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Speech Disruptions in the Sentence Formulation of School-Age Children with Specific Language Impairment

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Abstract

Background—Many school-age children with specific language impairment (SLI) produce sentences that appear to conform to the adult grammar. It may be premature to conclude from this, however, that their language formulation ability is age appropriate.

Aims—In this study, we sought to determine whether a more subtle measure of language use, speech disruptions during sentence formulation, might serve to distinguish children with SLI from their typically-developing (TD) peers at an age when grammatical accuracy was high. We analyzed the rate of speech disruptions in simple sentence production in school-age children with SLI and TD age-matched peers. We predicted that (1) the SLI group would exhibit more speech disruptions than the TD group as a result of reduced language proficiency even when grammatical accuracy was high and, (2) the SLI group would demonstrate greater reductions in disruption frequency as compared to the TD group when given sentences that model the target syntactic structures.

Methods & Procedures—Twenty-eight children (17 SLI, 11 TD, $M = 8;10$ years) with no history of stuttering were presented with a series of picture pairs. The examiner described the first picture using a simple sentence and asked the child to repeat the sentence; the child then described the second picture. There were two priming conditions: *Matching Syntax* condition (paired pictures requiring the same syntactic structure) and *Different Syntax* condition (paired pictures requiring different syntactic structures). All testing was audio-recorded and speech disruptions (repetitions, revisions, fillers, long silent pauses) were transcribed and tabulated for each target response. The data were analyzed in an analysis of variance (ANOVA).

Outcomes & Results—The SLI group demonstrated a significantly greater number of speech disruptions when compared to the TD group. There was no effect for priming.

Conclusions & Implications—School-age children with SLI appear to have difficulty with sentence formulation when compared to TD peers even when grammatical accuracy is high. We concluded that school-age children with SLI may demonstrate subtle but persistent language formulation difficulties.

Keywords

specific language impairment; school-age; speech disruptions; priming

It has been proposed that the incidence of speech disruptions (e.g., part-word repetitions) in the speech of children who do not stutter is associated with language formulation abilities. Research has shown that school-age children with a history of expressive language impairments and no history of stuttering exhibit more speech disruptions as compared to typically-developing (TD) children when producing more complex language in a narrative task. In this study, we ask whether the measurement of speech disruptions is sensitive enough to distinguish between school-age children with specific language impairment (SLI) and their TD peers within a single-sentence production task when grammatical accuracy is high for both groups.

What this study adds

The children with SLI displayed significantly more speech disruptions than the children in the TD group even though both groups demonstrated high grammatical accuracy. We concluded that school-age children with SLI may demonstrate subtle but persistent language formulation difficulties even on simple language tasks.

Introduction

It is well documented that preschool-age children with specific language impairment (SLI) often produce sentences with grammatical errors; by school age, these children are usually producing sentences that appear to conform to the adult grammar (Leonard, 1998). Nonetheless, given that difficulty in language persists in many individuals with SLI (e.g., Tomblin et al., 1997), it may be premature to conclude from these children's grammatically correct sentences that they are as proficient in language use as their peers. The current study investigates language formulation skills in school-age children with language impairments by using a potentially more subtle measure of language proficiency, the measurement of disruptions of fluent speech.

Much attention has been paid to language production errors in the speech of children with SLI. In the examination of these speech production errors, it is important to consider both the knowledge of grammatical forms and the ability to draw on this knowledge to formulate grammatical utterances. It seems likely that, once a child has acquired knowledge of a grammatical form, the child may need experience using this form for a period of time in order to achieve a level of automaticity. Since children with SLI are typically late in achieving high levels of accuracy, it is likely that they have had less experience using certain grammatical forms than their peers. As a result, the children with SLI may lag behind their peers in the progression from accuracy to automaticity and therefore be less proficient in their language formulation abilities. Given that grammatical accuracy is often age-appropriate in school-age children with language impairments, this reduced proficiency in language formulation abilities might be detectable in more subtle forms in language use. Speech disruptions may be one such sign.

It has been proposed that speech disruptions, including those considered to be normal disfluencies (e.g., phrase repetitions (PhR), phrase revisions) and those typically associated with stuttering (e.g., part-word repetitions (PWR), sound prolongations) may be associated with speech planning and monitoring processes. Specifically, the factors that increase language formulation demands, such as greater utterance length, syntactic complexity, and/or task

difficulty, are believed to contribute to a greater incidence of speech disruptions in children who do not stutter (see Tetnowski, 1998, for a discussion on disruption types and a review of research literature).

Researchers have further proposed that different types of speech disruptions reflect different aspects of language formulation. In one early study, MacWhinney and Osser (1977) posit that whole-word repetitions (WWR), PhRs, and fillers (called *filled pauses*; e.g., *um*) are used to “buy time” while the speaker plans the utterance (called *preplanning*). MacWhinney and Osser further suggested that phrase revisions (called *retraced false starts* by the authors) occur when the speaker is articulating the utterance (called *coplanning* of verbalization) in an attempt to increase what the authors call *explicitness* of the utterance (e.g., add more information, correct an error) (see also Tetnowski, 1998). MacWhinney and Osser further posit that, in both stages of sentence formulation, the speaker may use silent pauses as a way to buy time without adding unnecessary words (called *avoidance of superfluous verbalization*). Dollaghan and Campbell (1992) suggest that the speakers may use silent pauses (and thus buy more time for sentence formulation) when there are high demands on information processing abilities.

Not surprisingly, research on normal speech and language development has found that speech disruptions occur most frequently in young children’s speech as they are in the early stages of language learning, with a significant decrease in disruptions as language proficiency develops between preschool and high school (Hall, 1996; Hall and Burgess, 2000). This relationship between speech disruptions and language formulation abilities has also been reported for children with language impairment (Hall, 1996). In a recent study, Boscolo *et al.* (2002) examined speech disruptions in the narrative speech of 9-year-old children with and without a history of expressive specific language impairment (HSLI-E). They reported that children with HSLI-E exhibited more disruptions as compared to children without such an expressive impairment, particularly PWRs and prolongations (although no single disfluency type showed a statistical difference between the two groups). Boscolo *et al.* concluded that school-age children with HSLI-E may exhibit subtle difficulties in language formulation tasks even in the absence of more overt language deficits.

The narrative task used by Boscolo *et al.* (2002) may be considered a more difficult speech sampling condition than other speech elicitation techniques such as conversation because narration requires greater syntactic complexity, greater organizational demands, and little discourse support (MacLachlan and Chapman, 1988). Given that disruptions of fluent speech are associated with increased language formulation demands, it is not surprising that there is evidence that tasks such as narration that have greater language formulation demands associated with utterance length, linguistic complexity, and task demands result in a higher levels of speech disruptions in children who do not stutter (Bernstein Ratner and Sih, 1987; MacLachlan and Chapman, 1988; Rispoli and Hadley, 2001).

Boscolo *et al.* (2002) reported that the measurement of speech disruptions can distinguish children with SLI from typically-developing (TD) peers on tasks of narration. In the present study, we ask whether such a measure is sensitive enough to distinguish children with language impairment from TD children on a highly controlled simple-sentence production task in which both groups use the same sentence structures and perform at high levels of accuracy.

There does not appear to be much recent literature that examines speech disruptions on tasks that require single sentences. Lees *et al.* (1999) used two tasks to examine the incidence of disruptions in the single-sentence production of a small sample of children (around five years of age) with and without language impairments. In one task, the children simply imitated sentences produced by the examiner. In the other task, the children were asked to formulate single-sentence descriptions about pictures that were best described using a syntactic structure

(e.g., future tense) previously used by the examiner. The authors did not find statistically significant differences in the incidence of speech disruptions between the two groups of children, although, as the authors note, the sample was small and the children in both groups appeared to be relatively heterogeneous in their speech and language abilities. The authors did report, however, that the children demonstrated significantly more speech disruptions when they had to formulate their own sentences (after hearing the target syntactic construction in another sentence) than when they imitated the examiner. This finding suggests that such a sentence production task may provide a sensitive measure of how children respond to varying linguistic demands.

Structural priming studies have used a paradigm similar to the one employed by Lees *et al.* (1999) in order to examine how different linguistic stimuli affect the sentence productions of children (e.g., Miller and Deevy, 2006; Savage *et al.*, 2006). Structural priming refers to the increased likelihood of using a particular syntactic structure if that structure had been used in preceding sentences. The structural priming paradigm assumes that children must retrieve the relevant lexical items (e.g., subject noun, object noun) and syntactic frame when generating a sentence. Sentences that model the target syntactic structure should reduce the sentence formulation demands on the children when they generate a sentence using the same syntactic structure.

In one study, Leonard *et al.* (2000) reported that preschoolers with SLI were more likely to use grammatical morphemes in a picture description task if the examiner had modeled the same syntactic structure (e.g., examiner's prime: *The boys are washing the car*; child's target utterance: *The horse is kicking the cow*) rather than a different structure (e.g., examiner's prime: *The pig fell down*; child's target utterance: *The mouse is eating the cheese*). The children with SLI showed greater priming effects than younger TD children. Thus, the sentence formulation of children with language impairments appeared to benefit more than that of TD children when a potentially facilitative syntactic frame was provided.

There does not appear to be any current literature that applies a structural priming paradigm to examine the impact of varying sentence formulation demands on speech disruptions of school-age children. The reduction of sentence formulation demands results in improved grammaticality for young children with SLI; it is currently not clear whether these same reduced sentence formulation demands may reduce the frequency of speech disruptions in older children with SLI whose grammatical accuracy is high at the simple sentence level.

Current Experiment

In this study, we sought to determine whether the measurement of speech disruptions during single sentence formulation might serve to distinguish children with a history of language impairment from their same-age peers at an age when grammatical accuracy was high for both groups. Furthermore, we wanted to determine the effects of varying linguistic demands on the incidence of speech disruptions in the two language groups. To do this, we employed a structural priming paradigm to examine the incidence of speech disruptions in the speech of school-age children with a history of SLI and TD same-age peers. We hypothesized that the school-age children with SLI may still present with subtle language formulation deficits despite their high degree of grammaticality on a simple sentence task, and that these formulation problems may be reflected in a higher incidence of speech disruptions as compared to TD peers.

We further hypothesized that sentence formulation demands – and hence speech disruptions – should be reduced when the prime sentence provided a syntactic structure compatible with the target sentence versus when the prime sentence had a syntactic structure that was quite different from the structure needed for the target sentence. The benefit derived from priming was

predicted to be greater for the children with SLI given their presumed residual weakness in sentence formulation.

Method

Participants

Twenty-eight children participated in this study. These children were a subset of Tomblin *et al.*'s (1997) epidemiological study of SLI conducted at the University of Iowa. The children were originally part of a large sample of kindergarten children recruited from Midwestern communities. This sample of children received a brief language screening test using items from the Test of Language Development-2: Primary (TOLD-2:P; Newcomer and Hammill, 1988). All children who had failed and approximately 33% of those who had passed were then invited to participate in further diagnostic testing provided that they spoke English as their primary language, had no history of autism, mental retardation, or neurological problems, were not blind, and did not use hearing aids (see Miller *et al.*, 2001, and Tomblin *et al.*, 1997, for more information regarding recruitment and sampling procedures).

In the diagnostic phase, children were administered a hearing screening and were disqualified if they presented with persistent bilateral hearing loss. A measure of performance IQ was obtained by combining standard scores on two subtests of the Wechsler Preschool and Primary Scale of Intelligence – Revised (Wechsler, 1989); a combined score of 86 or greater was considered to be within normal limits on this measure. A battery of tests was used to measure language ability, including subtests of the TOLD-2:P (Newcomer and Hammill, 1988) and a narrative story task (Culatta *et al.*, 1983). Five composite scores were obtained by combining standardized test scores; performance was considered to be below age level if two or more composite scores fell 1.25 *SD* or greater below the mean (see Tomblin *et al.*, 1996, for more information about diagnostic testing).

A diagnostic battery was administered again two years later to the children in the original sample (82% of the children with language impairment and 84% of children without language impairment that had been invited to participate). The children completed a number of language tests including the Peabody Picture Vocabulary Test-II (Dunn and Dunn, 1997), subtests of the Clinical Evaluation of Language Fundamentals 3 (Semel *et al.*, 1994), and the Comprehensive Receptive and Expressive Vocabulary Test (Wallace and Hammill, 1994). The Performance scale of the Wechsler Intelligence Scale for Children II (Wechsler, 1991) was administered to measure nonverbal intelligence.

The 28 children in the current study were selected from the sample described above if their performance on both test batteries placed them in the same diagnostic category (SLI or TD). The mean age for both the SLI and TD groups was 8;10 years (*SD* = 4 months). None of the 28 children had a diagnosis of stuttering. Seventeen of the children were identified as SLI both at kindergarten and two years later; the remaining 11 were classified as having age-appropriate language skills (TD). All children had age-appropriate performance IQ scores ($M_{SLI} = 96$, *SD* = 8.12; $M_{TD} = 109$, *SD* = 7.71), although the SLI group had a mean IQ score that was significantly lower than that for the TD group, $t(1, 26) = 3.94$, $p < .001$ (see Appendix A).

Procedure

The children participated in a picture description task involving a series of black-and-white line drawings. There were a total of 72 drawings which were arranged in 36 pairs. In the task, the experimenter described the first picture in each pair (e.g., *The boys are washing the car*) and asked the child to repeat the sentence. The second, or target picture in the pair (e.g., a picture of a horse kicking a cow) was then presented and the child was asked, *Tell me what's*

happening here. Thus, the child heard a model for the first (prime) picture, but was asked to describe the second (target) picture without a model. All target pictures were best described using a transitive verb accompanied by auxiliary *is* (e.g., *The horse is kicking the cow*).

The 36 picture pairs were divided equally into two testing conditions such that there were 18 picture pairs per condition. In the *Matching Syntax* condition, the two pictures in each pair could be best described using the same syntactic structure (e.g., *The boys are washing the car*; *The horse is kicking a cow*; see Appendix B). As such, the examiner's description of the first picture employed a syntactic construction (subject - auxiliary - verb+ing - object) that would also be appropriate for the child's description of the second (target) picture. The prime sentences in this condition employed either a singular (*is*) or plural (*are*) auxiliary verb, as the likelihood of using a particular syntactic structure does not appear to be affected by variations in particular function words (Bock, 1989; Leonard *et al.*, 2000).

In the *Different Syntax* condition, the two pictures in each pair were best described using different syntax structures (e.g., *The pig fell down*; *The mouse is eating the cheese*; see Appendix B). As a result, the examiner's description of the first picture employed a syntactic structure that would not be appropriate for the child to use to describe the second picture. The prime sentences in this condition employed one of the following constructions: copula *is* (e.g., *The woman is old*), regular past tense (e.g., *The monkey jumped*), and irregular past tense (e.g., *The pig fell down*), as these do not model the target syntactic structure and do not result in priming effects (Leonard *et al.*, 2000).

The pictures and corresponding sentences were arranged into two different orders (see Appendix B) so that the target sentences had a different prime in each set. This was done in order to minimize any potential effects that a particular prime may have had on performance for a target sentence. The 36 picture pairs were divided into three blocks (12 pairs per block) and there were six pairs with a Matching Syntax condition prime and six with a Different Syntax condition prime in each block. The picture pairs were pseudo-randomized such that no main verb (e.g., washing, reading) was used for two consecutive items.

Data analysis

All testing was audio-recorded. The children's descriptions of the target (second) picture in each pair were later transcribed orthographically by a transcriber who was blind to the children's diagnostic category.

Speech disruptions were transcribed and tabulated for each target response. Speech disruptions identified in this study are associated with preplanning and coplanning as described by MacWhinney and Osser (1977). Disruptions associated with the preplanning function included *fillers* (i.e., semantically or structurally insignificant interruptions which would have best fit Dollaghan and Campbell's (1992) "orphan" category; e.g., *the um horse is kicking the cow*) and *repetitions* (identified as a major disruption category by Dollaghan and Campbell). The category of repetitions included part-word repetitions (PWR; e.g., *ba-ball*), whole-word repetitions (WWR; e.g., *ball-ball*), and phrase repetitions (PhR; e.g., *The goose is -the goose is chasing the cat*). *Revisions* (i.e., an unprompted change in the utterance; also a major disruption category identified by Dollaghan and Campbell; e.g., *The duck -goose is chasing the cat*) were included as this disruption type has been associated with the coplanning of language production.

Long silent pauses (equal to or greater than two seconds) have been associated with both the preplanning and coplanning functions (MacWhinney and Osser, 1977), and were included in the analysis as they are considered to indicate increased processing difficulty (Dollaghan and Campbell, 1992). The two-second duration was selected as a conservative criterion for

significant silent pauses after Dollaghan and Campbell (1992), for the majority of pauses in adult speech are shorter than two seconds, and adults are considered to have a faster speaking rate than children. The silent pauses were marked in the transcription and measured in the following way. The audio-recordings of the children's sentence productions were first digitized. The speech waveforms were then analyzed in Praat (Boersma, 2001) in order to measure silent pause durations. Because there was background noise in the recordings, pause start times (the end of the speech waveform preceding the pause) and stop times (the start of the next speech waveform) were determined using the speech waveforms in conjunction with auditory judgments. Pauses equal to or greater than two seconds (2000 ms) were then totaled for each child.

The data were tabulated for all 36 target responses for each child. Speech disruptions contained within revisions were not counted in order to avoid double-counting disruptions; in such instances only the revision was counted. To assess interrater reliability, the vocalized speech disruptions (repetitions, revisions, and fillers) were transcribed by a second person. The resulting percentage of agreement across these speech disruption types was 94. Data analysis was conducted using raw values rather than percentages given that the task was highly structured and there was little variability in sentence length. An alpha level of .05 was used for all statistical tests. Effect sizes were calculated (G*Power Version 3.0.3; Faul *et al.*, 2007) for significant main effects and interactions (f), and for relevant post-hoc comparisons (d) (Cohen, 1988).

Results

All children produced responses to each of the 36 target pictures. Both groups showed a high degree of grammatical accuracy in these picture descriptions and there was no significant difference between the two groups in terms of the number of grammatical utterances produced (SLI $M = 35.65$, $SD = 0.79$; TD $M = 36$, $SD = 0$), $t(16) = -1.85$, $p = .083$.

The children in the SLI and TD groups were compared in terms of the number of speech disruptions in their target picture descriptions. An analysis of variance (ANOVA) was conducted using participant Group (SLI, TD) as a between-subjects variable and Priming Condition (Matching Syntax, Different Syntax) and Speech Disruption Type (repetitions, pauses, fillers, revisions) as within-subjects variables.

There was a significant main effect for Group, $F(1, 26) = 10.77$, $p = .003$ ($f = 0.28$, medium to large effect size); the children with SLI were found to produce a significantly greater number of speech disruptions ($M_{SLI} = 2.04$, $SD = 1.96$, range = 0-10) than the children in the TD group ($M_{TD} = 1.10$, $SD = 1.29$, range = 0-5). There was also a significant main effect for Disruption Type, $F(3, 78) = 6.79$, $p < .001$ ($f = 0.51$, large effect size); Tukey Honestly Significant Difference (HSD) post-hoc testing (.05 level) revealed that repetitions were significantly more frequent than pauses, $p = .003$ ($d = 0.60$, medium to large effect size), fillers, $p < .001$ ($d = 0.60$, medium to large effect size), and revisions, $p = .014$ ($d = 0.44$, small to medium effect size) (table 1). There was no effect for Priming Condition, $F(1, 26) = 0.45$, and no significant interactions: Disruption Type $\times$ Priming Condition, $F(3, 78) = 0.98$; Group $\times$ Priming Condition, $F(1, 26) = 0.68$; Group $\times$ Disruption Type, $F(3, 78) = 1.64$; Group $\times$ Priming Condition $\times$ Disruption Type, $F(3, 78) = 0.50$.

Repetitions were examined in greater depth as they were the most frequent type of speech disruption. A repeated measures ANOVA was conducted with Group (SLI, TD) as the between-subjects variable and Repetition Type (PWR, WWR, PhR) and Priming Condition (Matching Syntax, Different Syntax) as the within-subjects variables. There was also a main effect for Group, $F(1, 26) = 7.06$, $p = .013$ ($f = 0.52$, large effect size), in which the SLI group exhibited

significantly more repetitions ($M_{SLI} = 1.2$, $SD = 2.13$) than the TD group ($M_{TD} = 0.55$, $SD = 1.53$). There was a main effect for Repetition Type, $F(2, 52) = 7.74$, $p = .001$ ($f = 0.55$, large effect size); a Tukey HSD revealed that there were significantly fewer phrase repetitions than PWRs, $p < .001$ ($d = 0.54$, medium effect size), and WWRs, $p = .03$ ($d = 0.32$, small to medium effect size) (table 2). There was no effect for Priming Condition, $F(1, 26) = 0.22$, and no significant interactions: Group $\times$ Repetition Type, $F(2, 52) = 0.91$; Group $\times$ Priming Condition, $F(1, 26) = 0.004$; Group $\times$ Repetition Type $\times$ Priming Condition, $F(2, 52) = 2.08$.

Utterances that conformed to the target sentence structure (article-subject-auxiliary-verb+ing-article-object) were further analyzed for repetition location in order to determine whether these most common speech disruptions were more likely to occur in particular sentence locations (table 3). The analysis included all PWRs and WWRs, and repetitions of subject, object, or verb phrases. There were five PhRs that crossed phrase boundaries in that they involved the subject noun phrase plus the auxiliary or auxiliary and lexical verbs. These PhRs were not included in the analysis as they do not fit well in the classifications above, and were not analyzed separately as they were few in number and had very little variability in terms of location. For all three disruption types analyzed (PWR, WWR, PhR), the majority of the repetitions occurred at the beginning of the sentence; 58% of the PWRs and WWRs, and 81% of the PhRs included in this analysis occurred in the subject noun phrase. The remaining PWRs and WWRs occurred on later content words (i.e., verb, object; 27%) and function words (i.e., article, auxiliary; 15%).

Discussion

The purpose of this investigation was to determine whether school-age children with SLI exhibit subtle signs of language formulation difficulty as compared to TD peers on tasks in which all children show a high degree of grammatical accuracy. In order to examine this, we employed a structural priming task in which the children were asked to describe a picture after hearing and repeating a prime that either matched or differed from the target response in its syntactic structure. Two predictions were made at the start of the study: (1) the SLI group would exhibit a greater frequency of speech disruptions than the TD group; and (2) varying the prime in the two conditions (Matching Syntax, Different Syntax) would affect the rate of speech disruptions of the SLI group to a greater extent than that of the TD group. Each prediction is discussed below.

The first study prediction was that the children with SLI would demonstrate a significantly higher level of speech disruptions than the TD group despite being equally grammatical in their responses. The findings supported this prediction, providing evidence that children with SLI may continue to demonstrate subtle difficulties in language formulation into the school years. Furthermore, these difficulties may even occur in simple sentence production when grammatical accuracy is high. Thus, measures that differentiate children with SLI from their TD peers at younger ages, such as measures of grammatical accuracy, may not be sufficient to identify areas of language formulation weakness during the school years as the manifestation of language deficits may change as the children age.

For both language groups, repetitions (PWR, WWR, PhR) were the most frequent disruption type, with the children with SLI producing the majority of these ($Total_{SLI} = 114$, $M_{SLI} = 1.2$; $Total_{TD} = 36$, $M_{TD} = 0.55$). MacWhinney and Osser (1977) had proposed that repetitions may be a mechanism employed when the speaker requires extra time for sentence planning. If so, it would then be expected that the majority of repetitions would occur at the beginning of the utterance. An informal analysis of the data suggests that this is in fact the case, with 62% of all disfluencies involving the subject noun phrase. As table 3 demonstrates, both the SLI and TD groups followed this trend. Taken together, these findings suggest that, even on a task in which only simple sentences were required and in which grammatical accuracy was high, the

children with SLI may have required more time for sentence planning and formulation than their peers.

There could be several plausible explanations for why the children with SLI may have needed extra time to formulate their responses. As suggested earlier in this paper, perhaps children with SLI have lower levels of automaticity in language formulation as a result of their delayed mastery of certain grammatical forms. It would be expected that less automatized responses require more time to formulate, and this need for extra planning time could have contributed to the higher incidence of repetitions. It is also possible that the children with SLI exhibited more repetitions than their peers as a result of other difficulties such as word retrieval problems (e.g., MacLachlan and Chapman, 1988), which could have also delayed sentence planning and execution.

No one repetition type distinguished the two groups. These findings are somewhat consistent with the findings of Boscolo *et al.* (2002) which documented a trend in which the children with SLI exhibited more PWRs and WWRs than the age-matched TD group. Unlike the current study, however, the children in the study by Boscolo *et al.* (2002) exhibited more PhRs, revisions, and fillers (called *interjections*) than PWRs. It is possible that the different relative speech disruption frequencies across the two studies reflect the differing natures of the task, as Boscolo *et al.* (2002)'s study elicited speech samples using a narrative task whereas the current study required the production of single simple sentences.

The second prediction was that, if structural formation demands were responsible for the increased speech disruptions in the SLI group, then the manipulation of sentence formulation demands by varying the prime sentence would differentially affect the rate of speech disruptions for this group as compared to the TD group. Analysis of the data revealed no significant differences in the incidence of speech disruptions based on priming condition, however.

It seems possible that the lack of a priming effect may have resulted from the nature of the simple sentence stimuli. The formulation demands associated with the simple sentences may have been low enough that varying the prime sentence structure did not sufficiently modify sentence formulation difficulty to elicit significant variation in the incidence of speech disruptions. Perhaps a priming task which employs a more difficult target sentence structure would elicit greater variation in speech disruption frequency across priming conditions as a result of the greater sentence formulation demands associated with the task.

Conclusion

We examined the incidence of speech disruptions in the simple sentence production of children with SLI as compared to their TD peers. We found that the children with SLI displayed more speech disruptions than their TD peers even though the sentences involved a simple, familiar construction and grammatical accuracy was high. The type and location of the speech disruptions may be taken to suggest that, even on this relatively simple task, children with SLI require more time for sentence formulation than their peers, and we discussed several possible explanations for this.

We concluded that school-age children with SLI may demonstrate subtle difficulties in language even on simple language tasks. Furthermore, these difficulties may not be detected by measures that distinguish younger children with SLI from their TD peers, such as grammatical accuracy. Clinicians, teachers and others working with children with SLI should therefore be careful not to assume full language proficiency based on the child's ability to produce adult-like grammatical sentences, as language difficulties may remain, but may appear in subtle forms such as reduced fluency in sentence production. Further investigation is needed

in order to better identify the sources of difficulty that give rise to these speech disruptions, as well as to develop school-age assessments that are sensitive to the subtle manifestations of language formulation problems in the school-age population.

Appendix

Appendix A

Standard Scores for testing in second grade

Group	Age	Sex	WISC-II	PPVT-II	CREVT	CELF-3				
						SS	Dir	WS	RS	LP
TD	8;10	F	120	99	95	10	14	12	13	20
TD	8;7	F	110	110	130	10	12	16	11	23
TD	8;8	M	111	139	121	12	14	13	16	24
TD	9;4	M	100	111	107	15	10	12	13	21
TD	9;2	M	110	95	97	12	10	12	11	17
TD	8;8	F	119	90	98	10	9	10	10	18
TD	8;7	F	107	98	81	10	11	11	7	23
TD	9;0	F	111	119	115	11	8	11	8	18
TD	8;6	M	111	113	112	10	12	16	15	21
TD	9;8	M	95	98	85	11	5	9	8	16
TD	8;6	F	100	94	99	15	6	10	6	18
SLI	8;8	M	108	68	75	13	6	6	3	13
SLI	8;11	F	107	85	83	10	6	7	6	16
SLI	9;2	M	112	72	88	8	3	4	3	19
SLI	8;6	F	100	69	98	13	3	8	7	10
SLI	9;4	M	94	84	70	10	6	5	9	10
SLI	8;2	F	87	78	84	10	9	6	5	7
SLI	8;10	F	98	88	85	7	5	6	4	12
SLI	8;9	F	87	56	75	8	4	6	4	10
SLI	8;8	F	91	80	92	11	4	7	6	14
SLI	8;7	M	96	80	75	8	3	8	5	19
SLI	9;6	M	86	89	83	6	4	7	7	18
SLI	9;5	M	86	97	90	8	6	7	6	9
SLI	8;11	M	102	80	100	10	5	9	9	10
SLI	8;3	M	98	57	80	8	6	6	6	19
SLI	8;3	M	89	71	81	8	6	7	6	11
SLI	8;9	F	96	73	81	9	7	7	8	15
SLI	9;3	M	102	99	92	7	3	6	5	12

CELF-3 Key: SS = Sentence Structure; Dir = Concepts and Directions; WS = Word Structure; RS = Recalling Sentences; LP = Listening to Paragraphs

Appendix B

Verbal Stimuli for Order A and Order B

Order A	<u>Prime</u>	<u>Target</u>
Block 1	1. The starfish is touching the rock 2. The plane crashed 3. The woman is old 4. The birds are building the nest 5. The Indian is sad 6. The pig fell down 7. The woman skated 8. The boys are washing the car 9. The goats are eating the apples 10. The moose is chewing the grass 11. The kitten is cute 12. The coach is flying the plane	The princess is chasing the cat The bus is pulling the car The nurse is feeding the cat The horse is kicking the cow The mouse is eating the cheese The fox is chasing the dog The horse is throwing the ball The witch is flying the kite The fish is chasing the spider The fox is digging the hole The witch is closing the door The goose is riding the horse
Block 2	1. The princess is happy 2. The bus is pushing the car 3. The doctor smiled 4. The witch is riding the broom 5. The zebras are taking a nap 6. The dog barked 7. The boys are flying the kite 8. The fireman is wet 9. The rabbit is little 10. The man laughed 11. The fox is chasing the bird 12. The cats are drinking the milk	The Grinch is eating the cake The mouse is reading the book The moose is pulling the bike The fish is eating the worm The ostrich is kissing the girl The prince is petting the frog The horse is eating the hay The witch is holding the balloon The fox is eating the cake The horse is driving the car The nurse is kicking the ball The fish is pushing the log
Block 3	1. The bird flew away 2. The fish is touching the boat 3. The dogs are chewing the sock 4. The baby fell down 5. The cows are eating the hay 6. The monkey jumped 7. The wagon is broken 8. The girls are flying the kite 9. The rose is climbing the wall 10. The rabbit is big 11. The dog is sad 12. The horse is eating the grass	The coach is washing the car The Grinch is reading the book The nurse is washing the shirt The goose is chasing the cat The coach is waving the flag The fox is licking the flower The horse is sweeping the floor The Grinch is walking the dog The moose is licking the cake The nurse is kicking the bike The walrus is pulling the rope The prince is throwing the ball
Order B	<u>Prime</u>	<u>Target</u>

Order A	Prime	Target
Block 1	1. The starfish is touching the rock 2. The plane crashed 3. The woman is old 4. The birds are building the nest 5. The Indian is sad 6. The pig fell down 7. The woman skated 8. The boys are washing the car 9. The goats are eating the apples 10. The moose is chewing the grass 11. The kitten is cute 12. The coach is flying the plane	- The walrus is pulling the rope - The mouse is eating the cheese - The horse is kicking the cow - The nurse is feeding the cat - The fox is chasing the dog - The horse is throwing the ball - The witch is flying the kite - The fish is chasing the spider - The fox is digging the hole - The witch is closing the door - The goose is riding the horse - The bus is pulling the car
Block 2	1. The princess is happy 2. The bus is pushing the car 3. The doctor smiled 4. The witch is riding the broom 5. The zebras are taking a nap 6. The dog barked 7. The boys are flying the kite 8. The fireman is wet 9. The rabbit is little 10. The man laughed 11. The horse is eating the grass 12. The cats are drinking the milk	- The mouse is reading the book - The moose is pulling the bike - The fish is eating the worm - The fish is pushing the log - The princess is chasing the cat - The horse is eating the hay - The witch is holding the balloon - The Grinch is eating the cake - The horse is driving the car - The nurse is kicking the ball - The prince is petting the frog - The fox is eating the cake
Block 3	1. The bird flew away 2. The fish is touching the boat 3. The dogs are chewing the sock 4. The baby fell down 5. The cows are eating the hay 6. The monkey jumped 7. The wagon is broken 8. The girls are flying the kite 9. The rose is climbing the wall 10. The rabbit is big 11. The dog is sad 12. The fox is chasing the bird	- The ostrich is kissing the girl - The nurse is washing the shirt - The goose is chasing the cat - The coach is waving the flag - The fox is licking the flower - The horse is sweeping the floor - The Grinch is walking the dog - The moose is licking the cake - The nurse is kicking the bike - The prince is throwing the ball - The coach is washing the car - The Grinch is reading the book

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Table 1

Total number of repetitions, pauses, revisions, and fillers with group mean frequencies (and standard deviations).

	Repetitions	Pauses	Revisions	Fillers
Total	150	79	89	56
SLI <i>M</i>	3.35(2.28)	1.88(1.89)	1.79(1.37)	1.12(1.51)
TD <i>M</i>	1.64(1.43)	0.68(0.84)	1.27(1.24)	0.82(1.40)

Table 2

Total number of PWRs, WWRs, and PhRs with group mean frequencies (and standard deviations).

	PWR	WWR	PhR
Total	75	54	21
SLI <i>M</i>	1.68(1.43)	1.21(1.34)	0.47(0.79)
TD <i>M</i>	0.82(1.05)	0.59(0.91)	0.23(0.53)

Table 3
Total number of PWRs and WWRs (top), and subject noun PhRs, object noun PhRs, and verb PhRs (bottom) by sentence position with group mean frequencies (and standard deviations)

	The	N1	is	Ving	the	N2
Total	29	31	9	15	7	13
SLI <i>M</i>	1.24(1.39)	1.29(1.57)	0.35(0.86)	0.65(0.86)	0.24(0.44)	0.65(0.86)
TD <i>M</i>	0.80(1.48)	0.90(0.98)	0.30(0.65)	0.40(0.92)	0.30(0.47)	0.20(0.40)

	Subject Noun PhR		Verb PhR		Object Noun PhR	
Total	13		2		1	
SLI <i>M</i>	0.59(0.94)		0.12(0.33)		0.06(0.24)	
TD <i>M</i>	0.27(0.47)		0		0	