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Effects of Verb Familiarity on Finiteness Marking in Children with SLI

Alyson D. Abel,
University of Texas at Dallas

Mabel L. Rice, and
University of Kansas

Daniel E. Bontempo
University of Kansas

Abstract

Purpose—Children with Specific Language Impairment (SLI) have known deficits in the verb lexicon and finiteness marking. This study investigated a potential relationship between these two variables in children with SLI and two control groups considering predictions from two different theoretical perspectives, morphosyntactic vs morphophonological.

Method—Children with SLI, age-equivalent (AE) and language-equivalent (LE) control children (N = 59) completed an experimental sentence imitation task that generated estimates of children's finiteness accuracy under two levels of verb familiarity - familiar real verbs vs. unfamiliar real verbs - in clausal sites marked for finiteness. Imitations were coded and analyzed for overall accuracy as well as finiteness marking and verb root imitation accuracy.

Results—Statistical comparisons revealed that children with SLI did not differ from LE children and were less accurate than AE children on all dependent variables – overall imitation, finiteness marking imitation and verb root imitation accuracy. A significant group x condition interaction for finiteness marking revealed lower levels of accuracy on unfamiliar verbs for the SLI and LE groups only.

Conclusions—Findings indicate a relationship between verb familiarity and finiteness marking in children with SLI and younger controls, and help clarify the roles of morphosyntax, verb lexicon and morphophonology.

Two key components of well-formed clauses are examined in this investigation: lexical verbs and the grammatical property of finiteness marking. Each of these components has been studied extensively in investigations of children's language acquisition, which show that during the preschool years children are adding to their verb lexicons at the same time they are mastering the obligatory properties of morphosyntactic finiteness marking (Fenson et al., 2007). Much less is known about whether these two strands of language acquisition

Author contact: Alyson D. Abel, Speech, Language, Hearing Sciences, San Diego State University. 5500 Campanile Dr. San Diego, CA 92182. alyson.abel@mail.sdsu.edu. Phone 619-594-4694. Fax 619-594-7109.
Alyson D. Abel is now at the School of Speech, Language & Hearing Sciences, San Diego State University. This research was part of the first author's PhD dissertation conducted at the University of Kansas.

influence each other as children sort out the rules for these key elements of clause formation. This gap in evidence warrants detailed investigation in children with Specific Language Impairment (SLI). Children with SLI are known to lag behind their age peers in both the acquisition of lexical verbs (Kan & Windsor, 2010) and the development of finiteness marking (Rice, Wexler, & Cleave, 1995). Finiteness marking is reported to be relatively weaker in children with SLI (e.g., Hadley & Rice, 1996; Hadley & Short, 2005; Leonard, 1998; Leonard, Eyer, Bedore, & Grela, 1997; Rice & Wexler, 1996; Rice et al., 1995), with lower performance relative to younger, language-equivalent typically developing children. The relative weakness of lexical verbs and finiteness marking in children with SLI raises the question of whether there is a relationship between these two clausal components that may contribute to the deficits in finiteness marking. In this study we draw upon two different theoretical perspectives, one which focuses on finiteness as a morphosyntactic property and another that focuses on morphophonological learning, for predictions of possible interactions between verb familiarity and finiteness marking in children with and without SLI. The outcomes have clinical as well as theoretical relevance.

Verb Deficits in SLI

Vocabulary deficits in children with SLI are well documented with consistent replication across studies. 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, 2012). They also perform at lower levels on experimental word learning tasks than age-equivalent control children, although at levels similar to language-equivalent control children (e.g., Dollaghan, 1987; Ellis Weismer & Hesketh, 1993, 1998; Gray, 2003, 2004, 2005; Rice, Buhr, & Nemeth, 1990; Rice, Buhr, & Oetting, 1992; Rice, Oetting, Marquis, Bode, & Pae, 1994). In order to learn unfamiliar words, children with SLI require about three times as many exposures as typical children (Kan & Windsor, 2010; Rice et al., 1994).

Studies investigating differences between grammatical categories of words report 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). Experimental studies also demonstrate greater difficulty with verb learning than noun learning for children with SLI compared to age-equivalent groups (Alt, Plante, & Creusere, 2004; Eyer et al., 2002; Oetting, Rice, & Swank, 1995; Rice et al., 1994), but not to language-equivalent groups (Rice et al., 1994). Because the previous experimental word learning studies contrasting nouns and verbs in children with SLI are relatively limited in diversity of methods, it remains an open question as to whether other methods of investigation would be more sensitive to familiarity effects in verb learning that could differentiate children with SLI from age- or language-equivalent comparison groups.

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. Finiteness marking develops throughout early childhood. During the course of typical development, English-speaking children go through a stage in which they inconsistently use finiteness markers. The Optional Infinitive theory refers to this as an optional use of forms that are obligatory in the adult grammar, an optionality that characterizes the grammar of young children (OI; Wexler, 1998). In the OI stage, children use both non-finite forms and finite forms when finiteness is required. The OI theory postulates that when children are in the OI stage, they know clause structure principles but optionally drop surface forms of tense marking. That is, they know word order requirements and the slot in the sentence where finiteness marking must appear at the same time they optionally omit the markers (see Guasti, 2002). Typically developing English-speaking children do not fully resolve the OI stage in simple declarative clauses until around age 5, at which time they begin to achieve adult-like levels of competence in finiteness marking (Rice & Wexler, 2001; Rice, Wexler, & Hershberger, 1998; Wexler, 1998).

The OI stage appears to be extended in children with SLI, a phenomenon explained 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 (an essential element of finiteness marking; Rice & Wexler, 1996; Rice et al., 1995) resulting in an extended OI stage. Production data indicate delayed emergence of finiteness marking in children with SLI but these children demonstrate early finiteness marking that patterns similarly to typically developing children (Hadley & Holt, 2006; Hadley & Rice, 1996; Hadley & Short, 2005). Delays in finiteness marking continue through the early school-age years, with five-year old children with SLI demonstrating persistent omissions of finiteness marking in simple declarative clauses compared to both age-equivalent and younger, language-equivalent control children (Rice et al., 1995). Longitudinal evidence indicates that, while typically developing children achieve adult-like levels of obligatory finiteness marking in simple clauses around age 5, children with SLI are not yet at adult levels in simple declarative clauses by almost 9 years of age (Rice et al., 1998). The limitations with finiteness marking persist into adolescence in sentences more complex than simple declarative clauses, such as questions (Rice, Hoffman, & Wexler, 2009). Interestingly, modeled growth curves for the children with SLI follow the same pattern as for the age- and language-equivalent controls, but the children with SLI, on average, do not "catch up" with the typically developing controls (Rice, 2012; Rice et al., 1998).

Relationship between Finiteness Marking and the Verb Lexicon

The weaknesses in both finiteness marking and the verb lexicon in the linguistic representation of children with SLI raise the question of whether these two different linguistic weaknesses may influence each other as children with SLI move forward in their language acquisition. At a theoretical level, the linguistic theory underpinning the EOI account posits that, in the adult grammar, lexical entries carry semantic information and also carry separate formal grammatical features that govern finiteness marking or the related morphosyntactic properties (Chomsky, 1995; Wexler, 1998). For example, the requirement of third person singular -*s* on lexical verbs is driven by the requirement to mark non-past events for third person singular subjects in English and is not thought to have a strong

semantic component. Auxiliary *DO* is inserted to mark finiteness in English questions but has no semantic addition to the meaning of the clause. The theory predicts that the association between children's finiteness marking and general vocabulary acquisition should be weak, a prediction supported by findings that finiteness marking has high clinical sensitivity and specificity of identifying children with SLI (Rice & Wexler, 2001), that finiteness marking is not predicted by general vocabulary measures in typically developing children or children with SLI (Rice et al., 1998; Rice, Wexler, & Redmond, 1999), and that heritability estimates in twin studies are higher for finiteness markers than vocabulary measures (Bishop, Adams, & Norbury, 2006; Rice, Zubrick, Taylor, Gayán, & Bontempo, 2013). However, at the level of clausal structure, the technical grammatical mechanisms at the interface of grammar and verb properties are not well worked out in either the adult grammar or in the grammars of typically developing children. The one clear prediction is that omissions of finiteness would appear in otherwise grammatical sentences.

An alternative perspective is provided by Bybee's usage-based network model (Bybee, 1995, 2003, 2006) as interpreted by Blom & Paradis (2013). Blom and Paradis (2013) provide a succinct description of their interpretation of a usage-based model of past tense acquisition by children with language impairments. They hypothesize that children with language impairments have a deficit in the ability to efficiently process linguistic input. "One result of this deficit could be fewer and less detailed lexical representations for verbal paradigms, which, in turn, leads to less productive schematization in the lexicon and a greater reliance on token-based learning of verb forms" (Blom & Paradis, 2013, p. 291). Bybee's network model is thought to similarly affect third person singular *–s* production, thus predicting a reliance on word frequency information for correct third person *–s* usage in children with language impairments (Blom, Paradis, & Duncan, 2012). The model does not address other possible kinds of errors in clausal structure, although we presume that if children have weak lexical representations as well as weak tense marking representations then grammatical errors of syntax or morphosyntax in addition to omissions of finiteness would be expected. To our knowledge, this prediction has not been tested, although there are reports that children with SLI are more likely to produce clausal deviations in sentence imitation tasks (Gillam, Cowan, & Day, 1995; Lee & Estes, 1981).

Previous descriptive empirical studies have addressed the hypothesized relationship between finiteness marking and the verb lexicon in SLI in two ways. One approach manipulates finiteness marking cues and evaluates verb learning. Eyer et al. (2002) showed that the presence of morphosyntactic cues did not aid in verb learning for children with SLI or language-equivalent, typically developing control children, leading to the conclusion that young children do not use morphosyntactic cues in verb learning. The second approach manipulates the verb lexicon and evaluates finiteness marking, focusing more on whether the two dimensions relate 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 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). The development of finiteness marking in bilingual children is reported to differ from that of monolingual children (see Paradis, 2005; 2007 for summaries) although there is recent evidence of similarities (Blom & Paradis, 2013). Thus, there is a need for research with monolingual children following this second approach of examining whether verb familiarity influences finiteness marking accuracy.

Another possible limit to generalization is the use of nonsense verbs in the experimental tasks. Early studies suggest that children are sensitive to differences between non-real words and unfamiliar, real words from their native language (Rice, 1990). More recently, Storkel (2013) reported that real words and nonsense words differ in phonological structure and cautions that word learning studies must consider whether it is safe to generalize outcomes from nonsense words to actual words. If nonsense words were used to assess children's mastery of finiteness, this method would be likely to result in an underestimation of the morphosyntactic abilities of children with SLI. It remains to be determined if the results of Jacobson and colleagues represent how monolingual children with SLI handle finiteness marking on less-familiar actual verbs.

Methodological considerations: Sentence Imitation Tasks

There are empirical challenges for examining how verb familiarity affects finiteness marking. Spontaneous language sampling is a well-documented method of assessing children's finiteness marking accuracy (e.g., Rice et al., 1995). However, spontaneous language sampling is not an appropriate method for studies looking at children's use of unfamiliar words because children typically overwhelmingly choose to use vocabulary familiar to them. An alternative method, sentence imitation, can provide a window into children's grammatical and vocabulary knowledge by asking children to repeat sentences including a variety of linguistic dimensions.

A prototypic sentence imitation task involves an adult saying a sentence for a child to repeat verbatim. Sentence imitation tasks bring the experimental advantage of systematic variation of key linguistic elements. For example, to examine whether finiteness marking is more accurate on one type of verb versus another, the type of verb used in the stimuli can be manipulated with all verbs marked for finiteness. The development of a coding system that captures imitation accuracy for the different linguistic components included in the stimulus item (e.g., verb root imitation, finiteness marking imitation) allows the assessment of performance on each component of interest. In this way, while sentence imitation is often used as an index of verbal memory, performance on sentence imitation tasks can also be used as an index of children's generative use of grammar such that children draw upon the grammar they have available as they hear the input clause and produce their response (e.g., Ambridge & Pine, 2006; Menyuk, 1964; Prutting & Connolly, 1976; Prutting, Gallagher, & Mulac, 1975; Smolik & Vavru, 2014; Vinther, 2002).

Prutting and Connolly (1976), drawing on findings from sentence imitation studies by 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. Thus, deviations from the target clause during imitation would be consistent with the grammar available to each child. Additionally, the full clause 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. If the child's grammar wasn't involved during imitation, deviations from the target clause would more likely result in ungrammatical clauses. The empirical evidence from these earlier studies was relatively limited and in need of replication in contemporary investigations.

Researchers have used sentence imitation tasks to measure language ability in both typically developing children and language impaired children, proposing that sentence imitation tasks may be a sensitive marker for SLI (Conti-Ramsden, Botting, & Faragher, 2001). The most frequently used dependent variable in such studies is the accuracy of response on an imitation task, determined by whether or not a child imitated correctly the item presented. Within the domain of finiteness marking, sentence imitation tasks have been used to examine whether typically developing children in the Optional Infinitive stage (Ambridge & Pine, 2006) and children with SLI in the Extended Optional Infinitive stage (Dalal & Loeb, 2005; Smolik & Vavru, 2014) are also optional with finiteness marking imitation. Evidence of optional finiteness marking imitation for both groups of children indicates that, in addition to being a sensitive marker of SLI, sentence imitation tasks are appropriate as an assessment of children's generative use of grammar and the likelihood that children default to their underlying grammars in sentence imitation tasks. More detailed analyses of children's responses, and types of errors on imitation tasks, could provide more information about how their underlying grammar may influence their imitation accuracy.

The Current Study

The present study uses a sentence imitation task to evaluate effects of verb familiarity on finiteness marking accuracy comparing children with SLI to age-equivalent and language-equivalent groups. Two experimental conditions are compared: Familiar verbs vs. unfamiliar verbs in clausal sites marked for third-person singular finiteness. The following research questions (RQ) address each of the three dependent variables of interest: (A) overall imitation accuracy, (B) finiteness marking imitation accuracy and (C) verb root imitation accuracy:

RQ1. Do the participant groups differ in imitation accuracy?

RQ2. Does imitation accuracy differ based on the familiarity of the target verb?

RQ3. If familiarity condition effects are evident, do the differences between conditions vary across groups?

In addition, we evaluated children's incorrectly imitated utterances for overall clausal structure grammaticality, as an indication of their ability to generate productive clauses even when their imitation of target elements was not accurate, and whether this level of productivity differed by group.

Predictions for finiteness marking imitation accuracy (dependent variable B) follow the EOI account and Bybee's usage-based network model. Regarding RQ1, the two accounts offer similar predictions for group differences in finiteness marking accuracy: 1) Children with SLI will make more overall imitation errors in finiteness marking compared to both comparison groups of children; 2) Because the age-equivalent comparison 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, although we did not find age-specific predictions in Bybee's model; 3) Language-equivalent comparison children will be less accurate on finiteness marking compared to the age-equivalent group. The two accounts differ regarding predictions for condition differences (RQ2) and a potential interaction between group and condition on finiteness marking (RQ3). The EOI account does not offer discrete predictions; instead, condition differences and a potential group by condition interaction are treated as open questions. Bybee's network model's predictions are also not clear. The age equivalent group may be expected to have well-formed lexical schemas for familiar verbs that should in turn be readily generalized to unfamiliar verbs, thus leading to no effects of verb familiarity. Alternatively, their lexical schemas may not be well formed enough to support generalization to unfamiliar verbs, thus leading to a verb familiarity effect. The SLI children are expected to make more errors imitating finiteness marking on unfamiliar verbs, with less-developed lexical representations, compared to familiar verbs. Language-equivalent children, who have had less input and therefore do not have well-established schemas for third person *–s*, are predicted to be less accurate on finiteness marking imitation for both familiar verbs and unfamiliar verbs. Children with SLI and age-equivalent children, considered to have roughly equivalent amounts of input, are expected to perform similarly on finiteness marking imitation accuracy for unfamiliar verbs.

Predictions for verb root imitation accuracy (dependent variable C) are based on previous studies of verb learning: RQ1) Because of limited lexicons, children with SLI and language-equivalent children will make more errors on verb root imitation than age-equivalent children; RQ2) Imitation of familiar verbs will be more accurate than unfamiliar verb imitation; RQ3) Children with SLI will make more imitation errors of unfamiliar verbs compared to the age-equivalent group, who are expected to correctly imitate the unfamiliar as well as the familiar verbs due to their larger verb inventory; it is an open question as to whether the sentence imitation task will pick up lower performance by the SLI group compared to the younger language-equivalent group.

Additional, detailed error analyses examine the extent to which children draw upon their underlying grammars or rely on input processing or retrieval during imitation. If children's imitations are guided by their underlying grammar, three predictions for deviations from the target clause during sentence imitations follow. One prediction is that deviations will follow the grammatical abilities of the child such that children with SLI and language-equivalent children will omit obligatory finiteness marking more than age-equivalent controls. The second is that the SLI and LE groups will default to familiar lexical verbs when unable to correctly imitate the unfamiliar verbs. The third prediction is that children will produce clauses consistent with their grammar even when deviating from the target on one or more

components; in effect, children will productively generate clauses that correspond to their underlying grammar.

The alternative possibility, that breakdowns in recall or input processing limitations such as hypothesized by a usage-based account (Blom & Paradis, 2013; Bybee, 1995, 2003, 2006) lead to limited imitation accuracy, generates two predictions for deviations from the target clause during imitation: 1) out-of-order or omitted clausal elements, reported to be more frequently produced by children with SLI versus the control groups (Gillam et al., 1995; Lee & Estes, 1981) and 2) omissions of early clausal elements.

Method

Participants

Participants were recruited in one of two ways. Some participants were from a longitudinal study of the development of morphosyntax in children with SLI and typically developing children recruited from areas in Kansas and Missouri as part of the Language Acquisition Studies Lab (LASLAB). Additional participants were recruited from local preschools and daycare programs. Three groups of children participated: children with Specific Language Impairment (SLI); age-equivalent (AE) typically developing children; and language-equivalent (LE) typically developing children defined on the basis of equivalent mean length of utterance (MLU). The SLI group contained 15 males and 5 females (n = 20) and had a mean (*SD*, range) age of 5;5 (3 months; 4;11 – 6;1). The AE group contained 10 males and 13 females (n = 23) and had a mean age of 5;5 (3 months; 5;0 – 5;11). The LE group contained 8 males and 8 females (n = 16) and had a mean age of 3;7 (2 months; 3;2 – 3;11). A preliminary analysis revealed no effect of gender on overall 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: Monolingual native speakers of English; normal or above nonverbal intelligence as demonstrated by a standard score at or above 85 on the Columbia Mental Maturity Scale (CMMS; Burgemeister, Blum, & Lorge, 1972)[1]; and normal hearing as determined by a standard pure tone audiometric screening (ASHA, 1997). To ensure that sentence imitation scoring was not confounded with articulatory abilities, all children passed the phonological probe on the Test of Early Grammatical Impairment (TEGI), confirming that they were able to produce morphological affixes of interest. The 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.

All children in the SLI group were originally recruited into the parent study as probands from speech-language pathologists' referrals. The common entry criterion was standard score performance on an age-appropriate omnibus language assessment of −1 standard deviations below age expectations. For this study, children in the SLI group received a

[1]Two children in the LE group obtained standard scores below 85 but within the standard error of measurement for their age (84 and 81). They also scored well within normal range on the language assessments so they were included.

standard score equal to or less than 85 on the Syntax Quotient on the *Test of Language Development – Primary* (TOLD-P2; Newcomer & Hammill, 1988), which is comprised of the Grammatical Understanding, Sentence Imitation and Grammar Completion subtests. All children in the AE and LE groups demonstrated typical language development, as evidenced by standard scores greater than 85 on 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. Other descriptive assessments included the *Peabody Picture Vocabulary-Revised* (PPVT-R; Dunn & Dunn, 1982), the Screening Test from the *Test of Early Grammatical Impairment* (TEGI; Rice & Wexler, 2001), and Mean Length of Utterance-Morphemes (MLUm) collected from spontaneous language samples that were elicited using a play-based sampling procedure, which yielded 200 utterances on average. Participant characteristics and descriptive statistics on the inclusionary criteria and descriptive assessments are described in Supplementary Table 1. Note that performance on the TEGI Screening Test was not used for group equivalence in this study because, although most children with SLI score low on the TEGI Screening Test in this age range, that is not the case for all children with SLI[2]. The exceptions were included in the SLI group in this study. We note that this is a conservative approach that works against our predictions but allows generalization to children with SLI who meet the entry criteria here.

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 of words produced by 5-year old children. A verb similar in meaning but considered to be unfamiliar to children in the age range for the current study based on its absence in the Hall, Nagy and Linn (1984) corpus was identified for each familiar verb. Each unfamiliar verb met the following criteria: 1. Synonym of the familiar verb (Roget's Thesaurus ("Roget's II: The New Thesaurus," 1988) and 2. An action verb with the same number of syllables as the familiar verb. 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. Relevant to the Bybee model evaluated here, the set of familiar verbs reported by also appeared in Hall, Nagy and Linn's (1984) list of verbs used by caregivers in children's environments whereas, with few exceptions, the unfamiliar verbs never appeared in the caregiver input lists (see Supplementary Table 2). Thus, the familiarity conditions as defined here are based on children's usage as well as caregiver input.

A sentence frame was written for each verb pair, resulting in 56 test sentences. 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 (Supplementary Table 3). 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

[2]See the TEGI manual for sensitivity and specificity estimates for the TEGI screener per 6 month age intervals. The manual is available for free at www2.ku.edu/~cldp/MabelRice/.

appropriately in the sentence frame, the *BBI Combinatory Dictionary of English: Third Edition* (Benson, Benson, & Ilson, 2009) was referenced when writing the sentences. Pilot studies with native English-speaking adult listeners confirmed that the familiar and unfamiliar verbs were semantically acceptable within the sentence frame written for each verb pair. Eight additional sentences were written to be used as training items. All training items were simple, active sentences; none followed the third person singular noun + lexical verb structure of the test items.

Stimulus recording and task administration—Training and task stimuli were recorded to ensure consistency in presentation in the full study. The previously described 56 test 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. Children listened to the pre-recorded stimuli through headphones and were asked to repeat each sentence exactly as they heard it. Further details are provided in Supplementary Text 1.

Coding—Each sentence imitation attempt was scored at two levels: overall imitation level and the level of each individual component. The full coding system (provided as Supplementary Text 2) follows the design provided as Supplementary Figures 1 and 2. The full coding system also describes detailed coding that was carried out to examine proposals that children draw upon their underlying grammars versus relying on input processing or retrieval during imitation. This level of coding offers unique insight into the factors that influence sentence imitation performance.

Variable creation—Four dependent variables were created to address the research questions. They vary by reference to the experimental stimuli versus the child's response to the stimuli: 1. Overall Imitation Accuracy is defined by accurate replication of the experimental item; 2. Experimental Verb Finiteness Accuracy is defined by accuracy of the finiteness morphemes as presented in the stimuli; 3. Produced Verb Finiteness accuracy is defined by the accuracy of finiteness marking on the verbs produced by the child instead of the experimental verbs; and 4. Verb Root Imitation Accuracy is defined by accurate imitation of the verb root. Each variable was derived using only scorable responses. Fifty-six responses were obtained from each subject (n =59, total responses = 3304). The SLI and LE groups had a higher percentage of unscorable responses compared to the AE group (4.1%, 6.1% and 2.2%, respectively) but, within each group, the proportion of unscorable responses (raw count unscorable responses) did not greatly differ: SLI = Familiar 2.1% (12), Unfamiliar 6.1% (34); LE = Familiar 5.4% (24), Unfamiliar 6.9% (31); AE = Familiar 2.2% (14); Unfamiliar 2.2% (14).

Overall imitation accuracy was calculated as the percentage of scorable imitations imitated without any deviations from the target with verb familiarity based on the classification of the target verb occurring in the stimulus item. Two finiteness marking imitation accuracy variables were calculated following different methods of designating verb familiarity. For each, finiteness marking accuracy was the percentage of correctly imitated finiteness markers in obligatory contexts for overt finiteness marking. Note that an obligatory context for overt finiteness marking contains a third person singular subject and a lexical verb (e.g.,

*the girl hide_*). First, verb familiarity was based on the a priori classification of the target verb in the stimulus item as familiar or unfamiliar (Experimental Verb Finiteness). The second method based familiarity on the verb root produced by the child, irrespective of the target verb classification (Produced Verb Finiteness). 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 by the child during imitation were coded as familiar. The final variable was Verb Root Imitation Accuracy, calculated as the number of correct verb root imitations. Verb familiarity was based on the classification of the target verb occurring in the stimulus item for verb root imitation accuracy.

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.

Reliability—Interjudge reliability was completed for transcription and coding of sentence imitation task performance for 18% of the sample (SLI $n = 4$, AE $n = 4$, LE $n = 3$). The same second judge performed both the transcription and coding reliability. Transcription reliability estimates were conducted on an individual word level and 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% (*SD* = 4.4%, range = 82.2 – 98.3). For each group, mean transcription reliability (*SD*, range) was as follows: LE = 90.8% (2.3%, 88.1 – 92.3), SLI = 90.3% (5.7%, 82.2 – 94.4), AE = 96% (2%, 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% (1%, 83.9 – 100), finiteness marking accuracy coding was 99.4% (1.2%, 96.34 – 100).

Results

The primary purpose of this study was to examine whether verb familiarity affects finiteness marking accuracy in typically developing children and children with SLI. This entails the degree to which verb familiarity influences finiteness marking imitation accuracy across the groups of children, as well as examining possible variables that affect incorrect finiteness marking imitation.

Fully-factorial multilevel models (MLM) were used for the four main accuracy outcomes. The model's predictors consisted of the 3-level group variable (SLI v. LE v. AE), the two-level verb condition variable (familiar v. unfamiliar), and two-way interactions of group and condition. Model parameterization used the AE group's population estimate of each outcome's accuracy for familiar verbs as the reference point, with simple effects for AE unfamiliar verb, SLI familiar verb, LE familiar verb, and two further effects for each of SLI and LE groups in combination with unfamiliar verbs. MLM is a strongly recommended analytic framework for repeated-measures data in language research (Quene & van den Bergh, 2004). Restricted maximum likelihood (REML) estimation was used because variance/covariance estimates are less biased than full maximum likelihood, especially in smaller datasets.

Population estimates of mean percent correct for each outcome were generated for the three groups, two familiarity conditions, and all six group-familiarity combinations. Significance of all main and interaction effects reported below is based on contrasts of these population mean estimates and their standard errors. Without covariates or missing data, these model-based estimates essentially replicate sample means; however standard errors adjusting for repeated measures are obtained. Contrasts based on these standard errors instead of sample standard deviations are more robust. For each contrast yielding a significant difference, critical-ratio (contrast/SE; z), *p*-value, Cohen's D effect size, and CI for Cohen's D is provided. Significance is reported based on model-based standard errors, but Cohen's D effect sizes are calculated using sample standard deviations. In interpreting effect sizes, Cohen (1992) considers $d = 0.2$ as "small," $d = 0.5$ as "medium", and $d = 0.8$ as "large."

Four dependent variables are central to this study, varying in the elements of clause structure to be measured: 1) Overall imitation accuracy; 2) Finiteness imitation accuracy based on the experimental verbs presented to the children to be imitated; 3) Finiteness imitation accuracy based on the verbs actually produced by the children; 4) Verb root imitation accuracy regardless of finiteness marking.

Overall Imitation Analysis

This analysis examined the proposed general language deficits in SLI by evaluating the percentage of overall imitation accuracy for group, verb condition, and interaction effects (see Table 1 for summary of findings). Significant effects for group and verb familiarity were found but there were no significant interaction effects indicating that the groups did not differ in the ways in which familiar verbs and unfamiliar verbs influenced overall imitation accuracy. The means (SD) of each group by condition are as follows: SLI: Familiar M = 49.8 (25.6), Unfamiliar M = 29.9 (18.4); LE: Familiar M = 55 (28.6), Unfamiliar M = 31.4 (19.9); AE: Familiar M = 84.5 (12), Unfamiliar M =63.7 (16.4).

The AE group was significantly more accurate in overall imitation than each of the SLI and LE groups ($z = 5.87$, $p < 0.05$, $d = 1.63$, 95% CI [1.13, 2.13]; $z = 4.97$, $p < 0.05$, $d = 1.41$, 95% CI [0.87, 1.93] respectively). The SLI group and LE groups did not significantly differ, SLI: M = 40.1 (21.3), LE: M = 43.2 (23.7), AE: M = 74.1 (12.5).

A significant difference was also shown between the familiarity conditions ($z = 11.83$, $p < 0.05$, $d = 0.83$, 95% CI [0.45, 1.2]), with greater mean percent correct for the familiar condition versus the unfamiliar condition, Familiar: $M = 64.7$ (27.2), Unfamiliar: $M = 43.5$ (24.1). Children were more accurate in imitating full clauses containing verbs familiar to them than verbs unfamiliar to them.

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 an effect of verb familiarity on finiteness marking, analyses at this level focused on finiteness marking imitation accuracy following the two methods of verb familiarity classification and verb root imitation accuracy.

Finiteness marking imitation: Experimental Verb Finiteness Accuracy—Recall that, in this grouping method, verb familiarity was based on the a priori classification of the target verb in the stimulus item as familiar or unfamiliar. This analysis revealed an association between unfamiliar verbs and finiteness marking accuracy for the SLI and LE groups only. Model-based population mean estimates for the AE group were higher (more accuracy imitating finiteness marking) compared to each of the SLI ($z = 3.48$, $p < 0.05$, $d = 1.09$, 95% CI [0.61, 1.57]) and LE groups ($z = 2.84$, $p < 0.05$, $d = 1.03$, 95% CI [0.51, 1.54]). The SLI and LE groups did not significantly differ, SLI: $M = 71.8$ (25.2), LE: $M = 75.7$ (21.8), AE: $M = 92.7$ (6.1).

Across groups, percent finiteness marking imitation accuracy was significantly higher for familiar verbs compared to unfamiliar verbs, Familiar: $M = 85.2$ (19.3), Unfamiliar: $M = 76$ (26.4), $z = 5.37$, $p < 0.05$, $d = 0.4$, 95% CI [0.03, 0.76]. 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.

Both group × condition interaction terms in the model were significant, such that the effect of familiar versus unfamiliar verbs in the SLI and LE groups significantly differed from the effect of an unfamiliar verb in the AE group (see Figure 1). Contrasts of model based estimates of group by familiarity population means showed that hearing an unfamiliar verb in the input clause conferred a significant disadvantage on finiteness marking imitation accuracy for the LE ($z = -4.44$, $p < 0.001$, $d = 0.61$, 95% CI [−0.11,1.31]) and SLI ($z = -3.96$, $p < 0.001$, $d = 0.46$, 95% CI [−0.17,1.09]) groups. However unfamiliar verbs did not significantly influence finiteness marking for the AE group, SLI: Familiar $M = 77.8$ (24.9), Unfamiliar $M = 65.3$ (28.8); LE: Familiar $M = 82.2$ (19.8), Unfamiliar $M = 66.5$ (30.6); AE: Familiar $M = 93.6$ (6.8), Unfamiliar $M = 91.8$ (7.2).

Finiteness marking imitation: Produced Verb Finiteness Accuracy—This finiteness marking imitation analysis defined familiarity on the verb produced by the child; therefore, if the child substituted a familiar verb for an unfamiliar verb, the produced verb would be considered familiar. The SLI and LE groups were more likely than the AE group to substitute a familiar verb for an unfamiliar verb during imitation, SLI: $M = 6.5$ (2.8), LE: $M = 6.2$ (3.2), AE: $M = 3.8$ (2.3).

Patterns of finiteness marking imitation accuracy for this analysis were broadly similar to the prior analysis; however, there were no significant interaction terms. The AE group was more accurate in finiteness marking imitation compared to each of the SLI and LE groups ($z = 3.36$, $p < 0.05$, $d = 1.06$, 95% CI [0.58, 1.53]; $z = 2.84$, $p < 0.05$, $d = 1.03$, 95% CI [0.5, 1.54], respectively). The SLI and LE groups did not significantly differ, SLI: $M = 71.9$ (25.2), LE: $M = 75.7$ (21.8), AE: $M = 92.7$ (6.1).

Additionally, in this analysis, percent correct was significantly higher for the familiar versus unfamiliar condition, Familiar: $M = 82.7$ (19.7), Unfamiliar: $M = 79.3$ (26.2), $z = 2.03$, $p < 0.05$, $d = 0.15$, 95% CI [−0.22, 0.51]). This indicates more accurate finiteness marking imitation when the verb the child produced was familiar to them versus unfamiliar to them.

Verb Root Imitation Accuracy—For the raw count of verb root imitation accuracy collapsed across experimental conditions, model-based population mean estimates for the AE group indicated more accurate verb root imitation compared to the SLI group ($z = -3.10$, $p < 0.05$, $d = 0.56$, 95% CI [0.12, 0.99]) and the LE group ($z = -3.56$, $p < 0.05$, $d = 0.77$, 95% CI [0.3, 1.24]. Again, the SLI and LE groups did not significantly differ, SLI: $M = 44.9$ (5.8), LE: $M = 43.8$ (4.8), AE: $M = 49.5$ (4.2).

An additional finding was that familiar verb root imitation accuracy differed from unfamiliar verb root imitation accuracy ($z = 11.5$, $p < 0.05$, $d = 1.63$, 95% CI [1.19, 2.07]) with greater accuracy for familiar verbs versus unfamiliar verbs, Familiar $M = 25.9$ (1.9), Unfamiliar $M = 20.5$ (4.3). This indicates that children were more accurate in imitating familiar verb roots compared to unfamiliar verb roots.

A significant group × condition interaction in the model for all groups qualifies the group and condition effects, LE: $z = 6.35$, $p < 0.05$, $d = 2.08$, 95% CI [1.15, 2.98]; SLI: $z = 8.37$, $p < 0.05$, $d = 1.95$, 95% CI [1.12, 2.76]; AE: $z = -5.19$, $p < 0.05$, $d = 1.4$, 95% CI [0.71, 2.07] (see Figure 1). These findings indicate that all children are better at imitating familiar verbs versus unfamiliar verbs and that unfamiliar verbs pose a greater challenge for the SLI and LE groups, SLI: Familiar $M = 25.9$ (1.8), Unfamiliar $M = 19$ (4.6); LE: Familiar $M = 24.8$ (1.9), Unfamiliar $M = 19$ (3.5); AE: Familiar $M = 26.7$ (1.5), Unfamiliar $M = 22.8$ (3.7).

Other Factors Influencing Sentence Imitation Performance

Additional analyses were conducted to determine whether patterns of deviations from the target utterances made by children in each participant group conformed to an underlying child grammar or if input processing or retrieval limitations contributed to the imitation responses.

To examine whether children's imitations are consistent with their underlying grammar, we examined three predictions: 1. Following their grammatical abilities, the SLI and LE groups will omit obligatory finiteness markers more than the AE group, 2. The SLI and LE groups will default to familiar lexical verbs when unable to imitate unfamiliar verbs, and 3. When deviating from the target imitation, children will produce grammatically correct clauses. To examine the first prediction, the percentage of omitted finiteness markers in obligatory contexts for finiteness (regardless of verb familiarity) was calculated. The SLI group and LE

group had a higher percentage of omitted finiteness markers in obligatory contexts compared to the AE group (22.7, 19.8 and 6.4%, respectively). A one-way ANOVA revealed that this difference was significant, $F(2, 56) = 5.51$, $p < 0.05$, $\eta = 0.16$, 95% CI [0.02, 0.32]. A closer look at differences between the groups indicated that the AE group differed significantly from each of the SLI and LE groups ($t(41) = 3.38$, $p < 0.05$, $d = 1.0$, 95% CI [0.36, 1.63]; $t(37) = 3.02$, $p < 0.05$, $d = 0.9$, 95% CI [0.22, 1.56], respectively), which did not significantly differ from each other. This pattern of findings is consistent with expectations based on understanding of the finiteness marking systems of the three groups, specifically that the SLI and LE groups are considered to be in a period of optional finiteness marking and are therefore expected to be more likely to omit obligatory finiteness markers than the AE group who are nearing adult-levels of competence in finiteness marking.

The second prediction, that the SLI and LE groups are likely to default to familiar verbs when unable to imitate unfamiliar verbs, was upheld. Specifically, of 28 target unfamiliar verbs, the SLI and LE groups substituted a familiar verb during imitation approximately 6 times, SLI: $M = 6.5$ (2.8), LE: $M = 6.2$ (3.2).

The third prediction is that, when incorrectly imitating the target clause, the children would draw on their grammar and produce grammatical clauses. The three groups differed in the number of incorrectly imitated full clauses they produced ($F(2, 56) = 20.76$, $p < 0.001$, $\eta = 0.43$, 95% CI [0.22, 0.56]) with the AE group producing fewer incorrect clauses compared to the SLI and LE groups ($M = 14.1$, 32.1 and 39.5, respectively). However, the groups did not differ in the proportion of incorrectly imitated clauses that were grammatical, LE: $M = 0.24$ (0.16); SLI: $M = 0.28$ (0.16); AE: $M = 0.35$ (0.14). Thus, while the SLI and the LE groups, both with a less mature 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.

The possibility that breakdowns in recall or input processing impact imitation accuracy also resulted in two predictions for deviations from the target clause during imitation. The first prediction is that children will produce out-of-order or omitted components with more such deviations for children with SLI than both control groups (Gillam et al., 1995; Lee & Estes, 1981). Toward this prediction, full clause imitations were explored for 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. In addition, the SLI group did not omit a greater number of noun phrases, verb roots and verb phrases in scorable utterances; instead their number of omissions fell between the LE group and the AE group, SLI: Noun phrase $M = 0.35$ (0.67), Verb $M = 0.35$ (0.67), Verb phrase $M = 0.15$ (0.49); LE: Noun phrase $M = 7.9$ (15.8), Verb $M = 1.4$ (2), Verb phrase $M = 0.25$ (2); AE: Noun phrase $M = 0.13$ (0.63), Verb $M = 0.09$ (0.29), Verb phrase $M = 0.04$ (0.21).

The second prediction was that breakdowns in input processing result in omissions of early input (noun phrases). As reported, noun phrase omission was generally uncommon and was most frequent for the LE group. These findings, taken together with the previously

mentioned out-of-order and omitted components findings, suggest that input processing or recall limitations are not strong influences on the error patterns.

Summary

To review, imitation accuracy was lower for children with SLI versus age-equivalent controls and similar to language-equivalent controls on all dependent variables (overall imitation, finiteness marking imitation and verb root imitation accuracy). All variables were also affected by familiarity, with greater accuracy for the familiar condition versus the unfamiliar condition. The groups were differentially affected by condition for Experimental Verb Finiteness accuracy and for Verb Root Accuracy. Findings also supported the likelihood that on this task children's imitations were guided by their underlying child grammar. Findings are summarized in Table 1.

Discussion

This study explored whether verb familiarity, defined here in terms of both child productions and caregiver input, influences finiteness marking accuracy in children with SLI and two groups of control children. An experimental sentence imitation task and analysis of imitation of clausal constituents allowed an evaluation of finiteness marking and verb root imitation accuracy in addition to a possible interaction between the two variables. In addition, detailed coding of the types of errors made during imitation allowed examination of two possibilities: 1) Sentence imitation taps children's underlying grammar and leads to grammatical clauses when imitation breaks down, or 2) Imitation deviations are due to breakdowns in input processing or recall limitations in SLI that lead to ungrammatical clauses.

Across all levels of analysis (overall imitation, finiteness marking imitation and verb root imitation accuracy), imitation was more accurate for the AE group than the SLI and LE groups, which were equivalent. Additionally, familiar verbs conferred an advantage on all levels of imitation, indicating that verb familiarity influences finiteness marking accuracy. Patterns of imitation deviations support sentence imitation as an index of children's grammatical abilities.

The findings have implications for the informativeness of sentence imitation task outcomes and for theoretical accounts of the source of poor performance on the part of children with SLI. With regard to informativeness, the conventional sentence imitation task outcome on standardized assessments is a calculation of overall imitation accuracy as "correct" versus "incorrect." The results of this study concur with the conclusion that "incorrect" sentence imitation can serve as a marker for SLI (Conti-Ramsden et al., 2001). At the same time, this summative score can obscure important details that can be very informative for clinical practice and for understanding the sources of difficulty on sentence imitation tasks. The conclusion is that children rely on their underlying grammatical representations, which they can recover from the input sentences even when their underlying grammar does not follow exactly the grammatical rules or lexical items presented. Children can default to familiar verb counterparts to unfamiliar verbs and they can selectively omit grammatical elements. It is necessary to examine children's "incorrect" responses in order to determine these patterns.

The evaluation of theoretical accounts is informed by scoring the individual components involved in the sentence imitation task. Both the EOI and Bybee accounts predicted that the children with SLI would demonstrate less accurate finiteness marking than the LE group. In this study, the SLI and LE groups did not differ in finiteness marking accuracy. Because finiteness marking was a dependent variable in this study, it was not used as an inclusionary criterion during group selection and assignment and 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 may account for the unexpected null finding of a difference in finiteness marking between the SLI and LE groups.

The key question of this study was whether verb familiarity differentially affects finiteness marking accuracy in children with SLI and two control groups. Collapsed across groups, finiteness marking was less accurate on unfamiliar verbs versus familiar verbs. How verb familiarity influenced finiteness marking for each group varied based on the methods used to designate verb familiarity. Following the Experimental Verb Finiteness method, hearing a familiar verb in the input imparted an advantage on finiteness marking for all groups but hearing an unfamiliar verb negatively affected finiteness marking accuracy more for the SLI and LE groups than the AE group. When verb familiarity was based on the verb produced by the child (Produced Verb Finiteness), the group x familiarity interaction was not significant.

These findings vary as to how they fit into the Bybee network model. For the AE group, the Bybee model predictions are unclear; these children may or may not have lexical schemas that are well-formed such that third person singular *–s* can be generalized to unfamiliar verbs. Across both verb familiarity designations, the AE group marked finiteness similarly for unfamiliar verbs and familiar verbs, suggesting that they have a well-formed third person singular –s schema. Unlike the AE group, both the SLI and LE groups show a familiarity effect, with less accurate finiteness marking on unfamiliar verbs versus familiar verbs. For the SLI group, this effect is consistent with Bybee network model predictions that the less productive schematization of third person singular *–s* in children with SLI results in their reliance on word frequency information for correct usage. For the LE group, given that they have had less input, the Bybee model predicted that they would have less well-established schemas for third person – s and, therefore, would have similar finiteness marking accuracy for familiar and unfamiliar verbs. This prediction was not upheld; instead, the LE group made more errors on finiteness marking for unfamiliar versus familiar verbs and, importantly, did not differ from the SLI group in finiteness marking accuracy on either verb type.

The verb root imitation analyses revealed that the SLI group was similar in accuracy to the LE group and less accurate than the AE group. In addition, the group x condition interaction indicated that unfamiliar verbs conferred a disadvantage on verb imitation for the SLI and LE groups only. These findings are consistent with predictions with other research showing 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). Additionally, the likely limited size of the verb lexicons of the SLI and LE groups is a

probable contributor to the finding that the less-established unfamiliar verbs are particularly difficult for SLI and LE groups.

Detailed error analyses suggest that children's underlying grammars guide their responses to sentence imitation tasks, as suggested by earlier studies (Prutting & Connolly, 1976; Prutting et al., 1975; Vinther, 2002) and demonstrated more recently by Smolik & Vavru (2014). 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, substituted familiar verbs for unfamiliar verbs during imitation, and, 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. In contrast, errors predicted as consequences of more general breakdowns in input processing and/or recall were rare in the error analyses, although it must be noted that if the stimuli were longer and more complex (i.e., passive constructions, relative or embedded clauses, etc.) the outcomes could differ. At the same time, it is important 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. In short, children's sentence imitations draw upon their underlying grammar as well as verbal recall and for short declarative sentences it seems that children's imitation errors reflect their linguistic system.

Recall that bilingual children are less accurate marking finiteness on nonsense verbs versus real verbs and that bilingual children with SLI show heightened difficulty with finiteness marking on nonsense verbs (Jacobson & Livert, 2010; Jacobson & Schwartz, 2005). This study builds on these findings by showing an effect of verb familiarity on finiteness marking in monolingual children with SLI and younger, LE children. In addition, to the extent that the verb familiarity influence on finiteness marking is apparent in less-familiar real verbs it is likely that outcomes from nonsense words may not generalize to real words.

Summary and Conclusions

In sum, this study shows that, while children with SLI imitated sentences at similar levels of accuracy to language-equivalent 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. One of the most informative aspects of this study was the examination of how children handle finiteness marking on unfamiliar verbs. This analysis revealed an effect of verb familiarity on finiteness marking accuracy for the LE and SLI groups, regardless of how verb familiarity was characterized. This pattern of findings was partly in conflict with predictions of input-based accounts, specifically the Bybee usage-based network model.

More detailed error analyses found that the children made deviations from the target clause that were in line with their underlying grammar. All three groups were likely to change one or more clausal components to produce a grammatically well-formed clause, in an apparent drive to produce an allowable grammatical alternative to the clause. Further, deviations from the target clause were not primarily omitted or out-of-order components. All in all, children with SLI bring significant strengths to sentence imitation tasks at the same time the tasks

reveal dimensions of underlying linguistic weaknesses running in parallel in patterns similar to younger children.

The outcomes of this study are in line with others that highlight the potential value for clinical assessment of well-designed sentence imitation tasks (e.g., Conti-Ramsden, Botting, & Faragher, 2001). It is very informative to move beyond simple yes/no judgments of imitation accuracy to detailed error analyses that help pinpoint strengths as well as particular weaknesses in syntax, morphosyntax and vocabulary development.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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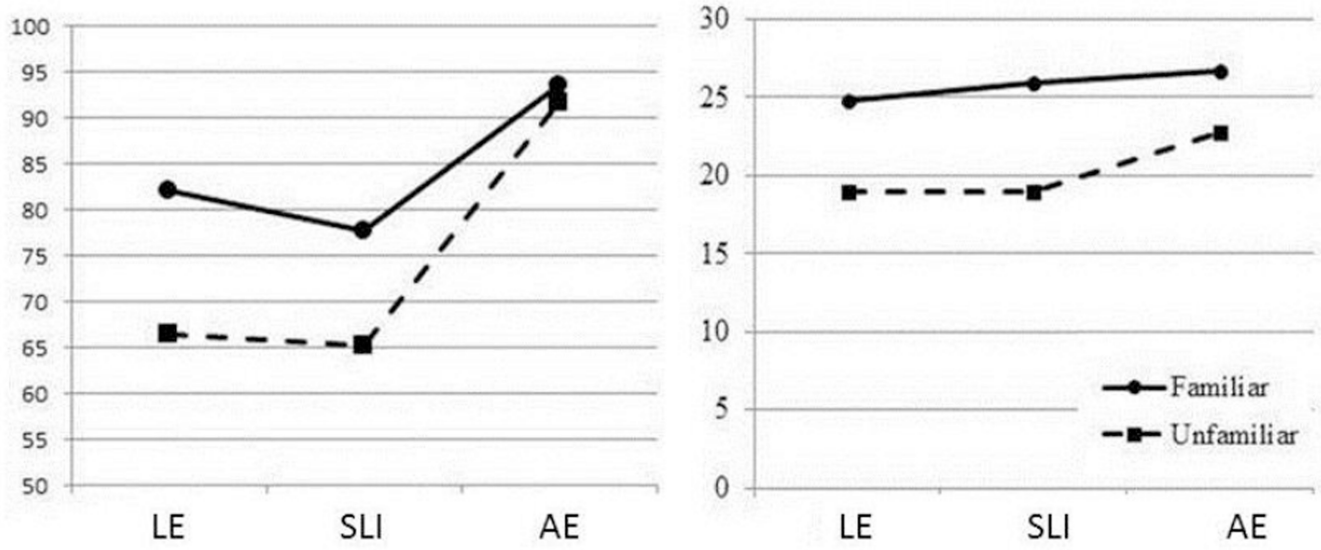

Figure 1.

Left panel: Mean percent correct Experimental Verb Finiteness Imitation (Max possible = 100%); Right panel: Mean number correct Verb Root Imitation (Max possible = 28)

Table 1

Summary of Findings from the Sentence Imitation Task Analysis

Analysis	Group Effects (effect sizes)	Condition Effects (effect sizes)	Interaction (effect sizes)
Overall Imitation Accuracy	AE > SLI = LE (d = 1.94, 1.63)	Fam > Unfam (d = 0.83)	ns
Individual Component Accuracy			
Finiteness Marking Imitation Accuracy Experimental Verb Finiteness	AE > SLI = LE (d = 1.14, 1.06)	Fam > Unfam (d = 0.4)	Group × Condition
Finiteness Marking Imitation Accuracy Produced Verb Finiteness	AE > SLI = LE (d = 1.13, 1.06)	Fam > Unfam (d = 0.15)	ns
Verb Root Imitation Accuracy	AE > SLI = LE (d = 0.98, 1.27)	Fam > Unfam (d = 1.63)	Group × Condition
Detailed Error Analysis			
Percent of Omitted Finiteness Marking in Obligatory Contexts	SLI = LE > AE		
Number of Familiar verb for Unfamiliar verb substitutions	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		