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Grammatical Morpheme Effects on Sentence Processing by School-Aged Adolescents with Specific Language Impairment

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Abstract

Sixteen-year-olds with specific language impairment (SLI), nonspecific language impairment (NLI), and those showing typical language development (TD) responded to target words in sentences that were either grammatical or contained a grammatical error immediately before the target word. The TD participants showed the expected slower response times (RTs) when errors preceded the target word, regardless of error type. The SLI and NLI groups also showed the expected slowing, except when the error type involved the omission of a tense/agreement inflection. This response pattern mirrored an early developmental period of alternating between using and omitting tense/agreement inflections that is characteristic of SLI and NLI. The findings could not be readily attributed to factors such as insensitivity to omissions in general or insensitivity to the particular phonetic forms used to mark tense/agreement. The observed response pattern may represent continued difficulty with tense/agreement morphology that persists in subtle form into adolescence.

Many children with specific language impairment (SLI) have problems that are longstanding, with difficulties often extending through elementary school and into adolescence (Aram, Ekelman, & Nation, 1984; Bishop & Adams, 1990; Wulfeck, Bates, Krupa-Kwiatkowski, & Saltzman, 2004). Relative to typically developing same-age peers, school-aged children and adolescents with SLI show weaknesses in areas that include sentence repetition (Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998), sentence comprehension (Stark, Bernstein, Condino, Bender, Tallal, & Catts, 1984), word-finding (Johnson et al., 1999), and nonword repetition (Ellis Weismer, Tomblin, Zhang, Buckwalter, Chynotweth, & Jones, 2000), among others. Reading is also relatively weak in older children with SLI (Conti-Ramsden, Botting, Simkin, & Knox, 2001), and psychosocial outcomes are generally less favorable (Snowling, Bishop, Stothard, Chipchase, & Kaplan, 2006).

Studies employing carefully constructed tasks of grammatical production and comprehension have revealed a variety of weaknesses in older children with SLI. These include the use of Wh-questions (van der Lely & Battell, 2003), the assignment of thematic roles in relative clauses (Friedmann & Novogrodsky, 2007), and the comprehension of passives (van der Lely, 1996; Bishop, Bright, James, Bishop, & van der Lely, 2000). Investigators' interpretation of the available findings have differed in whether the evidence supports a deficit that is domain

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specific (e.g., van der Lely, Rosen, & McClelland, 1998) or one that crosses domains (e.g., Bishop et al., 2000).

Whereas older children and adolescents with SLI present subtle symptoms of difficulties across a wide range of language areas, the linguistic profile of SLI is more uneven at younger ages. That is, although younger children with SLI often exhibit problems in a variety of areas of language, their difficulties with grammatical morphology are especially salient. The most commonly cited problems with grammatical morphology pertain to morphemes that express tense and agreement (Rice, Wexler, & Cleave, 1995; Leonard, Eyer, Bedore, & Grela, 1997; Oetting & Horohov, 1997; Leonard, Deevy et al., 2007). Problems with morphemes such as possessive '*s*, nonthematic *of* (as in *cup of coffee*) and other morphemes seemingly unrelated to tense and agreement have also been observed (Leonard, 1995); however, these are less well documented and seem to be resolved at an earlier age. Although difficulties with tense and agreement morphemes (hereafter, tense/agreement morphemes) are most striking during the preschool years, these difficulties seem to dissipate only slowly. Studies that extend into the school years report continued difficulty in the use of these morphemes by children with SLI (Rice, Wexler, & Hershberger, 1998; Marchman, Wulfeck, & Ellis Weismer, 1999; Norbury, Bishop, & Briscoe, 2001; Rice, Tomblin, Hoffman, Richman, & Marquis, 2004), including substantial difficulty in using these morphemes in less frequent phonotactic contexts (e.g., -[gd] as in *hugged*) that do not occur in monomorphemic words (Marshall & van der Lely, 2006).

Many recent studies have included a clinical group in addition to children with SLI, namely, a group of children with language impairments exhibiting nonverbal IQs below 85 that are therefore too low to meet the traditional criteria of SLI, yet too high to fall into the category of mental retardation. The inclusion of these children with non-specific language impairment (hereafter, NLI) is based on several considerations. First, several studies have demonstrated that children with nonverbal IQ scores above and below 85 appear to show the same language patterns of weakness (e.g., Tomblin & Zhang, 1999), and show gains in grammatical skills in response to treatment to the same degree (e.g., Fey, Long, & Cleave, 1994). Second, genetic studies of twins have revealed that discrepancy scores (marking the difference between nonverbal IQ and language test scores) show only a minimal level of heritability, and hence "may not reflect the underlying genetic influences involved in SLI" (SLI Consortium, 2002, p. 395). Finally, on the basis of the available evidence, a National Institutes of Health (USA) panel of language researchers recommended that children with lower nonverbal IQs be included in studies of SLI until or unless emerging evidence indicates that they constitute a distinct group (Tager-Flusberg & Cooper, 1999).

In their study of tense/agreement morpheme use in older children, Rice et al. (2004) included a group of children with NLI and found that they, like the group meeting the customary IQ criterion for SLI, showed similar weaknesses in using these morphemes. However, the patterns of growth in tense/agreement morpheme use from age 6 to 10 years were somewhat different in the NLI and SLI groups.

The difficulty in the use of tense/agreement morphemes is one of variability; that is, children with SLI use these morphemes in a smaller percentage of obligatory contexts than both typically developing children of the same age as well as younger typically developing children with similar sentence length (e.g., Rice & Wexler, 1996; Leonard et al., 1997). When morphemes are produced by these children, they usually appear in appropriate contexts. Rice, Wexler, and their colleagues have characterized this pattern of use as one of a failure to grasp the notion that tense and agreement are obligatory in main clauses (Rice & Wexler, 1996; Rice, 2003). Although typically developing children proceed through a similar stage for a brief period of time, children with SLI are assumed to linger in this optional stage for an extended period.

Most of the evidence revealing residual difficulty with tense/agreement morphemes in children with SLI has employed tasks of production. However, several studies have also employed other types of methods. Rice, Wexler, and Redmond (1999) and Redmond and Rice (2001) found that school-aged children with SLI do not perform as well as their peers on grammaticality judgment tasks. Hearing a sentence such as *He look happy now*, for example, children with SLI show a greater tendency to regard the sentence as acceptable, even though sentences such as *I drinks milk* will be correctly rejected. However, although judging the inappropriate absence of tense/agreement morphemes as acceptable seems to be the most common error by these children, some studies have also found other types of errors. Redmond and Rice found that children with SLI were more likely than typically developing peers to accept a tense-marked verb in contexts that required an infinitive form.

In a study of adolescents with SLI and NLI, Miller, Leonard, and Finneran (2008) found a more general insensitivity to grammatical morpheme errors by the two clinical groups relative to a group of typically developing same-age peers. The typically developing peers were highly sensitive to omissions of nontense morphemes (e.g., *The children are hide so they can surprise their friend*) (A' scores averaging .95) and the inappropriate insertion of tense morphemes (e.g., *Sue helped to hangs a picture last night*) (A' scores averaging .97) as well as the omission of tense morphemes (e.g., *Every day he tell a joke at lunch)* (A' scores averaging .92). The SLI group was significantly less sensitive than the same-age peers to all three error types, and did not differ from the NLI group. A' scores for the SLI and NLI groups averaged just over .90 for nontense omissions and inappropriate insertions of tense morphemes, with lower A' scores (averaging .85) for tense omissions. Although the participant groups differed in overall accuracy, all three groups were least accurate on tense omissions.

There are at least two reasons that might explain the differences between the specificity seen in the judgment errors of the SLI group in the Rice et al. (1999) study and the more general insensitivity of the SLI group in the Miller et al. (2008) study. First, the participants were older in the Miller et al. investigation, and it is possible that the response profile for SLI changes with age. However, the verbal working memory demands were also greater in the Miller et al. study. Whereas in the Rice et al. study, stimulus sentences ranged from 3 to 6 words in length with grammatical errors occurring in the second to fourth sentence position, in the Miller et al. investigation, stimulus sentences ranged from 6 to 12 words in length with almost all errors occurring between the third and eighth sentence position. The participants were not required to respond as soon as an error was heard, and by waiting until the sentence was completed, the participants had to hold all material in working memory until a response could be made. Verbal working memory limitations in the SLI population are well documented and have been observed as well in the particular cohort of SLI participants studied by Miller et al. (Leonard, Ellis Weismer et al., 2007). It seems possible that some of the failures to reject nontense omissions or inappropriate tense insertions could be attributed to the participants' failure to retain the relevant information by the time a response was required.

An alternative method for assessing sensitivity to tense/agreement morphology without placing metalinguistic demands on children is the word monitoring task. This task was originally employed by Marslen-Wilson and Tyler (1975, 1980) and has been applied to the study of both children (Tyler & Marslen-Wilson, 1981) and adults with aphasia (Tyler & Cobb, 1987; Tyler, 1992). In this task, participants are asked to listen for a particular word in a sentence and to respond as quickly as possible by means of a button or key press as soon as the word is detected. Tyler and Marslen-Wilson (1981) compared 5-, 7-, and 10-year-old children's response times (RTs) to the target word using three types of stimuli – meaningful grammatical sentences that permitted both interpretive and syntactic analysis of the sentence, grammatical but semantically anomalous sentences that allowed only a syntactic analysis, and strings of words in random order that provide little or no contextual support. Tyler and Marslen-Wilson found that when children were provided the exact word that would appear in the stimulus, children as young as 5 years of age showed the fastest RTs when the target word appeared in meaningful grammatical sentences and the slowest RTs when the target word appeared in random order word strings. These differences provided evidence that the children used both interpretive and syntactic information in their word monitoring.

The effects of grammatical morphology can also be examined in this type of task by employing sentences that contain a grammatical error immediately before the appearance of the target word in the sentence (e.g., Tyler, 1992). In typically functioning participants, the response time (RT) required to indicate the appearance of the target word is slower when an error immediately precedes the target word than when it does not. For example, the RT in detecting *sandwich* is slower in *Everyday Mommy make a sandwich for me* than in *Everyday Mommy makes a sandwich for me*.

The assumption is that slower RTs when the target word is preceded by a grammatical error are due to the participant's detection of something in the sentence that seems unnatural, and this causes a very brief delay in responding to the target word that immediately follows. An advantage of a word monitoring task is that no formal judgments are required of the participant; indeed, the participant is attending to the target word and the general meaning of the sentence. For this reason, the task seems to rely more on implicit language knowledge and less on working memory and metalinguistic skills than a task such as the grammaticality judgment task.

Montgomery and Leonard (1998) employed this type of task with 8-year-old children with SLI. These children's RTs increased when the error preceding the target word took the form of an omission of progressive *–ing*. However, when the error was an omission of either third person singular *–s* or past tense *–ed*, these children's RTs were not significantly slower than when the sentence contained no error. In contrast, both typically developing same-age peers and younger typically developing children matched on a receptive language test showed slower RTs in sentences with all three types of omissions. Montgomery and Leonard interpreted their findings as supporting the view that children with SLI are less sensitive to omissions when the omitted inflections have low phonetic substance, as in the consonant inflections of third person singular *–s* and past tense *–ed*. When the inflection has greater phonetic substance, as in the syllabic inflection *–ing*, these children are less deficient. However, it also is the case that the two low phonetic substance morphemes in this study express agreement and/or tense, whereas *–ing* does not mark either. In a subsequent study, Montgomery and Leonard (2006) found that acoustic enhancement of the morphemes with low phonetic substance had no effect on the RTs of the children with SLI.

We employ a word monitoring task in the present study, to explore further the processing of tense/agreement morphology in SLI. Our study adds several important elements to previous research. Recall that, in earlier work, morphemes of low phonetic substance were also those that marked tense/agreement. Morphemes with greater phonetic substance were unrelated to tense/agreement. In the present study, we included a morpheme – possessive '*s* – that is equivalent to one of the tense/agreement morphemes (third person singular – *s*) in its phonetic characteristics but does not pertain to tense/agreement.

A second additional element in the present study is that we included a condition in which tense/agreement morphemes appear but in inappropriate contexts, following the use of this type of condition by Rice et al. (1999) in grammaticality judgment tasks. The inclusion of this type of condition is important for two reasons. First, according to the proposals of Rice, Wexler, and their colleagues (Rice & Wexler, 1996; Rice, 2003), the difficulty with tense/agreement experienced by children with SLI is limited to a failure to grasp that tense/agreement is obligatory in main clauses. When these children use tense/agreement they do so in appropriate contexts. Therefore, if morphemes such as past tense *–ed* and third person singular *–s* appear in inappropriate contexts in a word monitoring task, the children's RTs when responding to the target word should be slower than when the sentence is properly constructed. To date, such "intrusion" errors have not been included in studies of word monitoring. A second reason for including a condition of this type is that it can provide some assurance that children with SLI are capable of detecting low phonetic substance morphemes such as past tense *–ed* and third person singular *–s*. Evidence of this type would make it less plausible that similar RTs for sentences such as *Everyday Mommy make a sandwich for me* and *Everyday Mommy makes a sandwich for me* by children with SLI are due to an inability to perceive *–s* (and *–ed*) in sentences. This is not to say that detecting the absence of these morphemes is perceptually comparable to detecting their (inappropriate) presence; however, slower RTs for sentences containing such intrusions can at least suggest that the participants also perceived the correct instances of these same morphemes in grammatical sentences.

The use of these three types of grammatical errors – those involving the omission of tense/agreement morphemes, those representing the omission of nontense/agreement morphemes, and those constituting the intrusion of tense/agreement morphemes – should allow us to determine whether earlier treatment of tense/agreement morphemes by children with SLI as optional might be identifiable as a subtle "residual" problem at a later age. If such a residual problem exists, it should take the form of similar RTs for grammatical sentences and ungrammatical sentences with missing obligatory tense/agreement morphemes, but faster RTs for grammatical sentences than for sentences with either missing nontense/agreement morphemes, or sentences with inappropriate inclusion of tense/agreement morphemes. Performance that is free of such residual effects should take the form of faster RTs for grammatical sentences than for all three types of ungrammatical sentences. We test such residual effects in 14-year-olds with and without language impairments – the same adolescents studied by Miller et al. (2008).

Both SLI and NLI groups were recruited for this study. As noted earlier, neither the behavioral nor the genetic distinction between these groups is well established. It seems possible that data from both groups on additional tasks may yield results that argue for or against keeping these groups separate in future studies. Although an earlier study by Rice et al. (2004) showed that the developmental trajectory of older children with NLI was not identical to that of older children with SLI, these investigators found that the individuals with NLI, like those with SLI, continued to be inconsistent in their production of tense/agreement morphemes for an extended period. Based on the available evidence, we hypothesize that our group of adolescents with NLI will show the same pattern on the word monitoring task that is exhibited by adolescents with SLI. Specifically, we expect that both groups will show similar RTs for grammatical sentences and sentences with missing tense/agreement morphemes yet will show slower RTs for sentences with missing nontense/agreement and intruding tense/agreement morphemes than for grammatical sentences. Such a pattern will serve as additional evidence for the growing view that nonverbal IQ above or below 85 is not a determining factor in defining profiles of language impairment.

The fact that the task employs RT enables us to explore another issue that is prominent in the literature on individuals with SLI and NLI. Kail (1994) advanced the notion that individuals with SLI as well as those with NLI are generally slower in processing than are their typically developing peers, and this general slowing can be seen across a wide variety of tasks that employ RT. According to Kail, this slower processing contributes to the children's impairment in language and explains why even children with SLI are sometimes weak in tasks involving nonlinguistic cognitive processing. Since Kail's initial work, studies by Windsor and Hwang (1999), Miller, Kail, Leonard, and Tomblin (2001), and Miller, Leonard, Kail, Zhang, Tomblin, and Francis (2006) have provided supportive evidence of the proposition of general slowing in most, though not all children with SLI and NLI. Windsor, Milbrath, Carney, and Rakowski (2001) discussed alternative statistical methods for detecting slowing and concluded that the evidence pointed more clearly to greater degrees of slowing in some domains than in others. Although the experimental task employed in the present study is concentrated on a single element of language – sensitivity to grammatical morphology – its use of RT offers yet another opportunity to evaluate the possibility that individuals with SLI and NLI are slow processors of information.

Method

Participants

The participants were 178 16-year-olds who represented a subset of the participants who took part in an earlier, large-scale epidemiological study of SLI conducted by Tomblin, Records, Buckwalter, Zhang, Smith, and O'Brien (1997). The larger sample was first seen at age 5 years. At that time the children were given a language screening test; the children who failed the screening and approximately one-third of the children who passed were then administered a diagnostic battery. The battery included an assessment of language, phonology, nonverbal intelligence, and hearing. Children meeting the criteria for language impairment (two or more language composite scores that were at least 1.25 SD below the age group mean) were identified and their parents were invited to join a registry. A total of 231 of the children with language impairments were registered as a result. In addition, 373 children whose language scores fell within normal limits were also registered in this manner.

The children were then followed for approximately eight years, with diagnostic testing repeated approximately every two years until the children were 14 years of age. Several previous publications have reported test results and findings from experimental tasks for this sample (e.g., Tomblin & Zhang, 1999; Ellis Weismer et al., 2000; Tomblin, Zhang, Buckwalter, & Catts, 2000; Miller, Kail, Leonard, & Tomblin, 2001; Leonard, Ellis Weismer et al., 2007), including the grammaticality judgment study of Miller et al. (2008).

The participants were 16 years of age when the present study was conducted. They were classified according to the most recent diagnostic testing, performed two years earlier. The language battery included the Concepts and Directions and Recalling Sentences subtests of the Clinical Evaluation of Language Fundamentals – 3 (CELF-3, Semel, Wiig, & Secord, 1994), the Peabody Picture Vocabulary Test – Revised (PPVT-R, Dunn & Dunn, 1981), the Expressive Scale of the Comprehensive Receptive and Expressive Vocabulary Test (CREVT, Wallace & Hammill, 1994), and the subtests of the Qualitative Reading Inventory – 3 (QRI-3, Leslie & Caldwell, 2001). The latter was employed as a measure of discourse comprehension and production and included an oral portion as well as a reading portion. From this battery of tests, five composite scores were calculated, and *z* scores were computed based on the entire data set. Three of the composites corresponded to the language components of Grammar (the two subtests of the CELF-3), Vocabulary (PPVT-R and Expressive Scale of CREVT), and Discourse (the subtests of the QRI-3). The remaining composites corresponded to Receptive and Expressive language. The latter two composites were the subtests of the same tests grouped into those requiring demonstration of comprehension, and those requiring production. Performance IQ was calculated based on performance on the Block Design and Picture Completion subtests of the Wechsler Intelligence Scale for Children – III (Wechsler, 1991). Participants were classified as language impaired if they scored at least 1.25 SD below their age group mean on two or more language composite scores. All participants classified as language impaired scored more than 1.25 SD below the mean on the Receptive and/or Expressive language composite, and one or more composites dealing with the language components of Grammar, Vocabulary, and/or Discourse, as detailed below. Those participants qualifying as language impaired were further classified as SLI if their Performance IQ was 85 and above, and NLI if their score was lower. As a result of testing, 106 participants were classified as typically developing (TD), 47 as exhibiting SLI, and 25 as NLI.

Given that the genetic sources of both SLI and NLI appear to be multifactorial (Bishop, 2006), leading to the possibility that some of the variation among children in these groups could reflect genuine phenotypes, we provide diagnostic details of our participants in Appendix A and B. To date, the only heritable deficits that are separable from other deficits are: (1) a weakness in grammatical computation, best seen during childhood in tasks that tap the use of tense/agreement morphemes; and (2) a weakness in retaining sequences of sounds, best observed during childhood through nonword repetition tasks (Bishop, Adams, & Norbury, 2006). It is also the case that, although these two weaknesses are genetically separable, many children show both types of deficits (Bishop et al., 2006). Of the two types of deficits, poor retention of sequences of sounds does not appear to be a sufficient condition for SLI or NLI. In fact, many children with specific reading disability are weak on measures of this type of ability but do not meet the traditional criteria for SLI (Bishop & Snowling, 2004). In older children and adolescents, some investigators have described a subgroup as exhibiting a “grammatical specific language impairment” (e.g., van der Lely, 1998). However, it is also true that many children who show the grammatical characteristics of this type of deficit also show deficits in other areas of language (Bishop et al., 2000).

The same picture of multiple areas of weakness is evident in Appendix A. Of the three composites dealing with components of language (Grammar, Vocabulary, Discourse), 16 participants in the SLI group met the criterion for impairment (at least 1.25 SD below the mean) on the Grammar composite only, and another 21 participants in the group met criteria on the Grammar composite plus one or more additional composites (Vocabulary and/or Discourse). (Recall that all participants in the SLI and NLI groups also met criterion on the Receptive and/or Expressive language composite.) Even for those cases meeting the criterion on only one component of language, the distinction between the components was not sharp. This is especially true for the participants who met the criterion on the Vocabulary composite only; three of the five cases were between 1.00 and 1.25 SD below the mean on the Grammar composite (the remaining participant was 0.83 SD below the mean on the Grammar composite). It is fair to say that grammar was the most prominent weakness in the SLI group. No participant in the SLI group met criterion on the Discourse composite only. It is also important to point out that when criterion was met on the Discourse composite plus Grammar and/or Vocabulary, the participant performed as poorly on the oral portion of the Discourse composite as on the written portion.

The NLI group showed a similar distribution, as seen in Appendix A, with the greatest number of participants meeting criterion on the Grammar composite only (4 participants) or on the Grammar composite plus the Vocabulary composite (8 participants), the Grammar composite plus the Discourse composite (2 participants), or the Grammar composite plus both the Vocabulary and Discourse composites (6 participants). The NLI group differed somewhat from the SLI group in that three participants met criterion on the Discourse composite only; all three of these participants scored as poorly on the oral portion of this composite as on the written portion. As was true for the SLI group, for the cases in which criterion was met on only one component of language, the distinction between components was not necessarily a sharp one. For example, one of the three participants meeting criterion on the Discourse composite only scored between 1.00 and 1.25 below the mean on the Grammar composite. The greatest difference between the SLI and NLI groups was one of severity. This is seen most clearly in Appendix B, where the NLI group’s composite scores are lower than those of the SLI group for Grammar, Vocabulary, and Discourse. For both the SLI and NLI groups, the lowest composite scores were seen for Grammar.

Materials

Eighty-four sentence pairs were created for the task; these sentences appear in Appendix C. Each sentence pair consisted of a fully grammatical sentence and an otherwise identical sentence that contained an error. The error occurred immediately before the target word in the sentence. Specifically, the target word appeared as the next word after the word containing the error, or was separated from the error by an intervening monosyllabic function word such as an article (e.g., *a*), a verb particle (e.g., *to*), or a possessive pronoun (e.g., *my*). For 28 sentence pairs, the error involved the omission of an inflection unrelated to tense/agreement. Hereafter these will be referred to as Nontense Omission contrasts. Fourteen of the errors were omissions of possessive '*s* and 14 were omissions of progressive *–ing*. Examples appear in (1). The target word appears in italics.

(1)

- **a.** I put a nail in my neighbor's *wall* to hang his painting

  I put a nail in my neighbor_ *wall* to hang his painting

- **b.** This rainy weather is ruining the *picnic* for the school

  This rainy weather is ruin_ the *picnic* for the school

An additional 28 sentence pairs were constructed so that the error was the omission of a tense/agreement inflection. For 14 pairs the error was the omission of third person singular *–s* and for 14 pairs the error was the omission of past tense *–ed*. Hereafter, these sentences will be referred to as Tense Omission contrasts. Examples are shown in (2).

(2)

- **a.** During the holidays she always decorates *rooms* with holly and mistletoe

  During the holidays she always decorate_ *rooms* with holly and mistletoe

- **b.** He heard a sound and turned his *head* to see the cat

  He heard a sound and turn_ his *head* to see the cat

For the remaining 28 sentences pairs, the error took the form of the insertion of a tense/agreement morpheme that should not have appeared. For 14 pairs the error was the inappropriate inclusion of third person singular *–s* and for 14 pairs the error was the inappropriate inclusion of past tense *–ed*. Hereafter, these sentences will be referred to as Tense Intrusion contrasts. Examples appear in (3).

(3)

- **a.** The police like to arrest *robbers* on TV

  The police like to arrests *robbers* on TV

- **b.** It is important to check a *map* when you are lost

  It is important to checked a *map* when you are lost

Sentences ranged from eight to 12 words in length, with the target word appearing in sixth, seventh, or eighth position and the error occurring on the fourth, fifth, sixth, or seventh word in the sentence. We ensured that the target words appeared after at least five words to provide some grammatical context. Because target word position was not a variable of interest, we did not vary the target word position to a large degree. However, slight variation of sentence position was necessary to avoid the participants' reliance on a word count or similar response strategy. The means and ranges for each contrast type appear in Table 1. All target words and all words containing errors had a frequency of occurrence of 2 or greater according to Francis and Kucera (1982).

The sentences were recorded in a sound booth by a native American English-speaking male with training in vocal performance. A head-mounted Shure WH20 microphone was used, connected to a Marantz PMD650 minidisc recorder. The ungrammatical as well as grammatical versions of each sentence were produced by the speaker. Prior to recording, the speaker practiced all sentences with the aim of producing both versions with natural intonation, free of inappropriate pauses or emphasis. Two or more recordings of each sentence version were made. After listening to all recorded productions, a research assistant independently selected pairs of ungrammatical and grammatical sentence tokens that seemed to be as similar and that sounded as natural as possible. The recordings that were selected were then digitized at a sampling rate of 22 kHZ, low-pass filtered, and amplitude normalized. The target words were recorded by the same speaker in the same manner as the stimulus sentences. These words were produced in isolation.

Two sentence lists were created. In one list, the grammatical versions of one-half of the sentence pairs for each contrast were selected, along with the ungrammatical versions of the remaining half of the sentence pairs for each contrast. The second list employed the versions not used in the first list. Thus, in each list there were seven ungrammatical versions and seven grammatical versions of the Nontense Omission contrast involving possessive *'s*, seven ungrammatical versions and seven grammatical versions of the Nontense Omission contrast involving progressive *–ing*, and so on. Approximately half of the participants in each group (TD, SLI, NLI) received the first list, and the remaining participants in each group received the second list. (Due to 47 and 25 participants in the SLI and NLI groups, respectively, one list was used with one additional participant in each of these groups.) The grammatical and ungrammatical version of the same sentence was not used in the same list because a participant's recognition of a previously heard sentence could lead to artificially fast RTs due to anticipatory effects, which would be especially problematic for the sentences containing errors given that slower RTs are ordinarily expected for such sentences.

The first stimulus list consisted of 14 blocks of 7 items, including one of each sentence type and a "catch" trial in which the target word did not appear in the following sentence. The use of catch trials encouraged participants to remain vigilant. The sentences were randomly assigned to blocks and randomly ordered within blocks with the constraint that within each block two to five sentences were to be grammatical and no more than three ungrammatical or five grammatical sentences could appear consecutively, including catch trial sentences, which were always grammatical. The second list was identical to the first except, of course, that it used the ungrammatical versions of the grammatical sentences appearing on the first list and the grammatical versions of the first list's ungrammatical sentences.

Each trial consisted of a target word and sentence. The trial began with a silent interval of 2 seconds, followed by the target word, another silent interval of 500 ms, and then the sentence (each sentence sound file had a silent lead-in of approximately 100 ms). A new trial sequence was initiated when the participant responded or when the sentence ended, if the participant responded before the end of the sentence. If there was no response (as in a catch trial), the computer program waited for 2 seconds following the end of the sentence, and then initiated the next trial sequence. Thus, if a participant did not respond, there was a 4-second interval between the end of the sentence and the beginning of the next target word.

The stimulus sentences and target words were presented, and the participants' responses detected using E-Prime version 1.1 software (Schneider, Eschmann, & Zuccolutto, 2002). This software was run on a Toshiba Satellite Pro 4600 computer. Responses were detected using a Psychology Software Tools serial response box.

Procedure

The word monitoring task was administered in one session, as part of a larger battery of experimental tasks. Participants were seen individually. Instructions were initially presented on a computer screen and read aloud by the experimenter. The instructions informed the participants that they would hear sentences and that before each sentence, they would hear a word that they should listen for in the sentence. The participants were instructed that as soon as they heard the word in the sentence, they should press the button indicated by the experimenter. Each participant was told to respond “as quickly as you can.” The participant and experimenter listened to the sentences through headphones connected to the computer. Before the stimulus sentences were presented 6 practice trials were used. The participants’ responses to the target words in each sentence were recorded in ms.

Results

As described earlier, the grammatical errors employed in the sentences were either omission errors in the case of the Nontense Omission contrasts and Tense Omission contrasts, or commission errors in the case of the Tense Intrusion contrasts. Consequently, for some contrasts, RTs were expected to be slower when an (obligatory) morpheme failed to appear, and for other contrasts, RTs were expected to be slower when a morpheme (inappropriately) appeared. In addition, the predictions were not the same for the three contrasts. According to a “residual” optional tense/agreement perspective, the SLI and NLI groups should show slower RTs for errors than for grammatical sentences in the Nontense Omission and Tense Intrusion contrasts, but comparable RTs for errors and grammatical sentences in the Tense Omission contrasts. The TD group should show slower RTs for errors than for grammatical sentences for all three contrast types. If, on the other hand, the difficulties of the SLI and NLI groups were related more to perceptual salience than to optional tense/agreement, their RTs for errors and grammatical sentences should be similar for Tense Intrusion contrasts as well as for Tense Omission contrasts. In addition, we might expect a participant group by inflection type interaction in the Nontense Omission contrast, owing to the SLI and NLI groups’ slower RTs for errors than for grammatical sentences in the contrasts involving progressive *–ing* but similar RTs for errors and grammatical sentences in the contrasts involving possessive *’s*. Again, the TD group would be expected to show RT differences for all three contrast types.

Given the contrast-specific nature of the predictions, separate analyses of variance (ANOVAs) were run for Nontense Omission contrasts, Tense Omission contrasts, and Tense Intrusion contrasts. In each analysis, participant group was a between-subjects variable and inflection type and grammaticality were within-subjects variables. Means and standard deviations are summarized in Table 2. The ANOVA for Nontense Omission contrasts revealed a significant main effect for grammaticality, with RTs faster for grammatical sentences (M = 501.54, SD = 364.52) than for those containing errors (M = 550.93, SD = 339.17), F (1, 175) = 21.50, $p < .001$, partial η^2 = 0.11. Main effects for participant group, F (2, 175) = 3.01, p = .052, partial η^2 = 0.03 and inflection type, F (1, 175) = 2.44, p = .120, partial η^2 = 0.01, were not significant, though the F value for the former approached significance. One interaction was statistically significant, participant group x inflection type, F (2, 175) = 3.17, p = .04, partial η^2 = 0.03. Post-hoc (Unequal N HSD) analyses revealed that the SLI group’s RTs for *–ing* (M = 479.54, SD = 311.49) were faster than for possessive *’s* (M = 526.24, SD = 360.29), but for the TD and SLI groups, RTs for *-ing* and possessive *’s* did not differ. No other interactions were significant. An illustration of the findings appears in Figure 1.

The ANOVA for Tense Omission contrasts revealed a significant main effect for inflection type, with RTs faster for past tense *–ed* (*M* = 435.56, *SD* = 289.75) than for third person singular *–s* (*M* = 492.57, *SD* = 316.70), *F* (1, 175) = 33.16, $p < .001$, partial $\eta^2 = 0.16$, and for grammaticality, *F* (1, 175) = 4.66, $p = .03$, partial $\eta^2 = 0.03$ (grammatical *M* = 455.47, *SD* = 312.67; ungrammatical *M* = 472.58, *SD* = 288.68). The main effect of participant group was not significant, *F* (2, 175) = 2.55, $p = .081$, partial $\eta^2 = 0.03$. However, a significant participant group x grammaticality interaction was observed, *F* (2, 175) = 4.20, $p = .017$, partial $\eta^2 = 0.05$. Post-hoc (Unequal N HSD) analyses revealed that the TD group had significantly slower RTs for sentences containing errors (*M* = 429.59, *SD* = 198.78) than for grammatical sentences (*M* = 401.46, *SD* = 214.61, $p = .015$). However, the SLI ($p = .90$) and NLI ($p = .31$) groups showed no such differences. Mean RTs for ungrammatical and grammatical sentences were 428.42 (*SD* = 248.22) and 442.17 (*SD* = 305.62), respectively, for the SLI group, and 559.72 (*SD* = 432.59) and 522.77 (*SD* = 281.26), respectively, for the NLI group. This interaction is illustrated in Figure 2. No other interactions were significant.

For the Tense Intrusion contrasts, a significant main effect was found for grammaticality, with faster RTs for grammatical sentences (*M* = 475.77, *SD* = 337.94) than for sentences containing errors (*M* = 508.85, *SD* = 374.17), *F* (1, 175) = 9.33, $p = .003$, partial $\eta^2 = 0.05$. A significant main effect was also found for inflection type, with faster RTs seen for past tense *–ed* (*M* = 476.40, *SD* = 358.46) than for third person singular *–s* (*M* = 508.22, *SD* = 347.09), *F* (1, 175) = 17.36, $p < .001$, partial $\eta^2 = 0.09$. There was no main effect for participant group, *F* (2, 175) = 2.92, $p = .057$, partial $\eta^2 = 0.03$, though the value approached significance. No interactions proved significant. An illustration of the findings is provided in Figure 3.

Discussion

Before discussing the results, we note here details of the study that warrant some caution in the interpretation of the data. First, it is possible that future research will identify subgroups of individuals with SLI or NLI that will constitute distinct phenotypes for different types of causal factors. At present, two types of heritable and separable deficits have been identified, one (involving the retention of sequences of sounds) that does not constitute a sufficient condition for SLI or NLI, whereas the other (involving grammatical computation) is a sufficient condition. Other differences among individuals with SLI or NLI (e.g., in vocabulary skill) are readily apparent in the literature; however, until such differences can be empirically determined to constitute distinct deficits, we believe that subdividing the SLI and NLI groups would result in a loss of statistical power with no known benefit in diagnostic accuracy. Given that for both the SLI and NLI groups in our study grammar was the most prominent weakness, we are confident that our groups capture the prototypical pattern of the language impairment.

A second reason for exercising some caution in the interpretation of the findings concerns slight discrepancies between RTs across inflection types. In particular, it is not clear why RTs were generally faster for past tense *–ed* contrasts than for third person singular *–s* contrasts in the analyses for Tense Omission contrasts and Tense Intrusion contrasts. The sentence position of the target word was, on average slightly later in the sentence for past tense *–ed* than for third person singular *–s* for the Tense Intrusion contrasts and this might have accounted for the difference. However, the sentence position of the target word was not later for past tense *–ed* than for third person singular *–s* for the Tense Omission contrasts. Another possibility is that the shorter duration of the stop consonant *–ed* relative to the fricative *–s* played a role in this difference. For example, inspection of the data suggested that the RTs for grammatical sentences containing *–ed* in the Tense Omission analysis were somewhat faster than the RTs for grammatical sentences containing third person singular *–s*. Likewise, in the Tense Intrusion analysis, the RTs for ungrammatical sentences containing an intrusive *–ed* appeared faster than the RTs for ungrammatical sentences containing an intrusive *–s*. Nevertheless, because no interaction involving the inflections past –ed and third singular -s reached statistical significance, we cannot conclude that the particular inflection employed was a decisive factor.

It appeared as if the word monitoring task functioned as intended. For all three sentence types, significant main effects were found for grammaticality, with faster RTs for grammatical sentences than for those containing errors. Thus, it appears that the task was sufficiently sensitive to detect subtle delays in children's responses when an error occurred in the sentence.

According to a "residual" optional tense/agreement account, the RTs of children with SLI and NLI should be similar for grammatical sentences containing tense/agreement inflections and ungrammatical sentences that lack obligatory tense/agreement inflections. Such reduced sensitivity to missing tense/agreement inflections might be taken to reflect the remnants of an earlier history of treating these inflections as optional. Yet, these same children should show the expected RT differences between grammatical sentences and sentences with errors when the errors take the form of missing inflections unrelated to tense/agreement, or when they are tense/agreement inflections that appear in inappropriate contexts. The findings were in line with each of these expectations. A participant group x grammaticality interaction was seen only for the Tense Omission contrasts. Further examination revealed that the SLI and NLI groups showed similar RTs for the grammatical sentences and the sentences with missing tense/agreement inflections. The TD group, on the other hand, showed the expected RT difference.

Alternative explanations do not appear as consistent with the findings as the "residual" optional tense/agreement view. Given that the SLI and NLI groups showed evidence of detecting both omissions of nontense/agreement inflections and commission errors involving tense/agreement inflection intrusions, they did not exhibit a more general insensitivity to ungrammatical sentences. Furthermore, the fact that they showed slower RTs for ungrammatical sentences than for grammatical sentences in the Tense Intrusion contrasts suggests that they were able to detect these low phonetic substance morphemes. In addition, inspection of the data for the Nontense Omission contrasts reveals that the SLI and NLI groups showed the same numerically larger RTs for ungrammatical sentences than for grammatical sentences for possessive *'s* as well as for progressive *–ing* a pattern matching the TD group.

The findings from word monitoring in this study differ somewhat from the findings from studies that have employed grammaticality judgments. Specifically, whereas Rice et al. (1999) reported selective difficulty rejecting tense omissions, Miller et al. (2008) found that adolescents with SLI were less likely than same-age peers to reject other types of errors as well. However, the sentences were longer in the Miller et al. study, and only accuracy on sentences with tense omissions had A' scores averaging below .90. We suspect the differences in the findings of the two studies were attributable in part to the greater verbal working memory demands associated with the longer sentences in the Miller et al. study. As noted earlier, verbal working memory limitations are well documented in the SLI population (e.g., Ellis Weismer, Evans, & Hesketh, 1999; Montgomery, 2000). In contrast to grammaticality judgment tasks, the word monitoring task employed in the present study required the children to respond immediately upon detecting the target word, and the grammatical error immediately preceded the target word. This difference may have rendered the word monitoring task less vulnerable to factors – such as verbal working memory limitations – that could have obscured real differences in the children's sensitivity to the three error types.

Our finding that the NLI group showed the same pattern of results as the SLI group parallels an earlier finding by Rice et al. (2004) that, in production, tense/agreement morphemes may continue to be optional even in older children with language difficulties who do not meet the customary IQ criterion for SLI. Given that Rice et al. also found that their NLI group showed a somewhat different growth pattern than their SLI group, it was possible that the NLI group in the present study – who were four years older than the group studied by Rice et al. – might differ in their response patterns from our SLI group. However, this did not prove true. Our findings together with those of Rice et al. suggest that even though SLI and NLI groups may differ in meaningful ways, tense/agreement morphology may loom as an especially vulnerable area for a struggling language learner in a language such as English.

Of course, finding a profile of responding that mimics an earlier pattern seen in production is no assurance that the earlier pattern is responsible for the later response profile. Without earlier production data from each participant, we cannot document that the particular children showing the clearest evidence of optional use of tense/agreement at an earlier age were precisely those children who showed similar RTs for grammatical and ungrammatical sentences in the Tense Omission contrasts.

It is also possible that, for independent reasons, tense/agreement omissions might be more difficult to detect. For example, nonfinite word sequences such as *the skater practice her routines* in *We watch the skater practice her routines everyday* and *the boy jump off the roof* in *We saw the boy jump off the roof yesterday* are regularly heard in the input. If participants did not track the sentence properly, the absence of third person singular *–s* or past tense *–ed* might not have appeared as aberrant as, for example, sequences such as …*to arrives at work* and …*to washed my car* (from the Tense Intrusion list), that are much less frequent in the input. The participants most likely to experience such sentence tracking problems were those in the SLI and NLI groups; therefore, they would be the groups most likely to miss the fact that an obligatory tense/agreement morpheme was absent.

Although we cannot demonstrate with certainty that the special problems associated with Tense Omission contrasts by the SLI and NLI groups can be traced to an earlier period of treating tense/agreement morphemes as optional, it is also clear that these problems co-occurred with an ability to detect other types of errors. Thus, whether the SLI and NLI groups' performance reflected a continued insensitivity to the obligatory nature of tense/agreement morphology, or the fact that identifying missing tense/agreement morphemes is an inherently difficult task, it is clear that our findings show a select area of processing that, at a group level, differentiates children with language impairment from their typically developing peers.

Finally, our use of RT as a dependent measure permitted us to provide a test of the general slowing hypothesis first put forth by Kail (1994) and subsequently evaluated by others. Taken at face value, our results provide relatively little support for the notion that children with SLI and NLI exhibit a general slowing, given that none of the main effects for participant group was statistically significant. However, we cannot regard our findings regarding slowing as definitive. The p levels for participant group approached significance in each of the three analyses (.055, .082, .057). Furthermore, reduced sensitivity to grammatical errors – as was seen in the SLI and NLI groups during the Tense Omission task in particular – results in faster, not slower RTs. These observations raise the possibility that our analyses did not have sufficient power to detect any group differences that might have existed. Nevertheless, it is surprising that differences were not statistically significant given that RTs for language material are influenced by the participants' command or knowledge of the material, and our findings clearly indicated that the three groups were not equivalent in this regard.

Together the findings suggest that individuals with SLI and NLI may exhibit deficits in select areas of grammatical processing. Although these deficits may not sharply distinguish individuals with SLI and NLI from their typically developing peers, the selective nature of this difficulty within the area of grammatical processing raises the possibility that it constitutes an important part of the language disorder at this age.

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Appendix

Appendix C

The Sentences Used in the Word Monitoring Task. For Each Error Type, Each Participant Heard One-Half of the Sentences in the Errant Form Listed Below and the Other Half in its Grammatical (Corrected) Form. Each Sentence was Presented in Grammatical Form, and in Ungrammatical Form to One-Half of the Participants in Each Group. The Error in Each Sentence is Underlined and the Target Word Appears in Italics. For Catch Trial Sentences, the Target Word The Participant Was Listening For Appears in Parentheses After the Sentence.

Nontense Omission

She looked at the man_ *watch* because she forgot her own.

In the morning I dropped Sue_ *daughter* at school.

While playing in the yard, the child_ *dress* got dirty.

The boy likes to pull the dog_ *tail* despite his mother's warnings.

The noise from the storm_ *thunder* woke me up.

I wish I had Sally_ *tan* instead of my sunburn.

The lawyer read the parent_ *will* to her family.

At the birthday, the excited boy_ *gifts* were piled on the table.

I put a nail in my neighbor_ *wall* to hang his painting.

At the restaurant, the waiter_ *voice* was loud because it was noisy.

The salesman rang the woman_ *doorbell* but no one was home.

The teacher scored the student_ *test* before meeting with him.

The groom lifted the bride_ *veil* during the wedding ceremony.

We are hoping that Michael_ *wish* comes true soon.

I will be buy_ my *father* a book for his birthday.

My sister keeps borrow_ my *phone* but never says thank you.

The young woman is choose_ *flowers* to put in her scrapbook.

I should be write_ my *paper* instead of playing games.

The Boy Scout troop is sell_ a *bike* to raise money.

She must be accept_ the *job* offer at the big company.

For her party, Chris is make_ *cards* on pink paper.

The doctor will be care_ for *grandma* when she goes home.

The coastguard is rescue_ the *ship* that had radioed for help.

This rainy weather is ruin_ the *picnic* for the school.

Today we are release_ the *bird* into the wild.

Thomas is always kick_ *rocks* and hurting his toes.

She is always annoy_ the *driver* of our bus by shouting loudly.

He will be repeat_ the *class* next year because he failed it.

Tense Omission

Brian likes it when he draw_ *cartoons* and funny faces.

You should watch closely as he paint_ *fruit* and flowers.

Sheila is impatient and she always interrupt_ *people* when they are talking.

During the holidays she always decorate_ *rooms* with holly and mistletoe.

Every year she travels and tour_ *museums* in big cities.

My mother always ignore_ our *jokes* that she considers in bad taste.

Mother says that my whistling bother_ my *sister* when she is studying.

If the man dies the son inherit_ *land* and money.

The famous star acts in and direct_ *movies* that make big money.

When not studying, Sue listen_ to *music* in her room.

On Sundays Marcy volunteer_ her *time* at the homeless shelter.

When company visits Betty pour_ *tea* and Clara passes out cookies.

The man likes sailing and own_ a *boat* at the yacht club.

Henry would like it if Chris marry_ *Peter* in a traditional ceremony.

Tanya went and pick_ a *book* for herself.

I changed and jump_ in the *water* quickly.

At snack time he ask_ for *crackers* and some juice.

Chris was happy because he love_ a *girl* in his class.

He heard a sound and turn_ his *head* to see the cat.

The child tripped and drop_ her *cone* on the ground.

We were hungry so we open__ a *can* of soup.

We went home and bake_ *cookies* with our mother.

Justin went to Kyle's house and play_ *chess* for an hour.

When she came inside she place_ her *coat* on the chair.

He wrote and type_ his *report* for science class.

They held hands and walk_ *home* in the rain.

She dialed the phone and call_ his *number* at work.

She came in and close_ her *door* before making the phone call.

Tense Intrusion

A good dog should learn<u>s</u> *tricks* when it is a puppy.

We plan to cheer<u>s</u> our team loudly if they win the game.

She is likely to arrive<u>s</u> at *work* late because traffic is heavy.

The janitor likes to hum<u>s</u> *tunes* from the radio as he cleans.

Their mother likes to show<u>s</u> *pictures* to the children at bedtime.

Jerry likes to carve<u>s</u> the *turkey* with a sharp knife.

Many people will whisper<u>s</u> in *church* because it is quiet.

You should never try to copie<u>s</u> *answers* from a friend.

In archery you aim<u>s</u> the *arrow* at the target.

The police like to arrest<u>s</u> *robbers* on TV.

Many parents like to name<u>s</u> *babies* after someone in the family.

Brian and Amy will pack<u>s</u> a *suitcase* tonight.

Some kids like to dare<u>s</u> a *friend* to do something dangerous.

It is rude to swear<u>s</u> at *dinner* but my brother does it.

He tends to scrap<u>ed</u> a knee or elbow when he plays.

The man likes to refus<u>ed</u> *help* because he is stubborn.

Make sure you remember to sav<u>ed</u> your *bottles* for tomorrow.

Cary knows that he will recogniz<u>ed</u> his *brother* in his Halloween costume.

In winter I seem to preferr<u>ed</u> *black* clothes.

It is important to check<u>ed</u> a *map* when you are lost.

I must remember to wash<u>ed</u> my *car* after going to the beach.

I like to watch her practic<u>ed</u> *soccer* at the field.

I want to buy and wrapp<u>ed</u> my *presents* before the holidays.

Mother needs to clean<u>ed</u> her *rugs* at least once a month.

In the summer I will hop<u>ed</u> for *rain* for my garden.

It isn't wise to spoil<u>ed</u> *children* with too many toys.

Karen is afraid to chipp<u>ed</u> her *nails* just after having them painted.

Ricky will always peel<u>ed</u> his *apple* before eating it.

Catch Trial Sentences

Father turned his boat around in the water. (Moon)

The people watched as the bull charged at the man. (Whisker)

Last week we danced at the party for hours. (Tree)

Last night, she talked on the phone. (Walnut)

Yesterday, Father chopped carrots for the salad. (Ink)

Her bike was stolen while she was in the store. (Deer)

Last week I called my friend from home. (Button)

Last year mother dyed her hair red but it looked orange. (Monkey)

Last week we biked ten miles with our friends. (Swing)

Yesterday I buttered my toast at breakfast. (Plane)

She said that she liked Steven because he was funny. (Pool)

At the fair last month she begged her mother for money. (Clock)

When he cooked dinner he burned his finger on the pot. (Lamp)

Last week he passed his test with an A. (Target)

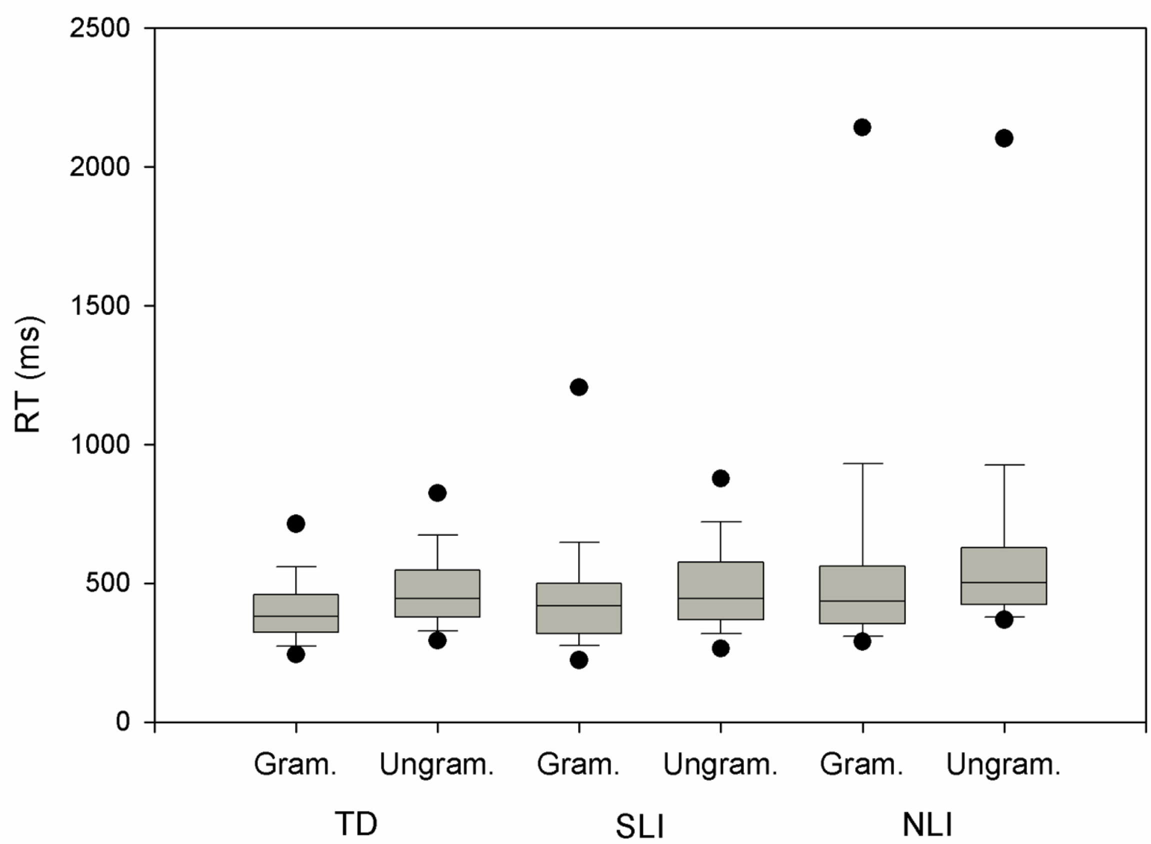

Figure 1.
Median response times (RT), 25th and 75th percentiles (boxes), 10th and 90th percentiles (whiskers), and 5th and 95th percentiles (circles) in ms on the grammatical and ungrammatical sentences in the Nontense Omission contrasts by the typically developing (TD) participants, the participants with specific language impairment (SLI), and the participants with nonspecific language impairment (NLI).

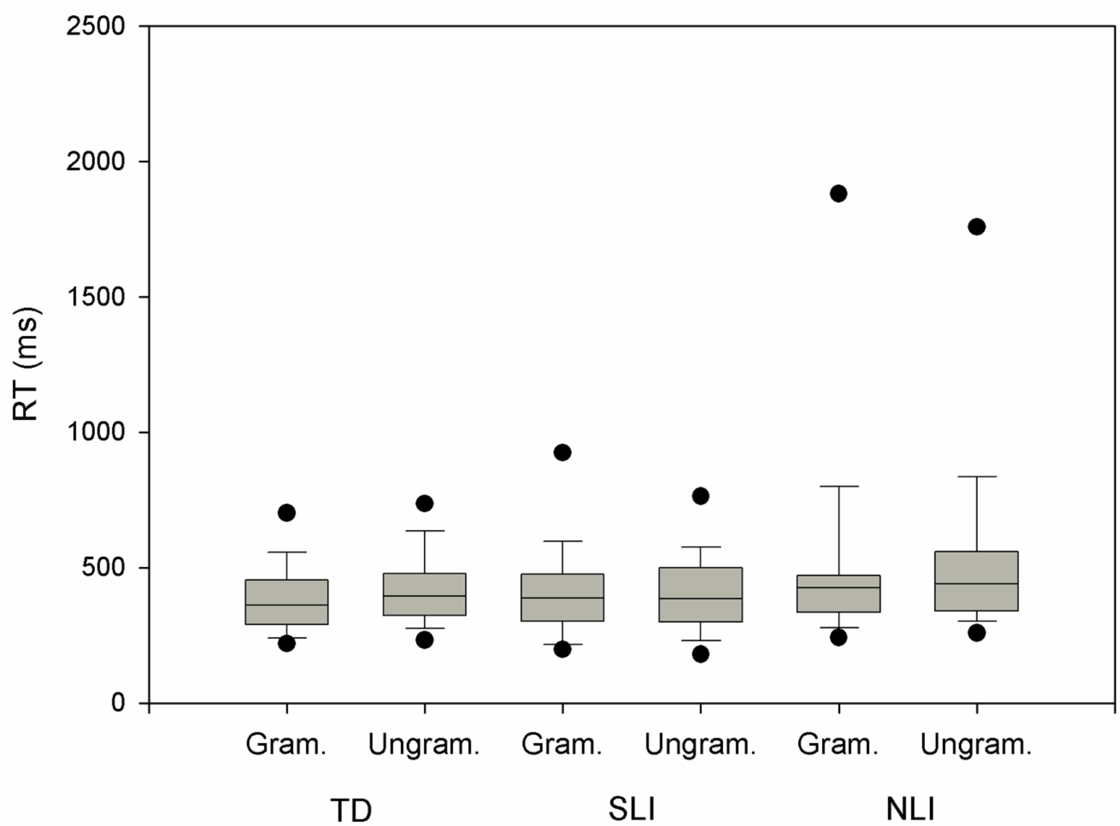

Figure 2.

Median response times (RT), 25th and 75th percentiles (boxes), 10th and 90th percentiles (whiskers), and 5th and 95th percentiles (circles) in ms on the grammatical and ungrammatical sentences in the Tense Omission contrasts by the typically developing (TD) participants, the participants with specific language impairment (SLI), and the participants with nonspecific language impairment (NLI).

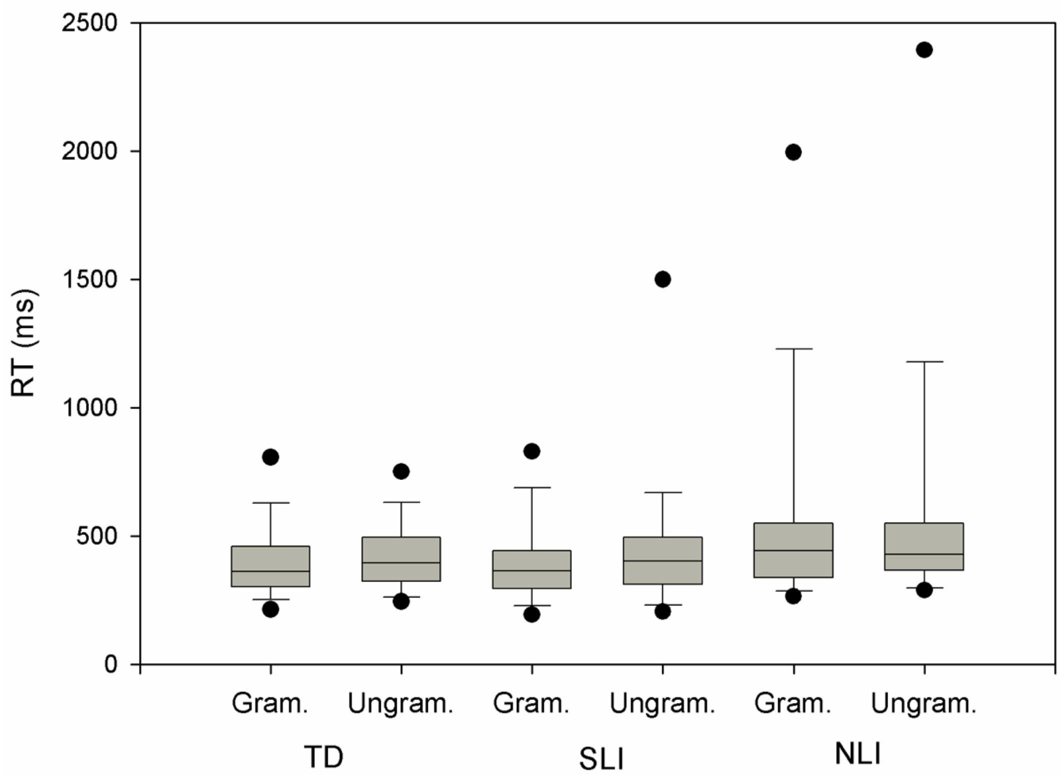

Figure 3.
Median response times (RT), 25th and 75th percentiles (boxes), 10th and 90th percentiles (whiskers), and 5th and 95th percentiles (circles) in ms on the grammatical and ungrammatical sentences in the Tense Intrusion contrasts by the typically developing (TD) participants, the participants with specific language impairment (SLI), and the participants with nonspecific language impairment (NLI).

Table 1

Sentence Length, Sentence Position for Target Words and Words Containing Errors for the Stimulus Sentences.

	Mean (Range)	**Mean (Range)**	**Mean (Range)**
Sentence Type	**Sentence Length in Words**	**Sentence Position of Target Word**	**Sentence Position of Error**
Nontense	10.43	6.57	5.57
Omission'*s*	(9–12)	(6–8)	(5–7)
Nontense	10.79	6.43	4.57
Omission–*ing*	(9–12)	(6–8)	(4–6)
Tense	11.07	7.29	5.93
Omission–*s*	(10–12)	(6–8)	(4–7)
Tense	10.00	7.14	5.29
Omission–*ed*	(8–12)	(6–8)	(4–7)
Tense	10.50	6.36	4.79
Intrusion–*s*	(8–12)	(6–7)	(4–6)
Tense	10.57	6.93	5.21
Intrusion–*ed*	(8–12)	(6–8)	(4–6)

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Table 2

Group Means (Standard Deviations) for Each Analysis by Grammaticality and Morpheme Type.

Group	Nontense Omission				Tense Omission				Tense Intrusion			
	Grammatical		Ungrammatical		Grammatical		Ungrammatical		Grammatical		Ungrammatical	
	-ing	poss. ‘*s*	*-ing*	poss. ‘*s*	3Sing	*-ed*	3Sing	*-ed*	3Sing	*-ed*	3Sing	*-ed*
TD	432 (271)	420 (235)	467 (213)	516 (230)	425 (214)	378 (214)	459 (211)	400 (182)	447 (225)	393 (237)	448 (224)	431 (233)
SLI	464 (317)	498 (352)	494 (310)	554 (370)	447 (293)	437 (321)	467 (240)	389 (253)	453 (290)	416 (320)	494 (358)	471 (361)
NLI	610 (544)	583 (432)	644 (484)	630 (432)	558 (444)	488 (371)	598 (487)	521 (376)	590 (447)	556 (481)	616 (557)	591 (535)

Appendix A

The Number of Participants in the SLI and NLI Groups Who Met Criterion (at Least 1.25 SD Below the Mean) on the Grammar (G) Composite, the Vocabulary (V) Composite, and/or the Discourse (D) Composite. All Participants in These Two Groups Also Met Criterion on the Receptive Composite and/or the Expressive Composite.

SLI Group (N = 47)						
G	**V**	**D**	**G+V**	**G+D**	**V+D**	**G+V+D**
16	5	0	13	4	5	4
NLI Group (N = 25)						
G	V	D	G+V	G+D	V+D	G+V+D
4	2	3	7	2	0	7

Appendix B

The Means (and Standard Deviations) for the SLI, NLI, and TD Groups on Performance IQ, and the Language Composites. The Language Composite Values are *z* Scores.

Performance IQ	Grammar Composite	Vocabulary Composite	Discourse Composite	Receptive Composite	Expressive Composite
SLI Group (N = 47, Age at Testing *M = 13.93 years, SD = 0.43*)					
97.83 (9.26)	−1.66 (0.77)	−1.22 (0.57)	−0.99 (0.45)	−1.34 (0.55)	−1.57 (0.58)
NLI Group (N = 25, Age at Testing *M* = 13.97 years, *SD* = 0.39)					
76.48 (5.33)	−1.91 (1.07)	−1.48 (0.56)	−1.16 (0.45)	−1.79 (0.76)	−1.62 (0.64)
TD Group (N = 106, Age at Testing *M* = 13.88 years, *SD* = 0.38)					
101.79 (9.92)	−0.13 (0.69)	−0.23 (0.86)	−0.13 (0.91)	−0.13 (0.77)	−0.23 (0.80)