Concerning the Relationship Between Oral Language Skills and Reading Achievement

Overall, research examining the relationship between oral language skills and reading comprehension generally indicates that vocabulary knowledge is related to reading comprehension performance. Listening comprehension skills, however, appear to have a stronger relationship with reading comprehension performance.

Purpose of This Study

The studies previously outlined demonstrate the importance of examining how different linguistic subsystems relate to pre-reading skills, word identification skills, and reading comprehension. Across a number of different populations (e.g., typical readers, children with reading disabilities, children with specific language impairment), results are consistent in indicating that oral language skills influence reading achievement. Without the inclusion of multiple measures of both linguistic skills and reading achievement, however, it is difficult to ascertain how these different skills relate to one another. Further, these studies highlight the importance of clearly defining reading as it is being conceptualized for a particular study (i.e., pre-reading and word identification skills vs. comprehension) and at specific developmental periods of reading achievement. To date, we know of no study that has attempted to include measures of receptive vocabulary, expressive vocabulary, listening comprehension, pre-reading, word identification, and reading comprehension skills in one comprehensive data analytic technique in order to examine the relationships that exist between these different linguistic skills and different aspects of reading achievement. Therefore, the purpose of this study was to use structural equation modeling techniques to examine proposed causal relationships that exist among different linguistic skills and different measures of reading achievement in a sample of children with reading disabilities (RD).

Our study improves on previous studies in four primary ways. First, multiple measures of linguistic skills and reading achievement are included. Second, we chose not to use global composite measures of either linguistic skills or reading achievement. These two aspects of our study allow us to test for potentially unique relationships between different linguistic skills and different aspects of reading achievement. As previously discussed, a confound associated with earlier research is collapsing across groups of children who may be at different developmental levels in the learning-to-read process. The current study combines children from the 2nd and 3rd grades for data analytic purposes. Because all of our participants were struggling to learn to read, however, pre-reading and reading scores (see Table 1) indicated that students from both grades were developmentally similar in their reading skills despite their age of entry into the study. That is, all of the students in our study were still trying to master basic word identification skills. Finally, our relatively large sample allowed us to use structural equation modeling techniques to test for proposed causal relationships between different linguistic skills and different aspects of reading achievement in one inclusive data analysis.

Research Questions

According to Metsala and Walley's (1998) LRM, the size and nature of the lexical store is influential for the development of pre-reading skills and not the child's ability to communicate his or her semantic knowledge. The LRM argue that it is a comparison across an increasing store of internally represented words that drives the development of pre-reading skills rather than the retrieval or definitional knowledge of these words. This suggests that receptive vocabulary would be more strongly related to the development of pre-reading skills when

Table 1. Mean standard and scale scores for measures of linguistic skills and reading achievement variables for students in the 2nd and 3rd grades.

		Measure of linguistic skill			Measure of reading achievement		
Grade	*n*	PPVT-R Receptive Vocabulary	WISC Expressive Vocabulary[a]	WIAT Listening Comprehension	WRMT Word Identification	WRAT Reading	WRMT Passage Comprehension
2	209	92.98	8.20[a]	83.37	79.13	78.79	77.04
3	70	94.91	8.33[a]	84.41	76.41	78.10	75.09

Note. PPVT-R = Peabody Picture Vocabulary Test–Revised; WISC = Wechsler Intelligence Scale for Children–Third Edition; WIAT = Wechsler Individual Achievement Test; WRMT = Woodcock Reading Mastery Test–Revised; WRAT = Wide Range Achievement Test–3.

[a]Reported scores are scale scores (M = 10, SD = 3).

compared with other linguistic skills, such as expressive vocabulary or listening comprehension skills. This suggestion is in contrast with Chiappe et al. (2004), who found that a measure of expressive vocabulary correlated more strongly with measures of pre-reading skills than did a measure of receptive vocabulary. With respect to word identification skills, the literature consistently indicates that vocabulary knowledge is related to word identification skills. It is still unclear, however, how receptive and expressive vocabulary may differentially relate to word identification skills. Because vocabulary knowledge is speculated to aid word identification performance through two routes (i.e., phonological representations and semantic knowledge), expressive vocabulary knowledge may be more strongly related to word identification performance than is receptive vocabulary knowledge. Additionally, there is some evidence to suggest that the relationship between receptive vocabulary knowledge and word identification skills is mediated by pre-reading skills (e.g., Catts, 1993). Finally, previous research (e.g., Nation & Snowling, 2004) has indicated that listening comprehension skills evidence the strongest relationship with reading comprehension when compared with pre-reading and word identification skills.

On the basis of the LRM and findings in the literature, three research questions of interest were generated: (a) What is the nature of the relationships between receptive and expressive vocabulary knowledge and pre-reading skills in a group of children with RD? (b) What is the nature of the relationships between receptive and expressive vocabulary knowledge and word identification skills in a group of children with RD, and how does the inclusion of pre-reading skills affect these relationships? (c) When measures of receptive and expressive vocabulary knowledge and pre-reading skills are included, do listening comprehension skills evidence the strongest relationship with reading comprehension?

Method

Participants

Data reported here are from a larger study in which the authors were interested in examining intervention effects on young school-aged children with RD (for a complete description of the larger study, see Morris et al., 2007). Participants were 279 second and third grade students from public elementary schools at each of the study sites (Atlanta, Boston, and Toronto) who were referred by their teachers for difficulties in learning to read. Because African Americans (Donahue, Daane, & Grigg, 2003) and male students (Shaywitz, Shaywitz, Fletcher, & Escobar, 1990) are disproportionately classified with RD, an attempt was made to recruit equal numbers of students of African heritage and Caucasian students and equal numbers of female and male students. Thus, Caucasian and female students were given precedent for inclusion into the study. One hundred thirty-five students (48.4%) were of African heritage, and 144 students (51.6 %) were Caucasian; 38.7 % (n = 108) were female students and 61.3 % (n = 171) were male. Their mean chronological age in months at the time of referral was 93.56 (SD = 6.08), and ranged from 81 to 110 months. The average IQ of the students was 91.50 (SD = 10.40). Based on the Hollingshead Four Factor Index of Social Status (Hollingshead, 1975), 153 students were classified as average socioeconomic status (SES), and 126 students were classified as below-average SES.

In order to be considered to evidence a RD, students could have met either Low Achievement and/or IQ-Discrepant criteria. Individuals with a Kaufamn Brief Intelligence Test (K-BIT; Kaufman & Kaufman, 1990) IQ Composite score greater than 70 and whose reading skills were equal to or less than a reading achievement standard score of 85 (15th percentile) evidenced on the Basic Skills Cluster (composed of the Word Identification and Word Attack subtests) of the Woodcock Reading Mastery Test–Revised (Woodcock, 1987) met Low Achievement criteria. Participants with a K-BIT IQ Composite score greater than 70 and whose reading achievement standard score was at least 1 SD of the estimate below their expected achievement level (calculated based on an average correlation of .60 between measures of reading performance and IQ) met IQ-Discrepant criteria. Thus, students who evidenced reading achievement scores below 1 SE of the predicted regression line were considered to fit our criteria for an IQ-discrepancy classification. Participants could, and frequently did, meet criteria for both classifications. The distribution of children meeting criteria for RD is as follows: 77 (27.6 %) met the Low Achievement classification, 24 (8.6 %) met the IQ-Discrepant classification, and 178 (63.8%) met both Low Achievement and IQ-Discrepant classifications.

Children with English as a second language, histories of hearing impairment, and uncorrected vision greater than 20/40 were excluded from the study. Further, any children diagnosed with emotional/psychiatric disorders (e.g., major depression, psychotic, or pervasive developmental disorder) or who had chronic medical/neurological conditions (e.g., seizure disorder, developmental neurological conditions, acquired brain injuries) were not included in the study.

Materials

Receptive Vocabulary

Peabody Picture Vocabulary Test–Revised (PPVT-R; Dunn & Dunn, 1981*).* The PPVT-R is a standardized

measure of receptive language skills. Each easel page of the PPVT-R contains four numbered pictures. Participants are required to choose the picture that best depicts a word orally presented by the test administrator. The test manual reports internal consistency coefficients that range from .67 to .88 (*Med* = .80) for Form L and from .62 to .86 (*Med* = .81) for Form M. Immediate re-test alternate form reliability coefficients have ranged from .73 to .91 (*Med* = .82), and delayed re-test alternate form reliability coefficients have ranged from .52 to .90 (*Med* = .78).

Expressive Vocabulary

Wechsler Intelligence Scale for Children–Third Edition (WISC-III; Wechsler, 1991*).* The Vocabulary subtest of the WISC-III was used. The Vocabulary subtest is a measure of expressive vocabulary. Children are presented a word orally and are required to provide a verbal definition of the target word. Internal reliability coefficients for the Vocabulary subtest of the WISC-III range from .79 to .91 (*M* = .87) for participants 6–16 years of age. Test–retest reliability statistics from the WISC-III manual were computed on a sample using six age groups: 6, 7, 10, 11, 14, and 15. Reliability coefficients ranged from .82 to .89 (*M* = .89).

Listening Comprehension

Wechsler Individual Achievement Test (WIAT; Wechsler, 1992*).* The Listening Comprehension subtest is composed of two sections. The first section requires participants to choose the picture that visually depicts an orally presented word by the test administrator. Participants are presented with four pictures for each word. In the second section, participants are presented with a single picture and an orally presented passage. The participant is then asked a question concerning the passage that had been read to them. Participants are asked to respond orally. The WIAT manual reports a mean reliability coefficient for the Listening Comprehension subtest of .83 (range = .80–.88) for ages 6 through 17 years. The mean test–retest reliability reported mean for Grades 1, 3, 5, 8, and 10 is .76 (range = .66–.81)

Pre-Reading Skills

The Comprehensive Test of Reading-Related Phonological Processes (CTRRPP; Torgeson & Wagner, 1996*).* Experimental versions of two subtests (Blending and Elision) of phonological processes in reading, which later became the Comprehensive Test of Phonological Processing (CTOPP; Torgeson & Wagner, 1999), were used to assess children's phonological processing skills. The Blending subtest presents words in serial syllabic and phonological segments. The goal of the subtest is to combine the smaller parts to identify the whole word (e.g., "What word do these sounds make? /m/ /a/ /d/"). The Elision subtest is a phoneme deletion task. A word is presented orally, and the participant is asked to identify the new word that is formed after a phoneme is deleted from the target word (e.g., "Say tiger without saying /g/."). Participants are asked to repeat the word exactly as it was presented to them.

Sound Symbol Identification (SSI; Lovett et al., 1994*).* The SSI test is composed of four subtests: Letter Sound Identification, Sound Combination Identification, Onset Identification, and Rime Identification. All four subtests present the child with letters or letter combinations one at a time on small cards similar to playing cards. The child's task is to say the sound represented by the letter or letter combinations. The Letter Sound Identification subtest is composed of individual letters, and the Sound Combinations subtest is composed of frequent English orthographic patterns (e.g., er, oy, and oa). The Onset Identification subtest presents pairs of orthographic patterns that frequently appear together at the beginning of English words (e.g., cl, sm, and pl). The final subtest, Rime Identification, is composed of orthographic patterns often found at the end of English words (e.g., ish, ent, and ade).

Reading Achievement

Wide Range Achievement Test–3 (WRAT-3; Wilkinson, 1993*).* The WRAT-3 includes three subtests that measure reading, spelling, and arithmetic skills. For the purpose of this study, only the Reading subtest was used. The Reading subtest assesses single word identification skills. Participants are presented with a list of 42 words that increase in difficulty. Internal consistency using coefficient alpha for the reading subtest ranged from .90 to .95 (Wilkinson, 1993). Test–retest reliability ranged from .91 to .98.

CTRRPP. An experimental version of one subtest of the CTRRPP, the Word Reading Efficiency subtest (WRE)—which was to become the Test of Word Reading Efficiency (TOWRE; Torgeson, Wagner, & Rashotte, 1999)—was used to assess reading fluency and accuracy. The WRE subtest is a word identification measure that contains two lists (A and B) of 104 words that increase in difficulty. Word reading efficiency is scored as the mean number of words read on both lists in 45 s.

Woodcock Reading Mastery Test–Revised (WRMT-R; Woodcock, 1987*).* Two subtests of the WRMT-R were administered: the Word Identification (WID) and Passage Comprehension subtests. The WID subtest is a measure of single word identification skills. The passage comprehension subtest requires participants to read a segment of prose with a missing word and provide an appropriate substitution for the missing word. Internal consistency

reliability coefficients of the WRMT-R obtained by split-half reliability for 1st through 3rd grade ranged from .91 to .98 (M = .94; Woodcock, 1987).

Design and Procedure

Children who were identified by their classroom teachers as struggling in learning to read were given a recruitment packet to take home that contained a description of the study and a consent form. Children who returned a signed consent form were screened for their possible participation in the study. Psychologists or doctoral students who were trained extensively in test administration conducted the assessments. Participants were administered all measures in their schools and were in the 2nd or 3rd grade in the years spanning 1996–2000.

If a child met the study criteria, he or she was randomly assigned to one of thee reading intervention groups or to a nonreading control condition. In this report, only reading achievement data from the baseline time point were analyzed. Measures of linguistic skills were administered at varying points throughout the school year. Inspection of the testing dates indicated that roughly equal numbers of students were administered the linguistic measures during the fall, winter, and spring time points.

Results

For all analyses, raw scores were used. Mean, standard deviation, and range of scores are reported in Table 1. The decision to use raw scores was grounded in the fact that most structural equation modeling (SEM) estimation procedures (the primary data analytic technique used) are based on the assumption that unstandardized variables will be analyzed (Kline, 1998). Therefore, using standardized variables could produce incorrect estimates. In addition, the use of standard scores computed on measures of reading achievement by children with reading disabilities can result in floor effects and limited variability across scores. To correct for age effects, age was regressed on each variable examined, and the unstandardized residuals were retained for data analyses.

Data Screening Techniques

Initial analyses involved a data screening process carried out to identify outliers, unusual data points, or atypical distributions that may have influenced the results of the statistical analyses. Outliers were considered those scores that were 3 SDs above or below the mean. In the small number of cases in which outliers were identified, scores were investigated to determine their validity. All outlying scores were retained for data analytic purposes because the scores were considered to accurately reflect performances by the population under study. Additionally, the influence of this small number of outliers on a large sample was considered to be minimal.

Deviations from normality were tested through visual inspection of histograms, the creation of p-p plots, and by means of dividing skewness and kurtosis statistics by their respective SEs. On the basis of this screening process, scores from three scales (i.e., Elision subtest, WRE, and PPVT-R) were found to violate the assumption of normality. According to Tabachnick and Fidell (2001), the transformation procedure that affects the distribution of the data in the least dramatic manner initially should be used. If violations of normality continue, techniques that result in more substantial change should be used. This procedure was followed, and a square-root transformation was found to be sufficient to correct for moderate deviations from normality in the scores from the Elision subtest, WRE subtest, and PPVT-R. Analyses were conducted separately with both transformed and untransformed data. No difference in results was found when using transformed or untransformed data. Therefore, original untransformed data were retained for the following reported analyses (see Table 2).

Statistical Analyses

Pearson correlations were conducted to examine the strength and direction of the relations between the linguistic and reading achievement variables (see Table 3). To further examine the relationships that exist between different linguistic skills and different measures of reading achievement, SEM techniques were used. Information obtained from the Pearson correlations, in addition to findings from previous research, were used to guide initial measurement and hybrid model testing. These statistical analyses were conducted using LISREL 8.51 (Joreskog & Sorbom, 2001).

SEM analysis allows for the testing of proposed causal relationships among latent and observed variables through the use of hybrid models, which combine measurement models and path analysis models. Measurement models depict latent variables as represented by observed variables, and path analysis models allow the specification of direct and indirect relationships among variables.

Guidelines put forth by Kline (1998) indicate that a minimum sample size of 100 is required to conduct path analyses and that a sample size greater than 200 is considered large. Complex models with large numbers of parameters, however, may require larger samples. Kline suggests the number of participants to parameter ratio

Table 2. Means, standard deviations, and ranges of raw scores for linguistic and reading achievement variables.

Variable	*M*	*SD*	Range
CTRRPP Blending (maximum score = 29)	9.50	4.69	0–23
CTRRPP Elision (maximum score = 25)	8.43	3.91	0–25
Sound Symbol Identification (maximum score = 37)	9.06	4.85	0–23
CTRRPP Word Reading Efficiency (maximum score = 104)	24.11	18.38	0–86
WRMT Word Identification (maximum score = 106)	18.18	12.40	0–47
WRAT Reading (maximum score = 67)	18.90	3.47	6–29
WRMT Passage Comprehension (maximum score = 68)	8.47	6.58	0–30
PPVT Receptive Vocabulary (maximum score = 175)	79.17	15.68	42–124
WISC Expressive Vocabulary (maximum score = 60)	15.73	4.41	5–29
WIAT Listening Comprehension (maximum score = 36)	14.15	5.11	3–26

Note. CTRRPP = Comprehensive Test of Reading-Related Phonological Processes.

should be 10:1 and should not fall below 5:1. Our sample size adequately fit both of these criteria.

Measurement Model

The first step in the SEM analyses involved assessing the fit of a measurement model (see Figure 1). Although the Blending and Elision subtests are purely oral in nature, we decided to include these variables with the SSI variable, which includes an orthographic component, to represent the latent variable pre-reading skills. This decision was based partly on a factor analysis conducted with the Blending, Elision, SSI, WRE, WID, and WRAT variables. The factor analysis indicated that the Blending, Elision, and SSI variables loaded on one factor that accounted for 39.58% of the variance, whereas the WRE, WID, and WRAT variables loaded on a second factor that accounted for 31.21% of the variance. Thus, findings from the factor analysis suggest that the Blending, Elision, and SSI variables represent one construct (i.e., pre-reading skills), whereas the WRE, WID, and WRAT represent another (i.e., word identification skills).

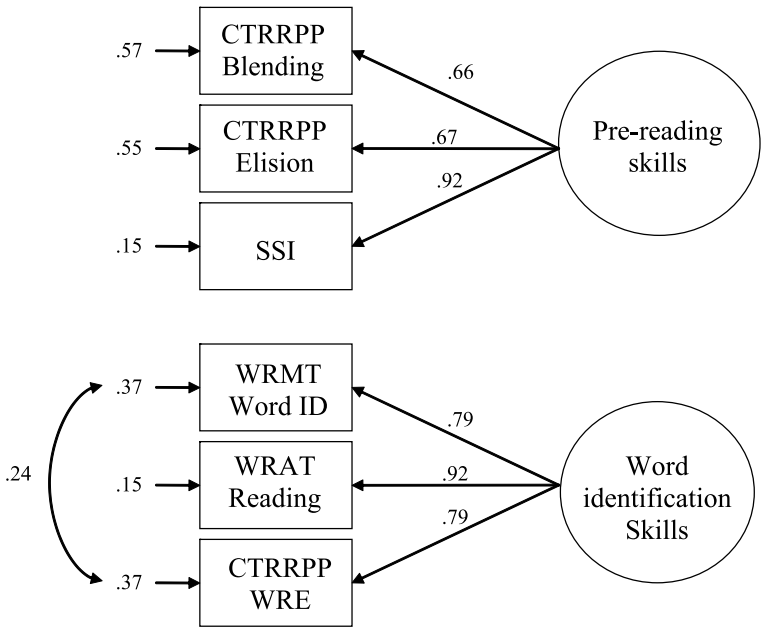
In addition to these findings, work submitted elsewhere (for a complete description, see, Wise, Sevcik, Morris, Lovett, & Wolf, 2007) indicates that awareness of individual phonemes in the speech stream—an awareness needed to perform traditional phonological awareness tasks—is not possible without orthographic knowledge. These results are theoretically supported by Stahl and Murray (1998), who believe that orthographic knowledge is necessary but not sufficient for the development of more sophisticated pre-reading skills, such as blending and phoneme deletion tasks. Stahl and Murray argue that children cannot perform these tasks until they realize that the phonetic elements of speech can be represented by orthographic patterns. Once this association is established, repeated shared reading experiences may improve pre-reading skills because a lexical–orthographic knowledge store is created that fosters well-defined grapheme/phoneme representations that result in effective pre-reading skills.

Table 3. Correlations among linguistic and reading achievement variables.

	1	2	3	4	5	6	7	8	9	10
1. CTRRPP Blending	—									
2. CTRRPP Elision	.51	—								
3. Sound Symbol Identification	.61	.60	—							
4. WRMT Word Identification	.31	.44	.60	—						
5. WRAT Reading	.45	.51	.69	.74	—					
6. CTRRPP Word Reading **7. Efficiency**	.34	.44	.62	.87	.73	—				
8. WRMT Passage Comprehension	.26	.39	.54	.80	.63	.75	—			
9. PPVT Receptive Vocabulary	.50	.36	.41	.15	.22	.16	.20	—		
10. WISC Expressive Vocabulary	.31	.38	.42	.24	.27	.32	.29	.49	—	
11. WIAT Listening Comprehension	.44	.42	.48	.23	.29	.28	.30	.64	.53	—

Note. All correlation coefficients are significant at the $p < .01$ level.

Figure 1. Measurement model. Circles represent latent variables; rectangles represent observed variables. Reported path coefficients are standardized and represent *r*. SSI = Sound Symbol Identification.



A domain-specific composite score of the SSI task was used because this increased statistical power by reducing the parameter-to-participant ratio. In addition, it was thought that a domain-specific composite measure would be a more reliable indicator of a student's knowledge of grapheme/phoneme relationships. Unlike using global composite scores that combine measures of related but different skills, using domain-specific composite scores collapsed across subtests purport to measure the same underlying construct. Therefore, the use of domain-specific composite scores does not limit the ability to examine relationships among several different constructs.

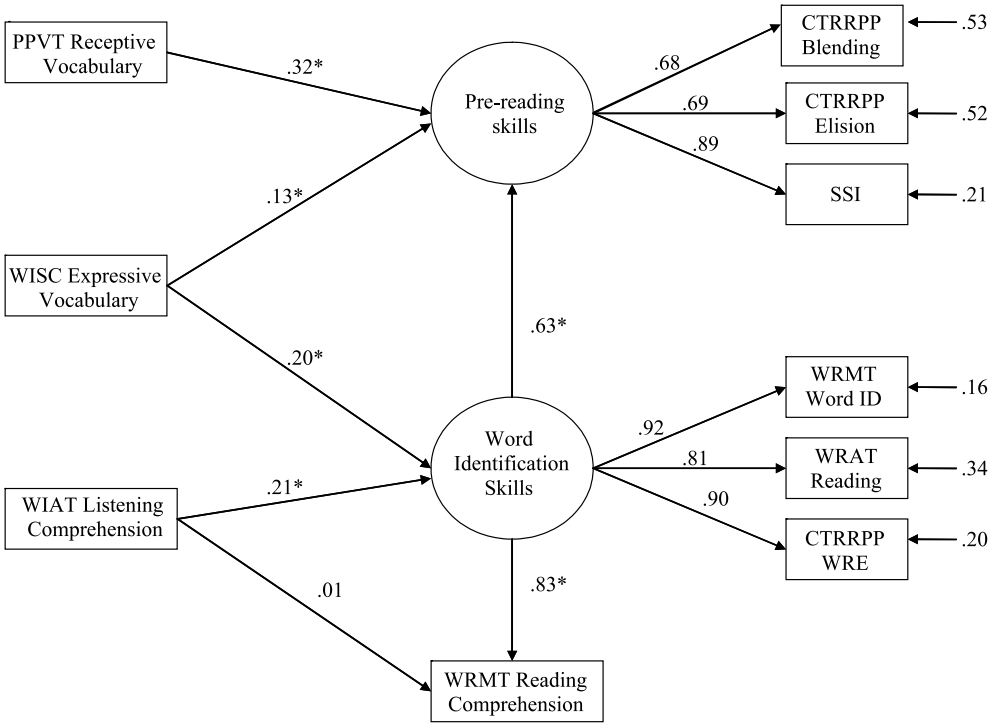
The WRE, WRAT, and WID served as the indicators of word identification skills. Inspection of a scatterplot between the WID and WRE variables indicated a high degree of multicolinearity (i.e. substantial overlap in the measurement of a construct). Based on this, we decided to correlate the errors between these two variables.

This measurement model was an excellent fit for the data, $\chi^2(7, n = 279) = 16.72, p < .05$, normed fit index (NFI) = .98, non-normed fit index (NNFI) = .98, comparative fit index (CFI) = .99, and standardized root-mean-square residual (SRMR) = .036 (see Figure 1). According to Kline (1998), because the chi-square statistic is sensitive to sample size, an alternative fit index, the chi-square/degree of freedom ratio may be used instead of the chi-square statistic itself. A chi-square/degree of freedom ratio below 3 is generally considered acceptable. Therefore, although the chi-square value for the measurement model was significant, the chi-square/degree of freedom ratio was less than 3 ($\chi^2/df = 2.39$) and indicated a good fit for the data.

Hybrid Models

Hybrid Model 1. A number of longitudinal models were tested that depicted the hypothesized relationships thought to exist between linguistic skills (i.e., receptive vocabulary, expressive vocabulary, and listening compression skills), pre-reading skills, and word identification skills. Only the model chosen for interpretation, however, will be discussed in detail. Model selection was based on theory, SEM fit indices, chi-square difference analyses between competing nested models, and the rule of parsimony. Our model-fitting procedure began with a model depicting all of the possible relationships between the different domains of linguistic skill and different domains of reading achievement. We then proceeded with model trimming by eliminating paths between linguistic skill domains and aspects of reading achievement based on the theoretical relationships suggested to exist by the extant literature. Based on our model fitting procedure, the best fitting and most appropriate model that included a path from listening comprehension to reading comprehension (see Figure 2) only evidenced marginal fit with the data, $\chi^2(28, n = 279) = 121.92, p < .05$, $\chi^2/df = 4.35$, NFI = .93, NNFI = .92, CFI = .95, and SRMR = .056., and did not produce significant paths between listening comprehension or

Figure 2. Hybrid Model 1. Circles represent latent variables; rectangles represent observed variables. Reported path coefficients are standardized and represent *r*. *Paths are significant at the $p < .05$ level.



other linguistic skills and reading comprehension as assessed by *t* values ($p > .05$).

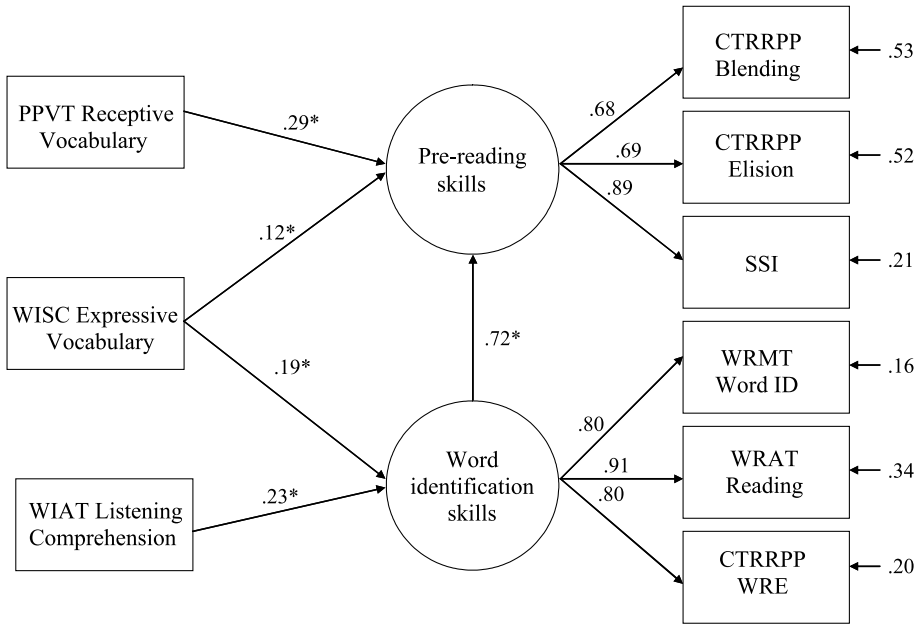
Eliminating the reading comprehension variable from the model increases the model fit considerably (see Figure 3). This increase in fit serves to further demonstrate the developmental level of the students in this study. Although the path between word identification skills and reading comprehension was rather strong, the reduction of fit of the overall model due to the inclusion of the reading comprehension variable suggests that these students did not possess the skills necessary for meaningful interpretation of connected text. Therefore, inclusion of the reading comprehension variable appears to be inappropriate. Based on these findings and the rule of parsimony, more simplistic models that eliminated the reading comprehension variable were tested.

The model chosen (see Figure 3) for interpretation fit the data well, $\chi^2(21, n = 279) = 56.84$, $p < .05$, $\chi^2/df = 2.71$, NFI = .96, NNFI = .95, CFI = .97, and SRMR = .046. All path coefficients reported are standardized values. This model indicated that receptive vocabulary and expressive vocabulary knowledge evidenced independent and significant paths to pre-reading skills (.29 and .12, respectively). In addition, expressive vocabulary knowledge and listening comprehension skills evidenced independent and significant paths to word identification skills (.19 and .23, respectively). Finally, the path from word identification skills to pre-reading skills was very strong and significant (.72).

Discussion

The purpose of this study was to examine proposed causal relationships that exist among different linguistic subsystems and different measures of reading achievement. To date, we know of no other study that has attempted to include measures of receptive and expressive vocabulary, listening comprehension, pre-reading, word identification, and reading comprehension skills to explicate the nature of the relationships among these variables. Based on the LRM (Metsala & Walley, 1998) and the extant literature, three research questions of interest were generated: (a) What is the nature of the relationships between receptive and expressive vocabulary knowledge and pre-reading skills in a group of children with RD? (b) What is the nature of the relationships between receptive and expressive vocabulary knowledge and word identification skills in a

Figure 3. Hybrid Model 2. Circles represent latent variables; rectangles represent observed variables. Reported path coefficients are standardized and represent *r*. *Paths are significant at the $p < .05$ level.



group of children with RD, and how does the inclusion of pre-reading skills affect these relationships? (c) When measures of receptive and expressive vocabulary knowledge and pre-reading skills are included, do listening comprehension skills evidence the strongest relationship with reading comprehension?

SEM analyses indicated that both receptive and expressive vocabulary knowledge were significantly related to pre-reading skills. According to the LRM (Metsala & Walley, 1998), children's phonological representations become segmental over time though a restructuring process that is driven by their developing lexicon. Findings from this study support the suggestion that vocabulary knowledge drives the development of pre-reading skills and indicates, at least with our sample, that receptive vocabulary knowledge is more strongly related to pre-reading skills than is expressive vocabulary knowledge. These findings are in contrast to Chiappe et al. (2004), who found that expressive vocabulary knowledge correlated more strongly with measures of pre-reading skills than did receptive vocabulary. Chiappe et al. argued that this finding was the result of oral expressive vocabulary tasks requiring more fully specified phonological representations than recognition receptive vocabulary tasks. Although results from our study cannot support or refute this argument, they do suggest that the nature of these tasks relate to pre-reading skills in a differential manner. Specifically, these findings are consistent with the LRM (Metsala & Walley, 1998), which suggests that receptive vocabulary knowledge would be more influential in the development of pre-reading skills than expressive vocabulary knowledge.

Differences in findings between this study and previous research may be related to the nature of the expressive vocabulary task used. Unlike many previous studies that have used a picture naming task to represent expressive vocabulary knowledge, the expressive vocabulary measure used in this study required participants to generate definitional knowledge of a word. These two tasks differ in that providing definitional knowledge of a word requires a higher level of semantic skill than providing a label for a pictured object or action. Previous research (McGregor, Friedman, Reilly, & Newman, 2002), however, has indicated that both of these tasks tap the same underlying semantic representations. Thus, although picture-naming tasks primarily tap phonological and semantic knowledge and definitional tasks tap additional decontextualized language skills (Snow, Tabors, Nicholson, & Kurland, 1995), the two tasks are considered to represent expressive vocabulary knowledge. This does not, however, preclude these two tasks from relating to reading achievement in a differential manner. Picture naming tasks are similar to receptive vocabulary tasks in that they tap underlying word-specific phonological representations. In contrast, definitional knowledge requires higher-order decontexualized language skills. Thus, it would be expected that picture-naming tasks would be more strongly related to pre-reading skills, whereas definitional knowledge would be more strongly related to

word identification skills. These expectations are further supported from findings concerning the relationship between receptive and expressive vocabulary and word identification skills.

In contrast to pre-reading skills, receptive vocabulary knowledge did not significantly predict word identification abilities. Expressive vocabulary knowledge, however, was found to significantly predict real word identification skills. This finding can be explained by the way in which vocabulary knowledge is theorized to assist word identification performance. Because expressive vocabulary knowledge encompasses accessing both phonological representations and semantic knowledge, expressive vocabulary knowledge may support word identification through two routes. Further, definitional knowledge of a word requires both linguistic and metalinguistic knowledge. Therefore, these vocabulary words should be more thoroughly represented conceptually than a child's receptive vocabulary store. Word meanings that are conceptually represented in more detail may be more strongly related to word identification skills because degree of vocabulary knowledge can affect the word retrieval process.

Listening comprehension skills also were found to significantly predict word identification abilities. This is consistent with previous research by Nation and Snowling (2004) that indicated listening comprehension skills made significant but small contributions to word identification abilities. Thus, it appears that comprehension of orally presented material influences word identification abilities. This result may be attributed to a higher order skill, such as listening comprehension skills, being reliant on more basic vocabulary knowledge.

When interpreting this finding, it is important to keep in mind the listening comprehension task used in this study. The Listening Comprehension subtest of the WIAT (Wechsler, 1992) is composed of two sections that are not independent of one another, as the receptive vocabulary section must be administered before the oral passage comprehension section can be administered. Therefore, this subtest is not a pure measure of listening comprehension skills. Because of the nature of the Listening Comprehension subtest, it is possible for a student to ceiling on the receptive vocabulary section before they were administered the oral passage comprehension section. This possibility, however, should occur only in rare cases. In support of this assumption, inspection of the raw scores on the Listening Comprehension subtest indicated that only 5% of the sample received a raw score below 5. A raw score of 4 would be the maximum score possible without being administered items from the oral passage comprehension section. Because of this, we are reasonably confident that the majority of our sample was administered items from the oral passage comprehension section. This confidence, however, does not discount the confounding effect of using a listening comprehension measure that included a receptive vocabulary section. Interpretations concerning the relationships evidenced in this study between listening comprehension skills and reading achievement should be made cautiously.

Reading comprehension was not found to enter into a significant relationship with any measure of linguistic skill and, subsequently, was excluded from further analyses. Although this finding may be related to the listening comprehension task used, it is more likely a result of the characteristics of the sample that was studied. The students participating in this study evidenced extremely poor reading skills. The majority of this sample (91%) produced word identification scores that were below the 16th percentile. These students likely did not possess pre-reading and word identification skills that were automatized to the degree that would allow for fluent reading of connected text that is required for comprehension of written material. Further, if students in this sample possessed the skills necessary to make meaningful interpretations of connected text, it would be expected that vocabulary knowledge would have been related to reading comprehension, if only weakly. Therefore, failing to find a relationship between listening comprehension skills and reading comprehension is not surprising.

Evidence for this lack of automatization of pre-reading and word identification skills resides in the nature of the relationship found between pre-reading skills and word identification skills. Somewhat counterintuitive, results suggested that word identification skills strongly influence pre-reading skills, rather than pre-reading skills influencing word identification skills. Given further consideration, however, these findings support the suggestion that the relationship between pre-reading skills and word identification skills is bidirectional (Foorman, 1995). When children enter school, they possess basic pre-reading skills, such as the ability to discriminate onset versus rime (Stahl & Murray, 1998); however, as children begin to engage in reading activities, they gain experience with sound and print correspondences that foster greater pre-reading skills. These skills, in turn, foster more fluent and automatized reading skills.

The finding that word identification skills influence pre-reading skills supports the theory that children's early reading is dictated by a process of associating a word visually, either in part or whole, with the name of the word (see Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). During this phase of the reading process, children may rely on memorizing the visual images of words without understanding the rules of

grapheme/phoneme relationships. Later in the development of the reading process, when pre-reading skills become more sophisticated, children do not have to rely heavily on a semantic store and instead, use pre-reading skills as the primary strategy during the word identification process. Therefore, finding that word identification skills were influencing pre-reading skills suggests that students in this sample were using sight word vocabulary as the primary means of word identification at the beginning of the study.

Limitations and Future Directions

A limitation of the current study was that the measures of linguistic skill could have been administered at any time during the school year. Inspection of the dates of administration, however, indicated that these assessments were distributed relatively evenly over the course of the study. It does not appear, then, that one or more of the linguistic measures were administered more often toward the beginning of the study or more often toward the end of the study. Therefore, it can be assumed that any influence of a specific test administration time point should have been minimized due to the relatively even distribution of test administration sessions. Further, it can be argued that linguistic skills are stable constructs and that measures of linguistic skills obtained later in the school year tapped the underlying mechanisms governing general linguistic development and can serve as proxies of linguistic skills evidenced at the beginning of the school year. In addition, because SEM techniques rely on covariances among variables rather than actual levels of performance, it is the pattern of relationships among variables that is important, rather than levels of performance among variables. The manner in which the measures of linguistic skill were collected, nevertheless, limits the level of confidence with which we can draw conclusions concerning the nature of the relationship between linguistic subsystems and domains of reading achievement.

The participants in this study were all classified with RD. Therefore, this study is limited in the generalizations that can be made to other populations of children. Therefore, conclusions concerning typically developing children may be unwarranted. Research, however, has indicated that children with RD represent the lower end of a normal distribution of reading ability and are not a distinct group (Shaywitz, Escobar, Shaywitz, Fletcher, & Maruch, 1992). Therefore, there is no reason to assume that the relationships between oral language skills and reading achievement evidenced in this study do not exist in younger typical readers. Future studies examining the relationship between oral language skills and the development of pre-reading skills may want to include a group of typically developing children as a comparison group.

Because dialect can influence performance on measures of linguistic skill and reading achievement, there is some concern as to the validity of the data collected from the students of African heritage. Most African American children begin their formal school years speaking African American Vernacular English (AAVE; Craig & Washington, 2002); therefore, a possibility exists that many of the children in our sample used AAVE, to some extent. This study was a multisite study encompassing the cities of Atlanta, Boston, and Toronto; however, many other dialects also were spoken by this sample. Further, a substantial portion of students of African heritage in this sample were from Canada, and the rates and nature of the dialect used by this population is unknown. Thus, because this sample evidenced a large amount of variability of dialects that were spoken, the possibility of a confound due solely to the use of AAVE was minimal.

Finally, when interpreting results from this study, it is important to acknowledge that SEM techniques are based on model fit, and multiple models may fit the same data set. Therefore, relationships found to exist between different linguistic skills and different domains of reading achievement in this study are proposed causal relationships that fit the current data set. Model fit does not guarantee that relationships evidenced in the model exist in the real world (Kline, 1998).

Conclusion

Keeping the study's limitations in consideration, the findings from this study were largely consistent with a large body of research indicating that oral language skills are related to reading achievement (Cooper et al., 2002; Olofsson & Niedersoe, 1999; Scarborough, 1990). This study, however, provided unique evidence that receptive and expressive vocabulary knowledge were independently related to pre-reading skills, whereas only expressive vocabulary knowledge was related to word identification abilities. Findings suggest that receptive and expressive vocabulary knowledge relate to pre-reading skills in differential ways because of the nature of each type of knowledge. Further, those children with better definitional knowledge may have an advantage in identifying words because of more thoroughly represented semantic knowledge. Finally, results from this study indicate that better listening comprehension skills facilitate word identification. Because of the nature of the listening comprehension task used, however, definitive conclusions as to the basis of this relationship cannot be made. This last finding may be driven by the confound

associated with the measure of listening comprehension that was used and the poor pre-reading skills evidenced by the students in the study.

Acknowledgments

Support for this research was provided by the National Institute of Child Health and Human Development Grant HD30970 to Georgia State University, Tufts University, and the Hospital for Sick Children/University of Toronto, and by the Research Program Enhancement Fund of Georgia State University. We thank our participants and their families for their cooperation and support.

References

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: The MIT Press.

Bell, L. C., & Perfetti, C. A. (1994). Reading skill: Some adult comparisons. *Journal of Educational Psychology, 86,* 244–255.

Catts, H. W. (1993). The relationship between speech-language impairments and reading disability. *Journal of Speech and Hearing Research, 36,* 948–958.

Chiappe, P., Chiappe, D. L., & Gottardo, A. (2004). Vocabulary, context, and speech perception among good and poor readers. *Educational Psychology, 24,* 825–843.

Cooper, D. H., Roth, F. P., Speece, D. L., & Schatschneider, C. (2002). The contribution of oral language skills to the development of phonological awareness. *Applied Psycholinguistics, 23,* 399–416.

Craig, H. K., & Washington, J. A. (2002). Oral language expectations for African American preschoolers and kindergartners. *American Journal of Speech-Language Pathology, 11,* 59–70.

Diakidoy, I. A., Stylianou, P., Karefillidou, C., & Papageorgiou, P. (2005). The relationship between listening and reading comprehension of different types of tests at increasing grade levels. *Reading Psychology, 26,* 55–80.

DiSimoni, F. (1978). *The Token Test for Children*. Boston: Teaching Resources Corporation.

Donahue, P. L., Daane, M. C., & Grigg, W. S. (2003). *The nation's report card: Reading highlights 2003*. Washington, DC: National Center for Education Statistics.

Dunn, L. M., & Dunn, L. M. (1981). *Peabody Picture Vocabulary Test–Revised (PPVT-R)*. Circle Pines, MNs: American Guidance Service.

Fletcher, J., Lyon, R., Barnes, M., Stuebing, K., Frances, D., Olson, R., et al. (2002). Classification of learning disabilities: An evidenced-based evaluation. In R. Bradley & L. Danielson (Eds.), *Identification of learning disabilities: Research to practice* (pp. 185–250). Mahwah, NJ: Erlbaum.

Foorman, B. F. (1995). Research on the "great debate." Code oriented vs. whole language appoaches to reading instruction. *School Psychology Review, 24,* 376–392.

Gardner, M. F. (1979). *Expressive One-Word Picture Vocabulary Test*. Novato, CA: Academic Therapy Publications.

Gernsbacher, M. A., Varner, K. R., & Faust, M. E. (1990). Investigating differences in general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16,* 430–445.

Hagtvet, B. E. (2003). Listening comprehension and reading comprehension in poor decoders: Evidence for the importance of syntactic and semantic skill as well as phonological skills. *Reading and Writing: An Interdisciplinary Journal, 16,* 505–539.

Hagtvet, B. E., & Lillestolen, R. (1985). *Reynells språktest. Norsk håndbook. [Reynell Developmental Language Scales, Manual; Norwegian adaptation.].* Oslo, Norway: å Universitetsforlaget.

Hollingshead, A. B. (1975). *Four factor index of social status*. Unpublished manuscript. New Haven, CT: Yale University.

Joreskog, K. G., & Sorbom, D. (2001). *LISREL 8.51*. Hillsdale, NJ: Scientific Software International.

Kaufman, A. S., & Kaufman, N. L. (1990). *Kaufman Brief Intelligence Test*. Circle Pines, MN: American Guidance Service.

Kline, R. B. (1998). *Principles and practice of structural equation modeling*. New York: Guilford.

Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22,* 1–75.

Lindsey, K. A., Manis, F. R., & Bailey, C. E. (2003). Prediction of first-grade reading in Spanish-speaking English-language learners. *Journal of Educational Psychology, 95,* 482–494.

Lovett, M. W., Borden, S. L., DeLuca, T., Lacerenza, L., Benson, N. J., & Brackstone, D. (1994). Treating the core deficits of developmental dyslexia: Evidence of transfer of learning after phonologically- and strategy-based reading programs. *Developmental Psychology, 30,* 805–822.

McBride-Chang, C., Wagner, R. K., & Change, L. (1997). Growth modeling of phonological awareness. *Journal of Educational Psychology, 89,* 621–630.

McGregor, K. K., Friedman, R. M., Reilly, R. M., & Newman, R. M. (2002). Semantic representation and naming in young children. *Journal of Speech, Language, and Hearing Research, 45,* 332–346.

Metsala, J. L. (1997). Spoken word recognition in reading disabled children. *Journal of Educational Psychology, 89,* 159–169.

Metsala, J. L., & Walley, A. C. (1998). Spoken vocabulary growth and the segmental restructuring of lexical representation: Precursors to phonemic awareness and early reading ability. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 89–120). Mahwah, NJ: Erlbaum.

Morris, R. D., Lovett, M. W., Wolf, M., Sevcik, R. A., Steinbach, K. A., & Frijters, J. C. (2007). *Multiple component remediation of developmental reading disabilities: A controlled factorial evaluation of the influence of IQ, socioeconomic status, and race on outcomes*. Manuscript submitted for publication.

Nation, K., & Snowling, M. J. (2004). Beyond phonological skills: Broader language skills contribute to the development of reading. *Journal of Research in Reading, 27,* 342–356.

Newcomer, P. L., & Hammill, D. D. (1988). *Test of Language Development–2, Primary*. Austin, TX: Pro-Ed.

Olofsson, A., & Niedersoe, J. (1999). Early language development and kindergarten phonological awareness as predictors of reading problems. *Journal of Learning Disabilities, 32,* 464–472.

Ouellette, G. P. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology, 98,* 554–566.

Rayner, K., Foorman, B. F., Perfetti, C. A., Pesetsky, D., & Seidenberg, M. S. (2001). How psychological science informs the teaching of reading. *Psychological Science in the Public Interest, 2,* 31–73.

Scarborough, H. S. (1990). Very early language deficits in dyslexic children. *Child Development, 61,* 1728–1743.

Shaywitz, S. E., Escobar, M. D., Shaywitz, B. A., Fletcher, J. M., & Maruch, R. (1992). Evidence that dyslexia my represent the lower tail of a normal distribution of reading ability. *New England Journal of Medicine, 326,* 145–150.

Shaywitz, S. E., Shaywitz, B. A., Fletcher, J. M., & Escobar, M. D. (1990). Prevalence of reading disability in boys and girls: Results of the Connecticut longitudinal study. *Journal of the American Medical Association, 22,* 998–1002.

Sinatra, G. M. (1990). Convergence of listening and reading processing. *Reading Research Quarterly, 35,* 115–130.

Snow, C. E., Tabors, P. O., Nicholson, P. E., & Kurland, B. F. (1995). SHELL: Oral language and early literacy in kindergarten and first-grade children. *Journal of Research in Childhood Education, 10,* 37–47.

Stahl, S. A., & Murray, B. (1998). Issues involved in defining phonological awareness and its relation to early reading. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 89–120). Mahwah, NJ: Erlbaum.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th edition). Needham Heights, MA: Allyn and Bacon.

Torgeson, J. K., & Wagner, R. K. (1996, January). *The Comprehensive Test of Reading Related Phonological Processes (CTRRPP)*. Tallahassee, FL: Author.

Torgeson, J. K., & Wagner, R. K. (1999). *The Comprehensive Test of Phonological Processing (CTOPP)*. Austin, TX: PRO-ED.

Torgeson, J. K., Wagner, R. K., & Rashotte, C. A. (1999). *Test of Word Reading Efficiency (TOWRE)*. Austin, TX: PRO-ED.

Vellutino, F. R., Scanlon, F. M., & Tanzman, M. S. (1994). Components of reading ability: Issues and problems in operationalizing word identification, phonological, and orthographic coding. In G. R. Lyon (Ed.), *Frames of reference for the assessment of learning disabilities: New views on measurement issues* (pp. 279–324). Baltimore: Paul H. Brookes.

Walley, A. C., Metsala, J. L., & Garlock, V. M. (2003). Spoken vocabulary growth: Its role in the development of phoneme awareness and early reading ability. *Reading and Writing: An Interdisciplinary Journal, 16,* 5–20.

Wechsler, D. (1991). *Wechsler Intelligence Scale for Children–Third Edition (WISC-III)*. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1992). *Wechsler Individual Achievement Test (WIAT)*. San Antonio, TX: The Psychological Corporation.

Werner, E. O., & Krescheck, J. D. (1983). *Structured Photographic Expressive Language Test–2*. Sandwich, IL: Janelle Publications.

Wilkinson, G. S. (1993). *The Wide Range Achievement Test–3 (WRAT-3)*. Wilmington, DE: Wide Range.

Wise, J. C., Sevcik, R. A., Morris, R. D., Lovett, M. W., & Wolf, M. (2007). The growth of phonological awareness by children with reading disabilities: A result of semantic knowledge or knowledge of grapheme–phoneme correspondences? *Scientific Studies of Reading, 11,* 151–164.

Woodcock, R. W. (1987). *Woodcock Reading Mastery Tests–Revised (WRMT-R)*. Circle Pines, MN: American Guidance Service.

Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock–Johnson Psycho-Educational Battery–Revised*. Chicago: Riverside.

Woodcock, R. W., & Munoz-Sandoval, A. F. (1995). *Woodcock Language Proficiency Battery–Revised, Spanish Form*. Chicago: Riverside.

Received January 25, 2006

Revision received June 30, 2006

Accepted December 18, 2006

DOI: 10.1044/1092-4388(2007/076)

Contact author: Justin C. Wise, Georgia State University, 1400 Decatur Street, SE, Suite 1151, Atlanta, GA 30303. E-mail: psyjcwx@langate.gsu.edu.