Effects of Verb Familiarity on Finiteness Marking in Children with SLI

BY

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Abstract

Children must acquire multiple language dimensions to ultimately achieve adult levels of language competence. Two such language dimensions, finiteness marking and the verb lexicon, are considered areas of weakness in specific language impairment (SLI). Given these weaknesses, the question arises of whether these two dimensions are related in children with SLI and/or typically developing children. One way to examine this question is to assess the hypothesis that verb familiarity influences finiteness marking accuracy. A sentence imitation task was developed to examine this hypothesis. In sentence imitation tasks, a child is asked to repeat a sentence verbatim. Sentence imitation has been proposed as an index of children's generative use of grammar (Child Grammar Account). An alternative proposal is that sentence imitation measures verbal memory instead of language ability (Verbal Memory Account).

The sentence imitation task employed in the current study allowed estimates of finiteness marking and the verb lexicon while examining whether verb familiarity influences finiteness marking. Imitations were coded and analyzed for overall sentence accuracy and deviations from the target sentence in individual clausal components (i.e., finiteness marking and the verb root). The coding system designed for this study also set up a comparison of the two proposed accounts of sentence imitation. Three groups of children completed the sentence imitation task: 20 children with SLI (5-years old), 23 age-equivalent control children (AE; 5-years old) and 16 language-equivalent control children (LE; 3-years old). The AE group was more accurate than each of the SLI and LE groups (who performed similarly) on overall sentence imitation accuracy, finiteness marking accuracy and verb root imitation accuracy. Familiar verbs conferred an advantage on overall sentence imitation, finiteness marking and verb root imitation accuracy as well. Results also reported group x condition interactions for finiteness marking and verb root

imitation. Patterns of deviations from the target sentence support the Child Grammar Account of sentence imitation, but not the Verbal Memory Account. Overall, study findings are consistent with expectations based on the literature and support the proposal that verb familiarity affects finiteness marking.

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Chapter I: Introduction

Language has multiple dimensions to be acquired by children. Consider the simple clause *the girl runs*. This clause has three base words (*the, girl, run*). In addition, the verb (*run*) has the grammatical element of finiteness marked by the *–s* at the end of the verb (run*s*). This *–s* indicates that the word to which it is affixed is a verb marked for present tense and a third-person singular subject (i.e., he, she, it, etc.). For a child to produce this clause correctly according to the adult grammar, all elements of the clause must be present. The absence of the finiteness marker *-s*, for example, would result in the ungrammatical clause **the girl run*. Children must acquire more than individual words to achieve adult levels of language competence. Different linguistic dimensions do not develop independently from one or another; instead, they are interconnected in their development.

Two key components of well-formed clauses that are of interest here are lexical verbs and the grammatical property of finiteness marking. Most children acquire lexical verbs and finiteness marking quickly and with relative ease; however, acquisition is not errorless. For example, typically developing children go through a period during development where they may or may not produce overt finiteness marking when it is required. Children with specific language impairment (SLI) are reported to lag behind their age peers in both the acquisition of lexical verbs and the development of finiteness marking. Finiteness marking appears to be relatively weaker in children with SLI, with lower performance relative to younger, language-equivalent typically developing children. The relative weakness of lexical verbs and finiteness marking in children with SLI suggests that these two clausal components may interact in ways that contribute to the deficits in finiteness marking. One way to evaluate whether a finiteness marking by verb lexicon interaction is present is to examine finiteness marking accuracy on verbs

differing in familiarity to children. If finiteness marking and the verb lexicon interact in SLI, we would expect less accurate finiteness marking on verbs less familiar to children with SLI. This study investigates the possible influence of verb familiarity on finiteness marking in children with SLI compared to two groups of control children.

Finiteness Marking Development

Finiteness marking is one element of morphosyntax – the relationship between morphology and syntax. Specifically, finiteness marking is the use of grammatical morphemes (in English: third person singular *–s*, past tense *–ed*, DO and BE) to mark tense and agreement (Pollock, 1989). In English, whether the finiteness marker appears overtly depends on the verb's tense and the subject of the clause. In the English present tense, syntactic positions following a third person singular subject (i.e., the girl, boy, man, woman, he, she, etc.) are marked for finiteness with the *–s* morpheme (e.g., the girl/boy/she hide*s*). For both singular and plural first and second person subjects (i.e., I, you, they), finiteness is present but is not overtly marked on the verb; instead, the verb appears as a bare stem (e.g., I/you/they hide). For example, in the clause "the girl runs", *run* is in a syntactic position that is overtly marked for finiteness; in "I run", *run* still occupies a syntactic position that requires finiteness checking but there is no overt finiteness marker. Children's representation of finiteness marking is important for representations of sentence structure that leads to an adult grammar (Rice, Wexler, & Cleave, 1995).

Finiteness marking develops throughout early childhood. During the course of typical development, children go through a stage in which overt marking of finiteness is optional – the Optional Infinitive stage (OI; Wexler, 1998). In the OI stage, children use both non-finite forms and finite forms when finiteness is required. It is believed that when children are in the OI stage, they know clause structure principles but optionally drop surface forms of tense marking.

Typically developing children do not fully resolve the OI stage until around age 5, at which time they begin to achieve adult-like levels of competence in finiteness marking (Rice, Wexler, & Hershberger, 1998; Wexler, 1998).

The OI stage appears to be extended in children with SLI - a phenomenon described by the Extended Optional Infinitive (EOI) account of SLI (e.g., Rice et al., 1995). According to the EOI account, children with SLI have an incomplete representation of grammatical tense (one element of finiteness marking; Rice & Wexler, 1996; Rice et al., 1995) resulting in the extension of the OI stage. Production data indicate that the emergence of finiteness marking is delayed in children with SLI but these children demonstrate early uses of finiteness marking that pattern similarly to typically developing children (Hadley & Rice, 1996). Delays in finiteness marking continue through the early school-age years, with five-year old children with SLI demonstrating less accurate finiteness marking than both age-equivalent and younger, language-equivalent control children (Rice et al., 1995). Evidence from growth curve modeling indicates that, while typically developing children achieve adult-like levels of obligatory finiteness marking around age 5, children with SLI are not yet at adult levels by almost 9 years of age (Rice et al., 1998). Interestingly, the growth curve for the children with SLI follows the same pattern as for the age- and language-equivalent controls, but the children with SLI did not "catch up" with the typically developing controls (Rice et al., 1998).

A commonly used benchmark in studies of children with SLI is the mean length of utterance (MLU), used as a broad index of language acquisition. Group comparisons to a control group of younger, typically developing children equivalent in MLU are used to investigate whether the language of children with SLI is "immature" (Hadley & Rice, 1996; Rice, Hoffman, & Wexler, 2009; Rice & Wexler, 1996; Rice et al., 1995; Rice et al., 1998). When compared to

this control group, children with SLI perform less accurately on finiteness marking but at equivalent levels of vocabulary, the development of non-finiteness marking morphemes (i.e., the plural *–s* and progressive *–ing*), and other grammatical markers (i.e., prepositions in and on and determiners a and the; Rice & Oetting, 1993; Rice, Redmond, & Hoffman, 2006; Rice & Wexler, 1996; Rice, Wexler, & Redmond, 1999). These findings support finiteness marking as an area of language disorder in SLI above and beyond a generally late acquisition of language. In addition, these results indicate that deficits are specific to those morphemes that mark finiteness, as opposed to widespread morphological deficits (Rice & Oetting, 1993; Rice et al., 2006; Rice & Wexler, 1996).

Verb Deficits in SLI

Research also consistently reports vocabulary deficits in SLI. Children with SLI, as a group, are likely to score lower on vocabulary assessments compared to age-equivalent control children (Kan & Windsor, 2010; Rice, 2003). They also perform poorer on experimental word learning tasks than age-equivalent control children and similar to language-equivalent control children. This pattern has been identified when novel words are explicitly taught (Alt & Plante, 2006; Alt, Plante, & Creusere, 2004; Ellis Weismer & Hesketh, 1993, 1998; Gray, 2003, 2004, 2005; Johnson & de Villiers, 2009; O'Hara & Johnston, 1997) and in tasks that teach novel words incidentally (Dollaghan, 1987; Leonard et al., 1982; Oetting, 1999; Oetting, Rice, & Swank, 1995; Rice, Buhr, & Nemeth, 1990; Rice, Buhr, & Oetting, 1992; Rice, Cleave, & Oetting, 2000; Rice, Oetting, Marquis, Bode, & Pae, 1994). In fact, children with SLI require about three times as many exposures as typical children to a new word to learn it (Kan & Windsor, 2010; Rice et al., 1994).

Some analyses reveal that the vocabulary acquisition of children with SLI can be lower than control groups of language-equivalent children. Analyses looking at differences between different types of words show that the vocabulary deficits in SLI are greater for verbs than nouns (Kan & Windsor, 2010). Children with SLI have a limited verb lexicon – they rely more on a small number of general all-purpose (GAP) verbs than age-equivalent and language-equivalent control children (Rice & Bode, 1993; Watkins, Rice, & Moltz, 1993). In addition, experimental studies demonstrate greater difficulty with verb learning than noun learning for children with SLI compared to both age- and language-equivalent groups (Alt et al., 2004; Eyer et al., 2002; Horohov & Oetting, 2004; Oetting et al., 1995; Rice et al., 1992; Rice et al., 1994). Children with SLI also show poorer retention of novel verbs compared to novel nouns and poorer retention of novel verbs compared to both age-equivalent and language-equivalent control children (Rice et al., 1994). Taken together, these findings indicate that children with SLI have broad vocabulary and word learning levels commensurate with general language level but verb lexicon and learning deficits that are not commensurate with language level expectations. Thus, for children with SLI, general vocabulary is considered an area of language delay but verb deficits are potentially disordered or out of synchrony with general language indices such as MLU.

Finiteness Marking by Verb Lexicon Interaction

The weaknesses in both finiteness marking and the verb lexicon in the linguistic representation of children with SLI raise the question of whether these linguistic weaknesses may interact in children with SLI. Previous studies have addressed the hypothesized finiteness marking x verb lexicon interaction in SLI in two ways: 1. by manipulating finiteness marking cues and evaluating verb learning or 2. by manipulating the verb lexicon and evaluating

finiteness marking. The first approach examines the possibility that underlying finiteness marking deficits in children with SLI drive difficulty learning new verbs because the children do not have the grammatical cues available to assist with verb learning, as suggested by Rice et al. (1994). Eyer and colleagues (2002) manipulated the frequency of morphosyntactic cues in an experimental verb learning task. The morphosyntactic cues utilized in the study were the infinitival *to* (e.g., he likes *to* walk) and past tense *–ed* (e.g., he walk*ed*). Eyer et al. (2002) reported that the presence of morphosyntactic cues did not aid in verb learning for children with SLI or language-equivalent, typically developing control children, concluding that young children do not use morphosyntactic cues in verb learning.

The other approach to exploring whether finiteness marking and the verb lexicon interact involves including real verbs and nonsense verbs and assessing finiteness marking accuracy as a function of the verb. Unlike the previously mentioned approach, this approach focuses more on whether the two dimensions interact on a more general level than on whether one dimension drives another. Using this approach, Jacobson and colleagues (Jacobson & Livert, 2010; Jacobson & Schwartz, 2005) reported two major findings in their sample of bilingual school-aged children: 1. bilingual children with and without SLI made more errors on marking nonsense verbs compared to familiar verbs (30% and 50% accuracy, respectively, for the older children with SLI; 6% and 12% accuracy, respectively, for the younger SLI group) and 2. both the older and younger bilingual children with SLI made more finiteness marking errors compared to typically developing bilingual children (63, 32, and 78% accuracy, respectively). Jacobson et al.'s (2010; 2005) findings suggest that bilingual children have more difficulty marking finiteness on nonsense verbs and the disadvantage of nonsense verbs is stronger for bilingual children with SLI, supporting an effect of verb familiarity on finiteness marking. This pattern of findings is

consistent with other work looking at finiteness marking in bilingual children with and without SLI (Paradis & Crago, 2000; Paradis, Crago, Genesee, & Rice, 2003). Because of differences in how finiteness marking develops between bilingual children and monolingual children (see Paradis, 2005; 2007 for summaries), there is a need for monolingual research on the issue of whether verb familiarity influences finiteness marking accuracy. In addition, it is believed that children are sensitive to differences between non-real words and unfamiliar, real words from their native language (Rice, 1990); therefore, the results of Jacobson and colleagues may not represent how children with SLI handle finiteness marking on less-familiar real verbs.

There are empirical challenges for examining how verb familiarity affects finiteness marking. Researchers often use spontaneous language sampling to assess children's finiteness marking accuracy (e.g., Rice et al., 1995). Spontaneous language sampling is not an appropriate method for studies looking at children's use of unfamiliar words, however, as children typically only spontaneously produce vocabulary familiar to them. Thus, there is a need for experimental methods to contrast the use of unfamiliar and familiar verbs. Sentence imitation tasks are potentially informative for this question. Sentence imitation tasks provide a window into children's grammatical and vocabulary knowledge by asking children to repeat sentences including a variety of linguistic dimensions. Alternatively, sentence imitation tasks have been proposed as measures of verbal memory rather than the child grammar.

Sentence Imitation Tasks

A prototypic sentence imitation task for children involves an adult saying a sentence for a child to repeat verbatim. There are two proposed accounts for children's sentence imitation task performance. First, sentence imitation tasks have been used as an index of children's generative use of grammar (e.g., Ambridge & Pine, 2006; Menyuk, 1964; Prutting & Connolly, 1976;

Prutting, Gallagher, & Mulac, 1975; Vinther, 2002). Under this account (referred to here as the Child Grammar Account), children draw upon the grammar they have available as they hear the input clause and produce their response. Prutting and Connolly (1976), drawing from the earlier work of Menyuk (1964) and Prutting et al. (1975),suggested that children's elicited imitations semantically and syntactically parallel their spontaneous utterance structures and that children have difficulty imitating grammatical forms not found in their spontaneous speech. Researchers have used sentence imitation tasks to measure language ability in both typically developing children and language impaired children (e.g., Ambridge & Pine, 2006; Menyuk, 1964; Prutting & Connolly, 1976; Prutting et al., 1975). Ambridge and Pine (2006) used a sentence imitation task with 3- and 4-year old typically developing children to assess finiteness marking accuracy on verbs presented in simple clauses. They did not report any conceptual difficulties with the task or task demands that exceeded the capabilities of their young participants. Findings included non-nominative subject errors and finiteness marking errors during imitation. These findings establish the appropriateness of sentence imitation tasks for young children and the use of sentence imitation tasks to assess children's generative use of grammar.

The other account, referred to here as the Verbal Memory Account, posits that sentence imitation tasks measure verbal memory instead of language ability (e.g., Conti-Ramsden, Botting, & Faragher, 2001; Fraser, Bellugi, & Brown, 1963; Willis & Gathercole, 2001). There are two proposals under this account, based on two different models of verbal memory. First, the Gathercole and Baddeley working memory model (e.g., Baddeley, 1992; Baddeley & Hitch, 1974; Gathercole & Adams, 1993; Gathercole & Pickering, 1999) predicts that during a sentence imitation task children store the stimulus item in their verbal memory as a string of sounds and produce the string in the order it was stored, without encoding the grammar or meaning of the

stimulus item (e.g., Conti-Ramsden et al., 2001; Fraser et al., 1963; Vinther, 2002). Alternatively, the Daneman and Carpenter (1980, 1983) model of verbal memory posits that verbal memory involves both storage and processing functions, which pull from the same, limited set of resources. According to this model, during the sentence imitation task, children store and process the verbal input simultaneously and if more resources are directed toward processing, storage is affected. Considering both verbal memory models, the Verbal Memory Account would predict that errors in sentence imitation would reflect verbal memory limitations that could in turn drive linguistic deficits. This study does not compare the two verbal memory models but assesses the Verbal Memory Account of sentence imitation that considers both models.

Sentence imitation tasks bring the experimental advantage of systematic variation of key linguistic elements. For example, to examine whether a child marks finiteness more accurately on one type of verb versus another, the type of verb used in the stimuli can be manipulated with all verbs marked for finiteness. Following the earlier studies of Menyuk (1964) and Prutting (Prutting & Connolly, 1976; Prutting et al., 1975), it is important to consider the ways in which children's responses differ from the input clause, in order to determine how children's grammar can influence their performance on imitation tasks. The development of a coding system that captures imitation accuracy for the different linguistic components included in the stimulus item (i.e., verb root imitation, finiteness marking imitation) allows the assessment of performance on each component of interest. Additionally, coding the deviations from the target clause during imitation would inform the two proposed accounts of sentence imitation task performance. The current study addresses the different types of information that sentence imitation tasks can

provide by coding task performance on the clausal level, at the level of each component of the clause, and by examining patterns of deviations from the target clause.

The Current Study

The present study utilizes a sentence imitation task to evaluate effects of verb familiarity on finiteness marking accuracy in typically developing children and children with SLI. This study employs a three-group design, which compares performance on a particular language dimension between a group of children with SLI and two control groups of children - one with equivalent chronological age and one younger in chronological age but equivalent in general language level. The three-group design is commonly used to examine the issue of language delay versus language disorder. Language disorders and language delays differ, in that language delays occur when the development of a language dimension is below age-level expectations and language disorders are characterized by linguistic deficits that exceed general language-level expectations. Comparisons with the chronological age-equivalent control children identify whether the language dimension of interest is delayed in children with SLI based on age expectations (language delay). Similarly, comparisons with the language-equivalent control children identify whether the language dimension is delayed in SLI based on general language level-expectations (language disorder). This distinction is helpful in sorting out the extent to which SLI is attributable to a delayed onset of language or to specific areas of weakness in the linguistic system (Rice, 2003).

In this study, participant groups are asked to imitate sentences in which the familiarity of the verb has been manipulated (familiar real verbs vs. unfamiliar real verbs) in clausal sites marked for third-person singular finiteness. Each sentence imitation attempt is coded for overall imitation accuracy and individual component-level accuracy, in order to evaluate finiteness

marking and verb imitation accuracy. An analysis of patterns of deviations from the target clause during imitation for each participant group evaluates imitation accuracy and grammaticality as a clue to linguistic processing of the input clause. These analyses will address the following research questions, subdivided to address each level of analysis:

1. Overall imitation accuracy:
    a. Do the participant groups differ in the number of items accurately imitated?
    b. Does the number of items accurately imitated differ based on the familiarity of the target verb?
    c. If condition effects are evident for the number of items correctly imitated, do the differences between conditions vary across groups?
2. Finiteness marking imitation accuracy:
    a. Do the participant groups differ in finiteness marking imitation accuracy?
    b. Does finiteness marking imitation accuracy differ based on verb familiarity?
    c. If condition effects are evident for finiteness marking imitation accuracy, do they differ across groups?
3. Verb root imitation accuracy:
    a. Do the participant groups differ in verb root imitation accuracy?
    b. Does verb root imitation accuracy differ based on the familiarity of the target verb?
    c. If condition effects are evident for verb root imitation accuracy, do they differ across groups?

4. Evaluation of interpretive accounts:

Do patterns of error types made by children in each participant group support the Child Grammar Account or Verbal Memory Account of sentence imitation task performance?

Predicted findings for each set of analyses/research questions are based on precedent in the literature. One prediction is that children with SLI will make more overall imitation errors compared to both groups of control children, in light of deficits in finiteness marking and the verb lexicon. At the individual component-level, it is anticipated that because the age-equivalent control children will be at or near adult-levels of competence on finiteness marking (Rice et al., 1998), they will not have many errors in finiteness marking, verb root imitation or an effect of verb familiarity on finiteness marking. The Child Grammar Account predicts that the language equivalent group will show optionality in finiteness marking imitation, make errors in verb root imitation and will demonstrate a finiteness marking x verb familiarity interaction (Rice et al., 1995). The generic Child Grammar Account predicts accuracy of finiteness marking imitation and verb root imitation to be lower for the children with SLI compared to both groups of control children (Kan & Windsor, 2010; Rice et al., 1995). The open question is whether the underlying grammar of children with SLI will generate a significant finiteness marking x verb familiarity interaction. A significant interaction of this sort would suggest a relationship between the two linguistic dimensions in SLI. On the other hand, no interaction would indicate that the two dimensions are independent in the language systems of children with SLI. The evaluation of interpretive accounts of sentence imitation task performance is predicted to support the Child Grammar Account of SLI performance on verbal imitation tasks rather than the Verbal Memory

Account. If so, the outcomes would lessen support for a memory deficit model of optional finiteness marking in children with SLI.

Chapter II: Methods

Participants

Participants were recruited in one of two ways: 1. from a longitudinal study of the development of morphosyntax in children with SLI and typically developing children that recruits from both Kansas and Missouri as part of the Language Acquisition Studies Lab (LASLAB) or 2. from preschools and daycare programs in the Lawrence and Topeka, Kansas areas. Three groups of children participated in this study: 1. children with specific language impairment (SLI), 2. age-equivalent (AE) typically developing children and 3. language-equivalent (LE) typically developing children. The SLI group contained 15 males and 5 females (n = 20) and had a mean age of 5;5 (SD = 3 months; range = 4;11 – 6;1). All but one of the participants in the SLI group were recruited from the LASLAB longitudinal study, which consistently reports greater numbers of males than females (e.g., Rice et al., 2010). The greater proportion of males than females is also consistent with reports of a higher percentage of males than females in a subset of children diagnosed with SLI (e.g., Tomblin et al., 1997). Thus, the greater number of males than females in the SLI group is expected for this population of participants. The AE group contained 10 males and 13 females (n = 23) and had a mean age of 5;5 (SD = 3 months; range = 5;0 – 5;11). The LE group contained 8 males and 8 females (n = 16) and had a mean age of 3;7 (SD = 2 months; range = 3;2 – 3;11). A preliminary analysis revealed no effect of gender on overall sentence imitation task performance for any group, SLI: $t(18) = 0.53$, $p = 0.6$; AE: $t(21) = 0.56$, $p = 0.68$; LE: $t(14) = 1.26$, $p = 0.21$.

All children met the following criteria: 1. monolingual native speakers of English, 2. normal nonverbal intelligence as demonstrated by a standard score at or above 85 on the Columbia Mental Maturity Scale (CMMS; Burgemeister, Blum, & Lorge, 1972) and 3. normal

hearing as determined by a standard screening (ASHA, 1997). Two children in the LE group obtained standard scores below 85 (84 and 81) on the CMMS. Considering the standard error of measurement (SEM) on the CMMS for children in the age-range of the LE group (5 standard score points), both children's scores fall within the SEM range of the inclusionary criterion for that measure of a standard score at or above 85.

To be included in the SLI group, children met one or more of the following inclusionary criteria: 1. a standard score equal to or less than 85 on a receptive vocabulary measure, the *Peabody Picture Vocabulary Test – Revised* (PPVT-R; Dunn & Dunn, 1982), 2. a standard score equal to or less than 85 on a language omnibus test, the *Test of Language Development – Primary* (TOLD-P2; Newcomer & Hammill, 1988) and/or 3. a mean length of utterance in morphemes (MLUm) more than one standard deviation below the mean for the participant's age (Rice et al., 2010). All children in the AE and LE groups demonstrated typical language development, as evidenced by standard scores greater than 85 on the PPVT-R and one of two language omnibus measures – the TOLD-P2, administered to children 4;0 and older, or the *Test of Early Language Development* (TELD; Hresko, Reid, & Hammill, 1999), administered to children 4;0 and younger - and an MLUm greater than one standard deviation below the mean for the participant's age. Participant characteristics and descriptive statistics on the inclusionary criteria are listed in Table 1.

Table 1

Mean, SD and Range of Participant Characteristics and Inclusionary Criteria

	LE group (*n*=16)	SLI group (*n*=20)	AE group (*n*=23)
Age	3;7 (0;2) 3;2 - 3;11	5;5 (0;3) 4;11 - 6;1	5;5 (0;3) 5;0 - 5;11
[c]CMMS	104.3 (11.8) 81 - 122	95.2 (6.2) 86 - 106	106.9 (12) 86 - 128
[d]PPVT-R	105.3 (9.9) 85 - 121	82.2 (12.9) 62 - 99	103.6 (10.7) 87 - 122
[e]TOLD-P2	[a]not applicable	80.2 (8.3) 56 - 90	100.7 (9.3) 88 - 124
[f]TELD	106.8 (10.4) 93 - 129	[b]not applicable	[b]not applicable
[g]MLUm	4.67 (0.58) 3.44 - 5.91	4.45 (0.71) 3.12 - 5.95	5.59 (0.72) 4.36 - 6.94
[h]GFTA-2 standard score	112.6 (11.7) 82 - 124	99.4 (12.8) 56 - 115	107 (7.4) 93 - 117
[h]GFTA-2 percentile	76.9 (25.3) 16 - 98	41.8 (20.1) 15 - 78	56.7 (24) 16 - 96

[a]Children in the LE group were not administered the TOLD-P2
[b]Children in the SLI and AE groups were not administered the TELD
[c]Columbia Mental Maturity Scale, Standard Score
[d]Peabody Picture Vocabulary Test, Revised Standard Score
[e]Test of Language Development, Primary Spoken Language Quotient Standard Score
[f]Test of Early Language Development Spoken Language Quotient Standard Score
[g]Mean Length of Utterance in morphemes
[h]Goldman-Fristoe Test of Articulation, 2nd Edition Standard Score and Percentile

All children also met two articulatory criteria: 1. pass the phonological probe on the *Rice Wexler Test of Early Grammatical Impairment* (TEGI; Rice & Wexler, 2001) and 2. score within/above one standard deviation or equal to/above the 20th percentile on the *Goldman-Fristoe Test of Articulation-Second Edition* (GFTA-2; Goldman & Fristoe, 2000). The TEGI phonological probe measures production of word-final /d/, /t/, /s/ and /z/, the last two of which are used to mark third-person singular finiteness in English, the morpheme of interest in this study. The GFTA-2 criteria was included to limit the sample to children with articulation within normal range for their age as well as identify any systematic misarticulations that may affect transcription and scoring of performance on the sentence imitation task. There were two children who did not meet either of the criteria for the GFTA-2; however, both children evidenced *w* for *r* substitutions (e.g., *wabbit* for *rabbit*) and, for one child, *w* for *l* substitutions (e.g., *wamp* for *lamp*) in isolation and in consonant clusters. These substitutions accounted for the majority of each child's errors but did not influence intelligibility; thus, both children were included in the final sample.

Finally, for descriptive purposes, all children were administered the TEGI Third Person Singular Probe. This probe is a picture elicitation task, where the child is prompted to produce a sentence containing a third person singular subject and verb with an obligatory context for the third person singular *–s* finiteness marker. The probe score is the number of third singular *–s* finiteness markers in obligatory contexts. Group means and standard deviations were: SLI: M = 52.8, SD = 37.8; LE: M = 72.6, SD = 20.2, AE: M = 90.8, SD = 12.9. These means and standard deviations are similar to the TEGI normative scores, indicating that these groups represent the broader respective population. A one-way Analysis of Variance (ANOVA) revealed a main effect of group, $F(2,56) = 11.7$, $p < 0.05$, $\eta = 0.29$. Post-hoc analyses reported that only the SLI

and AE groups differed significantly: $t(41) = 4.5$, $p < 0.05$, $d = 1.35$. Differences between the LE and each of the SLI and AE groups were not significant ($t(34) = 1.89$, $p = 0.07$; $t(37) = 3.43$, p 0.1, respectively). Because performance on the TEGI Third Person Singular Probe was not used as a participant inclusionary criterion, there was a wide range of performance on this probe. A closer inspection of the data revealed that 3 of the 16 children in the LE group scored in the clinical range of performance on this probe, which could account for the null finding of a difference between the SLI and LE groups.

Sentence Imitation Task

Stimulus development. Stimuli for the sentence imitation task included 28 pairs of familiar/unfamiliar verbs of similar meaning. Familiar verbs were action verbs selected from the Hall, Nagy, and Linn (1984) corpus. The Hall, Nagy, and Linn (1984) corpus consists of words spoken by 4.5 – 5-year old children ($N = 39$) and adults collected via naturalistic sampling in three sampling situations: 1. home, 2. school and 3. the transition between home and school. A verb similar in meaning but considered to be unfamiliar to children in the age range for the current study was identified for each familiar verb, following several steps. First, for each familiar verb, a list of possible synonyms was identified from Roget's Thesaurus (Roget's II: The New Thesaurus, 1988). All possible synonyms were action verbs with the same number of syllables as the familiar verb and used the same allomorph to mark third-person singular finiteness as the familiar verb (i.e., /s/, /z/, /əs/). Possible synonyms appearing in any form in the Hall, Nagy, and Linn (1984) list of child productions were excluded. To further constrain semantics (meaning) and syntactic behavior (argument expression), only those familiar/unfamiliar verb pairs that appeared in the same verb class in *English Verb Classes and Alternations: A Preliminary Investigation* (Levin, 1993) were included. In *English Verb Classes*

and Alternations, English verbs are classified according to shared meaning and behavior. For example, *pull* and *lug* are both carry verbs, *clean* and *scour* are verbs of removing, and *throw* and *sling* are verbs of throwing.

A sentence frame was written for each verb pair with all sentence frames following the same structure: third person singular subject (the man/woman/boy/girl) + verb marked for third person singular -*s* + noun phrase or prepositional phrase. Note that all stimuli are short clauses likely to be within the children's memory buffer capacity. To ensure that each verb in the pair was used appropriately in the sentence frame, the *BBI Combinatory Dictionary of English: Third Edition* (Benson, Benson, & Ilson, 2009) was referenced when writing the sentences. The *BBI Combinatory Dictionary* is a reference of how words combine with each other in sentences. Two pilot studies were conducted to evaluate the stimuli and task requirements, discussed in further detail below.

To further establish that the two verb types differed in familiarity with children in the age ranges of interest in this study, the frequency of each verb in two corpora was determined and frequency was compared across the two verb types. The two corpora included in this analysis were Kolson (1960) and Moe et al. (1982). Kolson's (1960) corpus consists of words (7,543 types/897,973 tokens) spoken by 494 kindergarten children collected in naturalistic sampling settings at school and home and during a picture stimulation task in which the child was asked to tell a story about the picture they saw. Moe et al.'s (1982) corpus (6,412 types/296,108 tokens) is the compilation of words spoken by 329 first grade children during 20-25 minute examiner-led interviews. As expected, the frequency of occurrence of the familiar verbs and unfamiliar verbs differed significantly in both the Kolson (1960) and Moe et al. (1982) corpora, $t(54) = 2.748$, $p < .01$; $t(54) = 2.435$, $p < .05$, respectively. The frequency data from the Hall, Nagy and Linn (1984)

child productions and adult productions, Kolson (1960), and Moe et al. (1982) corpora for each verb is provided in Appendix A.

Adult pilot study 1: Semantic goodness. The first adult pilot study examined the semantic goodness of each verb in its respective sentence frame. The examiner read six adult native speakers of English the sentences in a mixed order of presentation. Directly after hearing each sentence, each participant rated it on a 1-5 scale with a rating of 1 as "*This sentence makes sense to me*" and a rating of 5 as "*This sentence doesn't make sense to me*". Thirteen sentences were judged to have poor semantic goodness. Each sentence represented one verb in a pair and, because of the study design, rewriting or exclusion of one verb in the pair required the same for the other verb in the pair. Thus, from the 13 sentences receiving poor semantic ratings, four verb pairs were rewritten and nine verb pairs were excluded. Eleven new verb pairs (22 sentences) were written following the same format as described earlier. Five adult native speakers of English, none of who were included the first sample, rated the newly written sentences, rewritten sentences and the sentences that received good semantic judgments from the original sample following the same guidelines as the first sample. From this, two sentences received ratings of poor semantic goodness resulting in the exclusion of two verb pairs (4 sentences). The end result of the semantic goodness rating study was a set of 68 sentences to be further tested with children.

Child pilot study 1: Task requirements. The first child pilot study assessed whether any of the verbs would be particularly difficult for children to imitate and whether children would be able to successfully imitate the large number of sentences in the sentence imitation task. Eleven 3- and 4-year old children with typical language development, per parent report, participated in this study. During the pilot study, children heard sentences read to them by the examiner and were asked to imitate each sentence exactly as they heard it. For the eight training

sentences, repetitions were provided when necessary and feedback on imitation accuracy was provided. Repetitions and feedback were not provided for the test items. Three children were unable to complete the task, all of whom showed articulation deficits that would affect transcription and scoring. The first two children of the eight that completed the pilot task imitated 68 sentences. Based on the performance of these two children, two verb pairs (four sentences) were excluded from the task because the word-final consonant cluster that occurred in either the familiar or unfamiliar verb in the pair (-*sts*) was determined to be too challenging for the children to produce. Following this task modification, six children completed a task that contained the remaining 64 items. Upon completion of the data collection from these children, four additional verb pairs (eight sentences) were excluded because more than 50% of the children could not correctly repeat one of the verbs in the pair. The resulting 28 verb pairs and 56 sentences are provided in Appendices A and B.

Stimulus recording. While sentences were read to the adults and children in the initial pilot studies, training and task stimuli were recorded to ensure consistency in presentation in the full study. The previously described 56 test sentences and 11 training sentences appeared in a mixed order of presentation such that no familiar and unfamiliar verb sentence pairs appeared sequentially and familiar verb sentences did not always precede unfamiliar verb sentences or vice versa. A male native speaker of Standard American English recorded all stimuli in a sound proof booth. All sentences were digitized and edited and the duration of each sentence measured using Audacity. Sentence durations did not significantly differ across conditions, $t(54) = -0.45$, $p = 0.65$. Two additional pilot studies were conducted, one with adults and one with children, to assess the quality of the recorded stimuli.

Adult pilot study 2: Naturalness and transcription. A naïve group of five native English-speaking adult listeners listened to the pre-recorded stimuli and completed two tasks: 1. transcribe sentences at the word level to confirm that each word in the recording could be identified as the intended target and 2. rate the naturalness of the recording of each sentence on a 1-5 scale with a rating of 1 as "*This sentence sounds natural to me*" and a rating of 5 as "*This sentence doesn't sound natural to me*". Findings from the first task revealed that, with the exception of one substitution of *a* for *the*, all words were correctly identified as the targets. For the second task, naturalness ratings did not significantly differ across conditions, $t(54) = 0.17$, $p = 0.87$. Sentences were then presented to a subset of children from the first child study to ensure that children could complete the task when the sentences were presented to them via audiorecording.

Child pilot study 2: Imitating recorded stimuli. Four 3- and 4-year old children from the first child pilot study also participated in the second pilot study. These children listened to the pre-recorded stimuli through headphones and were asked to repeat each sentence exactly as they heard it. The examiner also listened to the stimuli on a second pair of headphones. For the 11 trial sentences, repetitions were provided when necessary and feedback on imitation accuracy was provided. Feedback was not provided for the test items and repetition was only provided if another noise prevented the child from hearing the stimulus. Any repetitions were provided from the taped stimuli. All four children completed the task with minimal redirection. It was also observed that no individual item was particularly difficult for the children to imitate. From this, it was determined that children at the youngest age of the age range of interest in the study could complete the task when stimuli were presented from pre-recorded audio.

Sentence Imitation Task Administration

Administration of the sentence imitation task during the full study was the same as the second child pilot study described above. The author administered, transcribed and scored the sentence imitation task for each child included in the study. The author conducted a preliminary transcription of all imitations online but imitations were also taped for additional transcription and scoring. Each imitation was transcribed at the level of each individual word. Words produced by the child that were not considered real words were transcribed phonetically. To check and correct transcriptions if needed, the author listened to each taped imitation via headphones in a quiet environment.

Sentence Imitation Task Coding

Each sentence imitation attempt was scored at two levels: 1. overall imitation level and 2. the level of each individual component. The full coding system (see Appendix C), described below, follows the design provided in Figure 1.

Overall imitation coding. The first level of item coding was for imitation of all components of the full clause in sequence. Each imitation was coded for overall imitation accuracy. Unscorable imitations were those that were not codeable as correct or incorrect. Items for which the child did not provide any attempt or said "I don't know" (or some variation thereof) were coded as *no attempt*. Items for which the child responded to the stimulus with an attempt deemed to be unrelated to the target (e.g., *we don't throw rocks*) were coded as *off-target*. Imitation attempts that contained one or more unintelligible or ambiguous elements that rendered the clause uninterpretable (e.g., *the girl xx kitchen, xx clean the kitchen*) were coded as *ambiguous*. These unscorable responses were not included in further analyses.

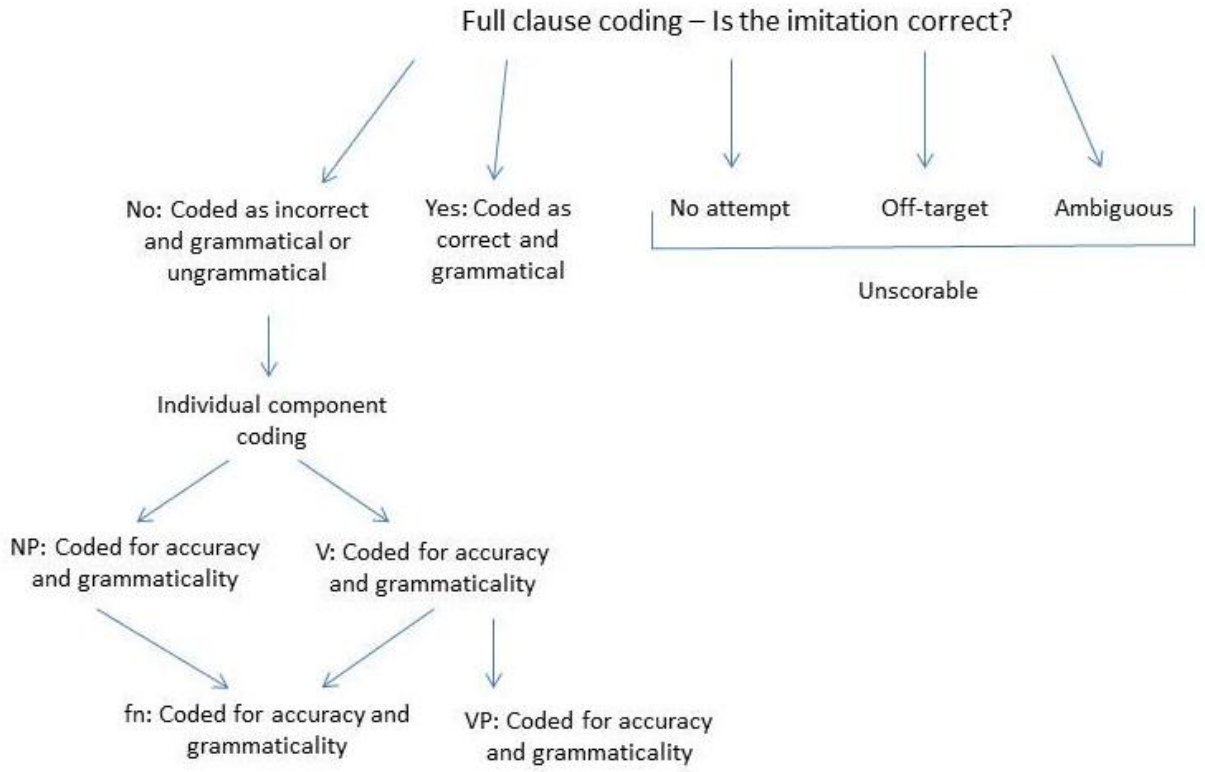

Figure 1. Sentence Imitation Task Coding Flowchart

Correct imitations contained all components of the target item in the same sequence as the input clause. Further, imitations in which the child substituted the determiner *a* for the determiner *the* or vice versa (e.g., *the boy got a/the sticker*) were adjusted and coded as correct imitations. Phonological similarities between *a* and *the* make it difficult to differentiate between the two determiners during imitation. Adjusting the number of correct imitations to include *a*/*the* substitutions resulted in 61 additional utterance attempts coded as correct imitations. Because the addition of these correct imitations did not influence the pattern of findings reported later and the distinction is not relevant to this study, all remaining analyses were conducted on the adjusted set

of scorable imitations. Imitations were coded as incorrect if there was any deviation from verbatim imitation, with the exception of the *a*/*the* adjustment. Imitations coded as correct or incorrect were considered scorable imitations.

In addition to overall imitation accuracy, the child's imitation attempt was coded for the grammaticality of the full clause, with each response receiving a code of *grammatical* or *ungrammatical*. A grammatical imitation attempt was one in which the response, regardless of accuracy of imitation, constituted a grammatical clause based on the adult grammar. Imitation attempts in which at least one component varied from that which is considered grammatical were coded as an ungrammatical response (e.g., **the girl clean the kitchen*). Importantly, imitation accuracy and grammaticality are redundant for correctly imitated clauses in that they are both correct and grammatical. Alternatively, incorrectly imitated clauses are not necessarily ungrammatical – a child can incorrectly imitate the target clause in a way that still renders the clause grammatical in the adult grammar. In this way, incorrect imitations are highly informative as to how children handle clauses that they are not able to correctly imitate.

Individual component coding. Recall that all required components of a clause must be present for the clause to be grammatical. Each stimulus item developed for the sentence imitation task has four components, three of which are required for a grammatically correct full clause. The four components in each target clause are:

Noun phrase (NP)	Verb root (V)	Finiteness marking (fn)	Verb phrase (VP)
The girl	hide	s	her doll

The noun phrase, verb root and finiteness marking are all required in the full clause but the verb phrase is only obligatory in those clauses containing transitive verbs, requiring a direct object (e.g., pulls). The clausal components are not independent of one another.

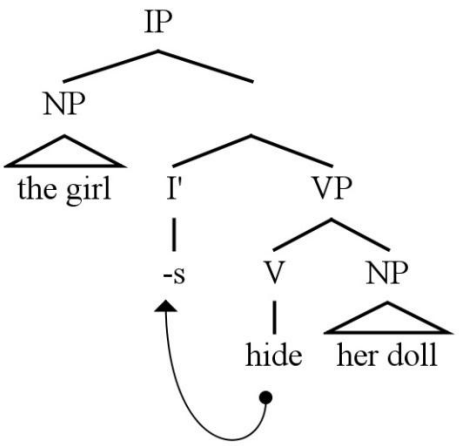

Figure 2. Syntactic Tree Demonstrating Relationship between Clausal Components

As shown in Figure 2, obligatory finiteness marking of the main verb appears in the verb head of the Inflectional Phrase (IP), whether finiteness is overtly marked or if the verb appears with null marking as in the case of a plural subject. In this study, the sentence imitation task stimuli were developed to capture children's use of overt finiteness marking by providing a third person singular subject in each target clause. At the level of individual component coding, each component's accuracy and grammaticality were coded considering the other components produced by the child during the imitation. For example, if the child incorrectly imitated the target third person singular subject, producing a plural subject such as *the girls*, then accurate imitation of finiteness marking on the verb would result in an ungrammatical utterance (i.e., **the girls hides her doll*). Additionally, if the child substituted a verb requiring a different number

and/or type of arguments for the target verb, accurate imitation of the verb phase would result in an ungrammatical utterance (i.e., **the girl gives her doll*). To demonstrate the interconnectedness of the coding system, for the last example, **the girl gives her doll*, the imitation attempt would be coded as follows:

Item level – *incorrectly imitated, ungrammatical full clause*

NP – correctly imitated, grammatical NP

V – *incorrectly imitated*, grammatical V

fn – correctly imitated, grammatical finiteness marking

VP – correctly imitated, *ungrammatical VP*

In addition to showing the interconnectedness of the independent component coding system, this example also demonstrates that imitation accuracy and grammaticality are not fully independent of one another at this level of analysis, in that a correct imitation is not necessarily grammatical and an incorrect imitation is not necessarily ungrammatical. Coding criteria and guidelines for each component were as follows.

Noun phrase imitation. Noun phrase imitation attempts were coded as *correct* or *incorrect*. Correct noun phrase imitation attempts contained all elements of the target noun phrase in the same sequence as the target. Incorrect noun phrase imitation attempts were coded as having one of more of the following deviations from the target noun phrase: 1. omitted/ambiguous subject (e.g., *the* or *the x*), 2. omitted/substituted determiner (e.g., *girl* or *x girl*), 3. substitution – other third person singular noun (e.g., *kid* or *boy* for *girl*), 4. substitution – plural subject (e.g., *girls* for *girl*), 5. substitution – nominative pronoun, third person singular (e.g., *he* or *she* for *girl*), 6. substitution – nominative pronoun, plural subject (e.g., *they* for *girl*), 7. substitution – other pronoun type (i.e., *him, her* or *them*) and/or 8. other type of deviation.

Noun phrase imitations were also coded as *grammatical* or *ungrammatical*. Grammatical noun phrase imitations were those which, regardless of accuracy, were grammatical based on the adult grammar. In ungrammatical noun phrase imitation attempts, one or more element of the component was incorrectly imitated resulting in an ungrammatical noun phrase (e.g., **womans* or **a girls*).

Verb root imitation. Verb root imitations were coded for accuracy, grammaticality and familiarity. For verb root imitation accuracy coding, the verb root produced by the child was coded as *correct* or *incorrect* based on whether it matched the target verb root. For this level of coding, preceding noun phrase and finiteness marking accuracy were not considered, as this analysis was only interested in verb root imitation and not accuracy of verb root imitation following a specific subject or with/without an overt finiteness marker. Correct verb root imitations were exact imitations of the target verb root. Incorrect verb root imitations differed from the target verb root and were coded as one of the following: 1. non-target lexical verb (e.g., *hide* for *stow*), 2. third-person singular irregular verb (e.g., *does, says, has*), 3. copula or auxiliary (e.g., *am, is, are*), 4. non-real verb (e.g., *smide*) and/or 5. other deviation from the target verb root.

Verb root imitations were also coded as *grammatical* or *ungrammatical*. The grammaticality of the verb root imitation was based on the grammaticality of the verb itself, again unrelated to the preceding noun phrase or finiteness marking. Grammatical verb root imitations were those which, regardless of imitation accuracy, constituted a real verb. Ungrammatical verb root imitations were ambiguous or non-real verbs (e.g., *smide* for *hide*). In addition to accuracy and grammaticality, the familiarity of the verb root produced by the child was also coded. Verb roots were coded as *familiar*, *unfamiliar*, or *ambiguous*. Only verb roots

that were originally provided as target unfamiliar verbs were coded as unfamiliar; all other real verb roots produced by the child were coded as familiar under the assumption that the child would not spontaneously produce an unfamiliar verb. Within the familiar category, the produced verb roots were further coded as familiar verbs provided as a target verb or familiar verbs not provided as a target verb (e.g., *love* for *lug*). Verb roots receiving a familiarity code of *ambiguous* were not recognizable as attempts at familiar or unfamiliar real verbs.

Finiteness marking imitation. Finiteness marking coding takes into consideration the noun phrase and verb root produced in the same clause. Finiteness marking accuracy and grammaticality coding could not be conducted on verb roots that were coded as ambiguous. Accuracy coding for finiteness marking was dependent on the subject and verb root produced in the same clause. The design of the sentence imitation task stimuli set up all verbs with an overt, third person singular *–s* finiteness marker. All finiteness marking imitation attempts containing the same *–s* morpheme were coded as *correct*. Incorrect finiteness marking imitations received one of the following codes: 1. omitted finiteness marking with a third person singular subject (e.g., **the girl hide*), 2. double marked for finiteness (e.g., **the girl hideses*), 3. past tense *–ed* morpheme (e.g., *the girl walked*), 4. presence of auxiliary or copula BE in an obligatory context (e.g., *the girl is hiding* or *the girl is pretty*), 5. omission of auxiliary or copula BE in an obligatory context (e.g., **the girl hiding* or **the girl pretty*), 6. null marker with plural subject (e.g., *the girls hide*) and/or 7. other deviation from the target finiteness marker. Note that while this investigation focuses on the third person singular *–s* morpheme finiteness marker, in English, the past tense *–ed*, copula BE and auxiliary BE also function as finiteness markers in English; thus, the presence or absence of these morphemes in obligatory contexts are informative as to theories of finiteness marking deficits in SLI.

Grammaticality coding of finiteness marking imitations was based on the subject produced in the same clause as the finiteness marker. Specifically, the production of a third person singular subject, regardless of whether it was the target subject, sets up an obligatory context for overt finiteness marking in the same clause so the absence of a finiteness marker would be ungrammatical (e.g., **the girl hide*). Alternatively, if the child produced a first-person, second-person or plural subject in the noun phrase, the presence of an overt finiteness marker would be coded as ungrammatical (e.g., **the girls hides*), because those subjects do not require overt finiteness marking on the verb. An imitation in which the child produced the bare stem of the verb after a first-person, second-person or plural subject, however, would be coded as grammatical (e.g., *the girls hide*). Whether the subject produced in the noun phrase was grammatical (e.g., *womans* for *woman* or *her* for *girl*) did not influence finiteness marking coding, as it was the number of the subject (first- v. second- v. third-person singular v. plural subject) that did/did not set up an obligatory contexts for overt finiteness marking.

Verb phrase imitation. Verb phrase imitations were coded for accuracy, grammaticality and argument structure. Revisiting Figure 1, verb phrase imitation coding is dependent on the verb root produced in the same clause, as different verb roots require different types and numbers of arguments. Verb phrase imitations received codes of either *correct* or *incorrect*. Correct imitations contained all elements of the verb phrase component in the same order as the target. Incorrect imitations were further coded as containing one or more of the following deviations from the target verb phrase: 1. omitted, substituted or added preposition (e.g., *the girl runs around the street* for *the girl runs down the street*), 2. omitted, substituted or added determiner (e.g., *the man sings on the stage* for *the man sings on stage*), 3. omitted/ambiguous noun (e.g.,

*_the girl hides the_ for _the girl hides the doll_), 4. substituted noun (e.g., _the girl hides the dog_ for _the girl hides the doll_) and/or 5. other deviation from the target verb phrase.

Verb phrase imitations were also coded as *grammatical* or *ungrammatical* based on how they followed from the verb root produced in the same clause. Similar to other components, this coding disregards the accuracy of the verb root imitation and accuracy of the verb phrase imitation. For example, a correctly imitated verb phrase following an incorrectly imitated target verb root, in which a verb with a different argument structure was substituted for the target verb, would be coded as ungrammatical (e.g., _the girl gives her doll_). Alternatively, a correctly imitated verb root with a subsequent incorrectly imitated verb phrase may also be coded as ungrammatical (e.g., *_the girl hides on the doll_). Verb phrase imitations were also coded as containing *correct* or *incorrect* argument structure. Again, this coding was based on the verb root produced in the same clause; however, this coding system disregarded verb root imitation grammaticality. Verb phrase imitations received codes for correct argument structure if they contained the correct number and type(s) of arguments as required by the verb root produced. For example, *give* requires an object and recipient so the omission of either object or recipient in the verb phrase would result in a code of incorrect argument structure (e.g., *_the girl gives the doll_ or *_the girl gives to the friend_).

Evaluation of interpretive accounts. Specific types of deviations from the target clause made during imitation were coded to set up an examination of the two proposed accounts of sentence imitation task performance – the Child Grammar Account and the Verbal Memory Account. The Child Grammar Account suggests that children draw on the grammar they have available as they listen to the input clause and prepare their response (e.g., Prutting & Connolly, 1976; Prutting, Gallagher & Mulac, 1975; Vinther, 2002). According to the Child Grammar

Account, deviations from the target clause during imitation would be consistent with the grammar available to each child. For example, children in the Optional Infinitive stage would also be optional with finiteness marking during imitation (as shown in Ambridge & Pine, 2006). Additionally, the full clause, if within the input buffer, is thought to be interpreted by their grammatical system; therefore, when all grammatical elements are present in their grammatical system, children will produce grammatically correct clauses even when incorrectly imitating the target clause. Consider the utterance *the girl hides her doll*. If the child substitutes *gives*, which takes three arguments, for *hides*, which takes two arguments, when producing their imitation attempt, they will likely add an additional argument (i.e., *in the box*) to satisfy the grammatical demands of the verb they produced. If the child's grammar wasn't involved during imitation, deviations from the target clause would more likely result in ungrammatical clauses. To examine the Child Grammar Account, imitation attempts were coded for imitation deviations consistent with children's developing grammatical systems (i.e., optional use of finiteness marking in obligatory contexts) and the grammaticality of imitations that were incorrectly imitated.

The Verbal Memory Account posits two possibilities for children's performance during the sentence imitation task. The first proposal is that children store the stimulus item in their verbal memory as a string of words in serial order and reproduce the string as it was stored (e.g., Conti-Ramsden et al., 2001; Fraser et al., 1963; Willis & Gathercole, 2001). Following this proposal, Gillam, Cowen & Day (1995) suggested that "mistakes in serial recall consist primarily of alterations in the reported locations of adjacent items" and Lee and Estes (1981) argued that individual items from the serial string will be lost during recall. For example, for the target item *the girl hides the doll*, the Verbal Memory Account would predict that errors in imitation would result in imitation attempts such as **the girl the hides doll* or **the girl the doll*. To examine these

proposals, imitation attempts were coded for out-of-order components and omitted components. The second proposal is based on Daneman and Carpenter's (1980, 1983) theory that verbal memory involves storage and processing functions that pull from the same set of resources. Building on this theory, Montgomery (1995, 2002, 2003) proposed that children with SLI have limitations in processing, and thus direct more resources toward processing, resulting in an inability to store the input in full, or "forgetting". Further, Montgomery predicted that children with SLI cannot integrate recently received input with previously received (and now "forgotten") input. This latter proposal predicts that, during the sentence imitation task, children with SLI would be more likely to omit the noun phrase (early input) and would produce more ungrammatical responses due to difficulty integrating old input with more recent input. Following this proposal, the number of omitted noun phrases and number of ungrammatical responses were compared across groups.

Procedures

Standardized and experimental testing procedures. Participants recruited from the larger LASLAB study were administered the sentence imitation task during their regularly scheduled bi-annual testing session. According to the LASLAB testing protocol, children are administered standardized measures annually and experimental measures (including spontaneous language sampling and therefore MLU) bi-annually. For those children not receiving standardized testing during the same time of testing as the sentence imitation task administration, standardized test scores were taken from the full testing session directly preceding or following the sentence imitation task administration, based on the age of the child.

For participants recruited for this study only, testing was completed in two one-hour sessions taking place either in a mobile testing unit customized for data collection with children

or in a quiet room at the child's daycare center. The standardized and experimental tasks were administered in the order shown below, with few exceptions as needed for individual children.

Session 1	PPVT-R Language omnibus measure (TOLD-P2 or TELD) GFTA-2 TEGI phonological probe
Session 2	Sentence imitation task CMMS Spontaneous language sample

Spontaneous language sampling procedures. Spontaneous language samples were collected at the same time of testing as the sentence imitation task by examiners trained in language sample collection and transcription/coding conventions. The language sample followed a play-based sampling procedure where the child and examiner played with a standard set of age-appropriate toys, including a house, furniture, people and farm animals. The examiner aimed for at least 200 complete and intelligible utterances per child, which typically requires 20 – 30 minutes of sample time with exceptions for more or less talkative or intelligible children. The examiner administering each sample also transcribed and coded each sample based on conventions set forth in the Kansas Language Transcript Database (Rice et al., 2004). Transcribed and coded language samples were submitted to the Systematic Analysis of Language Transcript (SALT) software for generation of MLU in morphemes and MLU in words, based on complete and intelligible utterances only.

Reliability

Interjudge reliability was completed for transcription and coding of sentence imitation task performance for 4% of each group (SLI group $n = 4$, AE group $n = 4$, LE group $n = 3$ participants). The same second judge performed both the transcription and coding reliability.

Transcription reliability estimates were conducted on an individual word level and estimates were calculated using the following formula: number of same words/number of total words. Across all 11 participants for whom transcription reliability was conducted, transcription reliability was 92.5% reliable (*SD* = 4.4%, Range = 82.2 - 98.3). For each group, transcription reliability was as follows: LE group = 90.8% (*SD* = 2.3%, Range = 88.1 - 92.3), SLI group = 90.3% (*SD* = 5.7%, Range = 82.2 - 94.4), AE group = 96% (*SD* = 2%, Range = 93.5 - 98.3).

Interjudge coding reliability was only calculated for those items on which transcription was the same for both transcribers. The formula used to calculate coding reliability for each variable was: number of same codes/number of total codes. Coding reliability was conducted for accuracy and grammaticality of overall imitation and each of the independent components. Overall coding reliability was 99% (*SD* = 1%, Range = 83.9 - 100). Complete results for the interjudge coding reliability are included in Appendix D.

Chapter III: Results

The primary purpose of this study was to examine a whether verb familiarity affects finiteness marking accuracy in typically developing children and children with SLI. Research questions were developed for each level of analysis required to address the study purpose. Study findings will be reported for each level of analysis.

Overall Imitation Analysis

The first level of analysis addressed the proposed general language deficits in SLI by evaluating overall sentence imitation accuracy. Three research questions were developed for this analysis:

1a. Do the participant groups differ in the number of items accurately imitated?

1b. Does the number of items accurately imitated differ based on the familiarity of the target verb?

1c. If condition effects are evident for the number of items correctly imitated, do the differences between conditions vary across groups?

To address these questions, overall imitation attempt accuracy was coded and analyzed. The dependent variable for this analysis was the percent of correctly imitated full clauses out of all scorable responses. Recall that a scorable response was one receiving a code of *correct* or *incorrect*. Responses receiving codes of *no attempt*, *off-target* or *ambiguous* were considered unscorable responses. The percent of unscorable responses out of the total number of responses was 6.1% for the LE group (55 unscorable/896 total), 4.1% for the SLI group (46 unscorable/1120 total) and 2.2% for the AE group (28 unscorable/1288 total). The groups differed significantly in number of unscorable responses ($F(2,56) = 3.96$, $p < 0.05$), with significant differences between the AE group and each of the SLI and LE groups ($t(41) = 2.27$, p

< 0.05, d = 0.68; $t(37) = 2.75$, $p < 0.05$, $d = 0.83$, respectively), which did not differ significantly from one another ($t(34) = 0.86$, $p = 0.4$). Within each group, the number of unscorable items did not differ significantly across conditions: LE – 24 familiar, 31 unfamiliar ($t(15) = 1.1$, $p = 0.29$), SLI – 12 familiar, 34 unfamiliar ($t(19) = 1.99$, $p = 0.06$), AE – 14 familiar, 14 unfamiliar ($t(22) = 0.0$, $p = 1.0$). Based on these results, the decision was made to conduct further analyses on the percent correct of scorable responses rather than raw counts of correctly or incorrectly imitated items. The following formula was used to calculate the dependent variable for this analysis:

> Percent correct of all scorable responses = Number of correctly imitated items/Total number of scorable items

Data were analyzed using a 3 group (SLI v. LE v. AE) x 2 condition (familiar v. unfamiliar) multilevel model containing a random intercept to address within-subject dependencies. In this analysis, verb familiarity was based on the classification of the target verb occurring in the stimulus item. Results are presented according to the research question addressed:

1a. Do the participant groups differ in the number of items accurately imitated?

The multilevel model showed significant differences between the AE group and each of the SLI and LE groups ($z = 5.87$, $p < 0.05$, $d = 1.94$; $z = 4.97$, $p < 0.05$, $d = 1.63$, respectively). The SLI group and LE groups did not significantly differ ($z = 0.52$, $p = 0.6$). As reported in Table 2, the percent correct was higher for the AE group compared to each of the LE and SLI groups (74.1%, 43.2% and 40.1% respectively). These findings indicate that the AE group was more accurate in full clause imitation compared to the LE and SLI groups, who were very similar in full clause imitation accuracy.

1b. Does the number of items accurately imitated differ based on the familiarity of the target verb?

A significant difference was also shown between the conditions ($z = 11.83$, $p < 0.05$, $d = 0.83$), with percent correct higher for items in the familiar condition compared to the unfamiliar condition (64.7% v. 43.5%). Thus, children were more accurate in imitating full clauses containing verbs familiar to them than verbs unfamiliar to them.

1c. If condition effects are evident for the number of items correctly imitated, do the differences between conditions vary across groups?

The analysis showed no significant group x condition interaction, indicating that the groups did not differ in the ways in which familiar verbs and unfamiliar verbs influenced overall imitation accuracy.

Table 2

Mean, SD and Range of the Percent Correct of Full Clause Imitations out of all Scorable Responses

	LE (n=16)	SLI (n=20)	AE (n=23)	Total (n=59)
Familiar	55 (28.6) 4-88	49.8 (25.6) 4-86	84.5 (12) 59-96	64.7 (27.2) 4-96
Unfamiliar	31.4 (19.9) 0-57	29.9 (18.4) 0-64	63.7 (16.4) 31-96	43.5 (24.1) 0-96
Conditions combined	43.2 (23.7) 4-71	40.1 (21.3) 2-75	74.1 (12.5) 54-96	54.2 (24.7) 2-96

Individual Component Analysis

The second level of analysis focused on imitation accuracy of individual components within the full clause. Considering the finiteness marking and verb lexicon deficits in SLI and the hypothesis of a finiteness marking x verb familiarity interaction, analyses at this level focused on finiteness marking and verb root imitation.

Finiteness marking imitation accuracy. The finiteness marking imitation accuracy analysis addressed three research questions:

2a. Do the participant groups differ in finiteness marking imitation accuracy?

2b. Does finiteness marking imitation accuracy differ based on verb familiarity?

2c. If condition effects are evident for finiteness marking imitation accuracy, do they differ across groups?

To examine these questions, finiteness marking imitation attempt accuracy was coded and analyzed. The dependent variable for this analysis was the percent correctly imitated finiteness markers in obligatory contexts for overt finiteness marking. An obligatory context for overt finiteness marking contains a third person singular subject and a lexical verb (e.g., *the girl hide_*). The following formula was used to calculate the dependent variable:

> Percent correct finiteness marking imitation in obligatory contexts = Number of correctly imitated finiteness markers in obligatory contexts/ Number of obligatory contexts for overt finiteness marking

For this analysis, verb familiarity was handled in two ways. For the first method, referred to as the experimental stimulus grouping method, verb familiarity was based on the a priori classification of the target verb in the stimulus item as familiar or unfamiliar. For the second method of classifying verb familiarity, familiarity was based on the verb root produced by the

child, irrespective of the target verb classification. To review, verb roots produced by the child were coded as *familiar, unfamiliar* or *ambiguous*. Only imitated verb roots that were originally classified as unfamiliar were coded as unfamiliar and all other real verbs provided during imitation were coded as familiar. The second method of handing verb familiarity, the produced verb grouping method, utilized the verb familiarity coding.

Like the overall imitation analysis, data were analyzed using a 3 group (SLI v. LE v. AE) x 2 condition (familiar v. unfamiliar) multilevel model. Results will first be reported from the experimental stimulus grouping of verb familiarity then from the produced verb grouping of verb familiarity.

Experimental stimulus grouping. For this analysis, familiarity classification was based on the a priori classification of the target verb as familiar or unfamiliar. Findings are presented according to the research questions guiding the finiteness marking component analysis.

2a. Do the participant groups differ in finiteness marking imitation accuracy?

Similar to item-level imitation accuracy, the AE group differed significantly from both the SLI and LE groups ($z = 3.48$, $p < 0.05$, $d = 1.14$; $z = 2.84$, $p < 0.05$, $d = 1.06$, respectively), who did not significantly differ ($z = 0.42$, $p = 0.68$). As shown in Table 3, percent correct was higher for the AE group than the LE and SLI groups (92.7%, 75.7%, and 71.8%, respectively). These findings indicate that the AE group was more accurate imitating finiteness marking compared to each of the SLI and LE groups, who did not differ.

2b. Does finiteness marking imitation accuracy differ based on verb familiarity?

Percent correct was significantly higher for the familiar condition compared to the unfamiliar condition (85.2% v. 76%), $z = 5.37$, $p < 0.05$, $d = 0.4$. This suggests that whether the

target stimulus item included a familiar verb or an unfamiliar verb affected finiteness marking accuracy on the verb produced during imitation.

Table 3

Mean, SD and Range of the Percent Correct of Finiteness Marking Imitations in Obligatory Contexts using Experimental Stimulus Grouping Classification

	LE (n=16)	SLI (n=20)	AE (n=23)	Total (n=59)
Familiar	82.2 (19.8) 22-100	77.8 (24.9) 18-100	93.6 (6.8) 75-100	85.2 (19.3) 18-100
Unfamiliar	66.5 (30.6) 0-100	65.3 (28.8) 0-100	91.8 (7.2) 77-100	76 (26.4) 0-100
Conditions combined	75.7 (21.8) 19-100	71.8 (25.2) 20-98	92.7 (6.1) 80-100	81 (20.9) 19-100

2c. If condition effects are evident for finiteness marking imitation accuracy, do they differ across groups?

This analysis revealed a significant group x condition interaction, such that there is a difference in conditions between the AE group and each of the SLI and LE groups ($z = 2.49$, $p < 0.05$, $d = 1.35$; $z = 3.03$, $p < 0.05$, $d = 1.22$, respectively), as depicted in Figure 3. The finding of a significant interaction qualifies the previously reported finding of significant group and condition differences. This finding indicates that hearing an unfamiliar verb in the input clause did not influence finiteness marking for the AE group but conferred a disadvantage on finiteness marking imitation accuracy for the LE and SLI groups.

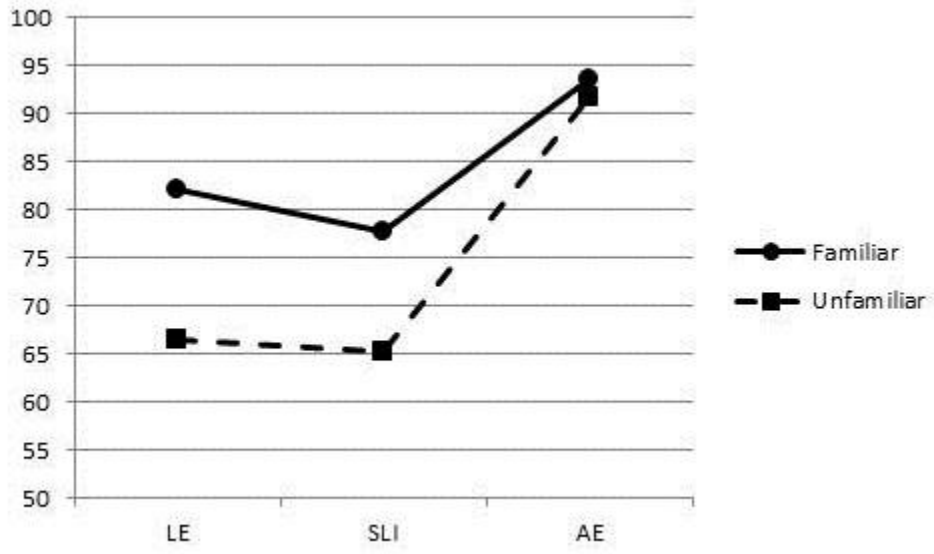

Figure 3. Percent Correct of Finiteness Marking Imitations in Obligatory Contexts using the Experimental Stimulus Grouping Classification

Produced verb grouping. For this analysis, familiarity classification was based on the verb produced by the child. If the child substituted a familiar verb for an unfamiliar verb, for example, the verb would be categorized as familiar in this analysis. A preliminary analysis revealed that the SLI and LE groups were more likely than the AE group to substitute a familiar verb for an unfamiliar verb during imitation. The number of familiar verb for unfamiliar verb substitutions for each group was: SLI: $M = 6.5$ ($SD = 2.8$), LE: $M = 6.2$ ($SD = 3.2$), AE: $M = 3.8$ ($SD = 2.3$). Therefore, the SLI and LE groups had more familiar verbs than unfamiliar verbs on which finiteness marking accuracy was assessed. Research questions 2b and 2c have been modified to account for the change in verb familiarity coding (with modifications underlined).

2a. Do the participant groups differ in finiteness marking imitation accuracy?

In this analysis, the AE group differed significantly from each of the SLI and LE groups ($z = 3.36$, $p < 0.05$, $d = 1.13$; $z = 2.84$, $p < 0.05$, $d = 1.06$, respectively). The SLI and LE groups did not significantly differ ($z = 0.3$, $p = 0.76$). As reported in Table 4, the AE group produced a

greater percent correct imitating finiteness marking than the SLI group and the LE group (92.7%, 71.9% and 75.7%, respectively). These findings reveal that the SLI and LE groups were poorer at imitating finiteness marking compared to the AE group.

2b. Does finiteness marking imitation accuracy differ based on the familiarity of the verb produced by the child during the imitation attempt?

In the condition comparison, percent correct was significantly higher for the familiar v. unfamiliar condition (82.7% v. 79.3%; $z = 2.03$, $p < 0.05$, $d = 0.15$). This finding suggests that finiteness marking imitation was more accurate when the verb produced by the child was familiar to them versus unfamiliar to them.

Table 4

Mean, SD and Range of the Percent Correct of Finiteness Marking Imitations in Obligatory Contexts using Produced Verb Grouping Classification

	LE (n=16)	SLI (n=20)	AE (n=23)	Total (n=59)
Familiar	77.8 (20.7) 19-100	75 (24.3) 24-100	92.9 (6.6) 76-100	82.7 (19.7) 19-100
Unfamiliar	72 (30.9) 19-100	69.5 (30.5) 0-100	92.6 (7.7) 74-100	79.3 (26.2) 0-100
Conditions combined	75.7 (21.8) 19-100	71.9 (25.2) 20-98	92.7 (6.1) 80-100	81.1 (20.9) 19-100

2c. If condition effects are evident for finiteness marking imitation accuracy when familiarity is based on the verb produced by the child during the imitation attempt, do they differ across groups?

This analysis showed no significant group x condition interaction, indicating that the groups did not differ in finiteness marking imitation accuracy on familiar verbs vs. unfamiliar verbs produced by them.

Verb Root Imitation Accuracy. For the verb root imitation accuracy analysis, data were analyzed using a 3 group (SLI v. LE v. AE) x 2 condition (familiar v. unfamiliar) multilevel model. The dependent variable was the number of correct verb root imitations and verb familiarity was based on the classification of the target verb occurring in the stimulus item. Results are reported for each research question developed for this level of analysis.

3a. Do the participant groups differ in verb root imitation accuracy?

The AE group differed significantly from each of the SLI and LE groups ($z = 3.10$, $p < 0.05$, $d = 0.98$; $z = 3.56$, $p < 0.05$, $d = 1.27$, respectively) but differences between the SLI group and LE group were not significant ($z = 0.63$, $p = 0.53$). As reported in Table 5, collapsed across experimental conditions, the AE group correctly imitated 49.5 verb roots, the SLI group correctly imitated 44.9 and the LE group correctly imitated 43.8 verb roots. According to these results, none of the groups made many errors in imitating the verb roots but the AE group was more accurate than the LE group with the SLI group's performance between that of the two control groups.

3b. Does verb root imitation accuracy differ based on the familiarity of the target verb?

Familiar verb root imitation accuracy differed from unfamiliar verb root imitation accuracy, ($z = 11.5$, $p < 0.05$, $d = 1.63$), with greater accuracy for familiar verbs compared to

unfamiliar verbs (25.9 v. 20.5). This indicates that children were more accurate in imitating familiar verb roots compared to unfamiliar verb roots. This effect is qualified by the interaction reported below.

Table 5

Mean, SD and Range of the Number of Correct Verb Root Imitations

	LE (n=16)	SLI (n=20)	AE (n=23)	Total (n=59)
Familiar	24.8	25.9	26.7	25.9
	(1.9)	(1.8)	(1.5)	(1.9)
	21-27	23-28	23-28	21-28
Unfamiliar	19	19	22.8	20.5
	(3.5)	(4.6)	(3.7)	(4.3)
	13-24	8-23	13-27	8-27
Conditions combined	43.8	44.9	49.5	46.4
	(4.8)	(5.8)	(4.2)	(5.5)
	16-34	33-51	39-55	33-55

3c. If condition effects are evident for verb root imitation accuracy, do they differ across groups?

The analysis revealed a significant group x condition interaction, such that there are differences in conditions between the AE group and the SLI and LE groups, $z = 2.59$, $p < 0.05$, $d = 2.25$ and $z = 1.56$, $p < 0.05$, $d = 1.06$, respectively. As shown in Figure 4, the interaction appears to be driven by differences in imitation accuracy of unfamiliar verbs between the AE and each of the SLI and LE groups. These findings indicate an advantage of familiar verbs on verb root imitation for all three groups and more of a disadvantage of unfamiliar verbs on verb root imitation for the SLI and LE groups.

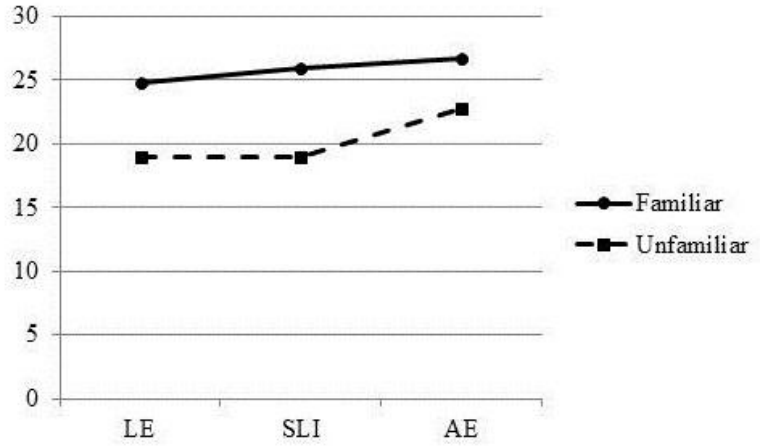

Figure 4. Number of Correct Verb Root Imitations

Evaluation of Interpretive Accounts. An analysis was conducted to determine whether patterns of deviations from the target clauses made by children in each participant group support the Child Grammar Account or Verbal Memory Account of sentence imitation task performance.

Child Grammar Account. To review, according to the Child Grammar Account, children process the stimulus clause using the grammar they have available and, therefore, imitations reflect the grammar of their spontaneous utterances (Prutting & Connolly, 1976; Prutting et al., 1975; Vinther, 2002). There are two predictions for deviations from the target clause during sentence imitations that follow from this account: 1. deviations will follow the grammatical abilities of the child and 2. children will produce clauses consistent with their grammar even when deviating from the target on one or more components. To examine the first prediction, imitations were coded for deviations consistent with children's developing grammatical systems. Given that the SLI and LE groups are considered to be in a period of optional finiteness marking in obligatory contexts, they were expected to be more likely to omit obligatory finiteness markers during imitation than the AE group who are nearing adult-levels of competence in

finiteness marking. Previous analyses demonstrated that the SLI and LE groups imitate finiteness marking less accurately than the AE group but did not specifically examine omissions of finiteness marking. The percent of obligatory contexts in which finiteness marking was omitted was computed. Results showed that the SLI group (M = 22.7, SD = 22.4, Range = 0 - 69) and LE group (M = 19.8, SD = 20.4, Range = 0 - 79) had a higher percentage of omitted finiteness markers in obligatory contexts compared to the AE group (M = 6.4, SD = 5.4, Range = 0 - 20). A one-way ANOVA revealed that this difference was significant, $F(2, 56) = 5.51$, $p < 0.05$, $\eta = 0.16$. A closer look at differences between the groups indicated that the AE group differed significantly from each of the SLI and LE groups ($t(41) = 3.38$, $p < 0.05$, $d = 1.0$; $t(37) = 3.02$, $p < 0.05$, $d = 0.9$, respectively), which did not significantly differ ($t(34) = 0.4$, $p = 0.69$, $d = 0.14$). This pattern of findings is consistent with expectations based on understanding of the finiteness marking systems of the three groups, therefore supporting the Child Grammar Account.

The second prediction of the Child Grammar Account was that, since children draw on the grammar they have available as they hear the input and produce their response, they will produce grammatical clauses even when incorrectly imitating the target clause. The three groups differed in the number of incorrectly imitated full clauses they produced ($F(2, 56) = 20.76$, $p < 0.001$) with the AE group producing fewer incorrect clauses compared to the SLI and LE groups, AE: M = 14.1, SD = 6.7; SLI: M = 32.1, SD = 11.5; LE: M = 39.5, SD = 11.5. However, an examination of the proportion of incorrectly imitated clauses that were grammatical revealed no group differences, AE: M = 0.35, SD = 0.14; SLI: M = 0.28, SD = 0.16; LE: M = 0.24, SD = 0.16) This indicates that while the AE group was less likely to incorrectly imitate the target clause, when clauses were incorrectly imitated, all three groups were equally likely to change one or more components to result in a grammatically well-formed clause. This finding

raised the question of whether the three groups were changing the clauses similarly. A probe into the subset of full clauses that were incorrectly, but grammatically, imitated examined this question. The number of times that one of the clauses in this subset contained an incorrect, grammatical imitation in only one component or multiple components is reported in Table 6.

Table 6

Mean, SD and Range of the Number of Incorrect, Grammatical Individual Components or Combination of Components in Incorrectly Imitated, Grammatical Full Clauses

	LE (n=16)	SLI (n=20)	AE (n=23)
Noun phrases	1.4 (2.2) 0-7	2.1 (2.4) 0-8	0.9 (1.4) 0-5
Verb roots	1.9 (1.7) 0-6	1.9 (2) 0-7	1.7 (1.2) 0-4
Finiteness marking	0.1 (0.3) 0-1	0 (0) 0	0.1 (0.4) 0-2
Verb phrase	1.3 (1.3) 0-4	1.6 (1.6) 0-7	1.4 (1.3) 0-5
Multiple components	1.4 (1.5) 0-4	2.7 (3.6) 0-14	0.7 (1.2) 0-4

Table 6 shows that the LE and SLI groups were similar in the ways in which they changed the components to make a grammatical full clause. The pattern for the AE group differed from those of the other two groups, however. Specifically, the AE group was less likely to change the noun phrases or multiple components; instead, changes to the verb root and verb

phrase accounted for most of the incorrect, grammatical full clauses by the AE group. These findings indicate that, while the children with SLI and the younger, LE group, who have a more immature grammar than the AE group, make more errors during imitation, they are still able to use the grammar they have available to produce a grammatical clause and do so similarly.

Verbal Memory Account. The Verbal Memory Account suggests that verbal memory instead of language ability influences sentence imitation task performance (e.g., Conti-Ramsden et al., 2001; Fraser et al., 1963; Willis & Gathercole, 2001). In addition, it has been argued that children with SLI have poorer verbal memory compared to typically developing children and will therefore perform more poorly on tasks involving verbal memory (e.g., Gathercole & Baddeley, 1990). The Verbal Memory Account puts forth two sets of predictions for deviations from the target clause during imitation. The first is that deviations will take the form of out-of-order or omitted components and that children with SLI will have a greater number of out-of-order or omitted components due to limitations in verbal memory (Gillam et al., 1995; Lee & Estes, 1981). To examine this prediction, full clause imitations were explored for cases of out-of-order components and omissions for each individual component were totaled. In each of the 3304 items examined (56 items for each of 59 participants) there were no instances of components imitated out-of-order. Independent component omissions in scorable utterances are summarized in Table 7. As shown, the children with SLI did not present a greater number of omitted components; instead their number of omissions was consistently less than that of the LE group.

Table 7

Mean, SD and Range of the Number of Omissions of Individual Components in Scorable Responses

	LE (n=16)	SLI (n=20)	AE (n=23)
Noun Phrase	7.9 (15.8) 0-45	0.35 (0.67) 0-2	0.13 (0.63) 0-3
Verb	1.4 (2) 0-8	0.35 (0.67) 0-2	0.09 (0.29) 0-1
Verb Phrase	0.25 (2) 0-8	0.15 (0.49) 0-2	0.04 (0.21) 0-1

The second set of predictions come from the work of Daneman and Carpenter (1980, 1983) and Montgomery (see Montgomery, 2002 for a summary), which proposes that children with SLI have limitations in processing, one component of verbal memory, and that these limitations result in poorer storage of linguistic input. This theory predicts that children will SLI will be more likely to omit the noun phrase (early input) and produce more ungrammatical imitations compared to both control groups. As can be seen in Table 7, it is uncommon for the children with SLI to omit the noun phrase and they omit noun phrases considerably less frequently than the LE group. A comparison of the number of ungrammatical imitations across groups indicates that the children with SLI are equally likely as the LE group and less likely than the AE group to produce ungrammatical imitations, SLI: $M = 23.8$, $SD = 11.6$; LE: $M = 23.4$, $SD = 13.2$; AE: $M = 9.1$, $SD = 4.3$. These findings, taken together with the previously mentioned out-of-order and omitted components findings, counter the predictions of the Verbal Memory Account of sentence imitation.

Summary

To review, the results of the sentence imitation task analysis revealed that, for most analyses, performance by the SLI group was below that of the AE group but similar to the LE group. Findings also supported the Child Grammar Account but countered the predictions of the Verbal Memory Account of sentence imitation. These findings are summarized in Table 8.

Table 8

Summary of Findings from the Sentence Imitation Task Analysis

Analysis	Group Effects	Condition Effects	Interaction
Overall Imitation Accuracy	AE > SLI = LE	Fam > Unfam	ns
Individual Component Accuracy			
Finiteness Marking Imitation Accuracy Experimental Stimulus Grouping	AE > SLI = LE	Fam > Unfam	Group x Condition
Finiteness Marking Imitation Accuracy Verb Produced Grouping	AE > SLI = LE	Fam > Unfam	ns
Verb Root Imitation Accuracy	AE > SLI = LE	Fam > Unfam	Group x Condition
Evaluation of Interpretive Accounts			
Percent of Omitted Finiteness Marking in Obligatory Contexts	SLI = LE > AE		
Proportion of Incorrectly Imitated Clauses that were Grammatical	SLI = LE = AE		
Number of Omitted Noun Phrases	LE > SLI = AE		
Number of Ungrammatical Imitations	AE > SLI = LE		

Chapter IV: Discussion

This study explored whether verb familiarity influences finiteness marking accuracy in children with SLI and two groups of control children. A sentence imitation task and coding system, both developed for this study, allowed an evaluation of finiteness marking and verb root accuracy in addition to a possible interaction between the two variables, addressed by an analysis of sentence imitation task performance at multiple levels. In addition, this study explored two accounts of sentence imitation task performance: the Child Grammar Account and the Verbal Memory Account.

Overall Imitation Accuracy

An analysis of overall imitation accuracy indicated that the AE group was more accurate in full clause imitation compared to the LE and SLI groups, who had similar levels of accuracy. Across all groups, children were more accurate in imitating clauses containing verbs familiar to them than verbs unfamiliar to them. The null finding of a group x condition interaction indicated that whether the verbs were familiar or unfamiliar did not differentially influence the accuracy with which the three groups imitated the clauses.

An interpretation of these findings comes from the work of Prutting et al. (1976; 1975), who posited that imitations semantically and syntactically mirror the child's linguistic abilities. The AE group was more accurate in imitation than the LE and SLI groups, each of which has a grammatical system less mature than that of the AE group. Considering the literature on the general linguistic deficits in children with SLI, the SLI group in this study performed as expected with overall imitation accuracy below age expectations and similar to language-level expectations. It must also be acknowledged that the advantage in overall imitation accuracy for

the AE group could be due to more robust verbal memory for that group compared to the SLI and LE groups, a possibility examined in more detail in subsequent levels of analysis.

The finding of greater imitation accuracy on clauses containing familiar verbs versus clauses containing unfamiliar verbs can also be accounted for by Prutting's theory of sentence imitation. Unfamiliar verbs, and their corresponding semantic and syntactic requirements, are considered to be less established in the child's linguistic system. Therefore, when the child encounters the unfamiliar verb in the sentence imitation input, they are less accurate in the imitation of that verb and its linguistic requirements.

It was predicted that the SLI group would be less accurate in imitation than the AE and LE groups due to weaknesses in finiteness marking and the verb lexicon. The finding of no significant group x condition interaction for overall imitation accuracy suggests that the effect of verb familiarity is the same for the SLI and LE groups. However, a failure to imitate correctly, following the logic of the Child Grammar Account, could be for different reasons. The individual component analysis, described below, permits a closer look into the grammatical systems of the individual groups. This analysis is, therefore, more informative as to whether the differences between the AE group and the SLI and LE groups are driven by differences in accuracy of one or more components and whether the SLI and LE groups, equivalent in overall accuracy, differ in the types of errors they make on individual components.

Individual Component Analysis

This level of analysis examined the hypothesized deficits in finiteness marking and the verb lexicon and the whether verb familiarity influences finiteness marking accuracy.

Finiteness marking imitation. For the finiteness marking imitation analysis, verb familiarity was handled two ways. In the experimental grouping method, verb familiarity was

based on the a priori classification of the target verb. The produced verb grouping method based verb familiarity on the familiarity of the verb produced by the child, irrespective of target verb classification. The finiteness marking analysis indicted that the AE group was consistently more accurate on finiteness marking than each of the SLI and LE groups, which did not differ.

For both methods of verb familiarity classification, finiteness marking imitation accuracy neared ceiling level performance for the AE group (92.7% in both methods). This finding is in accordance with the literature demonstrating that, while all children go through a period in which finiteness marking is treated as optional in their grammar, typically developing children begin to achieve adult levels of accuracy in finiteness marking at around age 5 (Rice et al., 1998). Based on consistent evidence that LE and SLI groups at the ages included in this study are optional in their use of finiteness marking, it was predicted that these two groups would show optionality in finiteness marking imitation (Hadley & Rice, 1996; Rice et al., 1995; Rice et al., 1998). This prediction was supported by finiteness marking imitation accuracy around 75% and 71% for the LE and SLI groups, respectively.

Because finiteness marking deficits in SLI exceed general language levels (Hadley & Rice, 1996; Leonard, Eyer, Bedore, & Grela, 1997; Rice et al., 2009; Rice & Wexler, 1996; Rice et al., 1995; Rice et al., 1998), it was expected that the children with SLI would demonstrate less accurate finiteness marking than the LE groups. This finding was not supported by findings from this study, in which the SLI and LE groups did not differ in finiteness marking accuracy. Because finiteness marking is a dependent variable in this study, it was not used as an inclusionary criterion during group selection and assignment. Closer inspection of the data suggested that there may have been sampling effects, such that some children in the LE group had particularly low levels of finiteness marking accuracy. Such sampling effects would account

for the unexpected null finding of a difference in finiteness marking between the SLI and LE groups. Additionally, finiteness marking accuracy for the LE group was similar for the sentence imitation task and the TEGI Third Person Singular Probe (75.7% and 72.6%, respectively), while the SLI group demonstrated greater finiteness marking accuracy on the sentence imitation task than the TEGI probe (71.9% and 52.8%, respectively). This finding suggests that the SLI group may have benefited more from the imitation context more than the LE group.

The prediction of an effect of verb familiarity on finiteness marking accuracy was supported by findings of greater finiteness marking accuracy for familiar verbs versus unfamiliar verbs for both verb familiarity classification methods. The results from the experimental stimulus grouping method indicate that whether the child heard a familiar or unfamiliar verb in the input influenced their finiteness marking accuracy during imitation. In addition, when verb familiarity was handled in this way, a significant group x condition interaction was identified, such that there was a difference in conditions between the AE group and each of the SLI and LE groups. Thus, hearing a familiar verb in the input clause imparts an advantage on finiteness marking for all groups but hearing an unfamiliar verb negatively affects finiteness marking accuracy more for the SLI and LE groups than the AE group. This finding has important implications for the development of the verb lexicon and finiteness marking – both areas of weakness in the linguistic systems of the SLI and LE groups compared to the AE group.

Recall that the SLI and LE groups were more likely than the AE group to substitute a familiar verb for an unfamiliar verb during imitation. The practice of changing unfamiliar target verbs to familiar verbs in the LE and SLI groups suggests that while these children heard an unfamiliar verb in the input, they retrieved a more available alternative. Children with SLI have been shown to rely on a small set of verbs in their spontaneous speech (Rice & Bode, 1993;

Watkins et al., 1993), suggesting that they prefer to use verbs that are more familiar to them, presumably because their representations of less-familiar verbs are not as robust in their mental lexicon. The SLI group's substitution of familiar verbs for unfamiliar verbs during imitation is consistent with the evidence of their preference for familiar verbs. The LE group may adopt the same strategy during imitation. The substitution of familiar verbs for unfamiliar verbs by the SLI and LE groups appears to confer an advantage on finiteness marking accuracy, as evidenced by an effect of verb familiarity on finiteness marking accuracy when verb familiarity is classified based on the verb the child produced. When the SLI and LE children default to a familiar verb in their imitations, the group x familiarity interaction is not significant. This is consistent with the likelihood that their mental representations are stronger for the familiar verbs, freeing up resources for finiteness marking. The effect of verb familiarity on finiteness marking was present for all three groups, indicating that, similar to the LE and SLI groups, the AE group was also more accurate for marking finiteness on familiar verbs. These results address the open question of this research: whether, in the underlying grammar of children with SLI, verb familiarity affects finiteness marking accuracy.

Further investigation is needed to examine the nature of the effects of verb familiarity on finiteness marking and why unfamiliar verbs in the input appear to affect finiteness marking accuracy for the SLI and LE groups but not the AE group. Importantly, the distinction of how children handle finiteness marking on unfamiliar verbs, both in the input and during production, is relatively unexplored in the literature. Most available data on finiteness marking accuracy only include familiar verbs primarily due to the previously discussed challenges with examining unfamiliar verbs. The nature of the sentence imitation task used in this study allowed for an examination of finiteness marking on unfamiliar verbs, an area not previously addressed in the

literature. At the same time, it must be acknowledged that optional finiteness marking appears for familiar as well as unfamiliar verbs in the imitation task, making it clear that while verb familiarity may moderate finiteness marking, it does not account for children's persistent omission of finiteness marking in their spontaneous utterances.

Verb root imitation. The verb root imitation analysis examined the proposal that the AE group would make fewer errors in verb root imitation than the LE and SLI groups, which would not differ. This proposal draws from vocabulary research, which consistently reports verb deficits in SLI and that children with SLI have a more limited verb lexicon than age-equivalent controls (Kan & Windsor, 2010; Rice & Bode, 1993; Watkins et al., 1993). When verb root imitation accuracy was combined across conditions, the AE group significantly differed from the LE and SLI groups. There was also a significant group x condition interaction, such that there was a difference in conditions between the AE and each of the SLI and LE groups. This interaction suggests an advantage of familiar verbs on verb root imitation for all three groups but that the unfamiliar verbs confer a disadvantage on imitation accuracy for the SLI and LE groups only. As previously discussed, these findings are consistent with the proposal of Prutting (1976; 1975) that children will make more errors imitating semantic and syntactic structures not in their spontaneous speech. Also, these results indicate that the less-established unfamiliar verbs are particularly difficult for children with SLI and the LE group, likely due to their verb lexicon limitations.

Accounts of Sentence Imitation Task Performance. In addition to examining imitation accuracy at the overall clause level and for individual components, the sentence imitation task and coding system were also developed to evaluate the two proposed accounts for sentence imitation. The first, referred to here as the Child Grammar Account, posits that sentence

imitation tasks index children's generative use of grammar because children draw on the grammar they have available during imitation (Prutting & Connolly, 1976; Prutting et al., 1975; Vinther, 2002). The Child Grammar Account predicts that 1. deviations from the target clause will follow the grammatical abilities of the child and 2. when all elements are present in their grammatical system, children will produce grammaticality correct clauses even when incorrectly imitating the target clause. Each of these predictions was borne out in the current study. The SLI and LE groups, predicted to be in a stage of optional finiteness marking, had a higher percentage of omitted finiteness markers in obligatory contexts compared to the AE group. Also, while the AE group was less likely than the SLI and LE groups to incorrectly imitate the target clause, when clauses were incorrectly imitated, all three groups were equally like to change one or more components to result in a grammatically well-formed clause.

These findings support the Child Grammar Account by showing that children for whom finiteness marking is optional in their grammar are optional when imitating finiteness marking. Additionally, when children are imitating a clause and deviate from the target clause in ways consistent with their grammar, they will change other components of the clause to ensure that the clause they produce is grammatically well-formed. If their grammar wasn't involved during imitation, deviations from the target clause during imitation would not require changes to other components because ultimate grammaticality of the produced clause would not be necessary.

The second account for sentence imitation proposes that verbal memory instead of language ability dictates sentence imitation task performance (Conti-Ramsden et al., 2001; Fraser et al., 1963; Gillam et al., 1995; Lee & Estes, 1981; Montgomery, 2002; Willis & Gathercole, 2001). Because of two contrasting theories of verbal memory, there are two sets of predictions for deviations from the target during imitation: 1. deviations would take the form of

out-of-order or omitted components, greater for children with SLI due to verbal memory limitations and 2. a greater number of noun phrase omissions and ungrammatical clauses for the SLI group, also due to verbal memory limitations. Unlike the predictions of the Child Grammar Account, none of these predictions were borne out in the data. There were no out-of-order components across all participants, the children with SLI were not more likely to omit individual components (including the noun phrase, which the LE group was more likely to omit), and the SLI group was equally likely to the LE group and less likely than the AE group to produce ungrammatical imitations. Recall that the stimuli designed for the sentence imitation task used in this study were all short, simple clauses thought to not exceed the verbal memory capacities of the participants. While the Verbal Memory Account predicts verbal memory deficits in SLI regardless of whether memory demands exceed their capacities, it should still be noted that the sentence imitation findings reported in the current study could differ if the stimuli were longer and more complex (i.e., passive constructions, relative or embedded clauses, etc.). It is of great import that the finiteness marking errors identified in this study occurred even in short, simple clauses and in otherwise well-constructed clauses and not in tandem with word-order errors. These findings indicate that sentence imitation is not solely dependent on verbal memory; it appears that children do not simply reproduce clauses from their buffer without running the clause through their linguistic system.

Interpretations of the evidence for Child Grammar and the Verbal Memory Accounts of sentence imitation provide further illumination of young children's sentence imitation. Not only do children appear to draw on their grammar during sentence imitation but the three groups appear to follow similar strategies during sentence imitation. While the AE group was consistently more accurate in sentence imitation, the pattern of deviations from the target clause

was similar across all three groups. In particular, the LE group and SLI group had parallel patterns of correct and incorrect imitations. The similarities of patterns indicate that the SLI group, while showing predicted deficits relative to age expectations, does not differ from children with typically developing language at equivalent levels in imitation. The comparison of finiteness marking accuracy on an elicited production task (TEGI) versus sentence imitation suggests that the SLI group may benefit more from the imitation context than the younger LE group. Further, the SLI group performs at levels equivalent to the AE group in their avoidance of omissions of noun phrases.

Summary and Conclusions

In sum, this study shows that, while children with SLI imitated sentences with similar accuracy to younger, language-equivalent control children and with less accuracy than age-equivalent controls, the errors in sentence imitation made by the SLI group are consistent with expectations based on their linguistic abilities. Inaccurate finiteness marking imitation and omitted finiteness marking during imitation by the children with SLI demonstrates that the SLI group is at a stage of optional finiteness marking, as expected based on the literature. Findings that the children with SLI made more errors in imitating verb roots than the age-equivalent controls add further support to claims of verb lexicon deficits in SLI. One of the most informative aspects of this study was that it allowed for an examination of how children handle finiteness marking on unfamiliar verbs, which is difficult to assess using standardized tests, spontaneous language sampling and other experimental methods. This analysis revealed an effect of verb familiarity on finiteness marking accuracy for all three groups, regardless of how verb familiarity was characterized. Additional results indicated that unfamiliar verbs in the input conferred a disadvantage for the SLI and LE groups but not the AE group, as evidenced by a

significant condition x group interaction for finiteness marking accuracy. This finding sets up further research into possible directionality of this interaction and further examination of why the interaction is present in some groups but not others.

This study also addressed two proposed accounts for sentence imitation, the Child Grammar Account and the Verbal Memory Account. Findings showing that deviations from that target clause followed the children's grammatical abilities and that all three groups were likely to change one or more clausal components to produce a grammatically well-formed clause support the Child Grammar Account. Additional findings that deviations from the target clause were not primarily omitted or out-of-order components and that the SLI group was not particularly likely to produce ungrammatical imitations countered the predictions of the Verbal Memory Account. Therefore, it seems that the sentence imitation task served as an index of the children's grammatical abilities, lending further support to the previously stated conclusions.

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Appendix A

Frequency of Verb Occurrence (combined stem and inflected form) in Three Corpora

Familiar verb (*n*=28)	Hall, Nagy & Linn (1984) - child	Hall, Nagy & Lin (1984) - adult	Kolson (1960)	Moe et al. (1982)	Unfamiliar verb (*n* = 28)	Hall, Nagy & Linn (1984) - child	Hall, Nagy & Lin (1984) - adult	Kolson (1960)	Moe et al. (1982)
bites	62	48	80	33	**gnaws**	0	0	0	1
carries	23	50	366	16	**transports**	0	*2	0	0
cleans	82	130	605	29	**scours**	0	0	0	0
climbs	38	25	75	35	**scales**	0	0	0	1
cooks	20	58	97	19	**broils**	0	0	0	0
cries	19	31	62	19	**wails**	0	0	0	0
draws	52	57	613	56	**drafts**	0	0	7	0
drinks	135	208	528	25	**swigs**	0	0	0	0
dumps	7	3	60	4	**scraps**	0	0	11	2
feeds	24	50	110	27	**fuels**	0	0	0	0
gets	1859	2522	5271	2416	**gains**	0	0	0	0
hides	56	26	48	138	**stows**	0	0	0	0
holds	208	251	376	62	**grips**	0	0	0	0
kicks	59	14	166	79	**punts**	0	0	0	0
looks	1548	1202	5905	285	**gapes**	0	0	0	0
moves	155	215	123	155	**shifts**	0	*3	0	1
picks	163	243	220	147	**plucks**	0	0	0	0
plays	491	461	858	822	**romps**	0	0	0	0

pulls	83	108	481	51	**lugs**	0	0	0	0
pushes	76	82	81	82	**nudges**	0	0	0	0
rides	36	33	911	183	**guides**	0	*2	2	3
rips	4	5	9	1	**shreds**	0	0	0	0
runs	120	126	973	335	**scoots**	0	0	0	4
sees	1855	2077	4594	995	**views**	0	*5	14	0
sings	88	119	218	39	**croons**	0	0	0	0
sneaks	7	6	0	9	**slinks**	0	0	0	0
talks	274	302	309	98	**gabs**	0	*14	0	0
throws	155	142	105	142	**slings**	0	0	0	0

*All of these verbs appeared only in their uninflected forms in the Adult speech, never in their inflected forms.

Appendix B

Verb Pairs in their Sentence Frames

Training Stimuli

1p. The car is blue.
2p. I have a big bunny.
3p. Her sister is walking to school.
4p. The kids like to write.
5p. Yesterday he cooked dinner.
6p. The dogs run around outside.
7p. Their mom is nice.
8p. You play on the swings at school.

Test Stimuli

1. The girl *bites/gnaws* into the cookie.
2. The man *carries/transports* the box.
3. The boy *cleans/scours* the kitchen.
4. The woman *climbs/scales* the ladder.
5. The girl *cooks/broils* the chicken.
6. The girl *cries/wails* for her mom.
7. The girl *draws/drafts* on the sidewalk.
8. The boy *drinks/swigs* the milk.
9. The man *dumps/scraps* the idea.
10. The girl *feeds/fuels* the fire.
11. The boy *gets*/*gains* a sticker.
12. The girl *hides/stows* her doll.
13. The woman *holds/grips* the phone.
14. The boy *kicks/punts* the ball.
15. The man *looks/gapes* at the tv.
16. The woman *moves/shifts* to the couch.
17. The woman *picks/plucks* the flowers.
18. The girl *plays/romps* in the yard.
19. The girl *pulls/lugs* the wagon.
20. The boy *pushes/nudges* the swing.
21. The man *rides/guides* the bicycle.
22. The girl *rips/shreds* the paper.
23. The boy *runs/scoots* down the street.
24. The boy *sees/views* his brother.
25. The man *sings/croons* on stage.
26. The girl *sneaks/slinks* through the bushes.
27. The girl *talks/gabs* with her friend.
28. The boy *throws/slings* the rocks.

Appendix C

Coding System for the Sentence Imitation Task

Overall

- Grammaticality
  - 0 = ungrammatical
  - 1 = grammatical
- Accuracy
  - 0 = errors in imitation
  - 1 = no errors in imitation
  - 2 = no attempt
  - 3 = adjusted accuracy for a/the
  - 4 = completely off target
  - 5 = ambiguous by speech production

NP

- Grammaticality
  - 0 = ungrammatical
  - 1 = grammatical
- Accuracy
  - 1 = accurate imitation
  - 2 = omitted/ambiguous subject
  - 3 = omitted/substituted determiner
  - 4 = substitution – other noun, 3rd person singular subject
  - 5 = substitution –noun, plural subject
  - 6 = substitution – pronoun, same gender
  - 7 = substitution – pronoun, different gender
  - 8 = substitution – pronoun, plural subject
  - 9 = substitution – other pronoun type (i.e., accusative)
  - 10 = other error

V

- Grammaticality
  - 0 = ungrammatical
  - 1 = grammatical
- Accuracy
  - 1 = accurate imitation of lexical verb
  - 2 = omitted/ambiguous lexical verb
  - 3 = non-target lexical verb
  - 4 = progressive, + *ing*
  - 5 = progressive, - *ing*
  - 6 = copula
  - 7 = 3rd singular irregular verb
  - 8 = other verb form
  - 9 = phonological variant

Familiarity

1 = familiar, given
2 = familiar, not given
3 = unfamiliar, given
4 = ambiguous

fn

Grammaticality

0 = ungrammatical
1 = grammatical

Accuracy

1 = accurate imitation of finiteness marking
2 = omitted finiteness with 3s subject
3 = double marked
4 = past tense *-ed*
5 = + BE aux/cop
6 = – BE aux/cop
7 = 3rd singular irregular verb marked
8 = 3rd singular irregular verb unmarked
9 = null marker with plural subject
10 = other error

VP

Grammaticality

0 = ungrammatical
1 = grammatical

Accuracy

1 = accurate imitation
2 = omitted/substituted/added preposition
3 = omitted/substituted/added determiner
4 = omitted/ambiguous noun
5 = substitution – noun, + semantics (includes plurals)
6 = substitution – noun, - semantics
7 = other error

Argument structure

0 = incorrect
1 = correct

Appendix D

Mean, SD, and Range of Interjudge Coding Reliability

	LE (n=3)	SLI (n=4)	AE (n=4)
Full clause grammaticality	100 (0) 100-100	99.1 (1) 98.2-100	100 (0) 100-100
Full clause accuracy	100 (0) 100-100	100 (0) 100-100	100 (0) 100-100
Noun phrase grammaticality	100 (0) 100-100	100 (0) 100-100	100 (0) 100-100
Noun phrase accuracy	100 (0) 100-100	100 (0) 100-100	99.6 (0.9) 98.2-100
Verb root grammaticality	99.4 (1) 98.2-100	99.1 (1) 98.2-100	100 (0) 100-100
Verb root accuracy	98.8 (2.1) 96.4-100	99.1 (1) 98.2-100	100 (0) 100-100
Verb familiarity	100 (0) 100-100	97.8 (2.2) 94.6-100	99.1 (1) 98.2-100
Finiteness marking grammaticality	100 (0) 100-100	99.6 (0.9) 98.2-100	100 (0) 100-100
Finiteness marking accuracy	99.4 (1) 98.2-100	98.7 (1.7) 96.4-100	100 (0) 100-100
Verb phrase grammaticality	94.6 (6.2) 87.5-98.2	98.2 (1.5) 96.4-100	100 (0) 100-100

Verb phrase accuracy	93.5 (8.2) 83.9-98.2	97.8 (2.2) 94.6-100	100 (0) 100-100
Argument structure	98.2 (0) 98.2-98.2	98.2 (1.5) 96.4-100	98.7 (1.7) 96.4-100