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What Do Children With Specific Language Impairment Do With Multiple Forms of *DO*?

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Purpose: This study was designed to examine the early usage patterns of multiple grammatical functions of *DO* in children with and without specific language impairment (SLI). Children's use of this plurifunctional form is informative for evaluation of theoretical accounts of the deficit in SLI.
Method: Spontaneous uses of multiple functions of *DO* were analyzed in language samples from 89 children: 37 children with SLI, ages 5;0–5;6 (years;months); 37 age-equivalent children; and 15 language-equivalent children, ages 2;8–4;10. Proportion correct and types of errors produced were analyzed for each function of *DO*.
Results: Children with SLI had significantly lower levels of proportion correct auxiliary *DO* use compared to both control groups, with omissions of the *DO* form as the primary error type. Children with SLI had near-ceiling performance on lexical *DO* and elliptical *DO,* similar to both control groups.
Conclusions: Plurifunctionality is not problematic: Children acquire each function of *DO* separately. Grammatical properties of the function, rather than surface properties of the form, dictate whether children with SLI will have difficulty using the word. Overall, these results support the extended optional infinitive account of SLI and the use of auxiliary *DO* omissions as part of a clinical marker for SLI.

Key Words: specific language impairment, morphology, language assessment

Much of what is known about young children's language acquisition is based on studies of particular linguistic forms or functions. For example, auxiliary *DO* has been the focus of numerous studies (Paradis, Rice, Crago, & Marquis, 2008; Rowland, 2007; Rowland, Pine, Lieven, & Theakston, 2005; Santelmann, Berk, Austin, Somashekar, & Lust, 2002; Stromswold, 1990). A significant outcome of this area of investigation is identification of auxiliary *DO* as part of a grammatical clinical marker for specific language impairment (SLI; Rice, Hoffman & Wexler, 2009; Rice & Wexler, 1996, 2001; Rice, Wexler, & Cleave, 1995; Rice, Wexler, & Hershberger, 1998). At the same time, *DO* carries multiple grammatical functions, most of which have received relatively little investigation in the child language literature. Multiple grammatical functions for a given form could increase the complexity of a child's task when acquiring auxiliary *DO* and possibly could contribute to the documented difficulty in acquiring this grammatical form. The general purpose of this investigation was to explicate five different grammatical functions of *DO* evident in young children's utterances and to describe use of the different functions by children with SLI and age- and language-equivalent control groups, with the aim of evaluating theoretical accounts of the grammatical deficits of SLI.

Five Functions of DO *in the Adult Grammar, From Verb Phrase to Complement Phrase: Lexical Verb, Emphatic Auxiliary, Auxiliary, Tag Question, and Ellipsis*

DO is a flexible form in English, assuming multiple, and very different, roles in the morphosyntax (cf. Lightfoot, 1999; Quirk, Greenbaum, Leech, & Svartvik, 1985). It can serve as a main verb of the clause; as a special form of auxiliary that precedes the main verb; or as a formal grammatical marker whose sole function is to mark finiteness, an obligatory requirement for clauses involving tense and agreement features of the grammar. X′ theory provides a precise model of the grammatical functions of *DO* (cf. Chomsky, 1993, 1995; Haegeman, 1991). Within this model, morphology is closely related to syntax because morphological elements carry word order and

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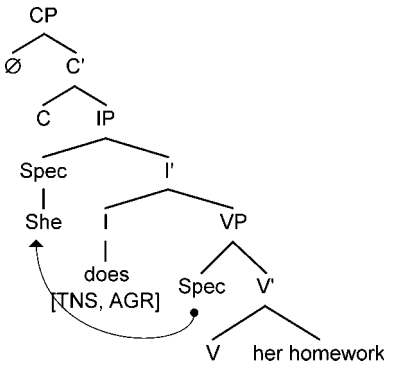
Editor: Janna Oetting
Associate Editor: Jessica Barlow
Received May 3, 2011
Accepted May 18, 2012
DOI: 10.1044/1092-4388(2012/11-0107)

phrasal movement requirements, hence the term *morphosyntax* (Pollock, 1989). In this model of the adult grammar, simple matrix clauses consist of a noun phrase (NP) and a verb phrase (VP). Verbs carry tense (TNS) and agreement (AGR) features that are essential for clause structure. An additional projection, the *inflection phrase* (IP), is needed for finiteness marking to meet the requirements of TNS and AGR checking in simple clauses. Figure 1 demonstrates an IP with *DO* as a lexical main verb. The subject NP is assumed to originate in the "specifier" position to the left of V ("head" of VP) and move to the specifier position to the left of the finite verb in the I ("head" of IP) position. The finite verb originates in the V (head) of the VP. (Note that each constituent, VP, IP, CP, has a specifier and an X′ position.) In English, lexical verbs originating in the V cannot move overtly to the I position of the IP. Instead, the V moves covertly to the I position of the IP in order to show TNS and AGR (in Figure 1, third-person present -s on the base form of *DO* in the clause "She does her homework"). As a finite lexical verb, *DO* shares an important grammatical property with other lexical finite verbs: It cannot raise to the left of the subject. "Does she her homework?" and "Completes she her homework?" are both ungrammatical clauses. In another way, lexical *DO* is different from other lexical verbs: The meaning is underspecified and must be determined from the interaction of its direct object with context. "She does her homework" may mean "She completes her homework" (with a more semantically specified main lexical verb) or "She is working on her homework" (with a different main lexical verb and an auxiliary form of BE that appears in I to carry TNS and AGR marking). Here, we are interested in the similar grammatical properties of main verb *DO* and other lexical main verbs, and we refer to this function as *Lexical Verb DO* in our coding system.[1] We are also interested in whether children could confuse lexical main verb *DO* with auxiliary *DO,* which does raise to the left of the subject.

In a different grammatical context, *DO* can appear as a stressed form before the main verb to mark a finite clause as positive rather than negative. As illustrated in Figure 2, in this usage, *DO* carries TNS and AGR in I, the head of IP projection, in communicative situations in which positive *DO* denies a stated or implied negative. Here, we refer to this usage as *emphatic DO*. This form of *DO* also cannot raise to the left of the subject. "Does she swim?" loses the emphatic positive sense and instead is interpreted as the auxiliary use of *DO*. It is not clear whether emphatic *DO* raises from V to I, or is inserted directly into I; for our purposes, we focus on the fact

[1]In this text, capitalized names for the forms of *DO* denote the names of coding categories as implemented in this study. Uncapitalized names are generic linguistic terms for the structures. In this section, first use of coding category names is italicized, as are the government and binding theory terms for morphosyntactic phrasal projections.

Figure 1. Lexical verb *DO*. CP = complementizer phrase; Ø = null or "no occupant" in the Spec of C position; C′ = C bar; C = head of CP; IP = inflection phrase; Spec = sister of I′; I = head of IP; VP = verb phrase; TNS = tense; AGR = agreement; V = head of VP.



that it clearly is in I as a verb form carrying finiteness marking.

Auxiliary DO in this study refers to auxiliary *DO* use in questions and is illustrated in Figure 3. Pollock (1989) worked out the syntactic properties of auxiliary *DO* and copula and auxiliary BE in English. Under this model, questions are derived from the matrix clauses via movement of TNS and AGR features to a projection above (i.e., to the left of) the IP, known as the *complementizer phrase* (CP). This projection also includes two sites: C and the specifier of C′ position. As shown in the illustrated clause, "Where does the girl swim?" the *Wh–* element is moved from the lower VP to the specifier of C′ position. Nonemphatic auxiliary *DO* occupies the C position where TNS and AGR appear via movement from I. The standard account is that auxiliary *DO* moves from IP in the same

Figure 2. Emphatic *DO*.

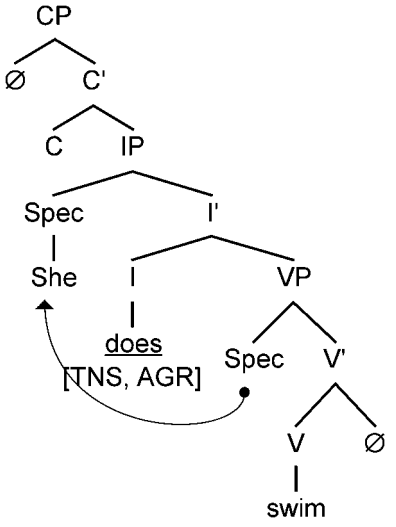


Figure 3. Auxiliary *DO*. t = the "trace" of a hypothesized movement within the syntax; i = the origin and final location of one movement; j = the origin and final location of another movement.

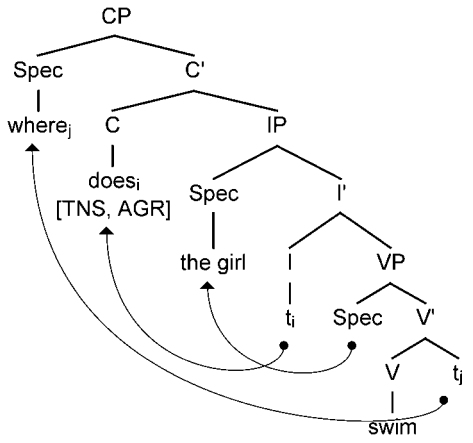
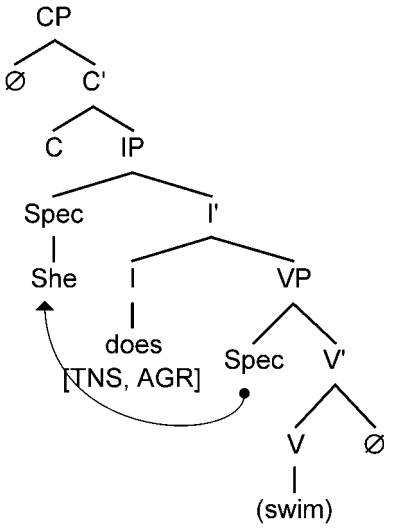


Figure 4. Elliptical *DO*.

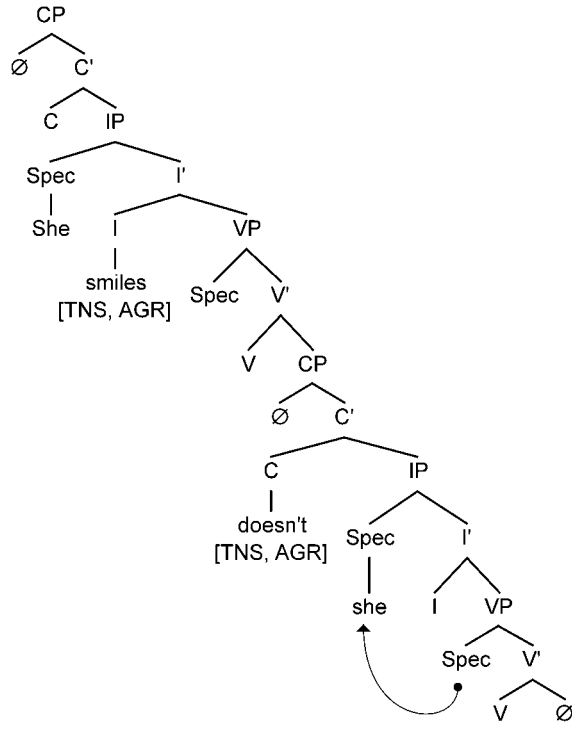


way as auxiliary BE (Pollock, 1989), although Chomsky (1995) suggests it may be directly inserted in C (p. 164, Footnote 20). Figure 3 depicts the standard version. In this position, *DO* does not carry the meanings of either the lexical verb usage or the emphatic *DO* usage. Because there is no apparent meaning for this use of *DO,* it is sometimes called *dummy DO*. Lightfoot (1999) argues that the introduction of *DO* as solely a structural requirement was triggered by historic changes in the verb movement system of English grammar. Importantly, although lexical verb and emphatic *DO* carry TNS and AGR, they appear in the IP, not CP, projection.

A type of auxiliary *DO* also appears in reduced clauses that are understood to repeat the content of an earlier clause, sometimes referred to as *stranding*. *Elliptical DO* is illustrated in Figure 4. This example is a reply to a question such as, "Does she swim in the morning?" In the reply, "She does," the omitted VP is inferred from the previous utterance. Of interest here is the requirement that elliptical *DO* carries TNS and AGR as the occupant of I. In this example, it does not move to C ("head" of CP), to the left of the subject.

Figure 5 illustrates the finiteness marking property of *DO* in tag questions, referred to here as *Tag DO*. The example clause, "She smiles, doesn't she?" is similar to elliptical *DO* in that the tag construction, "doesn't she," is related to another matrix clause. As such, the choice of *DO* for both elliptical *DO* and in tag constructions is linked to lexical verbs in matrix clauses. If the matrix clause has BE copula or auxiliary, as in "She is happy," *DO* is not allowed, and BE auxiliary must appear in the tag question, "isn't she?" or elliptical sentence, "She is." There are also important differences between elliptical and tag functions of *DO*. In tag constructions, *DO* moves to the left of the subject for TNS and AGR marking to C of the CP projection, with interrogative force. Also, as shown in the examples, the tag question must contrast positive and negative polarity, such that a positive clause has a negative tag. In the interest of simplicity, this semantic/pragmatic requirement is not included in Figure 5.

Figure 5. Tag question *DO*.



In summary, like other lexical main verbs, lexical *DO* includes the feature "+verb" and cannot move overtly outside the VP and thus cannot raise around the subject. Emphatic *DO* precedes the lexical verb in what could appear to be the auxiliary position, but it cannot raise to the left of the subject, presumably for semantic reasons. Auxiliary *DO* is generated in I and moves to C in main clause interrogatives and tag questions. Elliptical *DO* stays in I with an omitted VP. *DO* in tag questions moves to C and coordinates the selection of *DO* if a lexical verb appears in the matrix clause and contrasts the polarity of the tag (negative vs. affirmative) with the polarity of the main clause. Children must sort through these various grammatical requirements as they encounter instances of *DO* use in the speech they hear and as they use the forms of *DO* in their utterances. In short, there is much more to *DO* than auxiliary use in questions, with many possibilities of confusion about when movement is allowed to I or C and when movement is not allowed.

Brief Summary of Children's Acquisition of DO and DO as Part of a Clinical Marker of SLI

An emerging generalization is that auxiliary *DO* poses a particular challenge to young children learning English as a native language (Rowland et al., 2005, 2007; Santelmann et al., 2002; Stromswold, 1990) and for children learning English as a second language (Paradis et al., 2008). This generalization is also supported by evidence from young typically developing children studied as controls in studies of children with SLI (Rice et al., 2009; Rice & Wexler, 1996; Rice et al., 1995). Early on, there were indications that *DO* was part of a grammatical clinical marker for SLI (Morehead & Ingram, 1973), although the relationship of *DO* to other morphemes was not recognized in this early work.

In the 1990s, Rice and Wexler and colleagues instigated programmatic study of auxiliary *DO* as part of finiteness marking of TNS and AGR in English as a possible grammatical clinical marker of SLI, based on Wexler's theory of optional infinitives (Wexler, 1998). Essentially, the optional infinitive account predicts that Auxiliary *DO,* as part of the TNS/AGR morphosyntax of English, is likely to be omitted in the grammars of young children. Rice and Wexler hypothesized an extended optional infinitive (EOI) period in which children with SLI show a protracted period of omitted *DO* (Rice et al., 2009; Rice & Wexler, 1996; Rice et al., 1995), although other properties of the syntax, including the basic X′ scaffolding of Figures 1–5, is thought to be available to young children (cf. Wexler, 1998; Wexler, 2011). The emerging generalization is that children with SLI are more likely than younger language-equivalent children to omit auxiliary *DO* and to accept omitted auxiliary *DO* in questions as grammatical into the adolescent years (Rice et al., 2009).

Direct investigation of the forms of *DO* beyond auxiliary *DO* in the utterances of children with SLI is limited. Early on, studies documented that 4- to 5-year-old children with SLI use lexical verb *DO* as one of their most frequently used verbs (Rice & Bode, 1993; Watkins, Rice, & Moltz, 1993), with a very low rate of overt errors. Stromswold (1990) reported for typically developing children that lexical verb *DO* appeared in young children's utterances approximately five months earlier, on average, than auxiliary *DO,* at approximately 28 months of age. Hadley and Rice (1996) addressed this issue in a study of 11 young children with SLI, compared with seven younger typically developing children. This study included comparisons of lexical verb *DO* to auxiliary forms of *DO* (a category composed of *DO* in ellipsis, auxiliary *DO* in questions, and *DO* in negation). They reported the SLI group used lexical verb *DO* on average 1.5 months earlier than auxiliary forms of *DO,* at approximately 42 months. The pattern was also evident in the typically developing children, with lexical *DO* emerging at approximately 24 months, although with a shorter interval to first use of auxiliary *DO,* approximately 25 months (noting here that the difference did not meet statistical significance in the small sample). When examining the emergence patterns of the different auxiliary uses of *DO,* they found that in the SLI group auxiliary *DO* appeared first in ellipsis (for eight of the 11 children) or negation (for the remaining three children). In comparison, the control group showed ellipsis-first acquisition in two of the seven children, with four of the children using auxiliary *DO* in questions first, and one using negation first. Further, when mean length of utterance (MLU) averaged 3.00 or above, the SLI group's AGR accuracy for auxiliary *DO* in ellipsis, inversion, or negation contexts was 91%. The conclusion was that the morphosyntactic properties of *DO* in lexical verb and auxiliary *DO* contexts are available to the children with SLI early on, with few AGR errors. The limitation of the study was that the emergence measure, following Stromswold (1990), was first use of the target form. Investigation of somewhat more advanced children would allow for calculation of the percentage correct in obligatory contexts of use, a more robust metric. A full survey of the use of *DO* in lexical verb *DO* contexts compared with auxiliary, emphatic, ellipsis, and tag question uses in spontaneous speech is needed in order to evaluate relative ease and difficulty of the various forms and to evaluate whether plurifunctionality contributes to auxiliary *DO* omissions.

Interpretive Frameworks and Predictions

The plurifunctional properties of homophonous *DO* summarized above could contribute to the protracted period of acquisition for auxiliary *DO* for typically developing

children and children with SLI. The same phonological form has different underlying representations in the grammar, with different projections and different semantic, syntactic, and morphosyntactic rules and constraints. Further, the phonological form is a single syllable that often appears in clause-internal sites that could further add to processing demands. A child could be confused by multiple hypotheses for how to use *DO* across the different usages encountered in conversational speech. This could happen if the child had a breakdown in domain-general implicit learning (Tomblin, Mainela-Arnold, & Zhang, 2007) or possibly if children made the wrong inferences from their statistical learning from input (Evans, Saffron, & Robe-Torres, 2009), or perhaps the many grammatical functions of *DO* require verbal memory capacity that exceeds the verbal memory of children with SLI (Gathercole, 2006). If the child was confused about grammatical constraints, errors of usage—such as "Does she her homework?"—would be expected.

The surface account of SLI predicts omission of auxiliary *DO* as a consequence of a processing weakness such that grammatical forms with low perceptual salience are particularly affected when producing them requires the alignment of multiple types of information (Leonard, 1998). This accounts for why a homophonous phoneme can be produced accurately in word-final position but omitted as a morphological affix; for example, –/z/ in *rose* is accurate but omitted in the verb *flies* to mark third-person singular present tense. The account also predicts omission of single morpheme function words, such as BE, and, presumably, *DO,* as a consequence of incomplete processing (Leonard, 1998; Leonard, Eyer, Bedore, & Grela, 1997). The account focuses on "closed class" forms and does not address the learning challenges that could operate in the case of *DO* when children have to sort out whether (a) it is operating as an auxiliary with shared grammatical properties of other auxiliaries, (b) it is operating as a main verb with shared constraints of the main verb site in the syntax, or (c) it carries emphatic force but cannot move to the left of the main verb. In all these contexts, *DO* carries TNS and AGR markings, but the word order rules vary.

As noted above, the EOI account posits that children with SLI have access to the underlying syntactic framework, the scaffolding depicted in Figures 1–5. According to this account, the weakness for finiteness marking appears in the children's grammar as an under-specification of TNS and AGR in I and C. The account accurately predicts omission of finiteness markings in finite sites in the clause and avoidance of overt tense TNS/AGR morphemes in nonfinite sites. When children use forms of auxiliary *DO,* these forms are likely to be restricted to finite sites in the C projection and to show AGR when they are used. That is, overt errors of word order or AGR are unlikely to appear. These predictions follow from the assumption that children, even children with SLI, optionally omit TNS/AGR at the same time that they have the capacity to correctly represent TNS/AGR. If the representation is activated, then overt errors of word order or agreement are unlikely (cf. Rice & Wexler, 1996, p. 1242; also, Wexler, Schütze, & Rice, 1998). Another implication is that if children with SLI represent the syntactic category of V in the verb projection, then they would know that Lexical *DO* could not precede the subject.

Following a generative representational model, Snyder (2007, 2010) offers a broad view of young typically developing children's spontaneous utterances, across many languages, under a grammatical conservatism (GC) model, such that "children do not make productive, spontaneous use of a new syntactic structure until they have both determined that the structure is permitted in the adult language, and identified the adults' grammatical basis for it" (Snyder, 2011, p. 2). He notes that the majority of children's spontaneous errors involve omission, not overt errors of commission, and such errors of commission are limited to a tiny subset of the logical possibilities. He posits a model in which parameters of syntax guide children's acquisition such that children use only certain parameters that are definitely permitted in the target language. Further, he notes that the omissions of optional infinitives are exceptional properties of children's language use, probably under maturational control (as posited by Wexler, 2003). Snyder argues that finiteness omissions are also compatible with his claim of GC, given the fact that typically developing children show much knowledge of the adult grammar at the time that they omit finiteness forms (Snyder, 2007, pp. 170–171). In other words, the GC model presents a framework unifying the observation that young children avoid many possible grammatical errors in their speech while at the same time, in the languages that show optional infinitive use, they are likely to omit finiteness forms.

We suggest here an extension of the GC model to children with SLI, with the prediction that children with SLI also follow a GC path into their grammar, showing knowledge of grammatical representations of the sort demonstrated in Figures 1–5 in their spontaneous speech as they use multiple grammatical functions of *DO,* with varying constraints. Yet, at the same time, they persist in their use of a grammar that allows for omission of auxiliary *DO* but no omissions or errors of lexical verb *DO* or auxiliary *DO* in elliptical *DO* contexts. As in the EOI account, children with SLI are expected to be similar to their younger language-equivalent peers in their use of *DO* forms, with the exception of auxiliary *DO,* which is more likely to be omitted by children with SLI. Further, the GC account could explain if some forms of *DO* are used rarely in the children's spontaneous utterances, as this account predicts that young children will avoid producing

structures they have not identified in the adult target grammar for entry into their grammar.

This descriptive study across a wide range of *DO* forms addressed the following questions:

1. What are the early usage patterns of *DO* in children with and without SLI?
2. Are all categories of *DO* use evident?
3. Is the same profile of *DO* use observed in children with SLI compared with age-equivalent and language-equivalent control children?
4. Do errors of *DO* use differentiate children with SLI from age-equivalent and language-equivalent control children?
5. Does the evidence support the EOI and GC models?

Method

Participants

Thirty-seven children with SLI ages 5;0–5;6 (years; months) participated, with two control groups: 37 age-equivalent (AE) children and 15 language-equivalent (LE) children ages 2;6–4;10. The racial composition of the full sample was as follows: 80 White, six more than one race, one American Indian/Alaskan Native, two not reported. Ethnicity was 83 not Hispanic, four Hispanic, and two not reported. The participants were drawn from an archival database collected as part of an ongoing longitudinal study, approved by the University of Kansas Human Subjects Committee, of children with SLI, their siblings and parents, and control children and their siblings. (Rice, Smith, & Gayán, 2009; Rice et al., 2010). Children with SLI and control children were recruited from schools and attendance centers in Kansas and Missouri. Their siblings and parents were recruited into the study after the enrollment of the target children. All children in this study had normal or above-normal intellectual functioning defined as a standard score of 85 or above on the Columbia Mental Maturity Scale (CMMS; Burgemeister, Blum, & Lorge, 1972); a passing score on the phonological probe of the Test of Early Grammatical Impairment (TEGI; Rice & Wexler, 2001), which assesses final –t, -d, -s, and –z; no diagnosis of autism, intellectual, behavioral, or social impairments; a passing score on hearing screening at 25 dB (30 dB in noisy environments) at 1000, 2000, and 4000 Hz; and performance on the Goldman–Fristoe Test of Articulation (GFTA; Goldman & Fristoe, 2000) above the 15th percentile, in order to ensure sufficient intelligibility for coding morphemes in spontaneous speech samples (distortions of consonant blends in initial position were exceptions to the 15th percentile rule if they were the only source of low scoring).

Spontaneous language samples were collected from the children every 6 months. The samples were collected by trained examiners in naturalistic play settings with toys for the purpose of eliciting valid utterances for the calculation of MLU with sufficient numbers of obligatory finiteness contexts for analysis of finiteness markers. Each sample lasted approximately 25 min, with a target of 200 complete and intelligible child utterances per sample (see Rice et al., 2010). Intertranscriber reliabilities exceed 85% on utterance, word, code, and morpheme levels based on regular monitoring.

From the data archive, children in the SLI group were selected who met the following criteria:

1. A minimum of five instances of *DO* contexts in the spontaneous sample (Ingram, 1989).
2. An MLU from the spontaneous language sample in the affected range, defined as MLU standard score of 85 or less, based on local norms (Rice et al., 2010), where $M = 100$ and $SD = 15$.
3. Classified as having SLI in the longitudinal study based on at least one omnibus language standard score below 85, either the Test of Early Language Development—2 (Hresko, Reid, & Hammill, 1991), the Test of Early Language Development—3 (Hresko, Reid, & Hammill, 1999), or the Test of Language Development Primary—2 (Newcomer & Hammill, 1988), depending on age at time of testing. Omnibus test data were collected within 6 months of the language samples analyzed.
4. A composite standard score on the TEGI (Rice & Wexler, 2001) of 1 *SD* or more below the mean, based on the *M*s and *SD*s provided in the manual.

Children in the control groups met the following criteria:

1. A minimum of five instances of *DO* contexts in the spontaneous language sample.
2. An MLU from the spontaneous language sample in the unaffected range, defined as MLU standard score of 86 or greater, based on local norms (Rice et al., 2010).
3. Performed above 85 standard score on omnibus language measures (Test of Early Language Development—2, Test of Early Language Development—3, Test of Language Development Primary—2, depending on age at time of testing). Omnibus assessment was collected within 6 months of the analyzed spontaneous sample.
4. A composite standard score on the TEGI of higher than 1 *SD* below the mean, calculated with the *M*s and *SD*s provided in the manual.

The sample of children with SLI focused on the 5;0–5;6 age level as a time of early finiteness marking (Rice & Wexler, 2001). Thirty-seven children (mean age = 5;3)

Table 1. Group descriptive information: Means (and *SD*s) of inclusion criteria, *DO* probe, and omnibus language measures.

Group	*n*	Age (years;months)	GFTA percentile rank	MLU in morphemes	MLU standard score	Omnibus language standard score	TEGI composite standard score	TEGI *DO* probe standard score
SLI	37	5;3 (range = 5;0–5;6)	27.28 (16.05)	3.67 (0.32)	74.52 (6.62)	79.73 (7.04)	39.69 (15.88)	49.01 (27.08)
LE	15	3;8 (range = 2;6–4;10)	78.47 (22.85)	3.81 (0.20)	94.15 (8.31)	113.47 (15.90)	101.62 (8.22)	98.81 (12.83)
AE	37	5;3 (range = 5;0–5;6)	70.72 (17.38)	5.12 (0.49)	104.83 (10.2)	105.7 (10.55)	105.30 (8.15)	102.94 (11.13)

Note. GFTA = Goldman Fristoe Test of Articulation; MLU = mean length of utterance; TEGI = Test of Early Grammatical Impairment; SLI = specific language impairment; LE = language equivalent; AE = age equivalent.

were selected who met all criteria, with an obtained mean MLU of 3.67 (range = 3.3–4.11) for the SLI group. From the available younger children in the database, 15 were selected for MLU equivalence, defined as each child in the group having an MLU that was within 0.1 of at least one member of the SLI group (cf. Rice, Redmond, & Hoffman, 2006). The MLUs for these groups were not significantly different, $t(50) = -1.58, p = .12, d = 0.54$. The *n* for this group is smaller due to the relatively stringent inclusion criteria and fewer available unaffected younger children. The LE group's mean age was 3;8 (range = 2;6–4;10).[2] Finally, 37 children were selected for the AE group, with a mean age of 5;3 (range = 5;0–5;6). The children met all the criteria listed above.

Table 1 reports the means for each of the measures used in participant selection and the means of the TEGI *DO* standard score, calculated from *M*s and *SD*s provided by the manual (Rice & Wexler, 2001). The table indicates that the SLI group differed from the control groups on overall language performance at the time of the analyzed language sample.

Data Analysis Procedures

For each transcript, a concordance of all uses of forms of *DO* was generated using Version 9 of the Systematic Analysis of Language Transcripts program (SALT; Miller & Chapman, 2002). Each utterance containing a form of *DO* was coded. This included a polarity code, differentiating affirmative versus negative uses of *DO*. Because no previous reports exist of the distribution of affirmative and negative uses of *DO* by children with SLI and control groups, we wished to describe this distribution and to further code the affirmative uses according to the syntactic structures illustrated in Figures 1–5: Lexical Verb *DO,* Emphatic *DO,* Auxiliary *DO,* Elliptical *DO,* and Tag *DO*. We focused on affirmative uses because negation differs from the affirmative uses in semantic, morphophonological, syntactic, and dialectal ways that complicate direct comparisons across the two types of *DO* auxiliaries and the interpretation of children's errors relative to the adult grammar: Negation involves a semantic component that often appears as *DO* + a contracted form (i.e., "don't" and "doesn't"). Furthermore, the negation component is, under a generative model, hypothesized to reside in another functional projection, NEG, with complex related grammatical properties that may or may not involve another hypothesized functional projection for MOOD (see Guasti, 2002; Guasti, Thornton, & Wexler, 1995; Schütze, 2010). Finally, there are dialectal variants on the requirements of the third-person form of *DO* + NEG, such that "he don't" can be acceptable in local dialects, usage that can complicate inferences about AGR + NEG (Oetting & McDonald, 2001). This study generates an overall count of instances of negative uses of *DO,* without further analyses to differentiate the semantic, morphophonological, morphosyntactic, or dialectal properties, which warrant detailed analyses beyond the scope of this study. Given possible dialectal use of "don't" with third-person singular subjects, the coding of NEG reported below is conservative with regard to possible errors attributable to dialect and does not include non-agreeing "don't" in the Error category.

Children's affirmative responses were coded according to accuracy (correct/omission/error), subject person (first, second, third), subject number (singular/plural), and tense (present/past). Errors were categorized in a separate error table for each transcript. Transcripts were coded by a single coder, with a second coder trained to evaluate the reliability of the coding scheme. Intercoder reliability on 6% of the transcripts was 96.5%. Utterances with multiple *DO*s did not enter into analyses because of the complexities of interpreting errors when there is more than one *DO* in the clause. The counts of *DO,* whenever possible, are based on obligatory contexts, according to the adult grammar (Brown, 1973).

The accuracy code always referred to the accuracy of the *DO* form. Sentences that were malformed but in which the *DO* use was correct were counted as correct *DO* uses, although they received a code indicating there was another, non-*DO* error in the sentence. Nonomission

[2]The age range is somewhat larger than usual. Out of the children in the archival sample who met all the criteria for the LE group, all but two were in the age range from 2;6 to 4;1; the two exceptions were 4;8 and 4;10. Inspection of their *DO* contexts did not show performance differences from others in the LE group.

DO errors refer to errors of commission, such as using the wrong *DO* form (e.g., "Does they like candy?" or a BE substitution for *DO,* or vice versa (e.g., "Where is this go?"). Omissions referred to utterances where the *DO* form was obligatory in the adult grammar but had been omitted (e.g., "What you want?"). Omissions of *DO* in second-person yes/no questions were coded (e.g., "You want a cookie?") but were not included in counts of *DO* omissions in any analyses because these types of utterances are allowed in discourse contexts in the adult grammar. In utterances such as "where he go?," an omitted *DO* was assumed. Although it is possible that a modal verb, such as "can," was intended, transcribers had access to contextual information to infer that the semantics of a modal interpretation did not apply.

Results

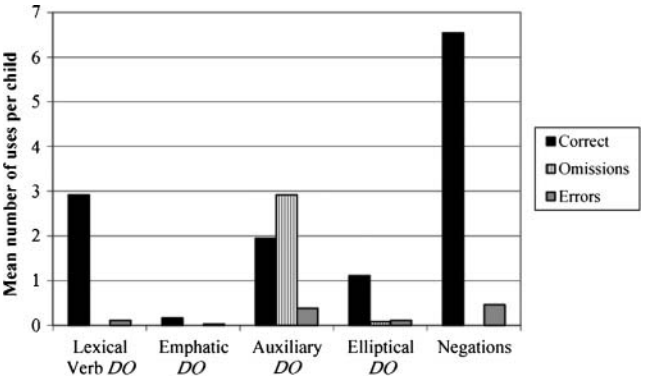
Each child's total number of correct responses, omissions, and errors for each category were calculated. Caveats apply for the identification of omission errors in some categories. Obligatory contexts for Negation, Lexical Verb, and Emphatic *DO* uses can be difficult to detect, rendering omissions as unlikely, although overt morphosyntactic or AGR errors are readily detectable. Obligatory contexts for Elliptical *DO* were observed in utterances such as "so (do) the windows" where the "do" was omitted. Another caveat is that plural present subjects do not require overt AGR morphology, as in "they do the housework"; if plural subjects appear frequently, this would limit the opportunities to observe omissions. Preliminary analyses revealed rare use of tag questions in the samples, with insufficient numbers for analyses. That category was dropped from further analyses.

Questions 1 and 2

What are the early usage patterns of *DO* in spontaneous utterances of children with and without SLI? Are all categories of *DO* use evident early on? These questions were treated as initial descriptive summaries of the data. Given the lack of such descriptive information in the literature, we report here all uses, affirmative and negative. The average number of correct uses, *DO* omissions, and nonomission *DO* errors were calculated to provide an overview of the general patterns of usage in these three groups. These means are presented in Figures 6–8.

Figures 6–8 demonstrate that general usage patterns of *DO* were similar across all groups. With the exception of Auxiliary *DO* use in the SLI group, errors and omissions of *DO* were rare in all groups and categories. At another level, we examined the proportion of children per *DO* form in each category for each group. These proportions are presented in Table 2.

Figure 6. Mean number of correct *DO* uses, *DO* omissions, and *DO* errors in all categories in the specific language impairment (SLI) group.



Figures 6–8 and Table 2 show that negative uses of *DO* were frequent and appeared in each child's sample, primarily in the form of "don't." It is clear that all the target categories of *DO* are not present in the spontaneous samples of all children. There is a wide range in the proportion of children who use *DO* contexts across categories. For example, Auxiliary *DO* and Lexical Verb *DO* appear for most children in all groups, but Emphatic *DO* appears for few children. Analyses of within-subject comparisons of accuracy across all forms of *DO* were not appropriate given the lack of use of all forms across all children.

Question 3

Is the same profile of *DO* use observed in children with SLI compared with AE and LE control children? For this question, analyses are restricted to affirmative *DO,* with a minimum number of three *DO* coding contexts in a given category in order for that child to enter

Figure 7. Mean number of correct *DO* uses, *DO* omissions, and *DO* errors in all categories in the language-equivalent (LE) group.

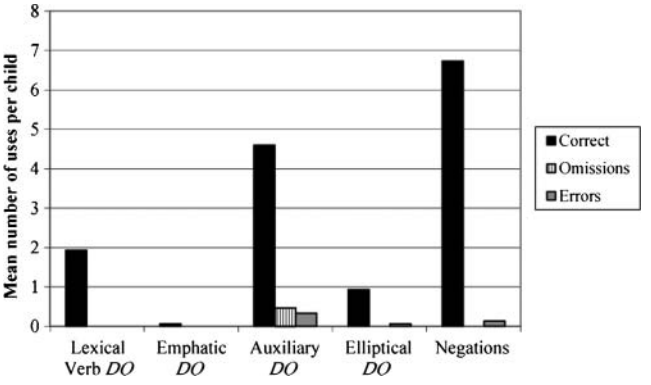
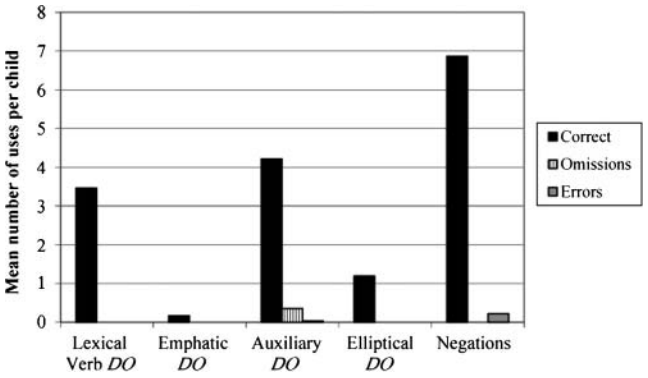


Figure 8. Mean number of correct *DO* uses, *DO* omissions, and *DO* errors in all categories in the age-equivalent (AE) group.



into comparisons for that category (Ingram, 1989). For Lexical Verb *DO,* there were 15 children from the SLI group, five children from the LE group, and 20 children from the AE group with at least three *DO* contexts. For Auxiliary *DO,* there were 23 children from the SLI group, nine children from the LE group, and 25 children from the AE group with at least three *DO* contexts. For Elliptical *DO,* there were nine children from the SLI group, two children from the LE group, and seven children from the AE group with at least three *DO* contexts. Because there were no children who had more than three contexts for Emphatic *DO,* this category was not included in this analysis.

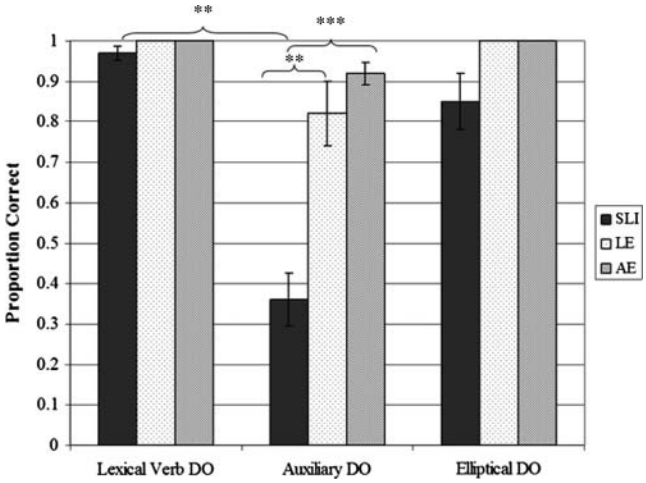
The dependent variable was the child's proportion correct out of all *DO* contexts per category, calculated as Total correct/Total correct + Total omissions + Total nonomission errors. Coding for grammatical subjects revealed relatively few uses of plural subjects, thereby reducing the possible complications for estimating omissions. The proportion of plural present tense subjects for Auxiliary *DO* contexts for the SLI group was 14%; AE group, 18%; and LE group, 11%.

For all comparisons, effect sizes for group analysis of variance (ANOVA) results are reported as η^2, and effect sizes for *t* tests are reported as Cohen's *d* values (Cohen, 1988). A one-way ANOVA was conducted to identify effects of group on the mean proportion correct for each category (see Figure 9). For Auxiliary *DO* use, the means

Table 2. Proportion of participants per each category of *DO* use.

Category	SLI (*n* = 37)	LE (*n* = 15)	AE (*n* = 37)
Lexical Verb *DO*	.76	.60	.92
Emphatic *DO*	.14	.07	.16
Auxiliary *DO*	.89	.93	.95
Elliptical *DO*	.59	.53	.57
Negative uses	1.00	1.00	1.00

Figure 9. Proportion correct *DO* use. Error bars represent standard error. $^{**}p < .01$. $^{***}p < .001$.



(*SD*s) per group are as follows: SLI, .37 (.32); LE, .82 (.24); and AE, .92 (.03). There was a significant effect of group, $F(2, 54) = 33.76$, $p < .01$, $\eta^2 = .56$. Follow-up pairwise comparisons revealed that the proportion correct on Auxiliary *DO* use was significantly different between the SLI and LE groups, $t(30) = -3.9$, $p < .001$, $d = 1.66$, and the SLI and the AE groups, adjusting for unequal variances, $t(29.9) = -7.7$, $p < .001$, $d = 2.43$, such that the SLI group had significantly lower levels of accuracy on Auxiliary *DO* than both the LE and AE groups.

For Lexical Verb and Elliptical *DO* use, all unaffected control children had perfect accuracy, with no variation in the accuracy levels. Therefore, an ANOVA was inappropriate for these categories. The SLI group scored trivially lower than the controls on Lexical Verb use, with a *M* (*SD*) proportion correct of .97 (.07). For Elliptical *DO* use, five children in the SLI group had perfect accuracy, one had a proportion correct *DO* use of .8, two had a proportion correct of .67, and one had a proportion correct of .5.

Although within-group comparisons were ruled out for the unaffected control children due to perfect accuracy on Lexical Verb and Elliptical *DO,* there were 10 children in the SLI group who had more than three uses of Lexical Verb *DO* and more than three uses of Auxiliary *DO,* allowing for a within-group comparison. A paired-samples *t* test revealed that this subset of the SLI group was significantly more accurate on Lexical *DO* than Auxiliary *DO,* $t(9) = 3.86$, $p < .01$, $d = 1.43$.

Question 4

Do errors of *DO* use differentiate children with SLI from AE and LE control children? To address the final

research question, an analysis of the error patterns for each group was conducted. Two categories of errors were considered: *DO* omissions and nonomission *DO* errors. In order to evaluate error rates, proportions of each error type were calculated and compared across groups.

In these analyses, the denominator for the calculation of proportion of errors reflected only the opportunities for that error type, such that the denominator in the calculation of proportion of errors depended on the type of error being analyzed. *DO* omissions can occur in any context in which the *DO* form is required structurally. Because Emphatic *DO* is never structurally required, it did not factor into the calculation of proportion of *DO* omissions. Therefore, the denominator for the proportion of *DO* omissions was each child's total number of Auxiliary *DO* contexts, Lexical Verb *DO* contexts, and Elliptical *DO* contexts. The nonomission *DO* errors category refers to errors of commission, where a *DO* form appeared but was incorrect either because the child made an error of TNS/AGR marking, confused the *DO* form with a BE form, or used an over-regularized form. Because nonomission *DO* errors can occur in any utterance containing a *DO* form, the denominator for nonomission *DO* errors was each child's total number of *DO* uses, including Emphatic *DO* uses. These proportions were then averaged for each group.

Table 3 contains the group means of these proportions in addition to the total number of each error type and the total number of contexts for each error type. A one-way ANOVA was conducted to evaluate group differences in proportion of errors. There was a significant effect for group on the proportion of *DO* omissions, $F(2, 86) = 12.35$, $p < .001$, $\eta^2 = .22$, and nonomission *DO* errors, $F(2, 86) = 3.45$, $p < .05$, $\eta^2 = .07$. Pairwise comparisons to probe these overall group effects were subsequently conducted.

Table 3. Mean (and *SD*) proportion of errors, total errors, and error contexts.

Error category	SLI (*n* = 37)	LE (*n* = 15)	AE (*n* = 37)
Proportion of *DO* omissions***	.28 (.28)	.11 (.26)	.04 (.09)
Total *DO* omissions	111	7	13
Total *DO* omission contexts	354	125	342
Proportion of nonomission *DO* errors*	.04 (.09)	.03 (.05)	.002 (.01)
Total nonomission *DO* errors	13	5	1
Total *DO* contexts	361	126	348

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

Independent-samples *t* tests were conducted to compare the error patterns of children with SLI to those of the LE group. Differences between the SLI and the LE control group were significant for the proportion of *DO* omissions, $t(50) = 2.07$, $p < .05$, $d = 0.64$, such that the SLI group had significantly more *DO* omissions than the LE group. There were no significant differences between the SLI group and the LE group on nonomission *DO* errors, $t(50) = 0.27$, $p = .79$, $d = 0.09$. The dominant error type for children with SLI in these data is omission of the *DO* form. The error patterns of the AE group compared with the SLI group were also evaluated using independent-samples *t* tests. Because the AE children had reached adult-level mastery, they performed at ceiling with minimal numbers of errors for each error type. Adjusting for inequality of variances, there were significant differences between the two groups on the proportion of *DO* omissions, $t(42.7) = 5.14$, $p < .001$, $d = 1.35$, and the proportion of nonomission *DO* errors, $t(37) = 2.47$, $p < .05$, $d = 0.73$, such that the SLI group had significantly more of each error type than the AE group.

Discussion

This study was designed to examine the early usage patterns of multiple grammatical functions of *DO* by children with and without SLI, as an investigation of how children manage a plurifunctional form, as well to evaluate theoretical accounts of the deficit in SLI. Multiple grammatical functions, with varying constraints, could pose particular problems for children with SLI as they sort through the differences, which could plausibly contribute to their known protracted acquisition of auxiliary *DO* (Rice et al., 2009; Rice & Wexler, 1996; Rice et al., 1998). If plurifunctionality adds to the learning problems for children with SLI, and therefore contributes to their difficulty with auxiliary *DO,* then children with SLI are likely to have difficulty with multiple functions of *DO,* with errors of commission as well as omissions across grammatical contexts. On the other hand, children with SLI could be similar to younger LE children in their deduction of fundamental syntactic representations such as the scaffolding depicted in Figures 1–5. They could form representations that would constrain commission errors while leaving auxiliary *DO* vulnerable to omission errors attributable to special weaknesses of underspecification of TNS and AGR, as predicted by the GC and EOI models.

The evidence from this investigation supports the prediction that children with SLI do not have general difficulties with *DO*. Instead, the difficulty appears to be localized to a tendency to omit auxiliary *DO* in finiteness-required contexts. Children with SLI had significantly lower proportion correct Auxiliary *DO* use compared to

both the LE and the AE groups. In stark contrast, children with SLI performed at near-ceiling levels for Lexical Verb *DO,* similar to both control groups. In addition, the within-group comparison demonstrates that children with SLI had a significantly lower proportion correct on Auxiliary *DO* compared with their use of Lexical Verb *DO*. These outcomes, based on proportion correct use, are consistent with earlier studies of the emergence of *DO* forms in young children's language (Hadley & Rice, 1996; Stromswold, 1990). Both groups of control children had 100% accuracy on Lexical Verb *DO,* with lower levels of accuracy for Auxiliary *DO*; the SLI group performed at near-ceiling levels for Lexical *DO* but continued to omit Auxiliary *DO* at a very high rate. Lexical verb *DO* is not only first to emerge in young children; it is also first to become mastered in comparison to auxiliary *DO*.

Children with SLI also had higher performance on Elliptical *DO* (mean proportion correct = .85) than on Auxiliary *DO* in questions (mean proportion correct = .37). Although this is a sizeable difference, interpretation is limited by variable accuracy rates in a small set of children for Elliptical *DO*. Of the nine children with SLI who met the criterion of three elliptical utterances, five had perfect performance, and four did not. The overall mean proportion correct of .85 can be taken as preliminary evidence that children with SLI are relatively accurate with Elliptical *DO,* although replication is needed. The high proportion correct with Elliptical *DO* is notable, however, considering the multiple dimensions that need to be aligned for proper use of Elliptical *DO*.

Error Patterns

The error patterns clearly show that the hallmark error for children with SLI was omission of Auxiliary *DO* in questions, rather than errors of commission. Overt agreement errors (errors of commission) were rare for all children. Group differences between the SLI group and the AE control group were significant for both error types due to the fact that the AE group had near-perfect accuracy in their *DO* use. However, the only significant difference between the SLI group and the LE group was for Auxiliary *DO* omissions. The two groups were similar in their rate of occasional agreement errors; children with SLI produced equivalent numbers of nonomission errors as their LE peers. Overall, children with SLI performed at significantly lower levels of accuracy than typical LE peers, due to the omission errors for Auxiliary *DO,* consistent with a selective difficulty with the morphosyntactic requirement of TNS/AGR marking (Rice, 2003). Omissions of Lexical Verb *DO* forms or Elliptical *DO* forms were exceedingly rare or nonexistent.

Note that the children did not make errors indicating confusion of different functions of *DO*. For example children never made errors in which a Lexical Verb *DO* was raised up to the CP to form a question, as in "Does she her homework?" As predicted by the GC and EOI models, the lack of errors with Lexical Verb *DO* suggests that the children with SLI, as well as the controls, know that this form of *DO* has the feature "+verb" and therefore it cannot undergo movement. The avoidance of these types of errors is consistent with the prediction that children acquire the many forms of *DO* separately, according to morphosyntactic properties. Taken together, the findings on early use of multiple functions of *DO* indicate that children, both typically developing and those with SLI, appear to acquire multiple functions of a pluri-functional form with minimal confusion of the distinct grammatical properties.

Theoretical Implications

Overall, the outcomes of the study are consistent with predictions of the GC account and the EOI account. A major advantage of these interpretations is that they can accommodate that the grammars of children with SLI, as well as younger children, apparently include accurate representations of syntactic properties of lexical verb *DO* and elliptical *DO* at the same time that auxiliary *DO* is omitted. Interestingly, children with SLI do not generate all possible forms of errors, nor do they omit all forms of *DO*.

The strengths of the grammars of children with SLI can be overlooked in models proposed to account for their weaknesses in grammatical acquisition based on general learning mechanisms (e.g., Tomblin et al., 2007). Other models, such as the surface account (Leonard, 1998; Leonard et al., 1997), assume children have access to syntactic representations, but such models have not addressed how to reconcile the pattern of omissions of auxiliary *DO* with avoidance of errors in the use of lexical or elliptical *DO*. A more complete evaluation of the predictions of the surface account for uses of *DO* will require evaluation of the salience of *DO* in its various clausal contexts.

Consistent with the GC account, we found very few errors of commission (nonomission *DO* errors), with many more errors of *DO* omission, particularly for the children in the SLI group. At the level of individual transcripts, however, we did observe one type of nonomission error, the addition of finiteness morphology on main verbs in utterances in which the *DO* serves an auxiliary function (e.g., "Where does this goes?"). These types of errors in the SLI group were closely examined to determine whether they are representative of the SLI group's grammar, and also to determine whether these should be considered in conflict with the GC predictions about errors of commission. Main verb finiteness errors in clauses with auxiliary *DO* were not representative of

the SLI group as a whole. Less than half of the children with SLI produced these types of errors at all, and of those that did, three children contributed more than half of the errors.

The question for the GC perspective is whether these types of errors represent a possible abstract grammar that the child is considering. Across the three children with the most main verb finiteness errors of this type, only one child demonstrated evidence that this error type was part of his abstract grammar. Examination of language samples collected within six months of the ones analyzed here revealed that one child showed continued main verb finiteness errors in clauses with auxiliary *DO,* making it possible that this error type was part of this child's grammar. Of the other two children with many main verb finiteness errors, one child's count was high because of frequent use of the phrase "where this goes?" during the setting-up period of the play session. Because this error type occurred in only one phrase construction, it could be limited to one context, or it could be more productive in clauses not elicited, making it impossible to determine whether this error represented a possible grammar the child was entertaining or an unanalyzed form. The third child with many of these errors had resolved this issue within 6 months. The presence of these types of errors in a few children demonstrates one way that the grammatical system could potentially break down. Therefore, it is notable that, in fact, the children in the SLI group overwhelmingly did not produce this type of error. This perspective is consistent with the GC account. Children with SLI generally do not misplace finiteness morphology in question formation.

Overall, we conclude that the grammatical properties of each form are what dictate whether it will be a challenge to children with SLI, in spite of the homophony of the *DO* form across different grammatical functions. The GC notion adds further specification to the EOI model, by clarifying further the ways in which children with SLI are similar to younger typically developing children, and suggesting possible mechanisms that guide children's acquisition of grammar that may be shared by children with and without SLI.

Let us acknowledge the empirical strengths and limitations of the study. The partitioning of negative from affirmative clauses is a strong element of the study, avoiding possible complications of interpretation attributable to the semantic dimension of negation, as well as morphosyntactic or dialectal variants. At the same time, detailed description of negative *DO* clausal contexts warrants further study. As with other studies of this kind, the group sizes are relatively small and therefore have limited power to detect small effects. This is especially important when low-incidence phenomena such as grammatical errors are of theoretical interest. Recall Snyder's (2007) notion that children will avoid producing new syntactic structures requiring grammatical structures they have not identified as grammatical in the adult grammar. This prediction bears on the results of this study, in which there were few tag questions, presumably related to the clausal requirements diagrammed in Figure 5. If children with SLI or young children are likely to avoid structures they do not have entered in their grammar (with the notable exception of auxiliary *DO*), then targeted elicitation procedures may be needed in order to generate sufficient examples for investigation of possible errors.

The multiple forms of *DO* and the findings reported here suggest ways to refine the design of clinical interventions to enhance the grammatical abilities of children with SLI. Clinicians could consider introducing Elliptical *DO* as a context to highlight early use of Auxiliary *DO*. In elliptical contexts, auxiliary properties of *DO* could be taught in tandem with auxiliary BE, highlighting the ways in which both forms can appear in the same site in questions or in ellipsis. At the very least, those who design intervention programs must be mindful of the multiple grammatical functions of *DO,* and of the likelihood that if *DO* is omitted for questions, it may not mean that *DO* will be omitted in all possible contexts of use. Likewise, our interpretive models must be mindful of the ways in which children with SLI apparently have robust access to subtle grammatical constraints at the same time they have persistent immature grammars for other properties of the grammar.

Acknowledgments

This research was funded by National Institutes of Health Grants T32DC000052, P30DC005803, R01DC001803, and R01DC005226, awarded to the first author, as well as by University of Kansas Intellectual and Developmental Disabilities Research Center Grant P30HD002528, awarded to John Columbo. The study is based on a thesis completed by the second author in partial fulfillment of the requirements for a Master of Arts degree at the University of Kansas. Portions of the study were reported at the Symposium on Research in Child Language Disorders, Madison, Wisconsin, June 2010, and at the Boston University Conference on Language Development, November 2010, Boston, Massachusetts. We thank past and present research assistants and students in the Language Acquisition Studies laboratory at the University of Kansas for data collection and data processing, Denise Perpich for her assistance with data processing and summaries, and the participating children and their families for their time and effort.

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J Speech Lang Hear Res 2013;56;222-235; originally published online Jun 28, 2012;
DOI: 10.1044/1092-4388(2012/11-0107)