
Production of English Finite Verb Morphology: A Comparison of SLI and Mild-Moderate Hearing Impairment

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The performance on production of finite verb morphology of 19 children (ages 5;9–10;7) with mild-moderate sensorineural hearing impairment (SNH) was compared with that of 14 children with specific language impairment (SLI) (ages 7;2–10;9) and age-matched and language-matched control groups. On average, the SNH group outperformed the SLI group and was comparable to controls. However, a subset of the SNH group ($n = 6$) was impaired on one or both of these tasks. Degree of hearing loss or age of receiving hearing aids was not directly related to performance, but other language measures were. The subset was also significantly younger than the rest of the SNH group, suggesting that acquisition of finite verb morphology may be delayed in children with hearing impairments. Verb regularity had no effect on performance of any group, but word frequency and phonological complexity did exert an influence. The findings are discussed in relation to causative theories of SLI.

KEY WORDS: SLI, hearing impairment, morphology, verb inflections

It is well established that children with SLI have disproportionate difficulty with English verb morphology (see Leonard, 1998 for a review). However, this difficulty does not represent a complete failure or random application of morphemes. In a review of language transcripts of school-age children with SLI, Bishop (1994) and Miller and Leonard (1998) found that use of grammatical morphemes was above chance and that when errors occurred they were errors of omission, not commission. Also, when a verb was inflected, it was always in the appropriate context. Furthermore, when the context demanded an inflectional marking, sometimes a verb would be inflected and at other times the same verb would not. These findings indicate that correct performance cannot be attributed to rote learning of specific inflected forms, leading to the conclusion that children with SLI do have some knowledge of the underlying grammar.

Not all grammatical morphemes present equal difficulty. Problems are particularly evident with morphemes that mark finiteness (tense and agreement) (Rice, Wexler, & Cleave, 1995). The reasons that these morphemes are so vulnerable have been hotly debated. In this article we compare mastery of finite verb morphology in children with mild to moderate hearing impairment and those with SLI in order to address the contrasting predictions made by different theoretical accounts.

Theoretical Accounts of SLI

Extended Optional Infinitive (EOI)

The EOI account of SLI put forward by Rice and colleagues (Rice, 2000; Rice & Wexler, 1996a, 1996b; Rice, Wexler, & Cleave, 1995; Rice, Wexler, & Hershberger, 1998) is based on a model of normal syntactic development in which young children have incomplete knowledge of the grammatical feature finiteness and so treat marking of verb tense and subject-verb agreement as optional (Wexler, 1996). This results in the omission of those grammatical morphemes that mark finiteness, such as third person singular *-s*, regular past tense *-ed*, the copular and auxiliary forms of BE, and the auxiliary DO. This account can explain why normally developing young children omit surface markers of finiteness on occasion but that when they do use tense markers, they use them appropriately and almost never in the wrong context. The theory maintains that by the time most children are 3;6–4;6 (years;months), their grammatical representations of finiteness are fully specified and they mark tense and agreement accurately.

Following on from this model, Rice and Wexler (1996b) proposed that children with SLI continue to treat tense marking as optional long after the age at which the grammar should be fully developed (hence the *extended* optional infinitive). In this view, children with SLI are not missing key grammatical principles or structures. Instead, they are thought to be following a normal developmental pattern, albeit at a considerably slower rate.

Another key feature of the EOI account is that grammatical knowledge of finiteness is thought to be independent of other types of linguistic knowledge. According to the EOI, the child's ability to mark tense is not a function of lexical knowledge or linguistic input. A recent longitudinal study (Rice et al., 1998) demonstrated that the morphemes responsible for finiteness marking grow together over time and that their use is not predicted by such variables as maternal education, non-verbal abilities, or receptive vocabulary. Rice and Wexler (1996b) demonstrated that normally developing children master finiteness marking around age 4 with accuracy of 90% or better, whereas children with SLI lagged behind controls even at the age of 8. Rice et al. (1998) noted that children with SLI may have deficits in other aspects of syntax or in other linguistic domains, such as semantics and pragmatics, but these are seen as unrelated to EOI and resulting from different causal factors. Thus, the EOI offers a radically different view of morphosyntactic development than accounts offered by other researchers working in a connectionist framework. For instance, Marchman and Bates (1994) proposed interdependence between different levels of language, with morphosyntactic development being dependent on level of vocabulary knowledge or "critical mass."

The Surface Hypothesis

Leonard, Sabbadini, Leonard, and Volterra (1987) demonstrated that in Italian, where the corresponding inflections are typically more phonologically salient than in English, children with SLI had less difficulty with verb inflections. This raises the question of whether the morphosyntactic difficulties seen in SLI could be solely due to problems in perceiving and producing certain phonemes. On the basis of further cross-linguistic work, Leonard (1998) proposed a "surface hypothesis" of SLI, which has two main threads. First, it proposes a general processing capacity limitation in children with SLI. Second, the hypothesis maintains that the surface properties of many English morphemes make them particularly difficult to acquire in both normal development and in SLI.

Unlike the EOI, the Surface Hypothesis regards the grammatical impairments seen in SLI as arising from deficits outside the syntactic system. Rather, it is the interaction of a limited processing capacity with the fragile morphological features of English that has such a devastating effect on grammatical acquisition in children with SLI. This can happen in a number of ways (see Leonard, 1998). Slowed processing may initially delay acquisition of certain grammatical forms, particularly those of low perceptual salience. Even after grammatical inflections have been acquired, production of low-salience morphemes will be vulnerable, owing to the processing demands of the situation. In order to process the grammatical morpheme, the word must be heard, it must be recognized as an inflected form of a known word, the inflection must be separated from the stem, its grammatical function must be realized, and it must be inserted in the appropriate cell of a morphological paradigm. All of this must be completed before the next item in an utterance enters the system. Therefore, perceived material may be lost owing to restrictions in working memory or because previous material is still being processed. Sometimes, an inflected verb will be fully processed, and at other times it will not.

Although they differ in their conceptualization of the underlying cause of SLI, both the EOI and the Surface Hypothesis maintain that children with SLI acquire the rules of grammar in the normal developmental sequence, albeit at a considerably slower rate. The two theories differ in how they account for the unusual difficulty children with SLI have with certain aspects of English morphology. The EOI offers a syntactic interpretation in terms of a maturational lag in complete grammatical knowledge of finiteness, attributed to genetic factors (Rice & Wexler, 1996a). Syntactic properties, rather than surface features of the morpheme, are seen as the critical determinant of performance. The EOI does not give an explicit account of why a child selects

the option of using a tense marker on one occasion but not on another. It does, however, maintain that phonetic salience is not of crucial importance. Therefore if a child was delayed in marking regular inflections compared to age-matched peers, one might expect similar difficulties marking tense on irregular verbs that are marked by a salient internal vowel change.

The surface hypothesis differs in two important respects. First, the deficit in SLI is not seen as selectively influencing one part of the grammar: Children who have problems with finite verb morphology should also have difficulties with nonsyntactic tasks that have high processing demands. Second, the surface hypothesis makes predictions about nonsyntactic factors that will influence whether or not a child uses an inflectional ending. Difficulties with finite verb morphology in SLI should be most evident for items of low perceptual salience, such as third person singular -s and past tense -ed. Irregular verbs, in which the internal vowel change is more perceptually salient, should pose less difficulty. The Surface Hypothesis is not the only account that offers nonsyntactic explanations of children's inconsistent performance with grammatical morphology. Other researchers have suggested that such variables as word frequency or phonological complexity of verbs might affect children's production of correctly inflected forms (e.g., Marchman, Wulfeck, & Ellis Weismer, 1999; Oetting & Horohov, 1997). These possible influences are not, of course, mutually exclusive.

Effects of Hearing Loss on Language Learning

If the low perceptual salience of finite verb morphemes makes them difficult to process in SLI, we might expect to see a pattern of deficit mimicking SLI in children with known auditory perceptual deficits. In the current study, we considered mastery of finite verb morphology in children with mild-moderate sensorineural hearing impairment (SNH) who are learning spoken English as their first language. To date very little research has been carried out on language development in this population, although there is evidence that vocabulary and literacy skills may be at risk (Blair, Peterson, & Viehweg, 1985; Davis, Elfenbein, Schum, & Bentler, 1986).

Gilbertson and Kamhi (1995) compared children with mild-moderate hearing impairment to children with no known hearing loss on measures of phonological processing and novel word learning. They found that word learning was highly correlated with vocabulary knowledge but not with phonological processing ability or degree of hearing loss. However, the SNH sample they studied had vocabulary delays of up to 2;6 years, reiterating

the findings of Blair et al. (1985) and Davis et al. (1986) that vocabulary might be vulnerable to even mild hearing losses.

An extensive literature search identified only one article that looked at morphological development of children with moderate hearing losses. Brown (1984) compared 10 children with moderate SNH (mean loss 54 dB) with 10 control children matched for MLU. She found that use of morphology in children with SNH was more accurate than in MLU controls, and both groups followed the same developmental sequence. However, the SNH group was on average 5.5 years older than the controls. This suggests a significant delay in morphological development. These findings were not considered within a theoretical context or in relation to language impairments in hearing children. Therefore, an important gap in the literature remains.

Aims of the Current Study

The first question addressed by the current study was how degraded auditory input affects learning of finite verb morphology. We were particularly interested to discover whether children with mild-moderate SNH resembled children with SLI in their ability to mark verb tense. The Surface Hypothesis, which stresses the role of perceptual input on language learning, would seem to predict that even mild hearing impairment might result in morphemes of low perceptual salience being missed and therefore delaying grammatical development. However, there is no reason to suppose that children with SNH have processing limitations (though the two would not be mutually exclusive). Therefore it is possible that some children with SNH may overcome initial delays in grammatical development. With respect to the EOI, a perceptual deficit alone would not be expected to result in a selective deficit in finiteness marking.

Our second question was how the properties of verbs (e.g., regularity, frequency, and phonological complexity) affect performance. Children with an underspecified grammatical representation of finiteness should have difficulty marking both irregular and regular verbs for tense, compared to their peers. On the other hand, the Surface Hypothesis might predict that regular verbs should be more difficult for both SNH and SLI groups because of the low perceptual salience of the inflectional ending. The EOI is not explicit as to how frequency or phonological complexity might affect performance, either in normal development or SLI, but insofar as these can account for patterns of inflection use, this indicates that factors outside the syntactic system are implicated.

A final question concerns how nonsyntactic language abilities, such as vocabulary level or verbal memory, relate to impairments of verb morphology. The EOI has

clearly stated that there is no relationship between lexical learning (i.e., receptive vocabulary) and morpho-syntactic development (Rice et al. 1998). Furthermore, the EOI account stresses that deficits in morphosyntax are independent of other linguistic deficits that may be present in SLI (Rice et al., 1998). Rice and Wexler (1996) acknowledge that certain cognitive prerequisites (such as memory, ability to process incoming speech, and basic conceptual development) are necessary for syntactic development to proceed. However, the minimal levels of ability in these areas have yet to be specified.

Method

Participants

Children With SLI

Fourteen children with SLI between the ages of 7.2 and 10.9 were recruited from special classes (language units) and special schools for children with language impairment in southeast England. All children had been diagnosed as having a language impairment by a speech-language therapist and were receiving intensive intervention. Any child with SNH was excluded, but children with a history of otitis media were not. As we were interested in looking at a homogeneous group of children with SLI, all children were screened for pragmatic impairments using the Children's Communication Checklist (Bishop, 1998), and only those with no evidence of pragmatic difficulties (scores of 132 or above) were included. Also, children with poor intelligibility (less than 80% consonants correct on a phonology screen) were excluded.

For inclusion in the study, children had to achieve a standard score of 80 or better on a test of nonverbal reasoning, Raven's Coloured Matrices (Raven, Court, & Raven, 1986; mean standard score = 105, $SD = 14.15$), and scores of more than one SD below the mean on at least two of four key language measures: the British Picture Vocabulary Scales (BPVS; Dunn, Dunn, Whetton, & Pintilie, 1982), the Test for Reception of Grammar (TROG; Bishop, 1983), the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals (CELF-R UK; Semel, Wiig, & Secord, 1987), and the Children's Test of Non-Word Repetition (CNRep; Gathercole & Baddeley, 1996).

Children With Mild-Moderate Sensorineural Hearing Loss (SNH)

Children with mild-moderate SNH were recruited via Local Education Authorities in the southeast of England. All children had received diagnoses by a certified audiologist in a clinical setting. All children with diagnosed SNH in England are referred to special educational services, and over 85% of those with mild-moderate

hearing loss are educated in mainstream settings (Eatough, 1994). We aimed to recruit children who attended mainstream classrooms full time, who were monolingual speakers of English, and whose hearing loss did not result from neurological impairment or a known syndrome. Children being educated in mainstream classes were chosen to avoid confounding factors that might result from exposure to signed language. Nineteen children between the ages of 5.9 and 10.7 met criteria for inclusion in the study. (The criteria included having a standard score on Raven's Coloured Matrices within the normal range.) Language status was not a selection criterion for this group. Seven children had a history of speech and language therapy, though none was currently receiving regular intervention. Four children (one of whom had no history of speech and language therapy) met our criteria for language impairment. Two of these children had mild losses, and two had moderate losses.

Hearing thresholds are given as pure tone averages (PTA) in dB HL in the better ear at 250, 500, 1000, 2000, and 4000 Hz (British Society of Audiology, 1998). Three categories of hearing loss were identified. Mild hearing impairment is defined as having a PTA of 20–40 dB ($N = 13$; Mean PTA = 34, $SD = 3.67$). Moderate hearing impairment is defined as having a PTA of 41–70 dB ($N = 3$; Mean PTA = 55.67, $SD = 4.73$). Because of the important role of high frequency fricatives in marking verb morphology, we also included three children with PTA less than 20 dB who had hearing thresholds greater than 25 dB at two or more frequencies at or above 2000 Hz (Mean PTA = 15.33, $SD = 3.51$).

In 53% of cases hearing loss was through no known cause; 37% were due to genetic factors, whereas the remaining 10% resulted from peri- or postnatal causes. The average age at which parents became concerned about their child's hearing was 26.1 months ($SD = 19.92$), but the average age at which children were fitted for hearing aids was 48.2 months ($SD = 19.42$). Therefore, during the time most children are mastering finite verb morphology, these children with SNH were receiving degraded auditory input. Eighteen of the children currently wore hearing aids, at least during school hours.

Control Children

Two groups of control children were used. A chronological age group (CA, $n = 20$) was matched on age and nonverbal ability (Raven's Matrices) to the SLI and SNH groups. A second language-age control group (LA, $n = 15$) was matched to the SLI group on language age equivalence from the British Picture Vocabulary Scales (BPVS; Dunn, Dunn, Whetton, & Pintilie, 1982), a measure of receptive vocabulary. Table 1 shows means and standard deviations on the measures that were used to match the groups.

Table 1. Mean (*SD*) age and score on tests used to match groups.

	SLI (<i>N</i> = 14)	SNH (<i>N</i> = 19)	CA (<i>N</i> = 20)	LA (<i>N</i> = 15)
Chronological age (mo.)	108.00 (14.11)	103.26 (16.47)	101.45 (18.67)	88.47 (15.24)
BPVS – Age equivalent (mo.)	89.50 (21.75)	103.26 (33.07)	114.40 (20.97)	91.73 (21.41)
Raven's Matrices – standard score	105.43 (14.15)	109.79 (14.07)	107.35 (12.84)	104.80 (7.67)

Both control groups were recruited from primary schools in Oxfordshire. None of the children had a history of hearing loss or speech and language impairment. All children achieved a standard score of 80 or above on Raven's matrices and scored within 1 *SD* of the mean on the core language measures. The control groups were matched to the two clinical groups in terms of the mean age that mothers left full-time education [$F(3, 59) = .131, p = .941$].

Procedure

The study reported here is part of a larger study looking at the language and literacy skills of children with mild-moderate hearing loss (also see Briscoe, Bishop, & Norbury, 2000). Each child attended two individual assessment sessions of approximately 45 min each. Each testing session was carried out in a quiet room at the child's school or home. The relevant tests given are described below.

Core Language Measures

1. Receptive vocabulary was measured using the long form of the British Picture Vocabulary Scales, a multiple-choice assessment in which the child is required to choose one of four pictures that matches a spoken word.

2. Test for Reception of Grammar (TROG; Bishop, 1983) is a multiple-choice test in which the child selects a picture from a choice of four that corresponds to a spoken sentence. The vocabulary is kept simple, but grammatical complexity increases as the test proceeds.

3. The Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals–Revised UK (Semel, Wiig, & Secord, 1987) was used to index expressive language skills. Sentences of increasing length and grammatical complexity are read aloud to the child, who is then required to repeat the sentence. This test has a heavy working memory component.

4. The Children's Non-word Repetition Test (CNRep; Gathercole & Baddeley, 1996) was used as an index of phonological short-term memory. This test consists of

40 nonwords, divided equally into 2-syllable, 3-syllable, 4-syllable, and 5-syllable items. It was administered using an audiotape, and all responses were recorded.

CNRep has norms for children between the ages of 4 and 8. We used normative data obtained by Bishop, North, and Donlan (1996) for cases between the ages of 7 and 12 years ($n = 98$).

Related Language Measures

1. In a phonological discrimination task (Bridgeman & Snowling, 1988) children were asked to make same/different judgments about 60 pairs of words and non-words that differed in terms of a single phonemic feature (guess/get) or a phoneme sequence (guest/gets). The phonemes sampled are limited to /t/ and /s/. It was decided to use this task as these are phonemes implicated in tense marking.

2. The Verb subsection of the Test of Word Finding (German, 1989) was used to estimate the child's verb vocabulary. The child is shown a picture of an action and is asked to provide one word to describe what the person is doing.

Finite Verb Morphology Tasks

1. The Third Person Singular task, which was audio- and videorecorded, is based on a method formulated by Van der Lely (1998). The child was seated in a quiet room and told, "I want you to tell me things that your family and friends do every day. You can pick which person you tell me about, but it has to be something different each time you tell me something. I want to know 15 different things. I'll go first to show you what I mean. 'Every day my mother gets out of bed.' or 'Every day Mark watches telly.' Now you try." If children repeated a verb, they were reminded that they had to tell something different each time and were asked for a new verb. Children who had difficulty thinking of verbs were encouraged to talk about typical household routines—for example, "Tell me what your dad does in the morning." Some children had great difficulty generating verbs, but all children produced at least 10 different verbs, and 85% of the total sample produced 15 verbs.

Responses were recorded online and coded as follows: (a) marked correctly with third person singular -s, (b) unmarked stem, and (c) verb tense error. The overall score was the percentage of the total number of different verbs that were marked with third person singular -s. One quarter of video recordings of children in the clinical groups were transcribed and recoded by the second author. Agreement was 96% for transcription and 99% for coding.

2. Past Tense Elicitation

The materials used to elicit past tense were derived

Table 2. Real and novel verb stems and COBUILD frequency counts^a of real verbs.

Real verb stem	Stem frequency	Past tense form	Past tense frequency	Novel verb stem	Plausible past tense form
Regular Verbs					
cross	4.5	crossed	5.1	spuff	spuffed
rush	4.1	rushed	4.4	dotch	dotched
look	7.2	looked	7.5	stoff	stoffed
stir	3.3	stirred	4.0	cug	cugged
chop	2.5	chopped	3.7	trab	trabbed
flap	2.6	flapped	2.6	crog	crogged
stalk	2.6	stalked	2.7	brop	bropped
scour	1.1	scoured	2.1	scur	scurred
Irregular Verbs					
make	7.6	made	8.2	strink	strinked/strunk
give	7.0	gave	7.2	frink	frinked/frunk
think	8.0	thought	7.2	strise	strised/strose
drive	5.3	drove	5.0	shrell	shrelled/shrelt
feed	4.4	fed	5.0	vurn	vurned/vurnt
bend	3.9	bent	3.9	crive	crived/crove
wring	1.6	wrung	2.3	steeze	steezed/stoze
grind	2.5	ground	2.9	sheel	sheeled/shelt

^aLog_e (raw frequency + 1)

from the task reported by Ullman and Gopnik (1999). The verbs were drawn from four classes: (a) eight regular verbs that took a regular -ed past tense inflection only (*look-looked*), (b) eight irregular verbs that could only take irregular past tense forms (*give-gave*), (c) eight nonwords that were expected to take a regular past tense inflection (*brop-bropped*), (d) eight nonwords derived from irregular verbs that could plausibly take either an irregular or regular past tense form (*frink-frinked/frunk*). Real words were divided into sets of high frequency and low frequency. Table 2 lists the real and novel verbs used in the task, as well as the real verbs' COBUILD word frequency counts for both stem and inflected forms, as reported by Ullman and Gopnik (1999).

Most of the irregular verbs required internal vowel changes, but two required stem-final changes (*bend-bent*, *make-made*), and one required a complete change (*think-thought*). The phonological complexity of all stems (real and nonwords) was high overall, with 71% of verbs containing a consonant cluster. Clusters were evenly distributed between high and low frequency verbs, regular and irregular verbs, and real and nonwords.

Children's responses were recorded online and coded as follows: (a) a regular -ed inflection; (b) an irregular inflection; (c) phonological/lexical error on stem, but marked with -ed; (d) unmarked stem; (e) phonological/lexical error on stem, unmarked; (f) other. Again, 25% of clinical samples were transcribed and recoded, resulting in reliability scores of 88% for transcription and 97% for coding.

Results

Group means on all assessments were compared using Analysis of Variance, with effect size given as η^2 . Post hoc comparisons were conducted using Scheffé tests. In instances in which variances were clearly unequal, post hoc comparisons were made using the Games-Howell test, which assumes unequal variance. The level of statistical significance was set at .05.

Core Language Measures

The standard scores achieved by each group are detailed in Table 3. There was no significant difference among the groups on Raven's Matrices [$F(3, 64) = .54$, $p = .66$]. Given the selection criteria, it is not surprising to find significant group differences on the core language measures for the SLI group as compared to the control groups [BPVS: $F(3, 64) = 11.98$, $p < .001$, $\eta^2 = .36$; TROG: $F(3, 64) = 7.72$, $p < .001$, $\eta^2 = .27$; Recalling Sentences: $F(3, 64) = 40.97$, $p < .001$, $\eta^2 = .67$; CNRep: $F(3, 63) = 26.40$, $p < .001$, $\eta^2 = .56$]. On two of these tests, Recalling Sentences and CNRep, no child in the SLI group scored within 1 *SD* of the mean.

Contrary to previous reports, we found that the children in the SNH group as a whole did not exhibit deficits on BPVS, and the group mean was well within normal limits, though significantly below that of the CA controls. On this test, the SNH group scored significantly

Table 3. Mean performance on assessment measures for each group.

Test	SLI (N = 14)	SNH (N = 19)	CA (N = 20)	LA (N = 15)
Raven's Matrices (SD)	105.43 14.15	109.79 14.07	107.35 12.84	104.80 7.67
BPVS (SD)	85.93 ^{ab} 12.10	98.63 16.22	110.15 7.87	103.20 8.89
TROG (SD)	88.29 ^{ac} 12.98	108.26 18.72	112.90 16.16	100.20 12.00
Recalling Sentences (SD)	3.86 ^{abc} 0.77	8.79 ^a 3.38	12.95 2.04	10.69 2.36
CNRep (SD)	60.50 ^{ab} 9.02	63.95 ^{ab} 15.01	98.74 16.51	83.47 15.17
Discrimination (SD)	45.43 ^a 12.23	49.53 ^a 10.78	58.35 1.46	52.00 9.34
Elicited verbs (SD)	13.71 ^a 2.81	17.26 3.45	19.11 2.30	15.73 4.40

Note. All scores reported as standard scores except phonological discrimination and elicited verbs, which are given as raw scores. Maximum correct for phonological discrimination = 60. Maximum correct for expressive verbs = 23.

^aMeans are significantly lower than CA group at $p < .01$ on Scheffé test. ^bMeans are significantly lower than LA group at $p < .05$ on Scheffé test. ^cMeans are significantly lower than SNH group at $p < .05$ on Scheffé test.

better than the SLI group, who did more poorly than both control groups. Similarly, on the TROG, the SLI group scored significantly worse than both the CA controls and the SNH group. There were no other group differences on this measure. Performance on Recalling Sentences for both the SNH and SLI groups was significantly below that of CA controls. In addition, the SLI group achieved a lower mean score than the SNH group and the LA control group. Finally, scores for the SNH and the SLI groups were significantly below both control groups on CNRep.

In sum, the SNH group tended to have more difficulty on expressive language measures than age-matched controls. However, with the exception of CNRep, they were within normal limits on standardized measures and outperformed the SLI group on all other measures. In contrast, the SLI group was impaired on all measures, even when compared to younger children.

Related Language Measures

Mean group scores on these measures are also shown in Table 3. A one-way ANOVA revealed significant group differences on phonological discrimination [$F(3, 64) =$

6.14, $p < .001$, $\eta^2 = .224$]. Post hoc comparisons indicated a significant difference between both the SLI group and the SNH group versus CA controls. There were no other statistically significant differences. There were significant group differences on the elicited verb vocabulary measure [$F(3, 62) = 7.61$, $p < .001$, $\eta^2 = .269$], where the SLI group achieved significantly lower mean scores than both the SNH group and the CA group.

Elicitation Tasks

Third Person Singular

Some children had great difficulty generating verbs, but all children produced at least 10 different verbs, and 85% produced all 15 verbs. The score for this measure was calculated as the percentage of accurately marked verbs from the total number of different verbs attempted. Both control groups approached ceiling on this measure. There was tremendous variation in the SLI group, with scores ranging from 0% to 100%. On ANOVA, a significant group difference was detected [$F(3, 64) = 12.64$, $p < .001$, $\eta^2 = .37$]. Post hoc comparisons using the Games-Howell technique revealed significant differences between the SLI group and both control groups (SLI vs. CA: $p = .003$, SLI vs. LA: $p = .003$). The difference between the SNH group and CA controls just failed to reach significance ($p = .058$).

Performance on this task was not all or nothing in that 87% of language impaired and 58% of hearing impaired children achieved scores between 7% and 93% correct. No child in the control groups scored below 66%, whereas half the SLI group did this poorly. In the SNH group, 3 out of 19 children scored below 66% correct; all 3 met criteria for language impairment.

Past Tense -ed

Two children in the SLI group were unable to repeat any of the practice items, even in the uninflected form. They were excluded from the analysis. All other children attempted all items, except for one child who made no response to seven items. Scores were converted to percentage of correctly marked past tense forms from the total number of verbs attempted. Table 4 summarizes group performances on the past tense elicitation task.

A one-way ANOVA was conducted to compare group means on the total percent correct, a combination of items coded 1 (regular past tense endings) and 2 (irregular past tense endings). Results indicated a significant difference between the groups [$F(3, 62) = 14.09$, $p < .001$, $\eta^2 = .405$]. Planned comparisons confirmed that the SLI group performed more poorly than all other groups. There were no significant differences between the SNH and control groups.

Table 4. Mean scores for five groups on finite verb morphology elicitation.

Measure	SLI	SNH	CA	LA
Third singular				
N	14	19	20	15
M	51.86 ^{ab}	81.95	98.30	94.13
SD	39.22	25.21	7.60	10.14
Past tense				
N	12	19	20	15
Total correct				
M	30.21 ^{abc}	62.91	82.34	64.58
SD	21.87	27.98	14.56	21.67
Total Past marked				
M	47.78 ^{abc}	80.51	92.50	76.04
SD	27.06	24.61	10.94	21.83
% Unmarked verbs				
M	51.79 ^{abc}	19.49	7.48	23.96
SD	27.11	24.61	10.93	21.83

Note. All scores given as percentage of inflected verbs relative to total number of different verbs attempted.

^aMeans are significantly lower than CA group at $p < .01$. ^bMeans significantly lower than LA group. ^cMeans significantly lower than SNH group.

All groups made phonological errors on verb stems, but both SNH and SLI groups made significantly more phonological errors than CA controls [$F(3, 62) = 9.26, p < .001, \eta^2 = .309$; Scheffé: SNH vs. CA, $p = .007$; SLI vs. CA, $p < .001$]. Because responses containing phonological errors were not included in the total correct score, it was possible that the children's ability to mark tense was underestimated. In order to focus more specifically on grammatical knowledge, the analysis was repeated using a Total Past score, in which children were not penalized for phonological errors and were credited for overgeneralizations on irregular verbs. In this category, any marking of past tense was considered correct so that score categories a, b, and c were combined, to give a percentage of items marked for tense in some way. This score more accurately reflects underlying knowledge of finiteness and was used for all subsequent analyses. The results were similar, with a significant difference between the groups [$F(3, 62) = 11.33, p < .001, \eta^2 = .35$]. Again, the SLI group did significantly worse than all other groups. There were four outliers in the SNH group, including the two youngest children (5.9 and 6.5 years old); the other two met criteria for language impairment.

The Total Past measure combined both real and nonwords. The inclusion of nonwords allows for exploration of generalization of tense marking. The means and standard deviations of the percentage of real and nonword verbs marked by each group are presented in

Table 5. The data show little difference between real and nonwords. The SLI group was less likely to mark tense on real verbs than any of the other groups [$F(3, 62) = 14.18, p < .001, \eta^2 = .407$]. They also achieved lower scores than the SNH and CA groups in marking the nonword verbs [$F(3, 62) = 8.28, p < .001, \eta^2 = .286$]. The SLI versus LA contrast was not significant.

Although the SNH group resembled the control groups overall, some children in the SNH group had difficulty with this task. Previous work has suggested that by the age of 4, typically developing children produce past tense forms with 95% accuracy (Rice et al., 1995). Taking a cut-off of 80% correct on a composite measure of tense marking, Rice and colleagues have been able to identify 97% of impaired children and 98% of unimpaired children.

Perhaps because of the memory demands of the past tense task used in this study (cf. Thomas et al., in press), a cut-off of 80% identified large numbers of younger control children as impaired. As past tense marking was significantly correlated with age in the control groups ($N = 35, r = .442, p = .008$), we used the regression of Total Past on age to compute a z score that represented how far a child's score fell below the expected score for age. Any child with a score more than 1.5 SD below the expected score was designated impaired on this measure. This measure correctly identified 75% of children with SLI and 94% of control children (CA and LA groups combined). Within the SNH group, 21% of children scored below $-1.5 SD$ on the total past marked measure. These were the same four outliers mentioned above.

As can be seen from Table 4, this pattern of performance is also evident in the percentage of unmarked verbs (those coded 4 or 5). There was a significant group difference [$F(3, 62) = 11.11, p < .001, \eta^2 = .35$], with the SLI group producing more unmarked forms than all other groups. Two outliers in the SNH group were identified as the youngest children.

Table 5. Means and standard deviations of real and nonword verbs marked for past tense.

	SLI (N = 12)	SNH (N = 19)	CA (N = 20)	LA (N = 15)
Real verbs	41.67 ^{abc}	82.42	93.13	76.25
(SD)	27.74	26.41	11.45	21.93
Novel verbs	51.56 ^{ac}	78.80	91.88	75.42
(SD)	26.40	25.00	11.84	25.49

Note. Means are reported as percentage of items marked for past tense.

^aMeans are significantly lower than CA group at $p < .01$. ^bMeans significantly lower than LA group. ^cMeans significantly lower than SNH group.

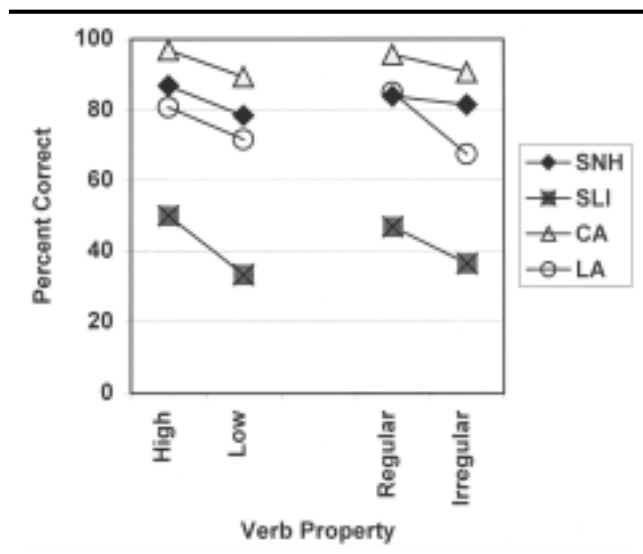
The Total Past score was significantly correlated with third person singular usage, suggesting that both tasks are tapping a similar construct ($N = 70$, $r = .666$, $p < .01$).

Properties of the Verbs in Past Tense Elicitation

We used repeated-measures ANOVA to look at the effects of verb frequency (high and low) and regularity (regular and irregular) on ability to mark past tense on real verbs (see Figure 1). A significant main effect was found for frequency [$F(1, 62) = 34.63$, $p < .001$, $\eta^2 = .358$]. A significant but weak main effect was also found for regularity [$F(1, 62) = 14.68$, $p < .001$, $\eta^2 = .191$]. There was a significant interaction between regularity and frequency [$F(1, 62) = 8.39$, $p = .005$, $\eta^2 = .119$], but interactions with group were nonsignificant. Thus the properties of verbs affected performance on this task overall, but these effects were similar for all groups.

In the course of administering the past tense elicitation task, we became aware that many language-impaired children were struggling to repeat the verb stems, especially when these involved nonwords. We therefore conducted a further analysis to check whether phonological complexity of the stem affected performance. A repeated-measures ANOVA was carried out with phonological complexity of the stem (4 levels: clusters at beginning, clusters at end, clusters at beginning and end, and no clusters) as the within-subjects factor and group as the between-subjects factor. The dependent variable was the Total Past score (percentage of items marked for past tense). Means and standard deviations for each of the four levels of complexity are reported in Table 6.

Figure 1. Mean (SE) correct inflections on real verbs in relation to verb frequency and regularity for four groups.



A significant main effect of complexity was detected [$F(3, 183) = 8.38$, $p < .001$, $\eta^2 = .121$], but the group \times complexity interaction was not significant.

Relationship of Other Variables to Tense Marking in the SNH Group

Although the group data showed little evidence overall of language deficits in the SNH group, there is substantial variability within this group, leading to the question of whether there are any systematic differences between those who did and did not have difficulties with inflectional morphology. To address this issue, we subdivided the SNH group into two subgroups based on whether or not they were impaired on tense marking (either scoring -1.5 SD on Total Past z score or below 66% on third person singular). The impaired group included 6 children, and the unimpaired group included 13. A series of t tests was conducted to see if the two groups differed significantly on other key measures. The results are summarized in Table 7.

The two groups did not differ significantly on measures of nonverbal ability (Raven's Coloured Matrices), hearing thresholds, or age at which they received hearing aids. However, the two groups did differ significantly on age, with the impaired group being significantly younger than the unimpaired group ($t = 3.99$, $p = .001$). There were also significant differences between the groups on all language measures, including receptive vocabulary and grammar, recalling sentences, expressive verb vocabulary, and phonological discrimination. There were no differences between the two groups on CNRep, perhaps because most of the children with SNH were poor on this measure (15 out of 19 scored more than 2 SD below the mean).

As Total Past and third person singular were highly correlated, a composite finiteness score was computed

Table 6. Means and standard deviations of verbs marked for tense in each category of phonological complexity.

	SLI ($N = 12$)	SNH ($N = 19$)	CA ($N = 20$)	LA ($N = 15$)
Clusters at the beginning (SD)	52.92 (29.20)	79.53 (27.00)	93.85 (11.08)	75.33 (21.69)
Clusters at the end (SD)	38.92 (34.44)	77.21 (27.42)	93.35 (17.45)	77.80 (32.57)
Clusters both ends (SD)	38.92 (34.44)	75.47 (26.94)	80.10 (22.68)	57.87 (32.14)
No clusters (SD)	39.75 (25.88)	82.47 (26.06)	93.90 (15.13)	82.27 (21.00)

Note. All scores given as the percentage of items marked for tense in that category.

Table 7. Comparison of age, hearing status, and cognitive assessment (mean and standard deviation) of children in the SNH group impaired on tense marking tasks and those unimpaired on tense marking.

Variable	Unimpaired (<i>n</i> = 13)	Impaired (<i>n</i> = 6)	<i>t</i> value <i>df</i> (17)	η^2	<i>r</i> with finiteness
Age at assessment	110.77 (12.60)	87.00 (10.96)	3.99***	.48	.746**
Pure tone average	32.46 (12.51)	38.83 (11.29)	-1.06		-.332
Age of ailing	48.77 (22.28)	47.00 (12.82)	0.18		-.033
Raven's Matrices	109.77 (13.78)	109.83 (16.02)	-0.01		-.099
Discrimination	54.69 (4.48)	38.33 (12.27)	4.33***	.524	.825**
BPVS-SS	105.31 (14.73)	84.17 (7.68)	3.28**	.388	.638*
Expressive verbs	18.77 (2.28)	14.00 (3.41)	3.63**	.437	.714**
Recalling Sentences	10.46 (2.67)	5.17 (.98)	4.66***	.561	.750**

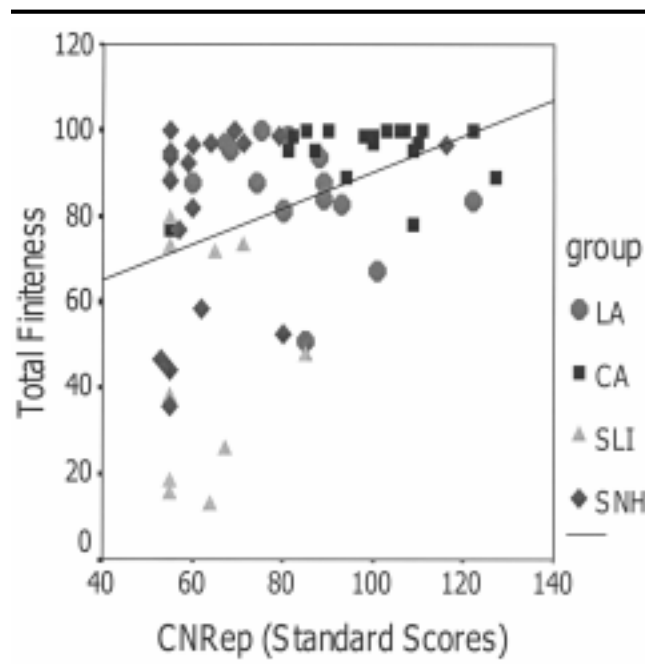
Note. All scores reported as standard scores except phonological discrimination and expressive verbs, which are given as raw scores. Maximum correct for phonological discrimination = 60. Maximum correct for expressive verbs = 23.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

by taking an average of the two scores. As can be seen in Table 7, correlations between the finiteness score and these language measures were all significant in the SNH group as a whole, with the exception of CNRep (Age: $r = .74$, BPVS: $r = .638$, Discrimination: $r = .825$, Recalling Sentences: $r = .750$, verbs: $r = .714$ —all significant at $p < .01$, TROG: $r = .529$, $p = .02$, $df = 33$).

An additional question is whether or not finiteness is selectively impaired in a subset of children with SNH or whether it is just a function of generally delayed language

Figure 2. Scatterplot depicting correlation between finiteness score (average of Total Past and third singular) and CNRep with all groups selected.



development. The mean “receptive language age” of this subset of children (based on average of age equivalent scores on BPVS and TROG) was 73.7 months ($SD = 14.93$), which is some 18 months older than the age at which tense marking is usually established (Rice et al., 1998). However, control data from Thomas et al. (in press) show that the processing demands of the past tense task lead to a later age of mastery, with 6-year-olds still making some bare-stem errors. Thus the difficulties with tense seen in a subset of our sample do seem compatible with their overall language level.

In the combined control groups ($N = 35$), age, expressive verb vocabulary, and expressive language abilities were all significantly correlated with the child's composite finiteness score (age: $r = .526$, verbs: $r = .644$, Recalling Sentences: $r = .507$ —all significant at $p < .01$, $df = 33$). In contrast, none of the language measures was correlated with past tense performance in the SLI group. Nonword repetition was not correlated with finiteness in any of the individual groups, but was significantly correlated with finiteness when all of the groups were combined ($r = .372$, $p = .002$, $n = 66$). This is illustrated in Figure 2.

Discussion

Effects of Hearing Loss Vs. SLI on Development of Finite Verb Morphology

Like Rice and colleagues (Rice et al. 1995; Rice et al. 1998), we found that children with SLI produce unmarked stems in contexts where the inflection is obligatory more often than age-matched or language-matched controls. We confirmed the observation of Rice (2000) that impaired marking of finite verb morphology has

good sensitivity and specificity as a potential diagnostic marker of SLI.

Our starting premise was that if difficulty detecting morphemes of weak perceptual salience caused the distinctive morphosyntactic problems of children with SLI, we might see similar deficits in children with SNH. Overall, this prediction was not confirmed. The mean of the SNH group was not significantly different from that of their peers on measures of tense marking—suggesting that, on the whole, their knowledge of finite verb morphology was age appropriate.

Can we therefore assume that degraded auditory input does not affect learning of morphosyntax? This would be too strong a conclusion, given that 22% of the SNH group met criteria for language impairment, and all of these children had difficulties with finite verb morphology. This is a higher rate of language impairment than one would expect in the normal hearing population, with prevalence estimates at 7% (Tomblin et al., 1997). Furthermore, the proportion of children in the SNH group with language difficulties in our sample is low compared to previous studies. Gilbertson and Kamhi (1995) found that 50% of their children with mild-moderate hearing impairment had language impairments. The difference could simply reflect sampling error, though the method of selecting children with SNH may also be important. We recruited our hearing impaired sample from mainstream schools. We may have found higher rates of language impairment had we included children with mild-moderate SNH who were educated in specialist units. However, these constitute a minority of such children in the U.K. As in the results reported here, Gilbertson and Kamhi did not find a correlation between severity of hearing loss and severity of language difficulty. They concluded that hearing impairment alone cannot cause language impairment and that the children with language difficulties could be characterized as “language-impaired children with a hearing loss” (p. 640). They hypothesized that hearing impaired children without language deficits may have above-average cognitive abilities that support language development. However, we found no significant differences between the high- and low-level language subsets of the SNH group on nonverbal ability.

The youngest children with SNH appeared to have more difficulty with tense marking than the older children in the group, suggesting that disrupted auditory input during the time of normal language acquisition may delay development of a number of linguistic skills, including tense marking. An important question for future research would be to determine whether tense marking improves as the children with SNH grow older and their receptive language age increases, or, as seen in children with SLI, whether tense marking continues

to lag behind other language skills. Only longitudinal data can answer this question.

The mixed picture seen for children with SNH does not offer unequivocal support for either of the theories outlined in the introduction, but it does suggest that problems in perceiving morphemes of weak phonetic substance is not a sufficient explanation for the morphological difficulties seen in SLI. We cannot rule out the possibility that children with SLI might have a central auditory processing disorder, which has a much more disruptive effect on speech perception than a peripheral hearing loss. However, if this were so, we would expect to have seen more striking differences between SLI and SNH groups on our test of phonological discrimination. The fact that the SLI and SNH groups were both impaired on phonological discrimination but distinct in terms of morphosyntax suggests that an additional factor differentiates the language functioning of the two groups.

Effects of Nonsyntactic Properties of Verbs on Tense Marking

Another indication that perceptual salience is not the principal determinant of performance on tense marking is the finding that irregular past tense forms (which are considered to be of higher perceptual salience) were just as difficult as regular forms for children with SLI. This finding can readily be accommodated in the EOI account, which maintains that it is the syntactic property of finiteness that is important, rather than surface features.

Nevertheless, we found evidence that other, nonsyntactic, factors influenced performance in all groups. We replicated the findings of Oetting and Horohov (1997) and Marchman, Wulfeck, and Ellis Weismer (1999) that performance on tests of finite verb morphology is dependent on verb frequency and phonological aspects. These previous studies found that children with SLI are most likely to inflect verbs that end in vowels or liquids and tend to omit inflectional endings on low-frequency items and items ending in alveolar stop consonants. Too few verbs used in the present study contained alveolar stop consonants for a meaningful comparison, but we did find that all children were sensitive to the phonological complexity of the verb stem. This is particularly striking as none of the children in our sample had overt phonological impairments. Oetting and Horohov (1997) found that both typically developing children and those with SLI were influenced by phonological and frequency factors. They admit these findings are not easily explicable in terms of the dual-mechanism model from which they were working and suggest the possibility that “observed frequency effects are tied to processing limitations at

the level of lexical access" (p. 77). Marchman et al. (1999) also suggested that the influence of surface features on inflectional morphology is not predicted by grammatical approaches, but is more in line with some processing accounts.

Insofar as the EOI maintains that children with SLI are following a normal but unusually protracted developmental course, one could argue that these findings are compatible with the theory because the effects of frequency and phonological complexity were similar across all groups. However, the demonstration of such nonsyntactic influences on performance of both normally developing children and those with SLI raises questions about the need to postulate an "optionality" parameter. It is evident that children's performance is not determined solely by a syntactic principle applied in a probabilistic fashion, but is related to surface features of verbs.

Relationship of Nonsyntactic Language Abilities to Tense Marking

Our study confirmed that children with SLI have wide-ranging difficulties on a range of language measures outside the domain of syntax. Proponents of the EOI accept that such difficulties exist, but argue that the grammatical knowledge of finiteness is independent of other types of linguistic knowledge, particularly lexical knowledge, and that the problems with morphosyntax are disproportionate. In line with this, children in the SLI group were matched to the LA control group on vocabulary level, yet did significantly worse on tense marking. Nevertheless, it would be incautious to conclude that morphosyntax is independent of verb vocabulary. There was a nonsignificant trend for those with SLI to obtain lower scores even than vocabulary-matched controls on a measure of expressive verbs (see Table 3). Also, although there was no relationship between verb vocabulary and tense marking within the SLI group, tense marking was significantly correlated with both receptive vocabulary and expressive vocabulary for verbs within the SNH group. One could interpret the findings in terms of a "critical mass" account by adopting the position of Conti-Ramsden and Jones (1997), who suggested that children with SLI may need an even larger number of verbs in the lexicon than typically developing children to reach the critical mass. This study did not set out to test this theory specifically, but the results suggest that further research on this topic, using longitudinal data, is warranted.

As well as having limited vocabulary, it is well established that children with SLI do poorly on tests that place heavy demands on verbal short-term memory—particularly nonword repetition and recalling sentences (see Bishop, 1997). The EOI and surface hypotheses differ in

the role they ascribe to such deficits in causing SLI symptomatology, with the former regarding them as non-causal and the latter treating them as indicators of processing limitations that lead to morphosyntactic deficits. In the current study, all those children in the SLI group who did poorly with finite verb morphology were also impaired on both nonword repetition and recalling sentences. In contrast, children in the SNH group were impaired relative to control children on nonword repetition, but were within normal limits on recalling sentences. Unlike those with SLI, children with SNH seem able to use semantic skills to fill in gaps in their perception.

It is easy to see how processing limitations could affect the finite verb morphology tasks used here. In the third person singular task, the child is required to think of different verbs (something that many children found remarkably difficult) and to include them in a sentence. In order to successfully complete the past tense elicitation task, the child had to attend to the examiner, perceive and remember a sentence (which may contain an unfamiliar word), repeat a sentence that may contain a nonsense word, and compute the past tense for the word or nonword. Thomas et al. (in press) found substantially lower rates of past tense marking by control children in this task than in a simpler task where the child was merely required to complete a word whose initial sound was provided (e.g., "The bull sometimes kicks. Yesterday it k..."). This raises the question whether the link between processing difficulties and past tense morphology is an artificial one caused by the specific task demands. This seems unlikely to be the whole story. In studies using spontaneous speech samples, some have reported levels of omission similar to those of elicitation tasks (Rice et al. 1998) whereas others report considerably higher levels of accuracy in spontaneous speech (Oetting & Horohov, 1997), but, overall, children with SLI have difficulties with morphosyntax that extend beyond elicitation tasks. A question for future research is whether the strong link between processing deficits and morphosyntactic impairments is also found in studies based on spontaneous language samples or whether one can find cases of children with major deficits in finite verb morphology who perform normally on measures of verbal short-term memory.

To summarize the complex findings of this study, we may conclude that they raise questions for both the EOI and the Surface Hypothesis. Although mild-to-moderate hearing impairment appears to act as a risk factor for delayed language development, it has a much less marked effect on morphosyntax than on phonological discrimination. This finding, together with the fact that both regular and irregular verb morphology are deficient in SLI, questions the importance of perceptual salience in mastery of morphosyntax. These results fit better with the EOI than with the Surface Hypothesis,

but other findings cannot be explained within a purely syntactic framework. Children's omissions of verb inflections are dependent on nonsyntactic features of the verb, raising questions about how far we need to invoke the notion of an optionality parameter to account for inconsistent patterns of performance. Furthermore, omission of verb inflections is closely related to sentence recall, which has a high loading on verbal short-term memory, suggesting that processing capacity limitations may play an important causal role in morphosyntactic deficits.

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References

- Bishop, D. V. M.** (1983). *Test for Reception of Grammar*. Published by the author; available from Age and Cognitive Performance Research Centre, Department of Psychology, University of Manchester, U.K.
- Bishop, D. V. M.** (1994). Grammatical errors in specific language impairment: Competence or performance limitation? *Applied Psycholinguistics*, *15*, 507–549.
- Bishop, D. V. M.** (1997). *Uncommon understanding*. Hove, U.K.: Psychology Press.
- Bishop, D. V. M.** (1998). Development of the children's communication checklist (CCC): A method for assessing qualitative aspects of communicative impairment in children. *Journal of Child Psychology and Psychiatry*, *39*, 879–892.
- Bishop, D. V. M., North, T., & Donlan, C.** (1996). Nonword repetition as a behavioural marker for inherited language impairment: Evidence from a twin study. *Journal of Child Psychology and Psychiatry*, *37*, 391–403.
- Blair, J. C., Peterson, M. E., & Viehweg, S. H.** (1985). The effects of mild sensorineural hearing loss on academic performance of young school-age children. *Volta Review*, *87*, 87–93.
- Bridgeman, E., & Snowling, M.** (1988). The perception of phoneme sequence: A comparison of dyspraxic and normal children. *British Journal of Disorders of Communication*, *23*, 245–252.
- Briscoe, J., Bishop, D. V. M., & Norbury, C. F.** (in press). Phonological processing, language and literacy: A comparison of children with mild-moderate sensorineural hearing loss and those with specific language impairment. *Journal of Child Psychiatry and Psychology and Allied Disciplines*.
- British Society of Audiology.** (1988). Descriptors for pure-tone audiograms. *British Journal of Audiology*, *22*, 123.
- Brown, J. B.** (1984). Examination of grammatical morphemes in the language of hard-of-hearing children. *Volta Review*, *86*, 229–238.
- Conti-Ramsden, G., & Jones, M.** (1997). Verb use in specific language impairment. *Journal of Speech, Language, and Hearing Research*, *40*, 1298–1313.
- Davis, J. M., Elfenbein, J., Schum, R., & Bentler, R. A.** (1986). Effects of mild and moderate hearing impairments on language, educational, and psychosocial behavior of children. *Journal of Speech and Hearing Disorders*, *51*, 53–62.
- Dunn, L. M., Dunn, L. M., Whetton, C. W., & Pintilie, D.** (1982). *The British Picture Vocabulary Scales*. Windsor, U.K.: NFER Nelson.
- Eatough, M.** (1994). *British Association of Teachers of the Deaf Survey 1994–England*.
- Gathercole, S. E., & Baddeley, A. D.** (1996). *The Children's Test of Nonword Repetition*. London: Psychological Corporation.
- German, D. J.** (1989). *Test of Word Finding*. Austin, TX: Pro-Ed.
- Gilbertson, M., & Kamhi, A.G.** (1995). Novel word learning in children with hearing impairment. *Journal of Speech and Hearing Research*, *38*, 630–642.
- Leonard, L.** (1989). Language learnability and specific language impairment in children. *Applied Psycholinguistics*, *10*, 179–202.
- Leonard, L. B.** (1998). *Children with specific language impairment*. Cambridge, MA: MIT Press.
- Leonard, L. B., Sabbadini, L., Leonard, J. S., & Volterra, V.** (1987). Specific language impairment in children: A cross-linguistic study. *Brain and Language*, *32*, 233–252.
- Marchman, V., & Bates, E.** (1994). Continuity in lexical and morphological development: A test of the critical mass hypothesis. *Journal of Child Language*, *21*, 339–366.
- Marchman, V., Wulfeck, B., & Ellis Weismer, S.** (1999). Morphological productivity in children with normal language and SLI: A study of the English past tense. *Journal of Speech, Language, and Hearing Research*, *42*, 206–219.
- Miller, C. A., & Leonard, L. B.** (1998). Deficits in finite verb morphology: Some assumptions in recent accounts of specific language impairment. *Journal of Speech, Language, and Hearing Research*, *41*, 701–707.
- Oetting, J. B., & Horohov, J. E.** (1997). Past-tense marking by children with and without specific language impairment. *Journal of Speech, Language, and Hearing Research*, *40*, 62–74.
- Raven, J. C., Court, J. H., & Raven, J.** (1986). *Raven's Coloured Matrices*. London: H. K. Lewis.
- Rice, M. L.** (2000). Grammatical symptoms of specific language impairment. In D. V. M. Bishop & L. B. Leonard (Eds.), *Speech and language impairments in children: Causes, characteristics, intervention and outcome*. Hove, U.K.: Psychology Press.

- Rice, M. L., & Wexler, K.** (1996a). A phenotype of specific language impairment: Extended optional infinitives. In M. Rice (Ed.), *Towards a genetics of language* (pp. 215–237). Mahwah, NJ: Lawrence Erlbaum.
- Rice, M. L., & Wexler, K.** (1996b). Toward tense as a clinical marker of specific language impairment in English-speaking children. *Journal of Speech and Hearing Research, 39*, 1239–1257.
- Rice, M. L., Wexler, K., & Cleave, P. L.** (1995). Specific language impairment as a period of extended optional infinitive. *Journal of Speech and Hearing Research, 38*, 850–863.
- Rice, M. L., Wexler, K., & Hershberger, S.** (1998). Tense over time: The longitudinal course of tense acquisition in children with specific language impairment. *Journal of Speech, Language, and Hearing Research, 41*, 1412–1431.
- Semel, E., Wiig, E., & Secord, W.** (1987). *Clinical Evaluation of Language Fundamentals-Revised*. New York: Harcourt, Brace, Jovanovich.
- Thomas, M. S. C., Grant, J., Barham, Z., Gsödl, M., Laing, E., Lakusta, L., Tyler, L. K., Grice, S., Pater-son, S., & Karmiloff-Smith, A.** (in press). Past tense formation in Williams syndrome. *Language and Cognitive Processes*.
- Tomblin, J. B., Records, N., Buckwalter, P., Zhang, X., Smith, E., & O'Brien, M.** (1997). Prevalence of specific language impairment in kindergarten children. *Journal of Speech, Language, and Hearing Research, 40*, 1245–1269.
- Ullman, M. T., & Gopnik, M.** (1999). Inflectional morphology in a family with inherited specific language impairment. *Applied Psycholinguistics, 20*, 51–117.
- Van der Lely, H. K. J.** (1998). SLI in children: Movement, economy, and deficits in the computational-syntactic system. *Language Acquisition, 7*, 161–192.
- Wexler, K.** (1996). The development of inflection in a biologically based theory of language acquisition. In M. Rice (Ed.), *Towards a genetics of language* (pp. 113–142). Mahwah, NJ: Lawrence Erlbaum.

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