MORPHOSYNTACTIC SKILLS OF POOR COMPREHENDERS

By

©2009
Suzanne M. Adlof

B.S., University of Central Arkansas, 2002
M.A., University of Kansas, 2004

Submitted to the Department of Speech-Language-Hearing: Sciences and Disorders and the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy

_____
Hugh W. Catts, Chairperson

_____
Mabel L. Rice

_____
Holly L. Storkel

_____
Diane Frome Loeb

_____
Sara Thomas Rosen

Date Defended: 6/15/09

The Dissertation Committee for Suzanne M. Adlof certifies that this is the approved version of the following dissertation:

MORPHOSYNTACTIC SKILLS OF POOR COMPREHENDERS

Committee:

_____
Hugh W. Catts, Chairperson

_____
Mabel L. Rice

_____
Holly L. Storkel

_____
Diane Frome Loeb

_____
Sara Thomas Rosen

Date approved: _____

ABSTRACT

Purpose: This study investigated the morpho-syntactic abilities of children who show deficits in reading comprehension in spite of adequate word reading abilities. These children are often referred to in the literature as "poor comprehenders," and their reading comprehension problems are believed to stem from oral language deficits. In fact, many studies have documented poor comprehenders' deficits in semantics, syntax, and higher level language skills. Because most poor comprehenders also display normal nonverbal cognitive skills, they share much in common with children with specific language impairment (SLI), and studies have documented substantial overlap between the two classifications. This study sought to determine whether poor comprehenders display the same morpho-syntactic deficits that are characteristic of children with SLI.

Method: Sixteen poor comprehenders and 24 controls participated in this study. All participants were in fourth grade and demonstrated good word reading and nonverbal cognitive abilities. They completed a battery of standardized language assessments and three experimental morpho-syntax tasks that examined knowledge of finiteness marking rules. The first two sets of analyses were conducted to determine if poor comprehenders showed morpho-syntactic weakness relative to controls and if their pattern of performance was characteristic of expectations for children with SLI. Then the poor comprehender group was subdivided into those who met criteria for SLI (PC-SLI) and those who did not (PC-Only). The third set of analyses looked for

differences in morpho-syntactic performance between poor comprehenders with SLI and poor comprehenders without SLI.

Results: The poor comprehender group achieved significantly lower scores than the control group on all non-phonological standardized language assessments, but the two groups performed equivalently on the phonological processing measure. The poor comprehender group also showed significantly weaker performance than controls across the three morpho-syntax tasks, and their pattern of performance indicated weakness with obligatory finiteness marking, regularization of irregular past tense, and subject-verb agreement. The first two weaknesses are characteristic of children with SLI. Although subject-verb agreement is not believed to be an issue for children with SLI, a small number of studies of older children with SLI have reported difficulty with this area. There was no distinguishable pattern of differences in morpho-syntactic performance between the PC-SLI and PC-Only groups. These results have implications for the early identification of later reading comprehension difficulties in children with good phonological skills.

ACKNOWLEDGMENTS

I am deeply indebted to many people for their guidance, support, and assistance with this project and the completion of my Ph.D. Words cannot fully express my gratitude, but I promise to make every effort to “pay it forward” in the future.

First, thanks to Hugh Catts for taking me as your student and showing me how fulfilling an academic life can be. I have thoroughly enjoyed working with you. I wasn’t quite sure what to expect when I began the graduate program seven years ago. Now I know that I could not have asked for a better mentor and friend. I appreciate the countless hours you devoted to helping me design and implement this study, analyze the data, and prepare the dissertation manuscript. More importantly, I am grateful for all the wisdom and advice—regarding both research and life in general—that you have shared with me over the years.

Thanks also to Holly Storkel, my secondary research mentor. Your professionalism inspires me, and it has been a pleasure to learn from you. I sincerely appreciate the time you spent reviewing the study proposal and offering suggestions, as well as giving me advice for an academic career. I am also grateful for the practical skills you taught me as I worked in your lab—they were invaluable as I began this dissertation.

Thanks to Mabel Rice whose work concerning the linguistic skills of children with specific language impairment was foundational to the preparation of this study. I am thankful for your guidance in preparing this study and analyzing the results, and I

appreciate the way you have always pushed me to think beyond my comfort zone. Furthermore, your leadership and advice on navigating an academic career will not be forgotten.

Thanks to the other members of my dissertation, prospectus, and comprehensive examination committees: Diane Loeb, Diane Nielsen, and Sara Rosen. Each of you was instrumental in the completion of this study, and I sincerely appreciate the time and effort you put into the study preparation and evaluation of the results.

Thanks to the participants in this study and to their parents. This study could not have been conducted without you. Thanks to the principals and teachers of the Lawrence and Kansas City, Kansas public schools (USD 497 and USD 501) for your assistance with participant recruitment and data collection. Special thanks to David Williams, principal of Prairie Park Elementary in Lawrence, and Sharyn Connor, principal of New Stanley Elementary in Kansas City. I appreciate how you both helped facilitate contacts with principals from other schools in your districts.

Thanks to the following sources of financial support for this project: the National Institute of Health Ruth L. Kirschtein National Research Service Award Individual Predoctoral Fellowship (F31 DC009133); the International Reading Association Jeanne S. Chall Research Fellowship, and the American Speech-Language-Hearing Foundation New Century Doctoral Scholarship.

Thanks to April Best, who assisted me in moving this project from an idea to a tangible study. I always appreciated your cheerful attitude as we proceeded through numerous tedious tasks as we prepared stimuli and analyzed data.

Thanks to Stacy Cates for helping me with data collection and processing. You were always so eager to share your time, and without your help, I might still be screening children for study participation!

Thanks to David Hahn for your help creating the visual stimuli and for keeping me laughing during the process.

Thanks to Jill Hoover for help with transcription reliability and to Jennifer Shipp for assistance with data collection.

Thanks to my graduate school support group: Audra Sterling, Jill Hoover, Andrea Ash, Mindy Bridges, Sophie Ambrose, Kristen Linnemeyer, and Carrie Hahn. My academic and personal life have both been enriched my relationship with each of you. I feel truly blessed to have such wonderful friends.

Thanks to Tiffany Hogan, my best friend and academic "big sister." Like most "little sisters," I have learned so much by simply watching you go first! The idea for this project began with chocolate croissants and coffee at your kitchen table, and your optimism gave me the confidence to move forward. Thank you for your support through the entire dissertation process. I cherish your friendship.

Thanks to my family, Eric, Lauren, and Dad for supporting me in continuing my education and for being my cheerleaders along the way. Thanks for always

reminding me of life outside of school and for not teasing me *too* much for being a student for so long! I love you all.

Finally, thanks to Tad Lewis, my future husband. This project began just after we met, and you've been with me all the way. Thanks for putting up with me, and thanks for working so hard to make things easy for me. I love you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

Children with reading disabilities are at increased risk for low academic achievement, limited employment opportunities, and behavioral and social problems (Kavale & Forness, 1996; McKinney, 1989; Osborne, Schulte, & McKinney, 1991; Sabornie, 1994; Spear-Swerling & Sternberg, 1996). In the last thirty years, a great deal of research has been aimed at developing effective interventions for children with reading problems (for reviews, see Pikulski, 1994; Swanson, 1999; Ehri, Nunes, Stahl, & Willows, 2001). Most of this research has focused on improving the word reading skills of children with dyslexia. Children with dyslexia display "difficulties with accurate and/or fluent word recognition" that significantly limit their ability to comprehend texts (International Dyslexia Association Board of Directors, 2002). It is generally agreed that phonological deficits are a causal factor of these difficulties. Accordingly, numerous studies have found that interventions incorporating explicit instruction of phonological awareness and sound-letter correspondences are highly effective for teaching children with dyslexia how to decode print (Ehri et al., 2001). As a result of this research, the use of explicit and systematic methods of word reading instruction is also recommended for typically developing students in mainstream classrooms (Ehri et al., 2001; National Institute of Child Health and Human Development, 2000).

More recently, researchers have identified another subgroup of poor readers who show the opposite profile of children with dyslexia. These children, referred to in

the literature as “poor comprehenders,” display marked reading comprehension difficulties in spite of having good word reading and phonological skills. It is estimated that 5-10% of all school-aged children fit the poor comprehender profile (Nation & Snowling, 1997; Yuill & Oakhill, 1991). Because poor comprehenders, by definition, have good word reading abilities, they provide an interesting window through which researchers can view the cognitive and linguistic processes that influence reading comprehension when word reading is controlled.

According to the simple view of reading, reading comprehension is comprised of two separate but related factors: word recognition and language comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990). Word recognition is the ability to pronounce printed words, whether by decoding or “sounding out” novel words, or by recognizing familiar words. Language comprehension is broadly defined as the ability to understand texts without reading them (i.e., by listening to them; Gough & Tunmer, 1986). Whether by listening or by reading, text comprehension is a complex process, involving the coordination of a wide array of language skills with background knowledge to form a cohesive representation of the text (Kintsch, 1998). Because poor comprehenders have good word reading skills, the simple view predicts that the source of their reading problems lies in language comprehension. In fact, numerous studies have documented a variety of oral language deficits in poor comprehenders. In many cases, these deficits are clinically significant—meeting clinical criteria for a diagnosis of language impairment (Catts, Adlof, & Ellis Weismer, 2006; Nation, Clarke, Marshall, & Durand, 2004). However, these oral

language deficits are also described as “hidden deficits” because very few poor comprehenders are ever identified by parents or teachers as having a reading or language problem in the absence of standardized testing (Catts et al., 2006; Nation et al., 2004).

Overall, the language deficits of poor comprehenders are centered on the non-phonological domains of language. Poor comprehenders tend to have strong phonological skills that support their word reading abilities, but they usually show weaknesses in every other area of language. Most of the research examining poor comprehenders’ language and cognitive skills has focused on phonology, semantics, and higher-level language skills, whereas less is known about their syntactic skills.

Language and Cognitive Profiles of Poor Comprehenders

Phonological Processing

For the most part, studies examining poor comprehenders’ skills in the phonological domain of language have found them to be relatively robust. This is expected because phonological skills are most strongly related to word reading abilities. Accordingly, poor comprehenders have performed similarly to typical readers on broad phonological awareness tasks, such as rhyme judgment, rhyme generation, and odd-one-out tasks that focus on rhymes (Cain, Oakhill, & Bryant, 2000; Nation et al., 2004; Nation & Snowling, 1998). They have also not differed from typical readers when asked to perform more fine-grained phonemic awareness tasks such as spoonerism (e.g., transposing the initial sounds of two words) and phoneme deletion (Cain et al., 2000; Catts et al., 2006; Nation et al., 2004; Nation,

Snowling, & Clarke, 2007; Stothard & Hulme, 1995). Moreover, poor comprehenders have performed similarly to typical readers on phonological working memory tasks, such as recalling lists of letters, words and nonwords (Cain et al., 2000; Catts et al., 2006; Nation, Adams, Bowyer-Crane, & Snowling, 1999; Nation et al., 2004; Nation et al., 2007). When slight differences have been found on tasks designed to assess phonological processing (e.g., Cain et al., 2000; Catts et al. 2006), they have been interpreted as indications that the tasks are tapping other cognitive and linguistic skills in addition to phonological skills.

Semantics

In contrast to their relative strengths in the phonological domain, multiple studies have documented significant semantic deficits in poor comprehenders. Across studies, poor comprehenders have consistently displayed limited expressive and receptive vocabulary knowledge compared to typical readers (Catts et al., 2006; Nation et al., 2004; Nation & Snowling, 1998; Nation et al., 2007). A recent study of word learning demonstrated that poor comprehenders were able to learn the phonological forms of words as quickly as typically developing children, but it took them significantly longer to learn the meanings of the words (Nation, et al., 2007).

Evidence from a large longitudinal study suggests that poor comprehenders' vocabulary deficits may be considered both a cause and an effect of reading comprehension difficulties. Catts et al. (2006) found that poor comprehenders, identified on the basis of eighth grade reading performance, showed significantly lower receptive vocabulary scores compared to good readers in kindergarten, second,

fourth, and eighth grades, but the severity of their vocabulary deficits increased across those time points. In kindergarten, poor comprehenders, on average, scored about one-half a standard deviation below the population mean, whereas by eighth grade they scored nearly a full standard deviation below the mean (Catts et al., 2006).

As further evidence of a reciprocal relationship between vocabulary and reading comprehension, studies indicate that poor comprehenders have particular difficulty deriving the meaning of new words from texts that they read (Cain, Oakhill, & Lemmon, 2004; Cain, Oakhill, & Elbro, 2003). This difference appears to be primarily quantitative rather than qualitative: Although poor comprehenders were able to derive the meanings of fewer words from text compared to good readers, they made the same types of errors (Cain et al., 2003).

Additional evidence of semantic deficits in poor comprehenders has come from studies of semantic processing. These studies indicate that poor comprehenders have especial difficulty recognizing and expressing abstract semantic relationships. For example, compared to typical readers, poor comprehenders have had difficulty generating lists of category members and making synonym judgments involving abstract words (Nation & Snowling, 1998). In behavioral studies utilizing priming tasks, poor comprehenders showed priming equivalent to controls for words that were functionally related (e.g, *shampoo-hair*) or highly-associated category members (e.g., *brother-sister*), but they did not show the same priming advantage as controls for category members that had low association strength (e.g., *goat-cow*; Nation & Snowling, 1999). In a more recent study utilizing ERP methodology, Landi & Perfetti

(2007) found that the semantic processing deficits might be more general than originally observed in Nation & Snowling's (1999) behavioral tasks. They found that adult poor comprehenders differed from skilled readers matched for decoding ability in their evoked responses to both categorically-related and highly associated words.

Syntax

Compared to phonological, semantic, and higher-level language skills, the syntactic abilities of poor comprehenders have received less attention. However, converging evidence of syntactic deficits has begun to build. Poor comprehenders have generally scored lower than typical readers on standardized language assessments that tap syntactic skills using sentence repetition tasks and sentence-picture matching tasks (Catts et al., 2006; Cragg & Nation, 2006; Marshall & Nation, 2003; Nation et al., 2004; Oakhill, Cain, & Bryant, 2003; Stothard & Hulme, 1992). Although these standardized assessments are useful for documenting general syntactic weaknesses, they sample a wide variety of structures; thus, they do not offer much insight into the specific syntactic structures that are problematic for poor comprehenders.

Two studies have used experimental tasks to document poor comprehenders' difficulties with active, passive, and dative sentences, as well as past tense inflection. Nation & Snowling (2000) used a word-order correction task to measure syntactic awareness in poor comprehenders and typically developing readers. First, participants were asked to unscramble active and passive sentences. Results showed a significant interaction between group and sentence type: Poor comprehenders performed

significantly worse on this task than typical readers for both sentence types, but they showed particular difficulty with passive sentences. Next, participants were asked to unscramble dative sentences (e.g., *The donkey pushed the food to the cat*), and the semantic complexity of each sentence was manipulated by varying the reversibility of each sentence's three noun phrases (i.e., reversible, medium, irreversible). Results showed a significant interaction between group and semantic complexity: Poor comprehenders performed significantly worse than controls across sentence types, but group differences were greatest for "medium" and "reversible" sentences. The authors interpreted these results as evidence of syntactic deficits in poor comprehenders that can be exacerbated by semantic deficits (i.e., because the semantically reversible sentences were significantly more difficult).

Nation, Snowling, & Clarke (2005) investigated poor comprehenders' knowledge of past tense rules by eliciting past tense inflections of real and novel verbs varying in regularity and frequency (for real verbs only). The details of this study are outlined in a later section discussing the morpho-syntactic skills of poor comprehenders, but a main finding was that poor comprehenders' most common error was the regularization of irregular past tense verbs. The authors interpreted this result as indication of a primary semantic, as opposed to syntactic, deficit.

Higher-Level Language Skills

Numerous studies have documented poor comprehenders' difficulty with higher-level language tasks. In fact, many of the early studies of poor comprehenders selected poor comprehenders who had good word reading skills *and* good written

vocabulary skills (measured by matching printed words to pictures), in order to focus specifically on higher-level language abilities required to construct a complete and coherent text representation. Such studies documented poor comprehenders' difficulties with inferences (Oakhill, 1982; Oakhill, 1983; Oakhill, 1984; Oakhill, Yuill, & Parkin, 1986; Yuill & Joselyne, 1988) and in determining pronoun antecedents (Oakhill & Yuill, 1986). A more recent study of metacognitive processing in poor comprehenders found that they were good at detecting word errors (i.e., nonsense words) but poor at detecting syntactic errors (i.e., incorrect word order) and semantic errors (i.e., anomalous sentences; Oakhill, Hart, & Samols, 2005). Lastly, studies of poor comprehenders' spoken and written narratives have also documented their weakness with integrating text segments into a coherent whole. Although poor comprehenders produced spoken and written narratives of equal length as typical readers, they showed significantly less recall of story content and inferred significantly fewer causal relationships (Cain, 2003; Cragg & Nation, 2006). Whereas control children's narratives contained integrated and cohesive story sequences, poor comprehenders' narratives consisted of basic descriptions of the stimulus pictures.

Nonverbal Cognitive Skills

After documenting a wide range of language difficulties in poor comprehenders, it is of interest to determine whether they can be explained by general cognitive deficits. The earliest studies of poor comprehenders did not assess nonverbal cognitive abilities, whereas more recent studies have varied in their approach to this issue. Some have required the poor comprehender group to be

matched to the control group on some measure of nonverbal intelligence (e.g., Landi & Perfetti, 2007; Nation et al., 1999; Nation & Snowling, 1998; Nation & Snowling, 2000). Of those studies that assessed nonverbal intelligence but did not require groups to be matched, some have found that poor comprehenders' scores did not differ from controls (e.g., Cain & Oakhill, 2006; Nation et al., 2007; Stothard & Hulme, 1995; Weekes, Hamilton, Oakhill, & Holliday, 2008) whereas others have reported that poor comprehenders score significantly lower than controls (e.g., Catts et al., 2006; Cragg & Nation, 2006; Nation, Clarke, & Snowling, 2002). When significant group differences in nonverbal cognitive abilities were found, they were controlled for in the examination of language deficits through the use of covariate analyses, and findings remained essentially unchanged. In general, because some studies have found group differences in nonverbal cognitive abilities, it appears that deficits in nonverbal cognition could play a role in explaining some reading comprehension difficulties. However, based on the findings of studies employing matching and covariate designs, comprehension problems do not appear to be attributable to nonverbal cognitive deficits alone.

Comparing and Contrasting Poor Comprehenders and Children with Specific Language Impairment

Because poor comprehenders display significant weaknesses across a wide array of non-phonological language skills that cannot be fully explained by low intelligence, it is possible that the term "poor comprehender" might be another way to refer to a child with "specific language impairment" (SLI). SLI is defined as a

significant impairment in oral language development that occurs in children with intact nonverbal cognitive skills, normal hearing ability, and with an unremarkable medical and neurological history (e.g., no autism, head injury, or developmental syndrome; Leonard, 1998). Children with SLI typically show deficits in syntax, semantics, and higher-level narrative language skills, and although many also show articulation and/or phonological processing deficits, not all do (Bishop, Adams, & Norbury, 2006; Bishop, Bishop, Bright, James, Delaney, & Tallal, 1999; Catts, Adlof, Hogan, & Ellis Weismer, 2005; Leonard, 1998). Whereas all domains of language can be negatively affected, there is a general agreement that morpho-syntactic difficulties are a hallmark of children with SLI (Bedore & Leonard, 1998; Marchman, Wulfeck, & Ellis Weismer, 1999; Norbury, Bishop, & Briscoe, 2001; Rice & Wexler, 1996; Rice, Wexler, & Cleave, 1995; Rice, Wexler, & Hershberger, 1998; see also Leonard, 1998, for a review).

There is substantial overlap between the two populations (SLI and poor comprehender), as many children with SLI show the poor comprehender profile (Kelso, Fletcher, & Lee; 2007), and many poor comprehenders meet traditional clinical criteria for an SLI diagnosis (Catts et al., 2006; Nation et al., 2004). However, the two labels have thus far remained distinct. One reason for this is that the diagnoses customarily focus on children of different ages. Whereas SLI is typically diagnosed in young children between ages of three and six, poor comprehenders cannot be identified until much later, after they have had time to demonstrate good word reading abilities. Additionally, it is unclear whether poor comprehenders display

the same types of morpho-syntactic difficulties that are characteristic of children with SLI (c.f., Nation et al., 2004; Nation, et al., 2005).

Morpho-syntactic Weaknesses in Children with SLI

Although children with SLI exhibit weaknesses across all domains of language, morpho-syntactic deficits, related specifically to finiteness marking, are often the most pronounced (Rice & Wexler, 1996; Rice, et al., 1995). Finiteness marking involves the marking of grammatical tense and agreement between the subject and verb. Although finiteness is obligatory in all main clauses, not all finiteness markers are overt in the English language. For example, the verb *like* in the sentence *I like baseball* is finite even though it appears in its bare form. In English, finiteness is overtly marked on only the following forms: third person singular present tense (e.g., *He walk<u>s</u> to school*), regular and irregular past tense (*She walk<u>ed</u> to school*; *He <u>ate</u> an apple*), auxiliary and copula forms of the verb *Be* (*The baby <u>is</u> crying*; *The baby <u>is</u> sad*), and auxiliary *Do* (*He <u>does</u> not have any*).

During the course of development, young children are known to occasionally omit these overt finiteness markers from their speech (e.g., *The baby crying*), but by approximately four years of age, typical children have mastered finiteness marking in their spoken language productions. In contrast, children with SLI continue to demonstrate weaknesses with these forms for an extended period of time. Thus whereas typically developing children are known to pass through an "Optional Infinitive" period which resolves itself by around age four, the language skills of children with SLI are marked by an "Extended Optional Infinitive" period, which

might not ever fully resolve (Rice & Wexler, 1996; Rice, et al., 1995; Rice, et al., 1998; Rice, Tomblin, Hoffman, Richman, & Marquis, 2004).

An important feature of the theories specifying optional infinitives in typically developing children and extended optional infinitives in children with SLI is that when children do mark finiteness, they mark it correctly. Their grammatical difficulty lies not in knowing which tense or agreement marker to use, but rather in knowing when the marker is obligatory. Thus, whereas errors such as "*The baby sleeping,*" may be common in the spontaneous utterances of preschoolers or older children with SLI, errors such as "*The baby are sleeping,*" are extremely rare (Rice et al., 1995).

Longitudinal evaluations of production data have shown that children with SLI continue to display instances of omitted finiteness in spontaneous and probed speech samples through age 8. Although they are able to achieve a high level of accuracy in finiteness marking (e.g., near 90%), their accuracy levels remain significantly lower than same-age peers and younger, language-matched controls, who show near-perfect accuracy (Rice et al., 1998). Likewise, a longitudinal examination of grammaticality judgment data found that children with SLI continued to judge simple declarative sentences with omitted finiteness errors (e.g., *He eat toast*) as "correct" significantly more often than age- and language-matched controls through age 8, whereas their sensitivity to agreement errors (e.g., *He are mad*) in grammaticality judgments was much higher and closer to that of controls (Rice, Wexler, & Redmond, 1999).

Whereas the initial studies of extended optional infinitives in children with SLI focused on simple sentence structures, more recent studies have documented difficulties with finiteness marking in complex sentences (e.g., Owen & Leonard, 2006) and yes/no and wh- questions (e.g., Betz, 2005; Rice, Wexler, & Hoffman, in press). In a continuation of their longitudinal study, Rice et al (in press) reported that children with SLI were significantly less sensitive than age- or language-matched controls to omitted finiteness errors involving the *Be* copula and auxiliary and the *Do* auxiliary in wh- and yes/no questions through age 15. Likewise, Betz (2005) found that 11-13 year-olds with SLI showed reduced sensitivity to omitted finiteness in wh-questions formed using the *Do* auxiliary (e.g., *Where a dog like to sit?*).

Interestingly, Betz (2005) also found that the 11-13 year-olds with SLI also showed reduced sensitivity to overt agreement errors in wh- questions formed with *Do* (e.g., *Where do a man like to sing?*). This finding was unexpected based on the extended optional infinitive account, which posits that children with SLI know which finiteness forms to use, but just consider those forms to be optional. Betz (2005) hypothesized that this finding might be explained by the properties of *Do* that differ from other verbs. Specifically, unlike other verbs, which are generated in the matrix clause and moved to form questions, the *Do* auxiliary is inserted in wh-questions for the purpose of marking tense and agreement. All of the stimuli in Betz's study involved the *Do* auxiliary; thus new studies are needed to evaluate whether children with SLI accept overt finiteness errors in questions with verbs other than the *Do* auxiliary.

Another possibility is that the nature of the morpho-syntactic deficits of children with SLI changes as they grow older. Two studies eliciting grammatical judgments from older children with SLI have reported that they show reduced sensitivity to a range of grammatical errors, including overt agreement errors as well omitted tense errors. For example, Wulfeck et al. (2004) elicited grammaticality judgments from 7-12 year-old children with SLI, typically developing children, and children with focal brain injuries. Errors consisted of omissions, substitutions (i.e., agreement errors), and word-order violations involving auxiliary verbs and noun determiners. Children with SLI showed reduced sensitivity to all error types relative to controls, but this difference was most pronounced for agreement errors. Furthermore, sensitivity to agreement errors showed the least amount of improvement across the age span compared to other error types for children with SLI.

Miller, Leonard, & Finneran (2008) recently elicited grammaticality judgments from 15-year-olds with SLI, non-specific language impairment (NLI), and normal-language controls. The stimuli included sentences with omitted tense errors, tense intrusion errors (where tense morphemes were inserted incorrectly), and omission errors involving non-tense grammatical morphemes. Results showed that the children in the SLI group were significantly less sensitive than the control group for all error types, and there was no group by error type interaction.

In summary, the extended optional infinitive account states that children with SLI treat tense marking as optional, but when they mark tense they mark it correctly. There is ample data to suggest that this is true for young children with SLI, who

follow this pattern in spontaneous language samples, elicited productions, and grammaticality judgments (Rice et al., 1995; Rice et al., 1998; Rice et al., 1999). Longitudinal investigations of children with SLI indicate that their reduced sensitivity to omitted finiteness errors might never fully resolve (Betz, 2005; Rice et al., in press; Rice et al., 2004). There is also evidence that older children with SLI are also less sensitive to other types of grammaticality violations, such as agreement violations and tense intrusion errors that are not predicted by the extended optional infinitive account (Miller et al., 2008; Wulfeck et al., 2004). However, these latter findings do not discount the substantial evidence supporting omitted finiteness errors as a clinical marker of SLI.

Morpho-syntactic Skills of Poor Comprehenders

Very little is currently known about the morpho-syntactic skills of poor comprehenders, as only one previous study has specifically examined any form of tense marking. Nation and colleagues (2005) compared the performance of 7-9 year-old poor comprehenders and controls matched for decoding skills and chronological age on three tasks eliciting productions of past tense verbs. In the first task, participants were asked to inflect nonsense words that were phonologically similar to real regular and irregular verbs. For example, the nonwords *strink* and *prend* were considered irregular novel verbs because they were phonologically similar to the real verbs *drink* and *lend*. In contrast, the nonwords *satch* and *grush* were considered to be regular. For this task, there was a significant effect of regularity but no effect of group: Poor comprehenders and controls achieved similar accuracy levels, and the

most common error for both groups was the regularization of irregular verb forms. The second and third tasks elicited inflections of real regular and irregular verbs of high and low frequency. Results showed a main effect of group, with poor comprehenders performing worse than controls across all items. There were no group interactions, but there was a significant regularity by frequency interaction. Both groups performed near ceiling on the regular verbs, but irregular verbs, especially infrequent irregular verbs, were much more difficult.

The authors interpreted these findings as evidence that poor comprehenders' problems with past tense were due to semantic, as opposed to morpho-syntactic weaknesses (Nation et al., 2004; Nation et al., 2005), primarily because poor comprehenders regularized irregular past tense more often than they dropped tense markers. Thus Nation and colleagues hypothesized that poor comprehenders and children with SLI could be distinguished on the basis of their morpho-syntactic skills, with poor comprehenders showing good skills (except as influenced by semantics) and children with SLI showing core morpho-syntactic deficits. Although the semantic deficits of poor comprehenders are undisputed, these results do not rule out the possibility of morpho-syntactic deficits in poor comprehenders. First, this study only looked at one piece of morpho-syntax, namely past-tense marking. Second, the study did not include any statistical analyses of omitted tense for the tasks involving real verbs. Because the real irregular verb stimuli included many verbs that are zero-marked for past tense (e.g., *hit, cut*), such analyses would have been invalid. Furthermore, regularizations of irregular past tense verbs are also common in children

with SLI, who do show morpho-syntactic difficulties (Marchman, et al., 1999; Rice, et al., 2004; Redmond & Rice, 2001). That is, children with SLI have been observed to both regularize irregular past tense verbs, as well as to omit tense (i.e., use the non-finite form) from sentences containing irregular verbs. In sum, it remains to be determined whether poor comprehenders display good or poor morpho-syntactic abilities.

Rationale for Exploring Morpho-syntax in Poor Comprehenders

This study is one of the first to specifically examine morpho-syntactic skills in poor comprehenders. Such an examination is useful for several reasons. First, although phonological skills, vocabulary, and higher-level language skills have been extensively studied in poor comprehenders, much less is known about poor comprehenders' syntactic abilities. Therefore, this study helps to fill in gaps in the knowledge base concerning poor comprehenders' linguistic strengths and weaknesses. Such information could be useful for diagnostic purposes as well as planning interventions to improve the reading comprehension abilities of poor comprehenders.

Second, this study provides additional information about which language skills can influence reading comprehension separately from word recognition. The language skills that are weak in poor comprehenders may also be weak in "garden variety" poor readers—those who have deficits in both word reading and language comprehension (e.g., Gough & Tunmer, 1986)—and could serve as potential targets to be included in a comprehensive reading intervention.

Third, this study provides information to help answer theoretical questions about whether the classification of "poor comprehender" diagnosis should remain categorically distinct from that of specific language impairment (SLI) (e.g., Nation et al., 2004; 2005). Morpho-syntactic difficulties, especially in the area of finiteness marking, are a hallmark of SLI. This study was designed to determine whether poor comprehenders display similar difficulties.

Fourth, if poor comprehenders do display morpho-syntactic difficulties similar to those reported in children with SLI, this information could be useful for developing early screening measures to identify children at risk for later reading comprehension difficulties. Currently, many of the commercially available screening batteries for identifying children at risk for reading difficulties focus on preliteracy skills associated with word reading, such as phonological awareness and alphabet knowledge (e.g., Good & Kaminski, 2002; Invernizzi, Juel, Swank, & Meier, 1997; Texas Education Agency, 2000). Poor comprehenders would likely be missed by these instruments, as phonological skills are an area of strength for them. However, morpho-syntax assessments have been shown to be very good predictors of language impairments (Rice & Wexler, 2001) with better sensitivity and specificity than measures of vocabulary (Gray, Plante, Vance & Henrichsen, 1999). There is also preliminary evidence to suggest that syntactic difficulties may actually be more sensitive markers of future reading comprehension problems than vocabulary or text-level skills. A recent longitudinal study of children with a history of SLI found that measures of receptive and expressive syntax, but not vocabulary, taken at 7 years of

age accounted for unique variance in reading comprehension at age 11, after controlling for age, nonverbal IQ, and reading accuracy at age 7 (Botting, Simkin, & Conti-Ramsden, 2006). Further logistic regression analyses also showed that expressive and receptive syntax measures, but not vocabulary measures, at age 7 significantly predicted whether a child would have a reading comprehension impairment at age 11. Similarly, a recent study of the kindergarten predictors of later reading impairments found that performance on a grammatical completion task was one of the strongest predictors of reading comprehension impairments in eighth grade (Adlof, Catts, & Lee, in press). These findings indicate that, whether or not grammatical deficits are causally related to reading comprehension impairments, they may serve as sensitive early markers of later reading difficulties.

Research Questions and Predictions

The overarching goal of the current study was to determine whether poor comprehenders show deficits in morpho-syntax, and if so, whether those differences are similar to or different from the morpho-syntactic deficits that have been observed in children with SLI. Two groups of participants were recruited to participate in this study: 1) a group of children who showed the poor comprehender profile of good word reading and nonverbal cognitive skills, but who had poor reading comprehension, and 2) a control group of children who had similar word reading and nonverbal cognitive skills as the poor comprehender group, but who showed good reading comprehension abilities. Participants completed several tasks designed to address three specific research questions.

Research Question 1: Do poor comprehenders display the general language deficits associated with specific language impairment (SLI)?

Before exploring the morpho-syntactic abilities of the poor comprehenders involved in this study, it was important to characterize their overall language abilities to ensure that this sample was comparable to the samples of poor comprehenders involved in previous studies. Therefore, each participant completed a battery of standardized language assessments, including a composite language assessment, a receptive vocabulary assessment, and an assessment of phonological processing. Based on the overall body of literature involving poor comprehenders, it was expected that the children in the poor comprehender group would show significantly worse performance than the children in the control group for all non-phonological language tasks, and that the two groups would not differ in performance on the phonological task. Furthermore, based on previous studies that have looked at the prevalence of SLI among groups of poor comprehenders (Catts et al., 2006; Nation et al., 2004), it was predicted that approximately one third of the children in the poor comprehender group would qualify for a diagnosis of SLI.

Research Question 2: Do poor comprehenders demonstrate significant difficulties with morpho-syntax compared to a control group of typical readers in the same school grade, with similar nonverbal intelligence and word reading abilities? If so, does their pattern of performance match that expected for children with specific language impairment?

This question was addressed using data from three tasks designed to assess participants' knowledge of finiteness marking rules. Participants first completed a grammaticality judgment task involving irregular past tense verbs. Three types of sentences were presented: correct sentences, sentences with omitted finiteness errors (i.e., the irregular verb was presented in its bare-stem form), and sentences with regularization errors, where the irregular verb was inflected with the regular past tense –ed suffix. Based on the findings of Nation et al. (2005), it was predicted that poor comprehenders would be more likely than controls to accept regularization errors. However, if poor comprehenders were following the same extended optional infinitive (EOI) grammar as children with SLI, they should also be more likely than controls to accept omitted finiteness errors. Thus, an overall main effect of group was predicted for this task, where poor comprehenders were less sensitive than controls to both types of errors.

The second task also involved making grammaticality judgments, but this time the stimuli were wh- questions formed using *Be* and *Do* auxiliary verbs. The use of wh-questions allowed for an examination of more complex syntactic structures, which could be more sensitive to morpho-syntactic differences in older children than simple declarative sentences. Three types of questions were presented for each verb, for a total of six conditions: correct questions, questions with omitted finiteness errors, where the *Be* or *Do* verb was omitted from the question, and questions with overt agreement errors, where the plural form of the *Be* or *Do* verb was presented with a singular subject. It was predicted that, if poor comprehenders were following

the same EOI grammar as children with SLI, they would be more likely to accept omitted finiteness errors than controls. The EOI account also predicts that children with SLI should reject overt agreement errors, and this finding has been supported in studies employing grammaticality judgments of declarative sentences (Rice et al., 1999). However, a recent study investigating SLI children's sensitivity to errors in wh-questions involving *Do* found that they showed reduced sensitivity to both omitted finiteness and overt agreement errors (Betz, 2005). Because this finding might have been explained by the unique properties of *Do*, the task for the current study was modified to include both *Be* and *Do*, and the examination of overt agreement errors was more exploratory in nature.

The third task used cloze sentences to elicit productions of three different forms of finiteness marking: third person singular present tense, regular past tense, and irregular past tense. In addition, plural nouns were also elicited as a control condition. It was predicted that, if poor comprehenders followed the EOI grammar of children with SLI, they would not differ from controls in their production of plural nouns, but they would show significant difficulties with the three forms of finiteness marking.

Research Question 3: Do poor comprehenders meeting the criteria for a diagnosis of SLI differ in their performance on morpho-syntactic tasks from poor comprehenders who do not meet SLI criteria and from the control group of typical readers?

The overall goal of the study was to determine whether poor comprehenders display the same morpho-syntactic deficits as children with SLI. Based on previous

studies (Catts et al., 2006; Nation et al., 2004) it was expected that approximately one third of the poor comprehender sample would meet standard criteria for a diagnosis of SLI. The presence of several children with SLI in the full poor comprehender sample could have influenced the group means and masked potential qualitative or quantitative differences in morpho-syntactic skills between poor comprehenders and children with SLI. Thus, to address this question, the group of poor comprehenders was divided into two subgroups: those who met criteria for SLI (PC-SLI) and those who did not (PC-Only). Then the morpho-syntactic performance of all three groups was compared. It was predicted that the PC-Only group would show the same patterns of strengths and weaknesses on the three morpho-syntax tasks as the PC-SLI group, but that the PC-SLI group would likely achieve lower scores, due to more severe language deficits. Conversely, it was possible that the PC-Only group would show morpho-syntactic skills more in line with those of the control group.

CHAPTER 2: METHODS

Participants

Participants for the study were recruited from public elementary schools within two local school districts: USD 497 in Lawrence, KS, and USD 500 in Kansas City, KS. Previous reports estimated that poor comprehenders comprise at most 10% of the entire school population (Nation & Snowling, 1997; Yuill & Oakhill, 1991). Thus, in order to expedite the identification of participants who would be eligible for the poor comprehender and control groups, recruitment efforts were divided into two phases: initial recruitment and eligibility testing.

Initial Recruitment

For the initial recruitment phase, consent forms were distributed to fourth grade students by their classroom teachers on the basis of performance on a school-administered reading assessment. Both school districts administered the Measures of Academic Progress (MAP; Northwest Evaluation Association, 2008) reading assessment three to four times per year for purposes of progress monitoring. The MAP reading assessment is a computerized adaptive assessment that examines several levels of reading comprehension, including answering literal and inferential questions, recognizing text structures, and evaluating sources of information. Teachers were asked to distribute study information, consent forms, and parent questionnaires to the parents of fourth grade students who scored between the 5^{th} and 30^{th} percentile (potential poor comprehenders) or between the 40^{th} and 85^{th} percentile (potential typical readers) on their most recent MAP reading assessment. Although

teachers used these MAP scores to distribute consent forms, these scores were not provided to the examiner for analysis in this study. Each participating teacher received a gift card in thanks for his or her assistance with recruitment.

The parent questionnaire (contained in Appendix A), requested demographic information as well as the child's medical and educational history. Based on responses to the questionnaire, children who had significant hearing impairments or any other physical or neurological conditions that would interfere with speech or language development (e.g., autism or seizure disorder) were excluded from the study. Two children, one who entered the poor comprehender group and one who entered the control group, had a mild high frequency hearing loss that did not affect their ability to complete the study tasks, and they were allowed to participate in the study. Neither of those two students reported any difficulty hearing or completing the study tasks; likewise, a visual inspection of the data indicated that their performance did not appear different from other children in their study groups.

Students whose parents reported a diagnosis of ADD/ADHD were initially intended to be excluded from the study. However, when it became difficult to locate a sizeable number of poor comprehenders for the study, two students with ADD/ADHD were allowed to participate and were included in the poor comprehender group. All analyses were conducted twice, once including their data, and once without. Overall, the results did not change between the two analyses, so results are reported here including their data.

In addition, students whose questionnaire indicated that they were bilingual or regularly exposed to languages other than English were excluded from the study. When the parent's response to the language exposure question was ambiguous, examiners asked the student questions about their language backgrounds during the eligibility testing phase. Students who reported that they knew a few common vocabulary words (e.g., greetings, alphabet, numbers) from school discussions, television shows, or books were allowed to continue in the study. Students who reported that they could understand or speak in full sentences or conversations were excluded from participation in the full study.

Finally, students who had ever received special education, supplemental reading instruction, or tutoring services were considered for the poor comprehender group but were excluded from the control group.

Eligibility Testing

Students whose parents gave consent to participate in the study and whose case history indicated that they were monolingual English speakers, without significant hearing, cognitive, or neurological deficits completed one to three brief eligibility tests to determine if they met criteria for either the poor comprehender or the typical control group. A summary of the eligibility tests and criteria is provided in Table 2-1. Eligibility assessments were completed at participants' schools or at the University of Kansas. The majority of the assessments were administered by the author, although a few were administered by trained research assistants who were prerequisite students in speech-language pathology. Protocols from tests administered

by the assistants were re-checked and scored by the author to ensure scoring reliability. Participants who completed eligibility testing during school were given small prizes as a token of appreciation for study participation, and eligibility testing was generally broken into 2-3 short sessions to reduce students' time out of the classroom. Participants who completed eligibility testing after school or on weekends were paid $15.00 for one session, which generally lasted 45 minutes to one hour. Parents received a written report listing their child's performance on all standardized assessments completed in the study.

First, the Sight Words subtest from the *Test of Word Reading Efficiency* (TOWRE; Torgesen, Wagner, & Rashotte, 1999) was used to ensure that all participants had average to above-average word reading abilities. In this subtest, students were asked to accurately read as many words as possible within 45 seconds. Words were presented in a list format, and the difficulty of the items increased throughout the test. Students were considered for participation in the full study if their grade-based standard score on the TOWRE was at or above the 39th percentile (e.g., a standard score of 96 or better). Since all participants were in fourth grade, they all had to correctly read at least 60 words in 45 seconds in order to meet the set criterion. In addition, students who scored more than one standard deviation above the mean (i.e., a standard score greater than 115) were excluded from the control group.

Next, the *Test of Nonverbal Intelligence-3* (TONI-3; Brown, Sherbenou, & Johnsen, 1997) was administered to ensure none of the participants would be

considered to have a nonverbal learning impairment. In this test, students were required to solve problems involving abstract geometric shapes and patterns. Students were considered for participation in the full study if their age-based standard score on the TONI was at or above the 10^{th} percentile (e.g., a standard score of 81 or better). Because the criterion was based on an age-based standard score, the minimum raw score for participation in the full study varied between students.

The final eligibility test was the Passage Comprehension subtest of *Group Reading Assessment and Diagnostic Evaluation* (GRADE; Williams, Cassidy, & Samuels, 2001). In this subtest, students were required to read six brief passages and answer four or five questions after each, for a total of 28 multiple-choice comprehension questions. Normative information for this subtest is provided in the form of stanine scores, with each stanine score representing a range of percentile ranks within the normal distribution. Separate norms are provided for students tested during the fall semester versus the spring semester. Because the range of percentile ranks associated with a single stanine score is large, a combination of raw score and stanine score criteria was used to select students for the poor comprehender and typical control groups.

Specifically, to be included in the poor comprehender group, a student had to achieve a raw score at or below the middle raw score of the fourth stanine. The fourth stanine corresponds to a percentile rank between 23 and 40. For students tested in the fall, a raw score between 11 and 13 corresponds to a stanine score of 4. Therefore, in this study, a student had to achieve a raw score less than or equal to 12 to be

considered a poor comprehender in the fall. In the spring, raw scores between 13 and 16 correspond to the fourth stanine; thus, to be considered a poor comprehender in the spring, a student had to achieve a raw score less than or equal to 14. Using these criteria helped maximize the sample of participants for the poor comprehender group, while ensuring that their reading comprehension skills were weak compared to both the control group and to their own word reading abilities.

To be included in the control group, a student had to achieve a raw score at or above the middle raw score of the fifth stanine, which corresponds to a percentile rank between 40 and 60. For students tested in the fall, a raw score between 14 and 18 corresponds to a stanine score of 5. To be included in the control group in the fall, a student had to achieve a raw score greater than or equal to 17. In the spring, raw scores between 17 and 20 correspond to the fourth stanine; thus, to be included in the control group in the spring, a student had to achieve a raw score greater than or equal to 19.

Table 2-1.

Group Selection Criteria

Source of Information	Poor Comprehender	Control
Parent Questionnaire	Monolingual Standard English speaker Normal hearing No neurological impairment	Monolingual Standard English speaker Normal hearing No neurological impairment No special education
TOWRE Sight Words Subtest	Score $\geq 39^{th}$ percentile	Score $\geq 39^{th}$ percentile
TONI-3	Score $>10^{th}$ percentile	Score $>10^{th}$ percentile
GRADE Passage Comprehension	Raw Score ≤ 12 (fall) or ≤ 14 (spring)	Raw score ≥ 17 (fall) or ≥ 19 (spring)

Sample Description

In total, 188 students from 14 public elementary schools in Lawrence and Kansas City, KS (5 schools participated twice) returned signed consent forms during the two year data collection period. Of those, 16 met the specified criteria for the poor comprehender group, and 26 met the criteria for the control group. Two of the original members of the control group were later dropped from the study. The first was dropped when it became apparent during later language testing that she used the African American English dialect. Because this study examined knowledge of standard American English morpho-syntax, it was not appropriate to include speakers of dialects that follow different morpho-syntactic rules. The second was dropped from the study because she could not understand how to complete the computerized

morpho-syntactic assessments, after completing two training attempts. This training is described in more detail in the Procedures section.

The recruitment sites and number of students who returned consent forms to participate in eligibility testing, as well as the final counts for students in the poor comprehender and control groups are listed in Appendix B. Note again that the full sample of students recruited for this study was not a fully representative sample. Students who had scored below the 5th percentile, between the 30th and 40th percentile, or above the 85th percentile on the school-administered MAP reading assessment were not invited to participate in the study. Furthermore, not all students who were invited actually participated. Thus, it is not possible from the data obtained in this study determine the prevalence rate of poor comprehenders in the participating school districts.

Table 2-2 lists the descriptive statistics for each group's performance on the eligibility assessments. Both groups showed average word reading skills. Although the intention for recruitment was for the two groups to be matched on word reading fluency, the word reading fluency standard scores were marginally significantly different, and the raw scores of the control group were significantly better than the raw scores of the poor comprehender group. However, as planned, the groups were well matched for nonverbal intelligence, and their reading comprehension scores showed large and highly significant differences.

Table 2-2.

Means, standard deviations, and significance tests for eligibility assessments

	Poor Comprehender n = 16		Control n = 24				
	Mean	SD	Mean	SD	*F*	*P*	*d*
TOWRE (raw)	65.25	4.58	68.54	4.14	5.58	.023	.78
TOWRE (SS)	101.94	5.17	105.17	5.58	3.41	.073	.61
TONI (raw)	16.75	3.61	17.83	4.30	.69	.41	.27
TONI (SS)	92.69	7.22	94.00	9.64	.22	.65	.15
GRADE (raw)	10.44	2.42	22.63	2.41	244.56	<.0001	5.18
GRADE (stanine)	3.19	.75	6.54	1.14	106.89	<.0001	3.42

To further confirm that the poor comprehenders' reading comprehension skills were, in fact, less than would be expected on the basis of their word reading abilities, a regression analysis was used. From the eligibility testing, scores from the TOWRE and the GRADE were available for 144 participants. Raw scores for both tests were approximately normally distributed: the TOWRE mean was 66.38 with a standard deviation of 7.06; the GRADE mean was 18.92 with a standard deviation of 5.23. The two scores were also significantly correlated, $r = .52$, $p < .001$, indicating that TOWRE raw scores accounted for approximately 27% of the variance in GRADE raw scores. The TOWRE raw scores of these 144 participants were then regressed onto their GRADE raw scores, and the standardized residuals were saved. The mean standardized residual of the poor comprehender group was -1.79 (SD = .63; range = -2.97 to -.89) whereas the mean standardized residual of the control group was .64 (SD =.53; range = -.50 to 1.51). This analysis confirmed that, on average, the reading comprehension scores of the poor comprehender group were nearly two standard

deviations lower than would be expected on the basis of their word reading scores, whereas the control group's reading comprehension scores were on average, about one half a standard deviation higher than was predicted by their word reading scores.

Group demographic and educational characteristics. Table 2-3 provides a description of the demographic and educational characteristics for each of the two groups. Although participants in both groups were predominately Caucasian (which was expected given the eligibility criteria of being monolingual Standard English speakers) there was approximately the same amount of racial diversity within both groups. Although previous studies (Yuill & Oakhill, 1991; Nation & Snowling, 1998) have reported more girls than boys in their samples of poor comprehenders, in this study the opposite was true. The poor comprehender group included more boys than girls, whereas the control group contained more girls than boys. Similar to reports of previous studies (Nation et al., 2004; Catts et al., 2006), the majority of parents of the poor comprehenders reported that their children had not previously received any type of special education services, and that the parents did not have any concerns about the child's language or reading abilities. Only two parents of children in the control group reported concerns about language or reading abilities. One parent's concern was actually about her child's "breathy" voice quality, whereas the other parent was concerned about his child's lack of reading interest. Few parents in either group reported a family history of language or reading difficulties.

Table 2-3.

Group Demographic and Educational Characteristics

	Poor Comprehender N = 16	Control N = 24
Gender		
Males	11 (69%)	8 (33%)
Females	5 (31%)	16 (67%)
Race		
African American/Black	4 (25%)	3 (13%)
Caucasian/ White	11 (69%)	19 (79%)
Multi-racial	0	1 (4%)
"Other"	0	1 (4%)
Not indicated	1 (7%)	0
Previous special education or tutoring services	7 (44%)	0
Parental concerns about reading or language	6 (38%)	2 (8%)
Family history of reading or language difficulties	3 (19%)	1 (4%)

Procedures

Upon completion of the eligibility testing, participants completed a battery of standardized, norm-referenced language assessments and researcher-designed morpho-syntax tasks. The entire battery lasted between one and one-half and two hours. Students who completed the study battery during school typically completed the assessments over a period of 2-4 short sessions; they were paid $10.00 in appreciation of their time and effort upon study completion. Students who completed the battery after school or on weekends were paid $15.00 per session for two sessions. The majority of the standardized language assessments were administered by the author, but a few were administered by trained research assistants who were speech-language pathology students.

Standardized Language Assessments

Three standardized, norm-referenced oral language assessments were used to document the extent of poor comprehenders' overall language deficits, to examine specific areas of linguistic strength and weakness, and to determine how many of the poor comprehenders in this study would meet traditional research criteria for a diagnosis of specific language impairment (SLI). Such an examination allowed for the direct comparison of the poor comprehenders in this study to those involved in previously published studies, as well as an analysis of possible differences in morpho-syntactic skills between poor comprehenders with and without SLI. Based on previous research with poor comprehenders, it was expected that they would perform significantly worse than the control group on all standardized language assessments except the phonological processing assessment.

Composite Language Assessment

First, participants completed the core subtests of the *Clinical Evaluation of Language Fundamentals-4th Edition* (CELF-4; Semel, Wiig, & Secord, 2006). This test provides a broad assessment of several language domains and is commonly used in the clinical diagnosis of language impairments. Some past studies of poor comprehenders have included subtests from an earlier edition (i.e., the CELF-3) in their assessment batteries. A composite language score can be derived based on the individual standard scores of the four core subtests, including Concepts and Directions, Recalling Sentences, Formulated Sentences, Word Classes. In this study, the composite score from the CELF-4 was used to identify the number of participants

within the poor comprehender or typical control group who would qualify for a diagnosis of SLI.

In the Concepts and Directions subtest, participants were asked to follow oral directions of increasing difficulty. Items assessed knowledge of temporal and spatial concepts (e.g., before/after; left/right), and chronological order (e.g., first/last). The accuracy of each item was scored online by the examiner in a dichotomous fashion (correct vs. incorrect) according to the test manual instructions. Administration of this subtest was video-recorded as often as possible to allow for reliability measurements. To assess on-line scoring reliability, a quasi-random sample of 7 participants (17.5%) for whom video was available were re-scored by a trained research assistant with a bachelor's degree in education. Point-to-point inter-rater reliability for this subtest was 98.6%; all disagreements were reviewed, and all scoring errors were corrected in the dataset.

In the Recalling Sentences subtest, participants were asked to repeat sentences that increased in length and grammatical complexity. Following to the test manual, any omission, addition, or substitution from the original sentence was considered an error. Full credit (three points) was given for an exact repetition, two points were given for a single error, one point was given for two to three errors, and no points were given for four or more errors. In this study, the examiner coarsely scored students' responses online in order to follow the ceiling rule during administration, and testing was discontinued only when it was very obvious that the ceiling rule had been met. However, most participants received all items from this subtest. All

participant responses were later transcribed from the audio recordings and re-scored, according to the test manual instructions to ensure scoring reliability.

The Formulated Sentences subtest required participants to generate sentences containing target vocabulary words in response to pictured scenes. Similar to the Recalling Sentences subtest, the examiner coarsely scored participant responses in order to follow the ceiling rule, but most participants received every item. Responses were later transcribed and scored from the audio recording. Following the test manual, full credit (two points) was given for grammatically correct sentences that included correct usage of the target word. Sentences containing one or two minor semantic or syntactic errors received partial credit (one point), and sentences with more than two errors received no credit. Because the scoring of this subtest was somewhat subjective, and data collection and scoring occurred over a two-year period, a scoring analysis was conducted to ensure that there was no drift in the scoring system. A random sample of 20 participants' transcripts (50%) was examined to ensure that, for each item administered, sentences of similar structure with similar types and numbers of errors received the same scores. A total of 11 inconsistent item scores affecting eight participants were identified. Thus, scoring was highly consistent across subjects.

Each item on the Word Classes subtest consisted of a receptive and an expressive component. In the receptive component, participants were asked to select, which two out of four words were most related. In the expressive component, participants were asked to describe how the two correct words were related. As

described in the test manual, participants were asked to complete the expressive component of each item, regardless of whether they answered the receptive component correctly. The ceiling rule for the subtest (both receptive and expressive components) stipulated that testing be discontinued after the child missed the receptive component on five consecutive items. The receptive portion of the subtest was dichotomously scored online during testing. The expressive portion of the subtest was scored later from the audio recording. Similar to the Formulated Sentences subtest, the scoring of the expressive component of this subtest can be somewhat subjective. Thus, a scoring analysis was conducted to ensure that there was no drift in the scoring system. A random sample of 20 participants' expressive responses (50%) was examined to ensure that similar responses received similar scores. Overall, the scoring was very consistent. Out of all 20 protocols, only six instances of inconsistent item scores were noted, involving five participants.

Criteria for Specific Language Impairment

In this study, the criteria for a classification of specific language impairment was a CELF-4 composite language score at least one standard deviation below the mean (i.e., a standard score less than or equal to 85). This cut-off is common in research on children with SLI (e.g., Bedore & Leonard, 1998; Flax, Realpe-Bonilla, Hirsch, Brzustowitz, Bartlett, & Tallal, 2003; Proctor-Williams & Fey, 2000), and it also represents a compromise between more conservative (e.g., Tomblin, Records, Buckwalter, Zhang, Smith, & O'Brien, 1997; Briscoe, Bishop, & Norbury, 2001;

Wulfeck, Bates, Krupa-Kwiatkowski, & Saltzman, 2004) and more liberal (e.g., Spaulding, Plante, & Vance, 2008) diagnostic criteria from past studies.

All of the participants in the full study were required to have TONI-3 nonverbal IQ scores at or above the 10th percentile. This cut-score again represents a compromise between cut-scores employed in previous studies identifying children with SLI. For example, some have endorsed the use of nonverbal IQ standard score cut-offs of 70 or 75, reflecting the DSM-IV criterion for mental retardation (American Psychological Association, 1994; Plante, 1998; Spaulding et al., 2008), others have used 80 (e.g., Flax et al., 2003; Wulfeck et al., 2004), and many have used 85, or one standard deviation below the mean (e.g., Proctor-Williams & Fey, 2000; Rice et al., 1995; Tomblin et al., 1997; Stark & Tallal, 1981). Still others have reported that children with SLI showed "normal" nonverbal IQ, but did not define the range of normal standard scores (e.g., Bedore & Leonoard, 1998).

Receptive Vocabulary Assessment

All participants also completed the *Peabody Picture Vocabulary Test-4th Edition* (PPVT-4; Dunn & Dunn, 2007), which is a measure of receptive vocabulary commonly used in clinical practice as well as in previous studies of poor comprehenders. For each item on this test, participants were asked to select from four choices the picture that best matched a word spoken by the examiner. Responses were scored online by the examiner. To assess on-line scoring reliability, a quasi-random sample of 7 participants (17.5%) for whom video was available was re-scored by the

trained research assistant. Point-to-point inter-rater reliability for this subtest was 99.4%.

Phonological Processing Assessment

Finally, participants completed the Nonword Repetition subtest from the *Comprehensive Test of Phonological Processing* (CTOPP; Wagner, Torgesen, & Rashotte, 1999). In this subtest, participants were asked to repeat 18 recorded nonsense words ranging from 1-7 syllables in length. Participants heard the nonsense words through headphones connected to a laptop computer. This subtest was always administered by the author. Some coarse transcription was completed on-line, but all tests were fully transcribed and scored from the audio recording. All participants were administered every item on the test, but the ceiling rule described in the manual was applied when calculating the standard score. The CTOPP manual specifies that each nonword be scored in a dichotomous fashion, where any deviation from the target (i.e., any sound omission, addition, or substitution) renders a repetition as incorrect. However, in this study, scoring focused only on consonants in order to avoid penalizing participants for variations in vowel productions that are common and acceptable in everyday language, such as reducing unstressed vowels to schwas. To assess transcription and scoring reliability, a random sample of 7 (17.5%) participants' audio recordings were transcribed by a doctoral student with extensive training in phonetic transcription and compared to the original transcripts. Point-to-point agreement of consonant transcriptions was 90.0%. Scores obtained from the

reliability transcriptions were also compared to original scores. Scoring agreement was 91.7%.

Morpho-syntax Assessments

Three experimental tasks were designed to assess participants' knowledge of the rules of finiteness marking. Two involved making grammaticality judgments, and one elicited productions of finiteness marking morphology. Each of the tasks was presented through high quality headphones connected to a laptop computer. The stimuli were presented using Direct RT experimental software (Jarvis, 2008).

Irregular Past Tense Grammaticality Judgment

This task was designed to assess participants' knowledge of rules for marking irregular past tense. A previous examination of poor comprehenders' production of irregular past tense found that they tended to regularize irregular past tense forms more frequently than controls (e.g., Nation et al., 2005), but no previous study had examined whether poor comprehenders ever omit tense marking from irregular past tense forms. This task used grammaticality judgments to determine which types of errors were acceptable (that is, not considered an error) to participants in the poor comprehender and control groups. Three types of sentences were presented: (a) correct sentences (e.g., *The girl swam a lap.*), (b) sentences with omitted finiteness errors (e.g., *The girl swim a lap.*), and (c) sentences with regularization errors, where the past tense form of the irregular verb was regularized by adding –ed (e.g., *The girl swimmed a lap.).* A main effect of group was hypothesized for this task. Based on Nation et al.'s (2005) findings, the poor comprehender group was expected to accept

regularization errors more often than controls. Furthermore, if poor comprehenders were following an EOI grammar similar to children with SLI, it was expected that they would also accept omitted finiteness errors more often than controls.

Stimuli design. Twenty irregular verbs were selected from the full sample of irregular verbs listed in the Moe, Hopkins, and Rush (1982) inventory of words spoken by American first graders. Because this database contains words found in the expressive vocabularies of first graders, it was decided they should also be familiar to fourth graders. All one-syllable irregular verbs that were overtly marked for past tense were selected for consideration as stimuli. Verbs that are zero-marked for past tense (e.g., *hit, cut*) were excluded because omitted finiteness errors are not possible with zero-marked verbs. Irregular verbs that formed the past tense by devoicing the final consonant (e.g., send, build) were also excluded due to concerns that participants might not hear the difference in pronunciation when presented on the computer. All of the irregular past tense verb stimuli for this task had a raw frequency of three or higher in the Moe, Hopkins, & Rush (1982) database; their corresponding uninflected verb stems had a raw frequency of 11 or higher.

To further ensure that the irregular verbs would be familiar to fourth graders, their frequency of occurrence was calculated using the *Educator's Word Frequency Guide* (Zeno, Ivens, Millard, & Duvvuri, 1995). This database contains over 60,000 text samples for students in kindergarten through twelfth grade, and it is intended to be representative of the printed vocabulary that American students encounter in school. A "D" statistic is given to estimate the likelihood that a word is to be

encountered in each grade. When choosing stimuli for this study, words were only considered if D was greater than or equal to 1.0, which indicated that they were likely to be encountered across all grades. The *Educator's Word Frequency Guide* also offers a "U" statistic, which represents a given word's frequency per million words, weighted by D. All of the irregular past tense verb stimuli for this task had a U value of 11 or higher; their corresponding uninflected verb stems had a U value of 25 or higher.

All correct sentences were five words and five syllables in length. Half of the sentences began with the subject "*the boy"* and half began with the subject "*the girl."* Following the verb was a two-word noun phrase (e.g., *The boy hid a toy.)* or prepositional phrase (*e.g.*, *The girl stood in line.*). Sentences with omitted errors or regularization errors were exactly the same as the correct sentences, with the exception of the verb. Thus, all of the omitted error sentences were also five syllables in length, but seven of the regularization error sentences contained six syllables due to the addition of an extra syllable when –ed followed word final /d/ or /t/ (i.e., *hided, slided, fighted, writed, rided, standed, sitted*).

Stimulus sentences were audio recorded in a soundproof booth by a female native speaker of English. Each sentence was recorded multiple times, digitized and edited. The highest quality recording of each sentence was used in the task. Appendix C contains a list of the irregular verbs, their frequency ratings, and the correct sentence frames.

Procedures. The procedures for this task were modeled after previous studies that have elicited grammaticality judgments from children with SLI (e.g., Betz, 2005; Redmond & Rice, 2001; Rice, Wexler, & Redmond, 1999; Wulfeck, 1993; Wulfeck et al., 2004). First, participants were trained to give button-press responses to visual stimuli. They were instructed by a recorded female voice to "*press the green button when you see a green circle on the screen, and press the red button when you see a red circle on the screen.*" The green button corresponded to a left mouse click, whereas the red button corresponded to a right mouse click. Participants were encouraged to answer quickly, but without making a mistake. Four trials (two red and two green) were given with feedback: "*Good job*" for a correct response, or "*Uh-oh*" for an incorrect response. Then ten trials (five red and five green) were given with no feedback. Green and red circles appeared on the screen in random order.

Next participants were trained to give button press responses to auditory stimuli. They were instructed by the same recorded female voice to "*press the green button when you hear me say 'green,' and press the red button when you hear me say 'red.'*" Again they were encouraged to answer quickly, but without making a mistake. Ten trials were given—five red and five green in random order—with no feedback.

The final training activity involved teaching the participants to make grammatical judgments of sentences containing the progressive –ing affix, which is an earlier-acquired morpheme that does not mark finiteness and was not a structure of interest for this study. An example of a correct sentence is, *The girl is washing her hands,* whereas an example if an incorrect sentence is *The boy is play outside.* A list

of all training sentences can be found in Appendix D. The recorded instructions were, "*Now you will hear me say some sentences. If the sentence you hear sounds good, press the green button. If the sentence you hear does not sound so good, press the red button*." Other researchers eliciting grammatical judgments from children have reported that children respond better when asked to indicate whether an adult's statement "sounds good" or "does not sound so good," as opposed to indicating whether it is "correct" or "incorrect" (e.g., Rice et al., 1999). Before each trial, a ready prompt (a picture of an ear, signaling the child to listen) was presented on the screen. For the first four training items, feedback for correct responses was "*Good job. You pressed the green button because that sentence sounded good"* or "*Good job. You pressed the red button because that sentence did not sound so good*." Feedback for incorrect responses was "*Uh-oh. You should have pressed the green button because that sentence sounded good*" or "*Uh-oh. You should have pressed the red button because that sentence did not sound so good.*" For the remaining six training items, feedback was shortened to simply, "*Good job*" or "*Uh-oh.*" All of the participants included in this study achieved a minimum of 90% accuracy on the grammatical judgment training items. As mentioned in the Participants section, one child who was originally selected for the control group could not achieve the minimum accuracy level for this task. She was given the training items twice, on two different days. On the first day, her accuracy was 30%, whereas on the second day her accuracy was 40%. Because her grammaticality judgments were determined to be unreliable, she was subsequently dropped from the control group.

Following the training, participants were told by the examiner that now they would be hearing more sentences from the computer but this time they would not hear the computer say "*Good job*" *or* "*Uh-oh.*" They were reminded to press the green button when a sentence sounded good and to press the red button when a sentence did not sound so good. Then the 60 irregular past grammaticality judgment items were presented in random order. Scoring of the task was automatically conducted by the Direct RT program. All individual data files were later collated in an Excel file, which was checked several times by the author for accuracy.

Be-Do Questions Grammaticality Judgment

This task was designed to assess participants knowledge of morpho-syntactic rules governing the use of the auxiliary verbs *be* and *do* in wh-questions. Because wh-questions involve more complex syntactic structures, this task was expected to be more difficult for both poor comprehenders and controls than the irregular past tense grammaticality judgment task. Participants were asked to judge three types of questions using each of the verbs: correct questions, questions containing omitted finiteness errors, and questions with overt agreement errors. The predictions for this task were based on the EOI account of SLI. Specifically, if poor comprehenders demonstrated an EOI grammar similar to children with SLI, they should have difficulty identifying omitted finiteness errors. The examination of agreement errors was exploratory in nature. Although the EOI account predicts that children with SLI should reject such errors, Betz (2005) found that children with SLI accepted overt agreement errors in *Do* questions.

Stimuli Design. The *Be-Do* question grammaticality judgment task utilized stimulus items developed by Atchley, Rice, Betz, Kwasny, Sereno, & Jongman (2005) and Betz (2005), which were used to elicit grammatical judgments of questions containing the *Do* auxiliary from children and adults with and without a history of SLI. Half of the original stimuli were modified for this study to also questions containing the *Be* auxiliary. All grammatical *Be* questions were of the form, *Where is a [subject] [verb]-ing?* All grammatical *Do* questions were of the form: *Where does a [subject] like to [verb]?* In questions with omitted finiteness errors, the *Be* or *Do* auxiliary was deleted (e.g., *Where a bear growling? Where a boy like to play?*); whereas in questions with overt agreement errors, a plural verb form was used with the singular subject (e.g., *Where a bear growling? Where do a boy like to play?*). Stimuli were recorded, digitized, edited, and selected following the same procedure as the Irregular Verb Grammaticality Judgment Task. Appendix E lists the correct stimuli for this task. Note that no information on verb frequency is provided, as there are only two auxiliary verbs, *Be* and *Do* for this task.

Procedures. The procedures for the *Be-Do* Question Grammaticality Judgment task were identical to those in the Irregular Verb Grammaticality Judgment Task.

Finiteness Elicitation

The Finiteness Elicitation task was designed to assess participants' ability to correctly produce finite verbs when completing simple sentences. This task allowed for an examination of the types of errors poor comprehenders make (or do not make)

in productions, and provided another mechanism for comparing poor comprehenders to children with specific language impairment. Four types of stimulus items were created to elicit productions of: (a) third person-singular present tense (b) regular past tense, (c) irregular past tense, and (d) regular plurals. The first three stimulus types involve finiteness marking—an area of marked weakness for children with SLI—whereas the stimuli eliciting plurals were included as a control condition, as plurals are not usually found to be difficult for either typically developing children or children with SLI. Thus, a Group by Item Type interaction was predicted, such that poor comprehenders and controls would be highly accurate at producing plural nouns, but that poor comprehenders would be less accurate than controls at producing finite verb forms. In addition, it was expected that, if poor comprehenders were operating under an EOI grammar, they would exhibit omitted finiteness errors more frequently than controls.

Stimuli design. This task included both audio stimuli (cloze sentence prompts), and visual stimuli (black and white pictures illustrating the target words). Three criteria were used to select target words for the audio stimuli, to ensure that the task primarily tapped morpho-syntactic knowledge as opposed to semantic, phonological, or other cognitive skills. First, all target words were one-syllable in length. Second, all target words were able to be illustrated using simple black and white line drawings. Third, all target words were high frequency words that are familiar to young children. The target words were selected from the two databases used to select verbs for the Irregular Past Tense Grammaticality Judgment task (i.e.,

(Moe et al., 1982; Zeno et al., 1995). A list of all target words, their inflected and non-inflected frequencies, and the cloze sentences used to elicit them is provided in Appendix F.

The visual stimuli for this task were simple, black and white line drawings used to illustrate the target nouns and verbs in each sentence. The drawings were obtained from *SPARC: Stimulus Pictures for Articulation Remediation, and Carryover* (Thomsen, 1982), a book containing over 2,000 drawings designed as stimulus materials for speech-language pathologists. Most of the drawings were scanned as-is and stored as digital files by a graphic designer. However, for some of the target words, there were no appropriate pictures provided in the book. For these items, the graphic designer either modified existing pictures or created new drawings following a similar style. Examples of visual stimuli created by the graphic designer for the elicitation task are provided in Appendix G.

Procedures. The procedures for this task were designed to elicit one-word responses containing the target grammatical forms. Participants wore high-quality headphones equipped with a headset microphone and connected to the laptop computer. For each item presentation, a picture stimulus appeared on the screen accompanied by an auditory prompt spoken in a female voice (e.g., *Here is a singer. Tell me what she does.*) Next, a pronoun was heard in a male voice inflected to signal the onset of the response sentence (i.e., *She* ____.). Participants were trained to complete the sentence with the correct target form (i.e., *sings*).

Training for the Finiteness Elicitation task involved two steps. First, the examiner (which was always the author), introduced the task by administering four training items, one of each type. If a child gave the target response, the examiner gave positive feedback which repeated the target word, "*That's right. She* ___." If the child gave a non-target response (e.g., used a different word) or an incorrect response, the examiner would say the correct answer, then have the child redo the item. Next, participants were trained to respond to the change in speaker voice. For these items, the female voice gave the command "*Say the word*" and the male voice said a monosyllabic noun (e.g., "house"). Finally, participants completed the same four training items on the computer, again, with feedback provided by the examiner. They were alerted when the training was complete and new items would be presented.

The entire task was transcribed online and audio recorded. To ensure reliability, all online transcripts were double-checked from the audio recordings by a trained research assistant, who was a pre-requisite speech-language pathology student with a bachelor's degree in education. The research assistant coded responses for accuracy and error type. Her codes were then double-checked by the author.

CHAPTER 3: RESULTS

This study investigated morpho-syntactic and broader language skills in two groups of fourth grade students who differed in reading comprehension ability but showed similar word reading and nonverbal cognitive abilities. Sixteen students in the "poor comprehender" group displayed reading comprehension deficits in spite of good word reading abilities. The control group consisted of 24 students who displayed similar word reading and nonverbal cognitive abilities as the poor comprehenders but had good reading comprehension skills. The study addressed three specific research questions:

1. *Do poor comprehenders display the general language deficits associated with specific language impairment (SLI)?*
2. *Do poor comprehenders demonstrate significant difficulties with morpho-syntax compared to a control group of typical readers in the same school grade, with similar nonverbal intelligence and word reading abilities? If so, does their pattern of performance match that expected for children with specific language impairment?*
3. *Do poor comprehenders meeting the criteria for a diagnosis of SLI differ in their performance on morpho-syntactic tasks from poor comprehenders who do not meet SLI criteria and from the control group of typical readers?*

Data obtained from a battery of standardized language assessments and research-designed morpho-syntax assessments were analyzed to address these research questions. It should be noted that although participants in both groups scored at or above the 40th percentile on a word reading fluency measure, the control group showed slightly better word reading fluency skills than the poor comprehender group. Thus, all analyses reported in this chapter were first carried out with the TOWRE raw score entered as a covariate. Because this covariate never reached significance in any analysis, all results reported here are based on analyses without the covariate.

Research Question 1: Do poor comprehenders display the general language deficits associated with specific language impairment (SLI)?

To address this question, the first set of analyses examined participants' performance on three standardized language assessments: 1) the *Clinical Evaluation of Language Fundamentals-4* (CELF-4; Semel et al., 2006), a comprehensive language assessment commonly used to diagnose the presence of a language impairment; 2) the *Peabody Picture Vocabulary Test-4* (PPVT-4; Dunn & Dunn, 2007), a measure of receptive vocabulary; and 3) the Nonword Repetition subtest from the *Comprehensive Test of Phonological Processing* (CTOPP; Wagner, et al., 1999), which is frequently used as a measure of phonological working memory. The use of these standardized language assessments provided a broad characterization of the language abilities of both the poor comprehender group and the control group. Additionally, using these assessments provided a mechanism for referencing the

language skills of the poor comprehenders in this study to those of previously published studies. Based on the findings of previous studies, it was predicted that the poor comprehender group would display general language weaknesses in all non-phonological domains of language. Therefore, significant between-group differences were expected for the CELF-4 and the PPVT-4, but not the CTOPP. Furthermore, it was expected that more children with specific language impairment (SLI) would be found in the poor comprehender group than in the control group.

Group Differences in Standardized Test Performance

Group differences in standard scores from the CELF-4 composite score and subtests, the PPVT-4, and the CTOPP Nonword Repetition subtest were first examined using MANOVA. The omnibus F test was significant F (8, 30) = 5.840, p<.001, indicating that the two groups performed differently across all standardized assessments. Therefore, group differences for each individual assessment were explored using a series of univariate ANOVAs. Table 3-1 displays group means and standard deviations, results of the univariate ANOVAs, and effect sizes for group differences. Overall, the poor comprehender group displayed weakness in the mild-to-moderately impaired range on most of the standardized language assessments assessing non-phonological language domains. As predicted, large and statistically significant group differences were found for all standardized language assessments except the CTOPP Nonword Repetition subtest.

Table 3-1.

Means, standard deviations, and significance tests for standardized language assessments

	Poor Comprehender n = 16		Control n = 24				
Assessment	Mean SS	SD	Mean SS	SD	*F*	*p*	*d*
CELF-4							
Composite Score	90.81	8.08	103.43	10.67	15.97	<.001	1.33
Concepts & Directions	7.31	2.52	9.91	2.47	10.30	.003	1.07
Recalling Sentences	7.81	1.68	9.43	2.41	5.40	.026	.78
Formulated Sentences	10.00	2.37	11.65	2.12	5.20	.028	.76
Word Classes Rec.	8.31	0.95	11.04	2.25	20.93	<.001	1.53
Word Classes Exp.	9.31	1.92	11.61	2.13	11.88	.001	1.15
PPVT-4	91.94	9.12	108.17	11.90	21.11	<.001	1.53
CTOPP: Nonword Rep.	8.94	1.95	8.87	2.69	.01	.932	.03

Prevalence of SLI in Poor Comprehender and Control Groups

The next analysis examined the number of participants in each of the two groups who would qualify for a diagnosis of specific language-impairment (SLI), by showing low language abilities not explained by general cognitive delays. Recall that all participants in this study were required to have a nonverbal IQ score at or above the tenth percentile. Then, those participants who achieved a CELF-4 language composite score of 85 or less (i.e., at least one standard deviation below the mean) were considered to display an SLI profile. Using these criteria, five participants in the poor comprehender group (31%) met criteria for the SLI diagnosis. None of the participants in the control group met these criteria.

Research Question 2: Do poor comprehenders demonstrate significant difficulties with morpho-syntax compared to a control group of typical readers in the same school grade, with similar nonverbal intelligence and word reading abilities? If so, does their pattern of performance match that expected for children with specific language impairment (SLI)?

Data from the three research-designed morpho-syntax tasks were used to answer this question. Each task was analyzed using mixed ANOVAs for repeated measures. An alpha level of .05 was used to determine the presence of statistically significant differences. Visual inspection of individual data points (provided in Figures 3-4 through 3-12 within the section concerning Research Question 3) indicated that some of the group means might have been affected by the presence of a few potential outliers. There was no a priori reason for excluding such children from the analysis; they met the eligibility criteria for the study, and they passed the training criteria. However, inclusion of their data could skew the results in a way that was not representative of the true population. Thus, each analysis was conducted with and without extreme outliers included. An extreme outlier was defined as a score greater than three inter-quartile ranges below the 25^{th} percentile score for that group (i.e., more than 3 inter-quartile ranges below the low "whisker" on a box-and-whiskers plot). Where there was no difference in statistical significance, the analysis that included outliers is reported; otherwise, all differences that affected the statistical significance are noted.

Irregular Past Tense Grammatical Judgment Task

In the Irregular Past Tense Grammaticality Judgment task, participants listened to 60 sentences containing 20 high-frequency irregular past tense verbs and were asked to indicate whether each sentence they heard sounded "good" or "not so good." In 20 sentences, the verbs were presented correctly according to the adult grammar (e.g., *The girl swam a lap*.). Another 20 sentences contained the same verbs in their non-inflected form, which constituted an error of omitted finiteness (e.g., *The girl swim a lap*.). In the last 20 sentences, the verbs were marked for past-tense using the regular morphological ending *–ed*, which constituted an over-regularization error (e.g., *The girl swimmed a lap*.). Based on findings from a previous study that elicited irregular past tense verbs from poor comprehenders (e.g., Nation, et al., 2005), it was predicted that the poor comprehender group would be significantly less accurate than controls at judging the over-regularized sentences as being "not so good." However, if the poor comprehender group employed an extended optional infinitive (EOI) grammar similar to children with SLI, they should have also been less accurate than controls at judging the sentences with omitted finiteness errors as being "not so good."

Calculation of A' Values

The dependent variable for the grammaticality judgment tasks was A', a commonly used measure of sensitivity in studies employing grammaticality judgments (e.g., Betz, 2005; Redmond & Johnson, 2001; Redmond & Rice, 2001; Rice et al., 1999; Wulfeck et al., 2003). Use of A' values helps to adjust for a child's

potential bias to accept any utterance produced by an adult as being grammatical (e.g., Rice et al., 1999). The A' formula is a measure of sensitivity based on signal detection theory, which compares the proportion of "hits" (i.e., saying a correct sentence "sounds good,") to the proportion of false alarms (i.e., saying that a sentence with an error "sounds good"). The formula for calculating A' is:

$$A' = .5 + (((y-x)\ (1+y-x)) / (4y\ (1-x)))$$

where y is equal to the proportion of hits, and x is equal to the proportion of false alarms.

Table 3-2 shows the percentage of hits, misses, false alarms, and correct rejections by group and sentence type for the irregular past tense grammaticality judgment tasks. These values were used to calculate A' values for each group and error type. It should be noted that one child's A' for regularization errors was not calculable by the original formula because his rate of false alarms (accepting sentences with errors) was higher than his rate of hits (accepting correct sentences). For this child, the (1-x) term in the denominator was equal to zero. To make the A' formula divisible, the zero term was changed to a small number, namely .01. This child's A' value then became -.75, by far the smallest A' value in the dataset. Because this negative A' value reflected a lack of bias for this particular child to accept adult utterances as being correct, his A' value was entered into the dataset as 0. This kept the child's score as the lowest score for any child but also avoided having an extreme negative score in the analyses.

Table 3-2.

Percentage of hits, misses, false alarms, and correct rejections by group and error type for Irregular Past Tense Grammaticality Judgment Task

	Response	Adult Grammar	Omitted Finiteness	Regularization
Poor Comprehender	Y	92.5% (hits)	14.1% (false alarms)	57.8% (false alarms)
	N	7.5% (misses)	85.9% (correct rejections)	42.2% (correct rejections)
Control	Y	94.4% (hits)	7.7% (false alarms)	31.0% (false alarms)
	N	5.6% (misses)	92.3% (correct rejections)	69.0% (correct rejections)

Analysis of Variance

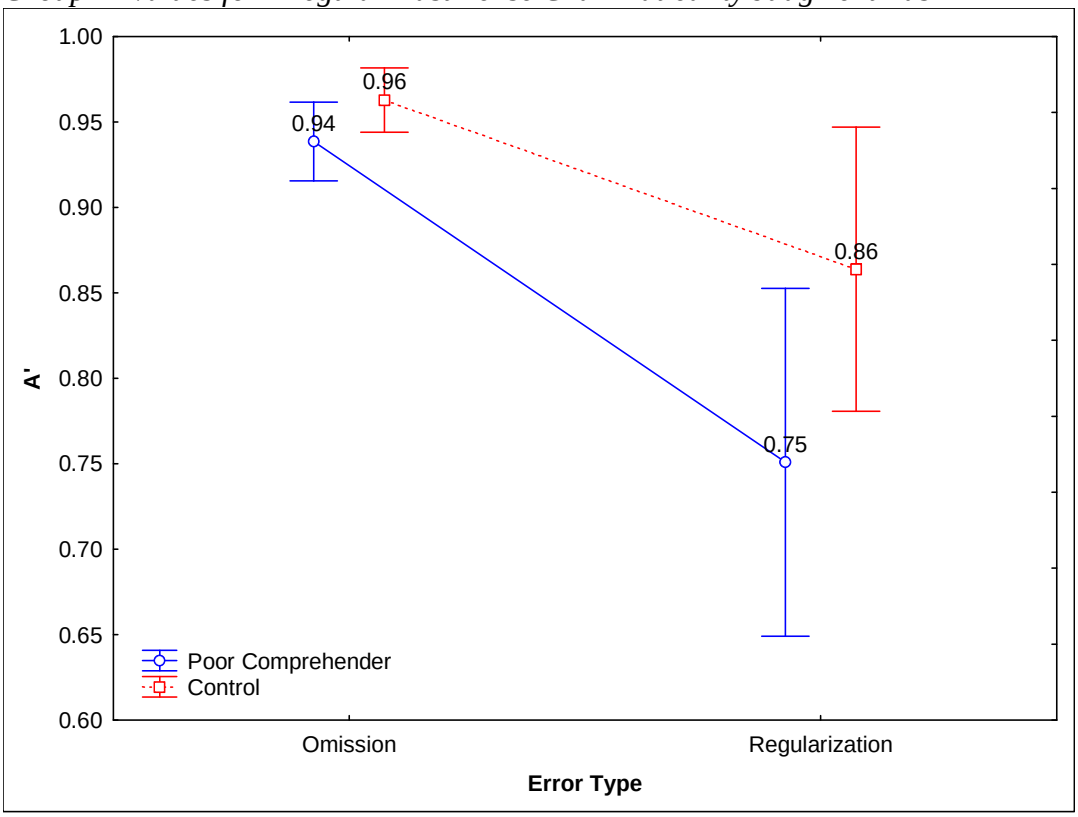
Next, the accuracy data, in the form of A' values, from the Irregular Past Tense Grammaticality Judgment task were entered into a 2 Group (poor comprehender vs. control) X 2 Error Type (omission versus over-regularization) repeated measures analysis of variance. Overall, poor comprehenders tended to be less accurate at making both types of grammatical judgments, and omitted finiteness errors were easier for both groups to detect than were regularization errors. The main effect of Group reached statistical significance, with a medium effect size, F (1, 38) = 4.10, p=.05, η_p^2= .10, power = .51. The main effect of Error Type was large and significant, such that both groups found regularization errors more difficult to detect than omission errors, F (1, 38) = 19.24, p<.001, η_p^2= .34, power = .99. The Group by

Error Type interaction was small and did not reach significance, F (1, 38) = 1.84, p=.18, η_p^2= .05, power = .26. These results are displayed graphically in Figure 3-1. Because the interaction was non-significant, no further analyses were conducted with the full sample.

As can be viewed in Figures 3-4 and 3-5, four extreme outliers were identified in the data for this task: One child in the control group was an outlier for the omitted finiteness condition, and one child in the poor comprehender group and two children in the control group were outliers for the regularization error condition. When these children were removed from the analysis, the main effects of Group and Error Type remained highly significant, and the Group by Error Type interaction also became significant F (1, 34) = 6.57, p=.015, η_p^2= .16, power = .702. Follow-up t-tests to decompose this interaction revealed that the poor comprehender group achieved significantly lower A' scores than the control group for both the omitted error condition [t(1,34)=-3.17, p=.003, d=1.12] and the regularization error condition [t(1,34)=-4.21, p<.001, d=1.48]. Although both effect sizes were large, the interaction appeared to be driven by a larger group effect for regularization errors than for omission errors.

Figure 3-1.

Group A' values for Irregular Past Tense Grammaticality Judgment Task



Note: Error bars represent 95% confidence intervals.

Be-Do *Question Grammaticality Judgment Task*

In the *Be-Do* question grammaticality judgment task, participants listened to 60 questions containing *Be* and *Do* auxiliary verbs. In 20 questions (10 containing *Be* and 10 containing *Do*), the verbs were presented correctly according to the adult grammar (e.g., *Where is a bear growling? Where does a cow like to sleep?*). Another 20 questions were presented without *Be* or *Do*, which constituted an error of omitted finiteness (e.g., *Where a bear growling? Where a cow like to sleep?*). In the last 20 questions, the plural form of the verbs were presented, which constituted an overt agreement error (e.g., *Where are a bear growling? Where do a cow like to sleep?*). Children in the control group were expected to be highly accurate at judging both omitted finiteness and overt agreement errors as sounding "not so good." If the poor comprehender group employed an EOI grammar like children with SLI, it was expected that they would be less accurate than controls at judging questions containing omitted finiteness errors as being "not so good." Although an EOI account suggests that children with SLI should not have difficulty identifying overt agreement errors, one previous study found that they did have difficulty identifying over agreement errors in *Do* questions (Betz, 2005). Thus the examination of overt agreement errors in this task with poor comprehenders was exploratory in nature.

Calculation of A' Values

Again, the dependent variable for this task was A', which was calculated in the same way as in the irregular verb grammaticality judgment task. Table 3-3 shows the group's percentages of hits, misses, false alarms, and correct rejections, which

were used to calculate A' for each error type. In this task, three participants' A' values for the *Do* Agreement Violation condition were not able to be calculated because they accepted more questions with *Do* agreement errors than correct questions. For one of these participants, using .01 in place of the zero term in the denominator resulted in an A' of .5. For the other two participants, this procedure led to negative A' values; these negative values were changed to zero in the final dataset.

Table 3-3.

Percentage of hits, misses, false alarms, and correct rejects by group, verb, and error type for Be-Do *Questions Grammaticality Judgment Task*

		Be			*Do*		
	Resp.	Adult Gram.	Omitted Finiteness	Agreement Violation	Adult Gram.	Omitted Finiteness	Agreement Violation
Poor Comp	Y	84.4% (hit)	14.4% (false alarm)	27.5% (false alarm)	90.0% (hit)	25.6% (false alarm)	51.3% (false alarm)
	N	15.6% (miss)	85.6% (correct rejection)	72.5% (correct rejection)	10.0% (miss)	74.4% (correct rejection)	48.8% (correct rejection)
Control	Y	92.7% (hit)	10.4% (false alarm)	15.0% (false alarm)	97.5% (hit)	7.1% (false alarm)	22.5% (false alarm)
	N	7.3% (miss)	89.6% (correct rejection)	85.0% (correct rejection)	2.5% (miss)	92.9% (correct rejection)	77.5% (correct rejection)

Analysis of Variance

The A' values from the *Be-Do* Questions Grammaticality Judgment task were entered into a 2 Group (poor comprehender vs. control) X 2 Verb (*Be* vs. *Do*) X 2 Error Type (omission versus agreement violation) repeated measures analysis of variance. It should be noted that the data for this task violated two assumptions for repeated measures ANOVAs. First, Box's *M* test was statistically significant ($p < .001$), indicating that the covariance matrices of the dependent variables were different between the two groups. Second, Levene's test was also significant for three of the four conditions (*Be* omit $p = .024$, *Do* omit $p < .001$, *Be* agreement $p = .061$, *Do* agreement $p < .001$), indicating that the error variances were significantly different between groups. These differences in the variance and covariance matrices were not surprising, given that the control group was expected to perform near ceiling and the poor comprehender group was expected to have more difficulty with the task. Although ANOVA tests are generally robust to heterogeneous variances when the two groups are of equal size, they can be too liberal when the smaller group has the larger variance, as was the case in this analysis (Tabachnick and Fidell, 2007). Thus, three separate analyses were conducted: One utilized the full sample of 16 participants from the poor comprehender group and 24 from the control group, the second the used full sample of 16 poor comprehenders and a random sample of 16 participants from the control group, and the final analysis utilized the full sample excluding extreme outliers. Because the patterns of results between the three analyses

were very similar, the results from the full sample are reported here, and any differences in significance values are noted.

The main effect of Group was large and significant, F (1, 38) = 20.72, p<.001, η_p^2= .35, power = .99, indicating that the control group achieved significantly higher accuracy compared to the control group across conditions. The main effect of Error Type was also large and significant, F (1, 38) = 16.60, p=.001, η_p^2= .26, power = .95; whereas the main effect of Verb was small and did not reach significance F (1, 38) = 2.25, p=.142, η_p^2= .06, power = .31. These main effects were qualified by three significant two-way interactions: Group by Error Type, F (1, 38) = 4.45, p=.042, η_p^2= .11, power = .54; Group by Verb, F (1, 38) = 5.12, p=.029, η_p^2= .12, power = .60; Error Type by Verb, F (1, 38) = 5.25, p=.028, η_p^2= .12, power = .61. Note that these interactions were only marginally significant for the second analysis using the random sample of 16 controls (p values were .08, .09, and .06, respectively), reflecting the smaller sample size, but their effect sizes were nearly equivalent (η_p^2= .10, .09, .11, respectively). The three way interaction between Group, Verb, and Error Type did not reach statistical significance, F (1, 38) = 2.40, p=.129, η_p^2= .06, power = .327. These results are displayed graphically in Figure 3-2.

As can be viewed in Figure 3-8, there were two extreme outliers identified in the data for this task. One child in the poor comprehender group and one child in the control group achieved A' values more than three inter-quartile ranges below the 25th percentile score for their respective groups for *Be* questions with omitted finiteness. When these children were excluded from the analysis, the results of the ANOVA

were essentially unchanged, except that the main effect of Verb became significant, F (1, 36) = 9.44, p=.020, η_p^2= .14, power = .655.

Group by Error Type interaction. The significant Group by Error Type interaction was decomposed by using univariate ANOVAs to examine the group differences within each error type separately. The Group effect was large and significant for both error types, such that the participants in the control group outperformed the poor comprehenders for both errors of omission, F (1, 38) = 9.30, p<.001, η_p^2= .20, power = .84 and errors of agreement, F (1, 38) = 17.61, p<.001, η_p^2= .32, power = .98. Although both effect sizes were large, the interaction appeared to be driven by larger group differences for agreement errors than omission errors.

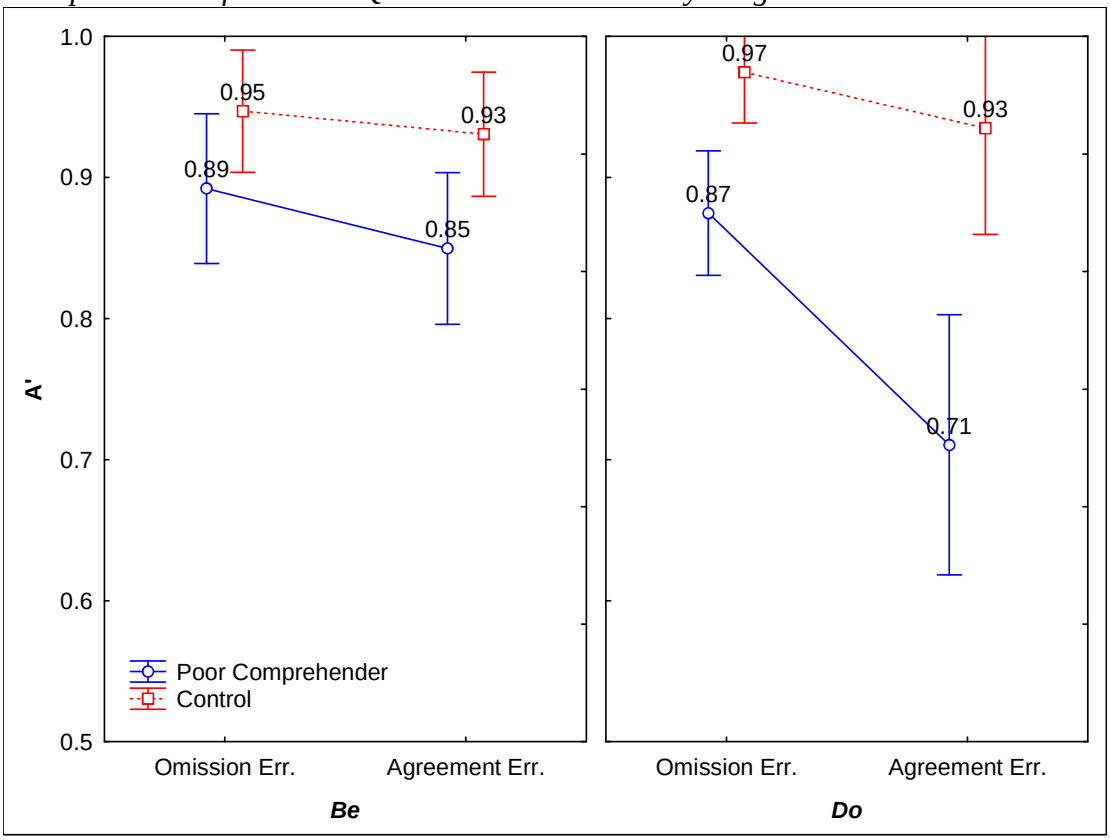
Group by Verb interaction. The significant Group by Verb interaction was decomposed by using univariate ANOVAs to examine the group differences within each verb separately. Participants in the control group showed significantly better performance than participants in the poor comprehender group for both verb types. Again, the interaction appeared to be driven by different effect sizes between the two verb types. A medium-sized effect of Group was found for *be* items, F (1, 38) = 4.55, p=.04, η_p^2= .11, power = .55; whereas a large effect of Group was found for *do* items, F (1, 38) = 23.28, p<.001, η_p^2= .38, power = .99.

Error Type by Verb interaction. The significant Error Type by Verb interaction was decomposed by examining the effect of error type within each verb separately. Similar to the previous two interactions, the effect of Error Type was significant for both verbs, but the size of the effect was larger for *do* [F (1, 39) = 7.84,

p=.008, η_p^2= .17, power = .78] than for *be* [F (1, 39) = 5.11, p =.029, η_p^2= .12, power = .60].

Figure 3-2.

Group A' values for Be-Do *Questions Grammaticality Judgment Task*



Note: Error bars represent 95% confidence intervals.

Finiteness Elicitation Task

In the finiteness elicitation task, participants completed 40 cloze sentences that elicited third person singular present tense verbs, regular past tense verbs, irregular past tense verbs, and plural nouns. Ten sentences were presented in each

condition, with the first three conditions eliciting finiteness markers, and the last condition, plural nouns, functioning as a control condition. It was predicted that all participants would be highly accurate at producing plural nouns. If poor comprehenders displayed a general verb weakness, they should make more errors than controls across all the verb items; furthermore, if they were employing an EOI grammar, they should exhibit more errors of omitted finiteness than controls.

Accuracy Analyses

The first set of analyses for this task was based on responses where participants used some form of the target word to complete the cloze sentence. Such responses were deemed "scorable responses," whereas responses where children used another word (e.g., "screamed" for "yelled"), changed the sentence structure (e.g., "stopped running" for "ran"), or said "I don't know" or gave no response were deemed "unscorable." The overall majority of responses from both groups were scorable (93.1% for participants in the poor comprehender group, and 93.2% for the control group), with the average participant giving two or three unscorable responses throughout the entire task. Although the groups' rates of unscorable responses did not differ, there were differences in the rate of unscorable responses for each item type. Participants were more likely to give unscorable responses for regular and irregular past items (where the average rate of unscorable responses was 1.4 and 1.2, respectively) than for plural and third person singular present tense items (where the average rate of unscorable responses was .08 and .1, respectively).

Because responses that did not include the target word were not scored, only two error types were coded for plurals, third person singular present, and regular past: 1) omission of the target inflection or 2) use of an incorrect inflection (e.g., past tense for third person singular present tense or vice versa). For the irregular past tense items, regularization errors constituted a third potential error type. Overall, both groups were highly accurate throughout the task. However, as shown in Table 3-4, the poor comprehender group exhibited lower accuracy rates than the control group across the last three inflection types, which elicited finiteness marking. These data are also displayed graphically in Figure 3-3. Parametric analyses were not appropriate for three of the four item types in this task, as the control group displayed almost no variance. Ceiling effects were observed for plurals, third person singular present tense, and regular past tense, where no more three than participants in the control group achieved less than a perfect score. More variance was found for both groups for the irregular past tense items. An independent samples *t* test revealed that the poor comprehender group achieved significantly lower scores than the control group on these items, $t(1,39) = -2.10$, $p=.042$, $d=.69$.

Error Analyses

The next set of descriptive analyses examined the types of errors exhibited by participants in each group during the Elicited Finiteness Task. Because the overall rate of errors was very low for both groups, the error analyses instead focused on the number of participants within each group who ever exhibited each type of error within each inflection type. The data in Table 3-5 show a high degree of accuracy for

both groups in the plural and third person singular present tense conditions. Greater group differences were observed in the regular and irregular past tense conditions. Whereas few participants from the control group made errors of any type, substantially more participants in the poor comprehender group made errors of omission of regular past tense as well as regularization of irregular past tense verbs.

Further examination of the error data for irregular past tense verbs suggested that the participants in the poor comprehender group were just as likely as participants in the control group to mark finiteness in irregular past tense verbs—they just marked it incorrectly, by using the regular form. A follow up *t* test comparing the each group's rate of finiteness marking for irregular past tense items confirmed that they did not differ, $t(1,38) = .13$, $p = .90$, $d = .06$.

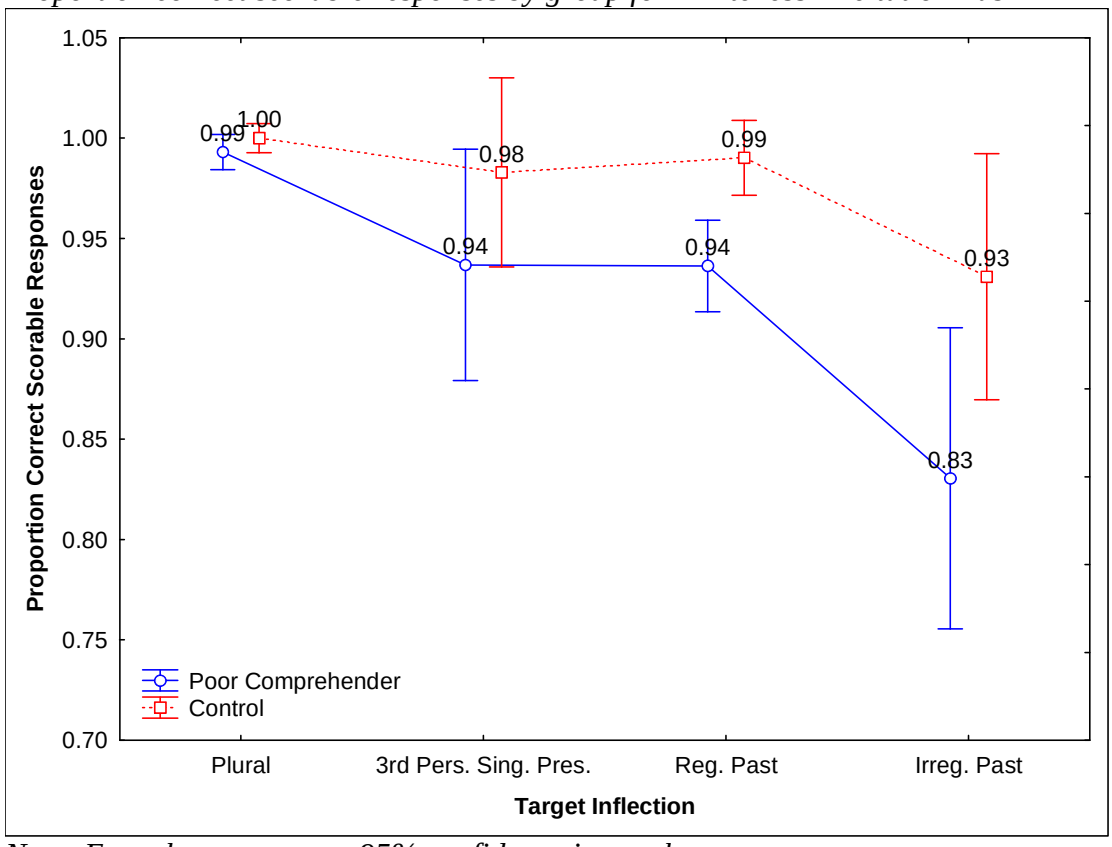
Table 3-4.

Group means, standard deviations, and ranges for proportion correct scorable responses in the Finiteness Elicitation Task

Inflection Type		Poor Comprehender	Control
Plural	Mean	.99	1.0
	SD	.03	0
	Range	.89-1.00	NA
Third Person Singular Present	Mean	.94	.98
	SD	.17	.04
	Range	.30-1.00	.89-1.00
Regular Past	Mean	.94	.99
	SD	.06	.03
	Range	.88-1.0	.88-1.0
Irregular Past	Mean	.83	.93
	SD	.16	.14
	Range	.38-1.0	.40-1.0

Figure 3-3.

Proportion correct scorable responses by group for Finiteness Elicitation Task



Note: Error bars represent 95% confidence intervals.

Table 3-5.

Number and percentage of participants in each group who exhibited omission errors, incorrect inflection errors, or regularization errors in the Finiteness Elicitation Task

Inflection Type		Poor Comprehender N=16	Control N=24
Plural	Omitted Inflection	1 (6.3%)	0
	Incorrect Inflection	0	0
Third Person Singular Present	Omitted Inflection	2 (12.5%)	2 (8.3%)
	Incorrect Inflection	3 (18.8%)	2 (8.3%)
Regular Past	Omitted Inflection	8 (50%)	1 (4.2%)
	Incorrect Inflection	1 (6.3%)	1 (4.2%)
Irregular Past	Omitted Inflection	2 (12.5%)	1 (4.2%)
	Incorrect Inflection	0	2 (8.3%)
	Regularization	13 (81.3%)	5 (20.8%)

Research Question 3: Do poor comprehenders meeting the criteria for a diagnosis of SLI differ in their performance on morpho-syntactic tasks from poor comprehenders who do not meet SLI criteria and from the control group of typical readers?

This research question was addressed by dividing the group of poor comprehenders into two subgroups: those who could be considered to have SLI, by scoring at least one standard deviation below the mean on the composite language measure (PC-SLI, n=5), and those who did not meet this criterion (PC-only, n=11). These two groups were then compared to each other and to the normal group, to determine whether there were qualitatively and/or quantitatively different patterns of results for poor comprehenders with or without SLI. In other words, were the morpho-syntactic deficits observed in the poor comprehender group in the preceding

analyses for Research Question 2 driven by the presence of children with SLI in the poor comprehender sample? Because there were only 5 participants in the PC-SLI group, it was not appropriate to conduct parametric tests of significant differences. Thus, the analyses reported here were fully descriptive in nature.

Irregular Past Tense Grammaticality Judgment Task

Table 3-6 provides the means and standard deviations for the three groups for the Irregular Past Tense Grammaticality Judgment Task. Individual data points for each of the three groups are also provided in Figures 3-4 and 3-5, where the size of each circle represents the number of participants represented by each data point. Note that the Y-axes in Figures 3-4 and 3-5 are on different scales due to different ranges of A' values for each error type. Data points marked by a red circle outline represent extreme outliers that were identified in the two-group analyses.

Table 3-6.

Means and standard deviations for three groups on Irregular Past Grammaticality Judgment Task

	PC-SLI N=5		PC-Only N=11		Control N=24	
Error Type	Mean	SD	Mean	SD	Mean	SD
Omission A'	.94	.08	.94	.04	.96	.04
Regularization A'	.78	.07	.74	.27	.86	.19

A review of the group means suggested that the PC-SLI and PC-only groups performed fairly similarly in judging both types errors in this task. An examination of the individual data points revealed that this was true for the regularization error items. However, only one of the children in the PC-SLI group seemed to show much difficulty judging omitted finiteness errors—the kind expected to be difficult for

children with SLI. This child happened to be one of the two children with ADHD and also had the lowest CELF-4 composite standard score in the sample (78), but his PPVT-4 and CTOPP Nonword Repetition standard scores were good (96 and 11, respectively). Also, note that although his score appeared to be an outlier compared to the PC-SLI group, he was not identified as an extreme outlier relative to the PC group as a whole in the two-group analyses. This child also achieved a higher A' value (.88) for judging regularization errors. The remaining four children in the PC-SLI group showed better sensitivity to omitted finiteness errors than most of the children in the PC-only group did. Thus, further investigation involving a larger sample of participants is needed to determine whether or not these two groups would truly overlap in their performance in the general population.

The display of the individual data points also allowed for closer examination of the overlap between the PC groups and the normal group. Recall that the effect of group was significant in the analyses including and excluding the outliers. However, there was still a moderate amount of overlap between the scores of the PC groups and the control group. A few of the children in the control group had difficulty with the task while some of the children in the poor comprehender group were highly accurate.

Interestingly, one child in the control group, who was marked as an outlier in the two-group analyses, showed the same A' value for omissions as the aforementioned child in the PC-SLI group. The child in the control group had good standardized language scores (CELF-4 Composite: 98; PPVT-4: 126; CTOPP Nonword Repetition: 10), but he also showed difficulty judging regularization errors

for this task (A'= .80), and he achieved the second lowest A' value of the control subgroup for *Be* questions with omitted finiteness (.83). From the data available in this study, there was no clear explanation for why this child displayed such difficulty with grammatical judgments, but it is possible that his very good vocabulary skills boosted his overall language performance and reading comprehension skills while masking grammatical difficulties.

In sum, although there were reliable mean-level differences between the poor comprehender and the control groups in grammaticality judgments for this task, there was not a clear distinction between poor comprehenders with or without SLI. A larger sample of poor comprehenders will be needed to investigate this question further. In addition, there did not appear to be a clear cut-point that would reliably separate the A' values for children with good or poor reading comprehension abilities.

Figure 3-4.

Three-Group Analysis of Omission Errors in Irregular Past Tense Grammaticality Judgment

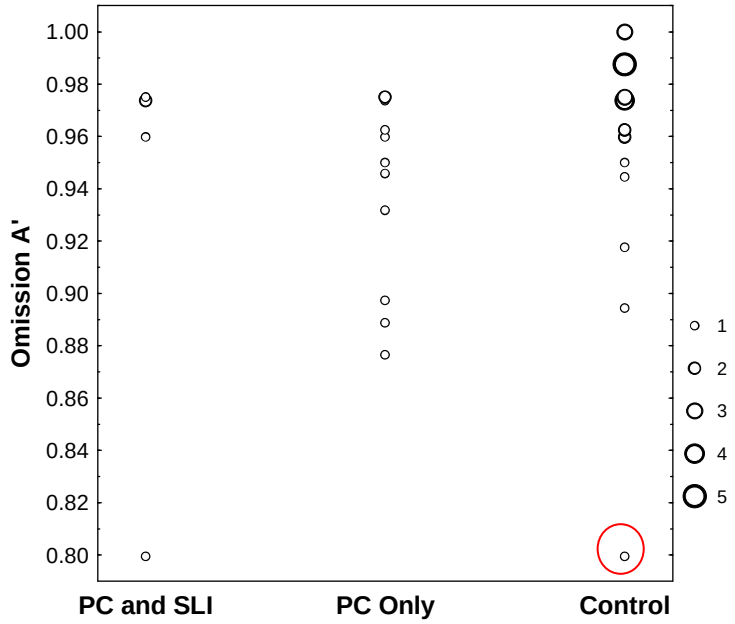
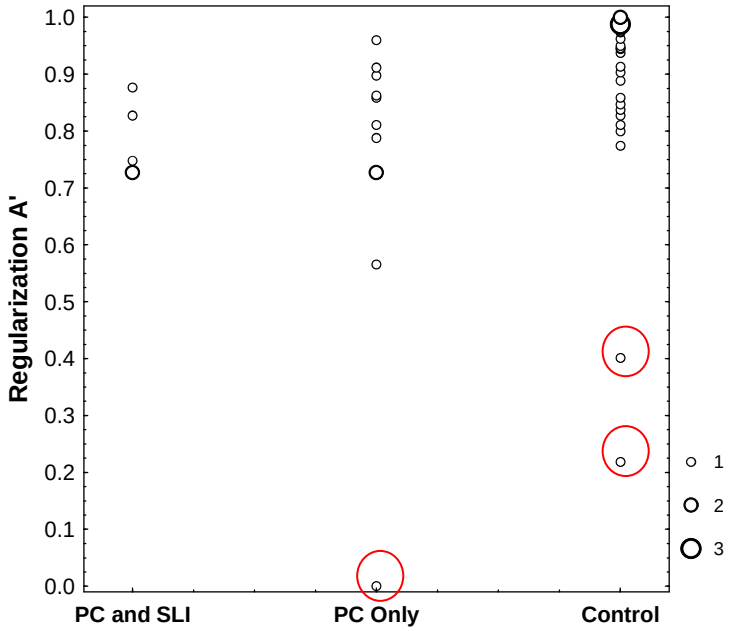


Figure 3-5.

Three-Group Analysis of Regularization Errors in Irregular Past Tense Grammaticality Judgment



Be-Do *Questions Grammaticality Judgment Task*

Table 3-7 lists the group means and standard deviations for the three groups' A' values achieved during the *Be-Do* Questions Grammaticality Judgment task. Individual data points are displayed in Figures 3-6 through 3-9 for *Be* omission, *Do* omission, *Be* agreement, and *Do* agreement errors, respectively. Again, note that the Y-axes vary between figures, due to different ranges of A' values across conditions. Data points outlined marked by a red circle outline represent extreme outliers that were identified in the two-group analyses.

Table 3-7.

Means and standard deviations for three groups on Be-Do Questions Grammaticality Judgment Task

	PC-SLI N=5		PC-Only N=11		Control N=24	
Error Type	Mean	SD	Mean	SD	Mean	SD
Be Omission A'	.85	.27	.91	.07	.95	.05
Do Omission A'	.92	.10	.86	.15	.97	.03
Be Agreement A'	.81	.19	.87	.12	.93	.08
Do Agreement A'	.78	.18	.68	.32	.93	.06

The PC-SLI and PC-Only groups showed a large degree of overlap in performance for this task. In each condition, there was at least one child who achieved a very low score, but note that only two outliers were identified in the two-group analyses for this task. Both outlying data points occurred in the *Be* omission error condition. The outlier from the PC-SLI group was same child who showed the lowest A' for omitted finiteness in the Irregular Verb Grammaticality Judgment task. Recall that this child had the lowest CELF-4 composite score of the entire sample of participants. The outlier from the control group for this condition displayed low-

average standardized language scores (CELF-4: 88, PPVT-4: 91, CTOPP Nonword Repetition: 8), and although she was not identified as an extreme outlier in other morpho-syntax tasks or conditions, her A' scores tended to be lower than the control group's mean (Irregular task: omission errors=.89, regularization errors = .40; *Be-Do* task: *Be* omission errors=.79, *Do* omission errors=.98, *Be* agreement errors=.79, *Do* agreement errors=.85). Thus, this child in many ways resembled a child with specific language impairment, but she did not display significant reading comprehension difficulties.

Overall, although there were clear and reliable mean-level differences in performance between the poor comprehender and control groups for this task in the two-group analyses, there did not appear to be any significant qualitative or quantitative differences in performance between the PC-SLI and PC-only subgroups.

Figure 3-6.

Three-Group Analysis of Be *Omission Errors in* Be-D*o Question Grammaticality Judgment*

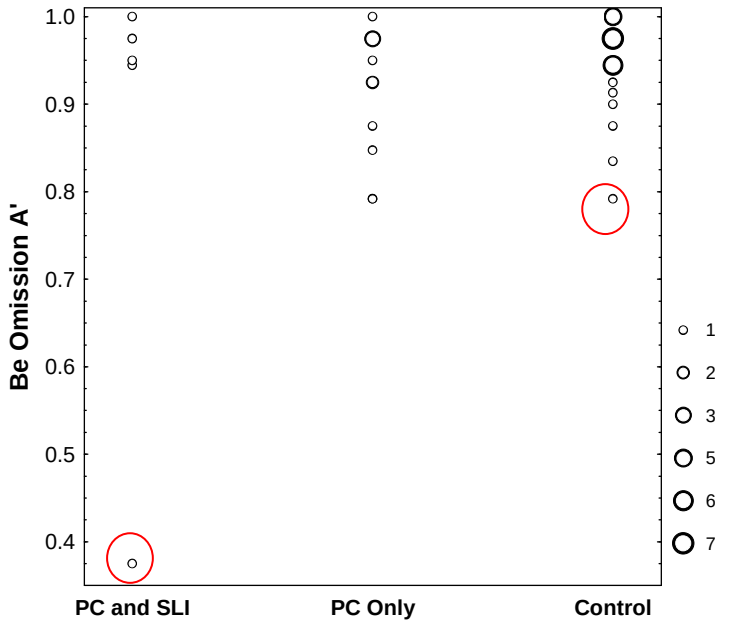


Figure 3-7.

Three-Group Analysis of Do *Omission Errors in* Be-Do *Question Grammaticality Judgment*

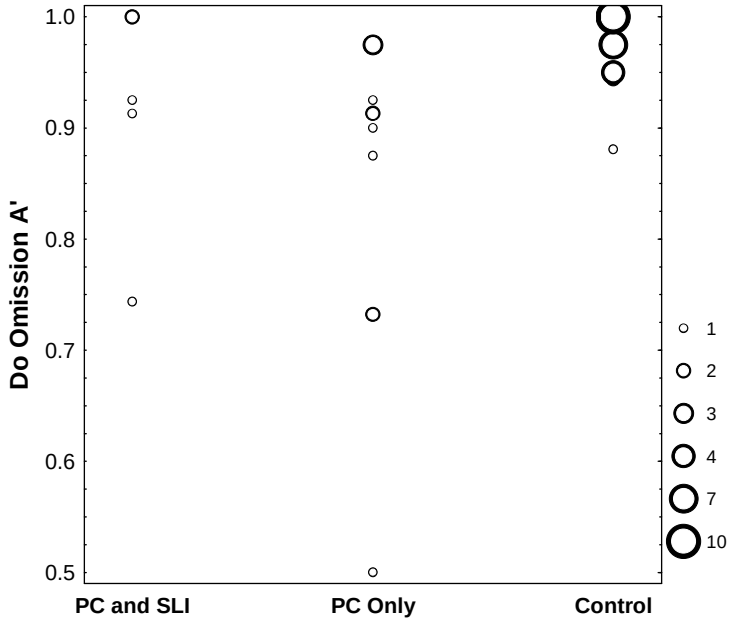


Figure 3-8.

Three-Group Analysis of Be *Agreement Errors in* Be-Do *Question Grammaticality Judgment*

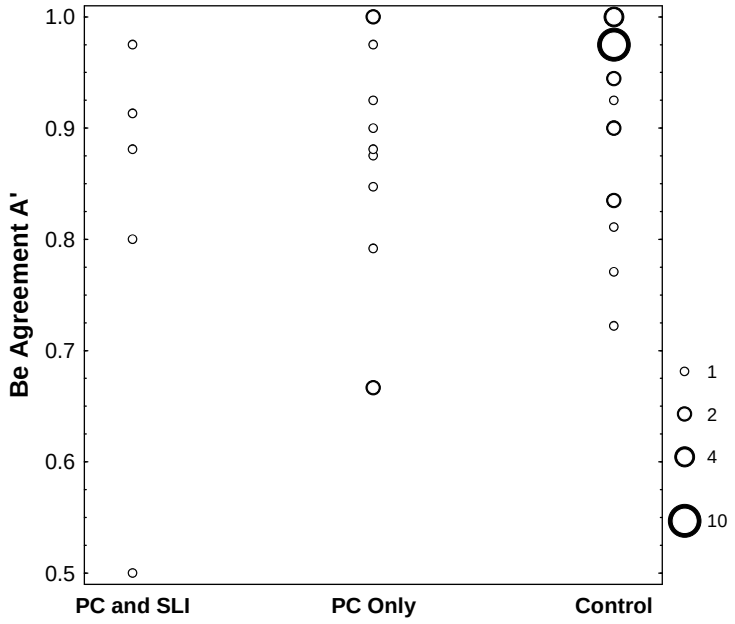
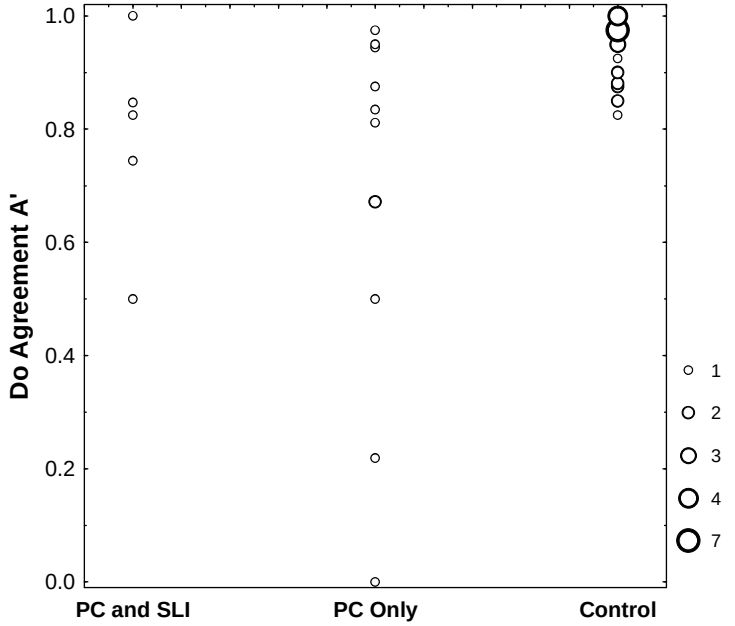


Figure 3-9.

Three-Group Analysis of Do *Agreement Errors in* Be-Do *Question Grammaticality Judgment*



Finiteness Elicitation Task

Means and standard deviations for the three groups' scorable accuracy for each type of inflection are displayed in Table 3-8. As reported in the two-group analysis, the overall accuracy rates were very high. Figures 3-10 through 3-12 display each group's individual data points for third person singular present tense, regular past tense, and irregular past tense correct scorable accuracy.

Table 3-8.

Means and standard deviations for scorable accuracy of three groups on Finiteness Elicitation Task

	PC and SLI N=5		PC Only N=11		Control N=24	
Inflection Type	Mean	SD	Mean	SD	Mean	SD
Plural	.98	.05	1.00	0	1.00	0
3rd Pers. Sing. Pres.	.96	.06	.93	.21	.98	.04
Regular Past	.94	.06	.94	.06	.99	.03
Irregular Past (Corr.)	.85	.10	.82	.18	.93	.14
Irregular Past (Fin.)	.98	.05	.99	.04	.98	.06

Across all the conditions for this task, there was very little difference in performance between the PC-SLI and PC-Only groups. There was also a large degree of overlap for all three groups for the third person singular present tense. The overlap between the PC groups and the control group was less for regular past and irregular past scorable accuracy, where most participants in the control group achieved perfect scores and most participants in the PC groups did not. In sum, a child who made any error on this task was more likely to be in the poor comprehender group than the control group, but there was no clear distinction between PC-SLI and PC-Only performance.

Figure 3-10.

Three-Group Analysis of Finiteness Elicitation: *Third Person Singular Present Scorable Accuracy*

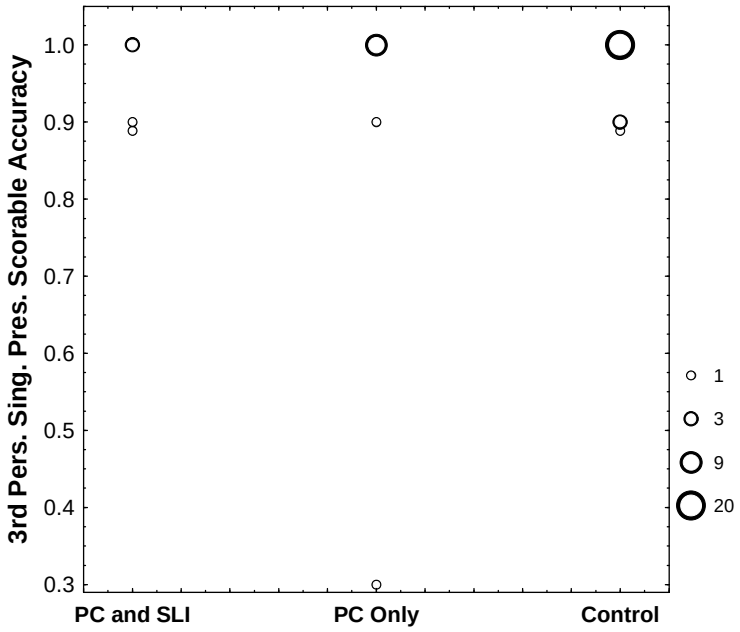


Figure 3-11.

Three-Group Analysis of Finiteness Elicitation: *Regular Past Scorable Accuracy*

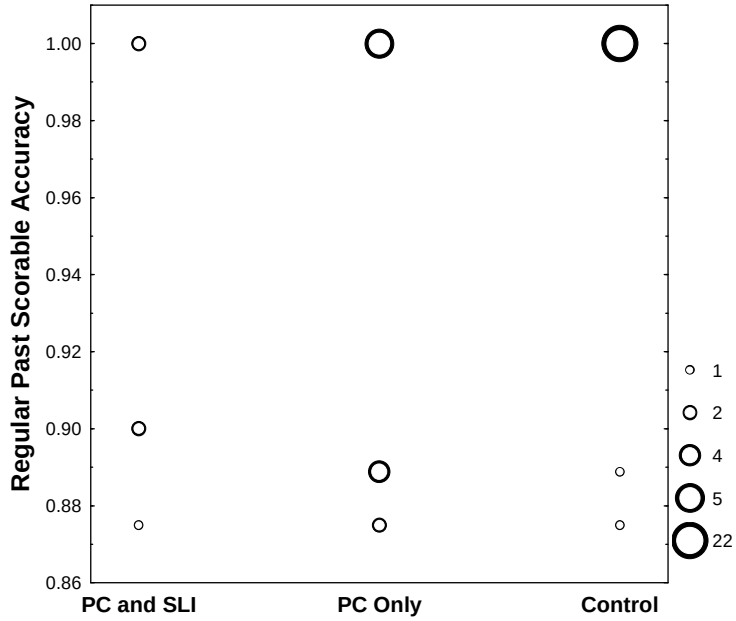
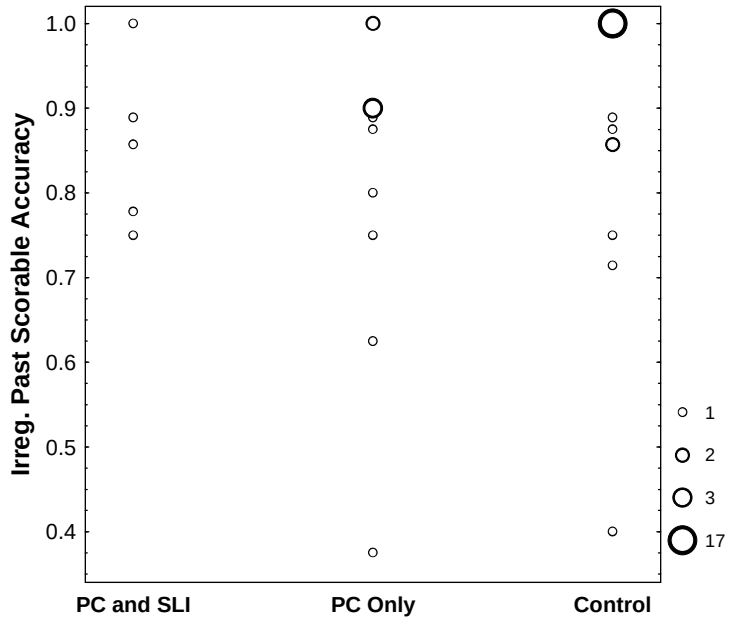


Figure 3-12.

Three-Group Analysis of Finiteness Elicitation: *Irregular Past Scorable Accuracy*



CHAPTER 4: DISCUSSION

This study was the first to specifically examine the morpho-syntactic skills of children referred to as "poor comprehenders," who displayed poor reading comprehension skills in spite of adequate word reading and nonverbal cognitive abilities. Approximately 5-10% of all school-aged children are believed to show the poor comprehender profile (Nation & Snowling, 1997; Yuill & Oakhill, 1991). Based on the simple view of reading (Gough & Tunmer, 1986; Hoover & Gough, 1990), the root of poor comprehenders' reading comprehension difficulties is believed to be non-phonological language deficits. In fact, there is a sizeable literature documenting poor comprehenders' relative strengths in phonological language skills—which support their word reading abilities—and deficits in non-phonological language domains, including semantics, syntax, and higher level language abilities. Furthermore, although many poor comprehenders' language deficits meet standard criteria for clinical speech-language pathology services, few poor comprehenders are identified by parents or teachers as having any language or reading difficulties without standardized assessments (Catts et al., 2006; Nation et al., 2004).

A study of the morpho-syntactic abilities of poor comprehenders was necessary for several reasons. First, in contrast to the considerable literature concerning other language domains, morpho-syntax had received relatively little attention in studies of poor comprehenders. Thus, the current study helped to fill in a gap in the knowledge base concerning the language profiles of poor comprehenders. Second, the study of morpho-syntax facilitates a theory-driven comparison of poor

comprehenders to children with specific language impairment (SLI). Although studies had documented a sizeable overlap between the two conditions (Catts et al., 2006; Kelso et al., 2007; Nation et al., 2004), they have remained distinct in the literature, partially because it was not clear whether poor comprehenders demonstrated the morpho-syntactic clinical markers (i.e., finiteness marking deficits) of children with SLI.

In addition, if poor comprehenders do have morpho-syntactic deficits involving finiteness marking, it is possible that morpho-syntax tasks could be incorporated into the early identification protocols used to screen children for risk of reading disabilities. Current early identification methods typically use tasks that predict word reading abilities, such as alphabet knowledge and phonological awareness, which are not sensitive to the non-phonological language deficits of poor comprehenders. The addition of morpho-syntactic measures to early identification protocols could potentially improve the sensitivity and specificity of identification of comprehension deficits not related to word reading (e.g., Adlof, et al., in press).

Broad Language Deficits in Poor Comprehender Group

The current study included 40 fourth-grade students recruited from local public schools: 16 in the poor comprehender group and 24 in the control group. The two groups differed in reading comprehension ability, but they showed similar performance on word reading and nonverbal cognitive assessments. Like poor comprehenders in past studies, the children in the poor comprehender group in this study performed similarly to the control group on the measure of phonological

processing, but they showed significantly worse performance than the control group on all non-phonological language assessments. The between group effect sizes for the non-phonological language measures were all very large, with Cohen's *d* values ranging from .76 to 1.53, whereas the effect size for the comparison of nonword repetition score was very small (i.e., *d* =.03). Nearly one-third of the poor comprehenders in this study (31.3%) showed language deficits severe enough to qualify for a diagnosis of SLI, which is comparable to the rates of SLI reported in the poor comprehender samples of Nation et al. (2004) and Catts et al. (2006). In terms of broad language performance, it seems reasonable to assume that this sample of poor comprehenders is similar to the samples included in past studies.

Morpho-syntactic Deficits in the Poor Comprehender Group

Three experimental morpho-syntax tasks were used to determine whether the children in the poor comprehender group displayed morpho-syntactic deficits similar to those reported for children with SLI. Two different analyses were conducted for each task. The first involved statistical tests of differences between the poor comprehender group as a whole versus the control group. In the second, the poor comprehender group was divided into two subgroups: those children who scored at least one standard deviation below the mean on the composite language assessment were called the "PC-SLI" group, and those who scored above this cutoff were called the "PC-Only" group.

Irregular Past Tense Grammaticality Judgment Task

The first morpho-syntax task required children to make grammaticality judgments of simple declarative sentences formed with irregular past tense verbs. Nation and colleagues (2005) had previously reported that their sample of poor comprehenders frequently regularized irregular past tense verbs. Likewise children with SLI also frequently regularize irregular past tense verbs (Marchman et al., 1999; Rice et al., 2004) and judge sentences with regularization errors as being acceptable (Redmond & Rice, 2001). In this study, it was expected that the children in the poor comprehender group would accept regularization errors as being correct. What was less clear was whether the children in the poor comprehender group would also accept errors of omitted tense as being correct. Such errors are a hallmark of children with SLI, but they had not been previously evaluated in poor comprehenders.

Results of the two-group analysis showed main effects of Group and Error Type, but no significant interaction. Although the regularization errors were harder for both groups to detect, the children in the poor comprehender group showed significantly worse performance for both types of errors. When extreme outliers were excluded from the analysis, the interaction became significant, but follow up tests indicated that the poor comprehender group still performed significantly worse than the control group for both types of errors. Thus, for this task, the poor comprehender group showed a pattern of performance that would be expected for children with SLI.

These results also speak to morpho-syntactic theories regarding the development of irregular past tense marking. For example, Redmond & Rice (2001)

describe two essential constraints of marking irregular past tense. Specifically, "morpho-syntactic constraints determine which word displays past tense within the verb phrase, and morpho-phonological rules determine how this form is eventually spelled out" (Redmond & Rice, 2001, p. 256). Other theories have debated whether regular and irregular past verbs require separate cognitive mechanisms (e.g., single-route vs. dual-route models; Pinker, 1999; Joanisse & Seidenburg, 1999). In this study, poor comprehenders clearly displayed deficits with both morpho-syntax and with the "spelling-out" of the irregular past tense form. That is, they accepted both irregular verbs with omitted finiteness (morpho-syntactic errors) and regularized forms (constituting a semantic/lexical error according to dual-route theories, or a morpho-phonological error according to Redmond & Rice). Because the poor comprehenders in this study displayed good phonological skills and poor semantic skills, it seems plausible that the source of their regularization errors would be semantic/lexical deficits, as opposed to phonological deficits.

There were not enough participants in the PC-SLI and PC-only groups to conduct statistical tests of differences between the three groups. However, the current descriptive results did not support the notion of obvious qualitative or quantitative differences in morpho-syntactic performance between the PC-SLI and PC-only groups. Only one child in the PC-SLI group showed marked difficulty identifying omitted finiteness errors, whereas several children in the PC-only group showed weakness on this task. This one child in the PC-SLI group also happened to show the very lowest composite language score. Thus, a possible explanation for the lack of

differences between the PC-SLI and PC-only groups is that the language deficits of the children in the PC-SLI group were not all that severe. However, the fact that there was more variability in the scores of the PC-only group, who had higher language scores, is evidence against that explanation. In any case, more data is needed to sort out these potential differences.

In sum, the results of the Irregular Past Tense Grammaticality Judgment task suggested that poor comprehenders do display morpho-syntactic deficits. The poor comprehender group, as a whole, performed significantly worse than the control group across error types on this task. Furthermore, the poor comprehender group's pattern of performance (difficulty with both omission and regularization errors) matched the pattern that would be expected for children with SLI of a similar age. However, it was somewhat surprising that the differences in overall language abilities between the PC-SLI and PC-Only groups did not lead to different levels of performance on this task.

Be-Do Questions Grammaticality Judgment Task

In the second morpho-syntax task, participants were asked to make grammaticality judgments of wh- questions formed using *Be* and *Do* auxiliary verbs. Such questions involve more complex grammatical structures than the simple declarative sentences of the first grammaticality judgment task; thus, more variability was expected within both groups for this task. Based on the Extended Optional Infinitive theory, children with SLI would be expected to make and accept errors of omitted finiteness but not overt agreement errors (Rice et al., 1995). However, a

previous study of 11-13-year olds with SLI found that they accepted both types of errors in wh- questions formed with the *Do* auxiliary (Betz, 2005). The *Do* auxiliary is unique, in that it is inserted to mark tense and agreement for the formation of questions, rather than being generated in the matrix clause and moved. Therefore, it was possible that Betz's (2005) finding was related to properties of the verb *Do* as opposed to a general lack of sensitivity to agreement errors. The current study modified the stimuli used in Betz (2005) to include both *Be* and *Do* verbs. It was predicted that poor comprehenders, if they were like children with SLI, would accept omitted finiteness errors in *Be* and *Do* questions. The examination of agreement errors was exploratory in nature.

Results of the two-group analysis showed three significant two-way interactions: Group by Error Type, Group by Verb, and Error Type by Verb. The three-way interaction did not reach statistical significance. Each of the two-way interactions was due to differences in effect size for each condition. For example, the main effect of Error Type revealed that agreement errors were more difficult to detect than omission errors. The effect size for Error Type was somewhat larger for *Do* questions ($\eta_p^2 = .17$) than for *Be* questions ($\eta_p^2 = .12$). Similarly, the main effect of Group was large overall, indicating that poor comprehenders achieved significantly lower accuracy levels than controls across conditions. However, the size of the Group effect was larger for *Do* questions ($\eta_p^2 = .38$) than for *Be* questions ($\eta_p^2 = .11$). The effect size for Group was also larger for agreement errors ($\eta_p^2 = .32$) than for omitted finiteness errors ($\eta_p^2 = .20$).

Although the children in the poor comprehender group clearly showed morpho-syntactic deficits on this task, the evaluation of whether poor comprehenders displayed a pattern of results similar to what would be expected for children with SLI was not straightforward. Poor comprehenders were less sensitive than controls to errors of omitted finiteness, a finding that would also be expected for children with SLI. However, they were also less sensitive than controls—and to an even greater extent—to overt agreement errors. Although overt agreement errors are not expected to be problematic for children with SLI under the EOI account, three studies have reported reduced sensitivity to overt agreement errors in older children with SLI (Betz, 2005; Miller et al., 2008; Wulfeck et al., 2004). Furthermore, although *Do* questions were more difficult than *Be* questions, the Group effect was still significant for *Be* questions. Thus, it did not appear that the poor comprehender group's reduced sensitivity to agreement errors compared to omitted finiteness errors could be explained solely by the unique properties of *Do* (e.g., Betz, 2005).

Although the focus of this study was on differences between groups of children (i.e., poor comprehenders and controls) vs. differences in performance on specific items, it is interesting that the *Do* questions were more difficult for all children than the *Be* questions. What can explain this finding? As mentioned previously, *Be* and *Do* questions differ structurally in that *Be* is generated in the matrix clause and moved to form questions, whereas *Do* is inserted in the complementizer clause simply to mark finiteness in the formation of wh- questions. However, *Be* and *Do* also display morpho-phonological differences in their inflected

forms. Specifically, the bare-stem form "be" only occurs in non-finite contexts. In contrast the word "do" represents both the non-finite form of *Do* as well as the third-person plural form. Thus, whereas questions of the form, "Where do a boy like to play?" were considered to display overt agreement errors in the current study, they could also be considered omission errors if one considers the "do" to reflect the bare-stem form. Future studies can manipulate stimuli to further investigate these vulnerabilities in typical children and children with language or reading impairments.

When the poor comprehender group was subdivided into those who did and did not meet criteria for SLI, there again appeared to be no clear qualitative or quantitative performance differences between the groups. Although the means of the PC-SLI and PC-only groups appeared slightly different (with PC-SLI showing worse performance for *Be* questions but better performance for *Do* questions), an examination of the data points of the children in each group showed that they generally overlapped with each other.

Thus the overall conclusions for this task mirrored those of the previous task: poor comprehenders clearly showed morpho-syntactic deficits, including difficulty with omitted finiteness errors, as would be expected for children with SLI. However, there did not appear to be a relationship between SLI status and performance on the *Be-Do* Grammaticality Judgment task within the group of poor comprehenders.

Finiteness Elicitation Task

The third morpho-syntax task used cloze sentences to elicit productions of three finiteness markers: third person singular present tense, regular past tense, and

irregular past tense. Plural nouns were also elicited as a control condition. It was predicted that poor comprehenders, if they were like children with SLI, would differ from the control group in their marking of finiteness, but not in their marking of plural nouns. Limited variability due to ceiling effects in the control group prevented the use of parametric statistics to analyze group differences for this task. In fact, both groups showed very high levels of accuracy across all conditions of this task. However, the descriptive analyses supported the overall predictions. Errors of any type were more likely to come from children in the poor comprehender group than from children in the control group. Although the most common error type was regularization of irregular past tense, half of the poor comprehenders omitted the regular past tense inflection at least once.

Lack of Differences between PC-SLI and PC-Only Subgroups

Taken as a whole, the results of this study demonstrated that poor comprehenders displayed the same deficits in finiteness-marking that would be expected for children with SLI. However, it was somewhat perplexing that the morpho-syntactic performance of poor comprehenders with SLI was as good as—and sometimes better than—that of poor comprehenders without SLI. One potential explanation for this finding is a lack of data, both in terms of number of subjects and in terms of severity of language impairments. It is possible that a larger sample of poor comprehenders with and without SLI would include poor comprehenders with more severe language deficits than those identified in this study and lead to a clearer distinction of performance. On the other hand, children with SLI and more severe

language deficits are likely to also have word reading difficulties; thus, they would be considered "garden-variety" poor readers as opposed to poor comprehenders.

Another explanation could be that the kinds of language deficits that lead to clinically significant scores on an omnibus language assessment are different for a fourth grader than for a young child between the ages of 3-6 (the age range when SLI is typically identified). The core subtests of the CELF-4 assessed global language skills, and poor performance could have resulted from a range of deficits, including semantic, syntactic, and higher-level language skills. None of the subtests specifically assessed morpho-syntax by itself. Thus, a child who achieved a lower score on the CELF-4 and qualified for the PC-SLI group might have weaker general language skills but might not necessarily have weaker morpho-syntactic skills. It is also possible that the children in the PC-Only group showed lower general language abilities at an earlier age, and whereas they were able to compensate in some areas, their morpho-syntactic abilities lagged behind. Morpho-syntax is an area of language that is very resistant to change, even with intervention. For example, a recent study indicated that even after 96 intervention sessions focused specifically on improving morpho-syntax, three- and four-year-old children with SLI had not mastered the use of finiteness markers (Leonard, Camarata, Pawlowska, Brown, Camarata, 2008).

Morpho-syntax as a Clinical Marker of Poor Comprehender Profile

Although the poor comprehender group as a whole showed statistically significant morpho-syntactic weaknesses relative to the control group, many children in the poor comprehender group showed high levels of accuracy on the morpho-

syntax tasks. An examination of the individual data displayed in the three-group analyses revealed a moderate degree of overlap between the poor comprehender group and the control group, and there was no distinct cut-point in performance that would accurately separate poor comprehenders from controls. Because of the observed ceiling effects, weakness with finiteness marking in fourth grade students would not be a highly accurate clinical marker of the poor comprehender profile, at least as measured by the tasks included in this study.

On the other hand, this type of clinical marker is not necessarily needed in fourth grade, when reading comprehension itself can be easily assessed. Furthermore, this finding does not preclude the use of finiteness marking tasks as early predictors of later reading comprehension skill. It is possible that there would have been less overlap between the groups on these particular tasks if they had been assessed at a younger age. For example, the *Test of Early Grammaticality Impairment* (Rice & Wexler, 2001), a standardized assessment of morpho-syntax used to diagnose SLI, shows high levels of sensitivity and specificity for children aged three through eight. It is possible that some of the children in the poor comprehender group who showed high levels of accuracy for finiteness marking tasks might have had more difficulty with them in the preschool or earlier school years. Likewise, it is possible that more separation would have been found between the groups on more difficult morpho-syntax tasks, such as those which incorporate more complex sentence structures. The tasks used in the current were selected based on tasks used in prior studies of children with SLI. There is less published research available on the morpho-syntactic skills of

older children and adults with SLI. Thus, to move this line of research forward, more difficult morphosyntax tasks will need to be examined in these groups. Moreover, longitudinal data is needed to document the early morpho-syntactic skills of poor comprehenders as well as the later morpho-syntactic skills of adolescents and adults with SLI.

Another likely possibility is that there are multiple routes to the reading comprehension difficulties observed in the poor comprehender group, only one of which being a language impairment like that seen in children SLI. For example, reading comprehension can be influenced by background knowledge. The selection of the GRADE as the reading comprehension measure for this study was partially based on the belief that it would be less influenced by background knowledge than some other reading comprehension tests might be. The children from the poor comprehender and control groups were also selected from the same schools in order to minimize differences in educational experiences. However, one cannot rule out the possibility that some of the children in the poor comprehender group simply had differences in background knowledge—as opposed to differences in language abilities—that limited their performance on the reading comprehension assessment.

Study Limitations and Future Directions

The results of the current study indicate that many poor comprehenders display morpho-syntactic deficits that resemble those that have been previously observed in children with SLI. Such a finding offers preliminary support to the use of morpho-syntax as a potential early clinical marker of later reading comprehension

difficulties. However, there are a few limitations to this study which should be addressed in future research.

The first limitation is the sample size of poor comprehenders who participated in the current study. Although most published studies of poor comprehenders have included similar numbers of participants, they have not attempted to further subdivide the poor comprehender group. The small number of poor comprehenders in this study could explain why few differences between PC-SLI and PC-Only subgroups were observed. A concerted effort was made to recruit a larger sample of poor comprehenders for this study. Several hundred invitations were distributed to students likely to meet the eligibility criteria, and 188 students were screened. One factor that may have limited the ability to find poor comprehenders in this study was the use of a word reading fluency measure, as opposed to a word reading accuracy measure, to determine that students had good word reading skills. Students who were accurate but slow word readers were excluded from study participation; thus, this criterion may have ruled out many potential poor comprehenders.

The second limitation involved the level of difficulty of the morpho-syntax tasks that were used in this study. Although there was enough variability in performance to detect differences between the poor comprehender and control groups, more variability may have been observed with more difficult tasks that included more complex syntactic structures. As mentioned previously, the tasks for the current study were designed based on previous studies of morpho-syntax in children with SLI. However, most of that research involves children of younger ages

than the children in this study. Future studies can investigate more complex syntactic structures in older children with SLI as well as poor comprehenders to compare and contrast their morpho-syntactic profiles at a more complex level.

A third limitation is that this study reflects only one point in time. The fourth-grade age group was chosen in order to ensure that both groups truly had well-developed word reading skills. However, it is difficult to truly compare and contrast the morpho-syntactic skills of poor comprehenders and children with SLI when the SLI diagnosis is made in fourth grade. Typically, studies investigating morpho-syntax in children with SLI focus on the preschool or early school years. Furthermore, it is difficult to say whether the poor comprehenders' morpho-syntactic profiles would have looked the same a few years before this study was conducted. Longitudinal data is needed to determine whether morpho-syntactic difficulties can be used as early clinical markers of later reading comprehension difficulties. In addition, longitudinal studies can also determine whether the grammatical difficulties of poor comprehenders ever resolve, or if they show a similar asymptote before mastery as children with SLI.

Theoretical and Clinical Implications

The results of this study support the simple view of reading in demonstrating that reading comprehension deficits problems may be linked to language deficits that occur in the absence of word reading difficulties. The existence of poor comprehenders draws attention to both the importance of language skills for reading comprehension and the independence of language comprehension and word

recognition/phonological processing skills. Furthermore these results highlight similarities between the language profiles of poor comprehenders and children with SLI, in the area of morpho-syntax as well as semantics and higher-level language skills. They suggest that any distinction between the classification of "poor comprehender" and "SLI" is primarily due to a different focus of assessment. That is, when oral language abilities are assessed, a poor comprehender might be classified as having SLI. Likewise, when reading comprehension is assessed a child with SLI (who had good word reading abilities) would be classified as a poor comprehender.

The findings of this study converge with those of previous studies to indicate that even very mild language deficits can be associated with significant reading comprehension difficulties. Although significant between-group differences were found for all non-phonological language assessments, only about a third of the poor comprehenders scored at least one standard deviation below the mean on the composite language assessment. Like the poor comprehenders in previous studies, the difficulties of the poor comprehenders in the current study could also be considered "hidden deficits" (e.g., Nation et al., 2004). Only about 40% of the poor comprehenders in this study had ever received special education services or been identified by parents as having any language or reading difficulties. Although most of the poor comprehenders in this study would not meet school criteria for special education services, they clearly might have benefited from some type of language or reading enrichment program to improve their reading comprehension skills.

The results of this study also offer some preliminary support for the use of morpho-syntax assessments as part of a protocol to identify children who might be at risk for later reading comprehension difficulties. These assessments would be used to supplement current screening batteries, which generally screen for phonological or alphabet knowledge deficits that would place a child at risk for later word reading difficulties. Longitudinal data will be needed to evaluate usefulness of such a clinical marker.

REFERENCES

Adlof, S.M., Catts, H.W., & Lee, J. (in press). Kindergarten predictors of second vs. eighth grade reading comprehension impairments. *Journal of Learning Disabilities*.

American Psychological Association. (1994). *Diagnostic and statistical manual, Fourth edition (DSM-IV).* Washington, DC: APA.

Atchley, R. A., Rice, M. L., Betz, S. K., Kwasney, K. M., Sereno, J. M., & Jongman, A. (2006). A comparison of semantic and syntactic event related potentials generated by children and adults. *Brain and Language, 99,* 236-246.

Bedore, L., & Leonard, L. (1998). Specific language impairment and grammatical morphology: A discriminant function analysis. *Journal of Speech, Language, and Hearing Research, 41,* 1185-1192.

Betz, S.K. (2005). Language based event-related potentials in children with and without specific language impairment. (Doctoral dissertation, University of Kansas, 2005) *Dissertation Abstracts International*, 66-12B. (ISBN No. 0542487764).

Bishop, D.V.M, Adams, C. & Norbury, C.F. (2006) Distinct genetic influences on grammar and phonological short term memory deficits: Evidence from 6-year-old twins. *Genes, Brain and Behavior, 5,* 158-169.

Bishop, D.V.M., Bishop, S.J., Bright, P., James, C., Delaney, T., Miller, S., & Tallal, P. (1999) Different etiological origin of auditory deficit and weak phonological short-term memory in children with specific language

impairment: Evidence from a twin study. *Journal of Speech Hearing & Language Research, 42,* 155-168.

Botting, N., Simkin, Z., & Conti-Ramsden, G. (2006). Associated reading skills in children with a history of specific language impairment. *Reading and Writing, 19,* 77-98.

Briscoe, J., Bishop, D.V.M, and Norbury, C.F. (2001) Phonological processing, language and literacy: A comparison of children with mild to moderate sensori-neural hearing loss and those with specific language impairment. *Journal of Child Psychology and Psychiatry, 42,* 329-340.

Brown, L., Sherbenou, R.J., & Johnsen, S.K. (1997). *Test of Nonverbal Intelligence-3*. Austin: PRO-ED.

Cain, K. (2003). Text comprehension and its relation to coherence and cohesion in children's fictional narratives. *British Journal of Developmental Psychology, 21,* 335-351.

Cain, K., & Oakhill, J. V. (1999). Inference making ability and its relation to comprehension failure in young children. *Reading and Writing: An Interdisciplinary Journal, 11,* 489-503.

Cain, K. & Oakhill, J. (2006). Profiles of children with specific reading comprehension difficulties. *British Journal of Educational Psychology, 76,* 683-696.

Cain, K., Oakhill, J. V., Barnes, M. A., & Bryant, P. E. (2001). Comprehension skill, inference making ability, and their relation to knowledge. *Memory & Cognition, 29*, 850-859.

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

Cain, K., Oakhill, J. V., & Elbro, C. (2003). The ability to learn new word meanings from context by school-age children with and without language comprehension difficulties. *Journal of Child Language, 30*, 681-694.

Cain, K., Oakhill, J., & Lemmon, K. (2004). Individual differences in the inference of word meanings from context: The influence of reading comprehension, vocabulary knowledge, and memory capacity. *Journal of Educational Psychology*, *96*, 671-681.

Catts, H. W., Adlof, S. M., & Ellis Weismer, S. (2006). Language deficits in poor comprehenders: A case for the simple view of reading. *Journal of Speech, Language, and Hearing Research, 49*, 278.

Catts, H. W., Adlof, S. M., Hogan, T. P., & Ellis Weismer, S. (2005). Are specific language impairment and dyslexia distinct disorders? *Journal of Speech, Language, and Hearing Research, 48*, 1378.

Cragg, L. & Nation, K. (2006) Exploring written narrative in children with poor reading comprehension. *Educational Psychology, 26***,** 55-72.

Dunn, L.M., & Dunn, D.M. (2007). *Peabody Picture Vocabulary Test-Fourth Edition.* Circle Pines, MN: American Guidance Service.

Ehri, L.C., Nunes, S.R., Stahl, S.A., & Willows, D.M. (2001). Systematic phonics instruction helps students learn to read: Evidence from the national reading panel's meta-analysis. *Review of Educational Research, 71*, 393-447.

Flax, J. F., Realpe-Bonilla, T., Hirsch, L. S., Brzustowitz, L. M., Bartlett, C. W., & Tallal, P. (2003). Specific language impairment in families: Evidence for co-occurrence with reading impairments. *Journal of Speech, Language, and Hearing Research, 46*, 530–543.

Good, R.H., & Kaminski, R.A. (2002). *Dynamic Indicators of Basic Early Literacy Skills (6th ed.).*Eugene, OR: Institute for the Development of Education Achievement. Available: http://dibels.uoregon.edu/.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *RASE: Remedial and Special Education, 7*, 6-10.

Gray, S., Plante, E., Vance, R., & Henrichsen, M. (1999). The diagnostic accuracy of four vocabulary tests administered to preschool-age children. *Language, Speech, and Hearing Services in Schools, 30*, 196-206.

Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing, 2*, 127-160.

International Dyslexia Association Board of Directors. (2002). What is dyslexia? Retrieved June 1, 2009 from http://www.interdys.org/FAQWhatIs.htm.

Invernizzi, M., Juel, C., Swank, L. K., & Meier, J. (1997). *PALS: Phonological awareness literacy screening*. Charlottesville, VA: University Printing Service.

Jarvis, B. G. (2008). *Direct RT research software (v2008)*. New York, NY: Empirisoft.

Joanisse, M. F. & Seidenberg, M. S. (1999). Impairments in verb morphology after brain injury : a connectionist model. *Proceedings of the National Academy of Sciences of the United States of America 98,* 7592–7597.

Kavale, K.A., & Forness, S.R. (1996). Learning disability grows up: Rehabilitation issues for individuals with learning disabilities. *Journal of Rehabilitation, 62,* 34-41.

Kelso, K., Fletcher, J., & Lee, P. (2007). Reading comprehension in children with specific language impairment: An examination of two subgroups. *International Journal of Language and Communication Disorders, 42,* 39-57.

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

Landi, N. & Perfetti, C.A. (2007). An electrophysiological investigation of semantic and phonological processing in skilled and less-skilled comprehenders. *Brain and Language, 102,* 30-45.

Leonard, L. B. (1998). *Children with specific language impairment*. Cambridge, MA: MIT Press.

Leonard, L.B., Camarata, S.M., Pawlowska, M., Brown, B., Camarata, M.N. (2008). The acquisition of tense and agreement morphemes by children with specific language impairment during intervention: Phase 3. *Journal of Speech, Language, and Hearing Research, 51*, 120-125.

Marshall, C. M., & Nation, K. (2003). Individual differences in semantic and structural errors in children's memory for sentences. *Educational and Child Psychology, 20,* 7-18.

Marchman, V. A., Wulfeck, B., & Ellis Weismer, S. (1999). Morphological productivity in children with normal language and SLI: A study of the English past tense. *Journal of Speech, Language, and Hearing Research, 42*, 206-219.

McKinney, J.D. (1989). Longitudinal research on the behavioral characteristics of children with learning disabilities. *Journal of Learning Disabilities, 22,* 141-150, 165.

Miller, C.A., Leonard, L.B., & Finneran, D. (2008). Grammaticality judgements in adolescents with and without language impairment. *International Journal of Language and Communication Disorders, 43*, 346-360.

Moe, A. J., Hopkins, C. J., & Rush, R. T. (1982). *The vocabulary of first-grade children*. Springfield, IL: Thomas.

Nation, K., Adams, J. W., Bowyer-Crane, C. A., & Snowling, M. J. (1999). Working memory deficits in poor comprehenders reflect underlying language impairments. *Journal of Experimental Child Psychology, 73,* 139-158.

Nation, K., Clarke, P., & Snowling, M. J. (2002). General cognitive ability in children with reading comprehension difficulties. *British Journal of Educational Psychology, 72*, 549-560.

Nation, K., Clarke, P., Marshall, C. M., & Durand, M. (2004). Hidden language impairments in children: Parallels between poor reading comprehension and specific language impairments? *Journal of Speech, Language, and Hearing Research, 47*, 199-211.

Nation, K., & Snowling, M. (1997). Assessing reading difficulties: The validity and utility of current measures of reading skill. *British Journal of Educational Psychology, 67*, 359-370.

Nation, K., & Snowling, M. J. (1998). Semantic processing and the development of word-recognition skills: Evidence from children with reading comprehension difficulties. *Journal of Memory and Language, 39*, 85-101.

Nation, K., & Snowling, M. J. (1999). Developmental differences in sensitivity to semantic relations among good and poor comprehenders: Evidence from semantic priming. *Cognition, 70*, B1-B13.

Nation, K., & Snowling, M. J. (2000). Factors influencing syntactic awareness skills in normal readers and poor comprehenders. *Applied Psycholinguistics, 21*, 229-241.

Nation, K., Snowling, M. J., & Clarke, P. (2005). Production of the English past tense by children with language comprehension impairments. *Journal of Child Language, 32*, 117-137.

Nation, K., Snowling, M.J. & Clarke, P.J. (2007) Dissecting the relationship between language skills and learning to read: semantic and phonological contributions to new vocabulary learning in children with poor reading comprehension. *Advances in Speech-Language Pathology, 9*, 131-139.

National Institute of Child Health and Human Development. (2000). Report of the National Reading Panel. *Teaching children to read: an evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups* (NIH Publication No. 00-4754). Washington, DC: U.S. Government Printing Office.

Norbury, C.F., Bishop, D.V.M., Briscoe, J. (2001). Production of English finite verb morphology: A comparison of SLI and mild-moderate hearing impairment. *Journal of Speech, Language, and Hearing Research, 44*, 165-178.

Northwest Evaluation Association. (2008).*Measures of academic progress*. Lake Osweego, OR: NWEA.

Oakhill, J. (1982). Constructive processes in skilled and less skilled comprehenders' memory for sentences. *British Journal of Psychology, 73*, 13-20.

Oakhill, J. (1983). Instantiation in skilled and less skilled comprehenders. *Quarterly Journal of Experimental Psychology*, *35A*, 441-450.

Oakhill, J. (1984). Inferential and memory skills in children's comprehension of stories. *British Journal of Educational Psychology, 54*, 31-39.

Oakhill, J. V., Cain, K., & Bryant, P. E. (2003). The dissociation of word reading and text comprehension: Evidence from component skills. *Language and Cognitive Processes, 18,* 443-468.

Oakhill, J., Hart, J., & Samols, D. (2005). Levels of comprehension monitoring and working memory in good and poor comprehenders. *Reading and Writing, 18,* 657-686.

Oakhill, J., & Yuill, N. (1986). Pronoun resolution in skilled and less-skilled comprehenders: Effects of memory load and inferential complexity. *Language and Speech, 29,* 25-37.

Oakhill, J., Yuill, N., & Parkin, A. J. (1986). On the nature of the difference between skilled and less-skilled comprehenders. *Journal of Research in Reading, 9,* 80-91.

Osborne, S.S., Schulte, A.C., & McKinney, J.D. (1991). A longitudinal study of students with learning disabilities in mainstream and resource programs. *Exceptionality, 2,* 81-95.

Owen, A.J. & Leonard, L.B. (2006). The production of finite and nonfinite complement clauses by children with specific language impairment and their typically developing peers. *Journal of Speech, Language, and Hearing Research, 49,* 548-571.

Pennington, B.F., & Bishop, D.V.M. (2009). Relations among speech, language, and reading disorders. *Annual Review of Psychology, 60,* 283-306.

Pikulski, J.L., (1994). Preventing reading failure: A review of five effective programs. *The Reading Teacher, 48,* 30-39.

Pinker, S. (1999). *Words and rules*. London: Weidenfield and Nicolson.

Plante, E. (1998). Criteria for SLI: The stark and tallal legacy and beyond. *Journal of Speech, Language, and Hearing Research, 41*, 951-957.

Proctor Williams, K. & Fey, M.E. (2000). Recast density and acquisition of novel irregular past tense verbs. *Journal of Speech, Language, and Hearing Research, 50,* 1029-1047.

Redmond, S.M., & Rice M.L. (2001). Detection of irregular verb violations by children with and without SLI. *Journal of Speech, Language, and Hearing Research, 44,* 655-669.

Redmond, S. M., & Johnson, S.S. (2001). Evaluating the morphological competence of children with severe speech and physical impairments. *Journal of Speech, Language and Hearing Research, 44*, 1249-1257.

Rice, M.L., Hoffman, L. & Wexler, K. (in press). Judgments of omitted *BE* and *DO* in questions as extended finiteness clinical markers of SLI to fifteen years: A study of growth and asymptote. *Journal of Speech, Language, and Hearing Research.*

Rice, M. L., Tomblin, J. B., Hoffman, L., Richman, W. A., & Marquis, J. (2004). Grammatical tense deficits in children with SLI and nonspecific language impairment: Relationships with nonverbal IQ over time. *Journal of Speech, Language, and Hearing Research, 47*, 816-834.

Rice, M. L., & Wexler, K. (1996). Toward tense as a clinical marker of specific language impairment in English-speaking children. *Journal of Speech and Hearing Research, 39,* 1239-1257.

Rice, M. L., & Wexler, K. (2001). *Rice-Wexler Test of Early Grammatical Impairment*. San Antonio, TX: The Psychological Corporation.

Rice, M.L., Wexler, K., & Cleave, P. (1995). Specific language impairment as a period of Extended Optional Infinitive. *Journal of Speech and Hearing Research, 38,* 850-863.

Rice, M. L., Wexler, K., & Hershberger, S. (1998). Tense over time: The longitudinal course of tense acquisition in children with specific language impairment. *Journal of Speech, Language, and Hearing Research, 41,* 1412-1431.

Rice, M. L., Wexler, K., & Redmond, S. M. (1999). Grammaticality judgments of an extended optional infinitive grammar: Evidence from English speaking children with specific language impairment. *Journal of Speech, Language, and Hearing Research, 42,* 943-961.

Sabornie, E. J. (1994). Social-affective characteristics in early adolescents identified as learning disabled and nondisabled. *Learning Disability Quarterly, 17,* 268-279.

Semel, E., Wiig, E.H., & Secord, W.A. (2006). *Clinical Evaluation of Language Fundamentals-4th Edition.* San Antonio, TX: Harcourt.

Spaulding, T.J., Plante, E., & Vance, R. (2008). Sustained selective attention skills of preschool children with specific language impairment: Evidence for separate

attentional capacities. *Journal of Speech, Language, and Hearing Research, 51*, 16-34.

Spear-Swerling, L., & Sternberg, R. J. (1996). *Off track: When poor readers become learning disabled*. Boulder, CO: Westview-HarperCollins.

Stark, R. E., & Tallal, P. (1981). Selection of children with specific language deficits. *Journal of Speech and Hearing Disorders, 46*, 114-122.

Stothard, S. E., & Hulme, C. (1992). Reading comprehension difficulties in children: The role of language comprehension and working memory skills. *Reading and Writing: An Interdisciplinary Journal, 4*, 245-256.

Stothard, S. E., & Hulme, C. (1995). A comparison of phonological skills in children with reading comprehension difficulties and children with decoding difficulties. *Journal of Child Psychology and Psychiatry, 36*, 399-408.

Swanson, H.L. (1999). Reading research for students with LD: A meta-analysis of intervention outcomes. *Journal of Learning Disabilities, 32*, 504-532.

Tabachnick, B. G., and Fidell, L. S. (2007). *Using Multivariate Statistics, 5th ed.* Boston: Allyn and Bacon.

Texas Education Agency. (2000). Texas primary reading inventory. Austin, TX: Texas Education Agency.

Thomsen, S. (1982). *SPARC: Stimulus Pictures for Articulation Remediation, and Carryover*. East Moline, IL: LinguiSystems.

Tomblin, J. B., Records, N., Buckwalter, P., Zhang, X., Smith, E., & O'Brien, M. (1997). Prevalence of specific language impairment in kindergarten children. *Journal of Speech, Language, and Hearing Research, 40,* 1245-1260.

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1999). *Test of word reading efficiency*. Austin: PRO-ED.

Wagner, R.K., Torgesen, J.K., & Rashotte, C.A. (1999). *Comprehensive Test of Phonological Processing*. Austin: PRO-ED.

Waltzman, D. E., & Cairns, H., S. (2000). Grammatical knowledge of third grade good and poor readers. *Applied Psycholinguistics, 21*, 263-284.

Weekes, B.S., Hamilton, S., Oakhill, J.V., & Holliday, R.E. (2008). False recollection in children with reading comprehension difficulties. *Cognition, 106,* 222-233.

Wexler, K. (2003). Lenneberg's dream: Learning, normal language development, and specific language impairment. In Y. Levy & J. Schaeffer (Eds.), *Language competence across populations: Towards a definition of specific language impairment* (pp. 11-61). Mahwah, N.J.: Lawrence Erlbaum.

Williams, K. T., Cassidy, J., & Samuels, S. J. (2001). *Group Reading Assessment and Diagnostic Evaluation*. Circle Pines, MN: American Guidance Service.

Wulfeck, B. (1993). A reaction time study of grammaticality judgments in children. *Journal of Speech and Hearing Research, 36,* 1208-1215.

Wulfeck, B., Bates, E., Krupa-Kwiatkowski, M., & Saltzman, D. (2004). Grammaticality sensitivity in children with early focal brain injury and

children with specific language impairment. *Brain and Language, 88,* 215-228.

Yuill, N., & Joscelyne, T. (1988). Effects of organizational cues and strategies on good and poor comprehenders' story understanding. *Journal of Educational Psychology, 80,* 152-158.

Yuill, N., & Oakhill, J. (1991). *Children's problems in text comprehension: An experimental investigation*. New York: Cambridge University Press.

Yuill, N., Oakhill, J., & Parkin, A. J. (1989). Working memory, comprehension ability, and the resolution of text anomaly. *British Journal of Psychology, 80,* 351-361.

Zeno, S.M., Ivens, S.H., Millard, R.T., & Dubburi, R. (1995). *The educator's word frequency guide.* Brewster, NY: TASA.

Appendix A:
PARENT QUESTIONNAIRE
Spoken Language and Reading Comprehension

Child First Name _____ Child Last Name _____

Child's Date of Birth: Month _____ Day _____ Year _____

Child's Gender: Male Female

Parent/Guardian Name _____

Address _____

City _____ State_____ Zip _____

Home Phone _____ Work Phone _____ Cell _____

Child's Teacher_____

Child's Race: *Please circle one (optional).*
American Indian /Alaska Native Asian Black/African American
Native Hawaiian/ Pacific Islander White Other

Child's Ethnicity: *Please circle one (optional).* Hispanic/Latino Not Hispanic/Latino

What language(s) does your child speak? *(Please list all).* _____

What languages, other than English, does your child hear from teachers, family, or friends? _____

How often does your child hear a language other than English? _____

Does your child have a history of (please check all that apply)
- □ Hearing loss? □ Diagnosed motor disorder? □ Diagnosed ADD/ADHD?
- □ Physical or medical problems that could interfere with speech or language?

Has your child ever received speech, language, reading or other special education services? _____ If yes, please describe below.

Is there a family history of language or reading disabilities in your family? _____
If yes, please describe below.

Do you have any concerns about your child's language or reading abilities? ____
If yes, please describe below.

Appendix B

Recruitment Sites with Numbers of Participants Screened and Entered into Full Study

School Name	District	Returned Consent Forms	Poor Comprehender Group	Control Group
2007-2008 School Year				
Broken Arrow	Lawrence	2	0	0
Cordley	Lawrence	2	0	0
Hillcrest	Lawrence	2	0	0
Kennedy	Lawrence	13	0	2
New York	Lawrence	5	1	0
Prairie Park	Lawrence	29	2	2
Quail Run	Lawrence	0	0	0
Wakarusa Valley	Lawrence	0	0	0
Woodlawn	Lawrence	2	0	0
2008-2009 School Year				
Kennedy	Lawrence	27	1	2
Langston Hughes	Lawrence	28	4	5
New Stanley	Kansas City	11	1	3
New York	Lawrence	7	0	1
Prairie Park	Lawrence	18	1	2
Stony Point North	Kansas City	0	0	0
Stony Point South	Kansas City	18	1	3
T.A. Edison	Kansas City	13	2	2
Wakarusa Valley	Lawrence	10	3	2
Woodlawn	Lawrence	1	0	0
Totals		188	16	24

Appendix C

Irregular Verb Grammaticality Judgment Task Stimuli

Irregular Past Verb	Correct Stimulus Sentence	MHR Raw Freq. (Past)	EWFG U (Past)	Stem	MHR Raw Freq. (Stem)	EWFG U (Stem)
blew	*The boy blew a horn.*	41	29	blow	59	47
brought	*The boy brought a book.*	48	259	bring	77	167
bought	*The boy bought a game.*	51	69	buy	66	163
fell	*The boy fell in dirt.*	194	124	fall	73	153
fought	*The boy fought at school.*	6	40	fight	66	93
flew	*The boy flew a kite.*	26	42	fly	50	86
heard	*The boy heard a crash.*	85	300	hear	82	233
hid	*The boy hid a toy.*	22	14	hide	112	47
rang	*The boy rang a bell*	4	21	ring	39	54
stood	*The boy stood in line.*	3	191	stand	47	146
dug	*The girl dug a hole.*	3	27	dig	11	27
gave	*The girl gave a speech.*	116	259	give	117	427
lost	*The girl lost a ball.*	56	193	lose	35	66
rode	*The girl rode a horse.*	21	42	ride	136	84
sat	*The girl sat in gum.*	91	182	sit	105	105
slept	*The girl slept in class.*	26	26	sleep	88	121
slid	*The girl slid in mud.*	10	16	slide	43	25
swam	*The girl swam a lap.*	9	11	swim	45	45
wore	*The girl wore a dress.*	7	50	wear	74	82
wrote	*The girl wrote a note.*	15	111	write	18	210

MHR Raw Freq = Raw Frequency from Moe, Hopkins, & Rush (1982) inventory of first grade expressive vocabulary. EWFG U = U value from *Educator's Word Frequency Guide* (Zeno, Ivens, Millard, & Duvvuri, 1995). U represents the frequency of word occurrence per million words, weighted by the word's likelihood to appear in texts across all grade levels.

Appendix D

Grammaticality Judgment Training Sentences

Grammatical
The boy is swinging the bat.
The boy is watching T.V.
The girl is painting her nails.
The girl is reading a book.
The girl is walking her dog.

Ungrammatical
The boy is eat a pear.
The boy is hold her hand.
The boy is play outside.
The girl is wash her hand.
The girl is draw a house.

Appendix E

Be-Do Question Grammaticality Judgment Correct Stimulus Items

Adapted from Atchley, Rice, Betz, Kwasny, Sereno, & Jongman (2005)
and Betz (2005)

Be Questions

Where is a bear growling?
Where is a bird flying?
Where is a bug biting?
Where is a cat crawling?
Where is a clown painting?
Where is a dad driving?
Where is a duck quacking?
Where is a fox standing?
Where is a goat climbing?
Where is a mom talking?

Do Questions

Where does a boy like to play?
Where does a cook like to bake?
Where does a dog like to sit?
Where does a fish like to swim?
Where does a frog like to jump?
Where does a girl like to cry?
Where does a man like to sing?
Where does a mouse like to drink?
Where does a pig like to snort?
Where does a cow like to sleep?

Appendix F

Finiteness Elicitation Cloze Sentence Stimuli

Target	Cloze Sentence Stimuli	MHR Raw Freq.	EWFG U	Stem	MHR Raw Freq. (Stem)	EWFG U (Stem)
Plural Nouns						
kings	*Here is a king. Tell me what two of them are called. They're ____.*	16	31	king	76	210
hills	*Here is a hill. Tell me what two of them are called. They're ____.*	10	62	hill	46	91
cats	*Here is a cat. Tell me what two of them are called. They're ____.*	31	30	cat	131	78
lights	*Here is a light. Tell me what two of them are called. They're ____.*	18	67	light	31	464
chairs	*Here is a chair. Tell me what two of them are called. They're ____.*	36	26	chair	256	78
snakes	*Here is a snake. Tell me what two of them are called. They're ____.*	11	20	snake	18	34
ropes	*Here is a rope. Tell me what two of them are called. They're ____.*	3	10	rope	59	17
boats	*Here is a boat. Tell me what two of them are called. They're ____.*	21	40	boat	77	97
legs	*Here is a leg. Tell me what two of them are called. They're ____.*	33	120	leg	40	56
drums	*Here is a drum. Tell me what two of them are called. They're ____.*	3	9	drum	2	17

Target	Cloze Sentence Stimuli	MHR Raw Freq.	EWFG U	Stem	MHR Raw Freq. (Stem)	EWFG U (Stem)
Third Person Singular Present Tense						
dances	*Here is a dancer. Tell me what she does. She___.*	3	6	dance	5	35
hits	*Here is a hitter. Tell me what he does. He___.*	46	217	hit	284	88
rides	*Here is a rider. Tell me what he does. He___.*	47	13	ride	136	84
paints	*Here is a painter. Tell me what he does. He___.*	5	8	paint	44	47
runs	*Here is a runner. Tell me what he does. He___.*	48	49	run	287	266
works	*Here is a worker. Tell me what he does. He___.*	39	91	work	96	941
skates	*Here is a skater. Tell me what she does. She___.*	6	9	skate	9	8
drives	*Here is a driver. Tell me what she does. She___.*	10	12	drive	16	155
reads	*Here is a reader. Tell me what she does. She___.*	13	14	read	103	436
walks	*Here is a walker. Tell me what she does. She___.*	11	17	walk	155	148

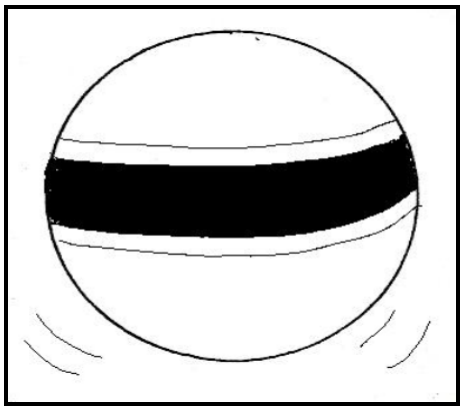
Target	Cloze Sentence Stimuli	MHR Raw Freq.	EWFG U	Stem	MHR Raw Freq. (Stem)	EWFG U (Stem)
Regular Past Tense						
handed	*Here the girl is handing a gift to her friend. Now she's done. Tell me what she did. She____.*	3	31	hand	142	438
climbed	*Here the girl is climbing up a ladder. Now she's done. Tell me what she did. She ____.*	19	43	climb	25	41
closed	*Here the girl is closing a door. Now she's done. Tell me what she did. She ____.*	16	101	close	49	242
washed	*Here the woman is washing a dish. Now she's done. Tell me what she did. She ____.*	6	40	wash	24	40
slipped	*Here the girl is slipping on a rug. Now she's done. Tell me what she did. She____.*	7	28	slip	4	23
baked	*Here the man is baking a cake. Now he's done. Tell me what he did. He____.*	4	10	bake	5	7
yelled	*Here the boy is yelling at his friend. Now he's done. Tell me what he did. He____.*	5	30	yell	4	6
fixed	*Here the man is fixing a sink Now he's done. Tell me what he did. He____.*	30	56	fix	20	27
lifted	*Here the man is lifting a weight. Now he's done. Tell me what he did. He____.*	4	49	lift	11	35
cried	*Here the boy is crying. Now he's done. Tell me what he did. He____.*	10	88	cry	11	55

Target	Cloze Sentence Stimuli	MHR Raw Freq.	EWFG U	Stem	MHR Raw Freq. (Stem)	EWFG U (Stem)
Irregular Past Tense						
sang	*Here the woman is singing a song. Now she's done. Tell me what she did. She____.*	5	28	sing	30	32
bit	*Here the girl is biting her sandwich. Now she's done. Tell me what she did. She____.*	66	100	bite	28	21
grew	*Here the girl is growing some flowers. Now she's done. Tell me what she did. She____.*	10	173	grow	17	258
felt	*Here the girl is feeling some sand. Now she's done. Tell me what she did. She____.*	10	302	feel	14	299
taught	*Here the woman is teaching the class. Now she's done. Tell me what she did. She____.*	7	68	teach	7	47
fed	*Here the boy is feeding his dog. Now he's done. Tell me what he did. He___.*	8	38	feed	27	68
threw	*Here the boy is throwing a ball. Now he's done. Tell me what he did. He___.*	65	45	throw	114	48
won	*Here the boy is winning a race Now he's done. Tell me what he did. He___.*	77	71	win	156	55
met	*Here the boy is meeting a friend.. Now he's done. Tell me what he did. He___.*	18	112	meet	11	135
ran	*Here the boy is running. Now he's done. Tell me what he did. He___.*	189	191	run	287	266

Appendix G

Finiteness Elicitation Task Visual Stimulus Examples

Ball (Sample stimulus for plural elicitation items)



Feeding dog/ Fed dog (Sample stimulus pictures for irregular past elicitation items)