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Similarities in weak syllable omissions between children with specific language impairment and normally developing language: a preliminary report

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Abstract

Two-year-olds with normally developing language (NL) and older children with specific language impairment (SLI) omit initial weak syllables from words (e.g., ''banana'' ~ ''nana''). Previous research revealed a phonetic "trace" of syllables omitted by children with NL (Carter, 1999; Carter & Gerken, submitted for publication). The present study asked whether similar evidence could be found for omissions by children with SLI. Fourteen children with SLI produced sentences containing reduced or unreduced disyllabic proper names (e.g., "Feed_cinda," from "Feed Lucinda" vs. "Feed Cindy"). Acoustic analyses revealed a significantly longer duration for verb-onset to name-onset of sentences containing the reduced name, indicating that although segmental material is omitted, an acoustic trace remains. In addition, a phonological examination showed similarities between groups regarding sentential and syllabic factors that affect omission rates, as well as an interesting difference that suggests different strategies the groups use in acquiring adult targets.

Learning outcomes: As a result of reading this article, participants should (1) have a better understanding of similarities and differences in the language production of children with specific language impairment and normally developing language, with regard to prosodic development, (2) be familiar with several models of the phenomenon of weak syllable omissions in children's developing language, and (3) recognize the importance of

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using a combination of linguistic analysis types when studying issues in child language production.

Keywords: Specific language impairment; Child language production; Prosodic development; Syllable omission; Acoustic analysis

1. Introduction

When English-speaking children with normal language development (NL) begin to produce polysyllabic utterances (e.g., between 18 and 32 months), they often omit certain syllables. Specifically, children at this age omit weak syllables significantly more often than strong syllables, and they omit weak syllables that precede main word stress significantly more frequently than syllables that follow main word stress (Allen & Hawkins, 1980; Demuth, 1996; Demuth & Fee, 1995; Gerken, 1994a, 1994b, 1996; Kehoe & Stoel-Gammon, 1997; Wijnen et al., 1994). Examples are shown in 1a–1b (Gerken, 1996, p. 687; Klein, 1981, p. 401):

(1a) banana → nana
(1b) giraffe → raffe

Older children (between the ages of 4 and 6 years) with specific language impairment (SLI) exhibit this type of weak syllable omission as well (Chiat & Hirson, 1987; Leonard, 1989, 1998). Examples of omissions by children with SLI are given in 2a–2b (Chiat & Hirson, 1987, p. 46):

(2a) escape → zgape
(2b) forgot → got

Children with SLI also make phonological substitutions in unstressed syllables and omit morphemic weak syllables including verb inflections, articles and auxiliaries (e.g., Chiat & Hirson, 1987; Leonard, 1989, 1998; Menyuk & Looney, 1972). The prevalence of difficulties with weak syllables seen in children with SLI makes understanding the nature of their weak syllable production potentially important for understanding the nature of SLI more generally.

Focusing specifically on weak syllable omissions, current models of this phenomenon in normally developing children emphasize prosody, and in particular, the strong–weak, or trochaic, foot. This prosodic unit is viewed as the earliest one that English-speaking children master, after passing through the monosyllabic stage (Demuth, 1996; Fee, 1996; Gerken, 1996). On this view, words containing syllables that do not fit into a trochaic foot are modified during production to better conform to the preferred prosodic structure. For example, in the phonological representation of the word “banana,” the initial syllable “ba-” is unfooted, and is often deleted, resulting in a disyllabic trochaic

Table 1
Mean verb-to-name durations (ms) and standard error for reduced and non-reduced names in monosyllabic and disyllabic verb contexts, for 10 participants who omitted initial syllables in monosyllabic and disyllabic verb contexts

	Reduced names (_sandra and _cinda)		Non-reduced names (Sandy and Cindy)	
	Mean duration	S.E.	Mean duration	S.E.
Monosyllabic verbs	521.51	71.27	412.92	42.15
Disyllabic verbs	527.81	33.03	453.66	28.94

Reproduced from Experiment 2, Carter and Gerken (submitted for publication).

form such as ‘‘nána’’ (Demuth, 1996; Demuth & Fee, 1995; Gerken, 1994a, 1994b, 1996; Kehoe & Stoel-Gammon, 1997). Importantly, each of the main models of prosodic development suggests that the omitted syllable is deleted in its entirety.

In contrast with this view, previous work suggests that 2-year-olds with NL leave an acoustic trace of the weak syllables they omit (Carter, 1999; Carter & Gerken, submitted for publication). Carter and Gerken performed an acoustic analysis of sentences from which weak initial syllables had been omitted and compared these to sentences from which no omissions had been made. The main finding was that words preceding an omitted syllable had a longer duration than the identical words when they preceded the present syllable (Table 1). This result was interpreted to mean that children do not fully omit syllables that do not conform to the common stress pattern, but rather they maintain a timing slot for the syllable. Within this framework, one step in developing the ability to produce less frequent stress patterns is to assign all intended syllables a timing slot. Subsequently, as the child more fully masters the ability to produce a variety of stress patterns, the slot can be filled in with the consonants and vowels of the intended word.

This new view of weak syllable omissions made by children with NL raises an important question about the apparently similar phenomenon in children with SLI, namely, can an acoustic trace of omitted weak syllables also be found in children with SLI? If so, children with SLI might be seen as engaging in a normal, albeit delayed, process of mastery of weak syllables. If not, weak syllable omissions by children with SLI might be better explained by some other mechanism. The question of whether or not children with SLI leave an acoustic trace of omitted syllables was the primary focus of the research presented here. A secondary focus was to compare the phonological similarity of productions of children with SLI to the younger children with NL studied by Carter and Gerken (submitted for publication). We wanted to know whether the superficial similarity in weak syllable omissions observed in the two populations would continue to be present when both groups were tested on the same stimuli.

2. Method

2.1. Participants

Participants were 14 children, between the ages of 4.2 and 6.1, with a mean age of 4.11. These children were diagnosed with SLI by a speech-language pathologist. In order to ensure that their poor language skills were not attributable to hearing loss, neurological deficits, or dysarthria, the speech-language pathologist determined that each child classified as SLI met the following criteria: (a) hearing within normal limits (20 dB HL) at 500, 1000, 2000, and 4000 Hz bilaterally (American National Standards Institution [ANSI], 1969); (b) non-verbal IQ (NVIQ) no more than 1.67 SDs below the mean (i.e., a NVIQ of 75 or better) on the Non-verbal Scale of the Kaufman Assessment Battery for Children (K-ABC, Kaufman & Kaufman, 1983); and (c) except for articulation or phonological problems, no evidence of a frank neurological problem or additional developmental disorder reported by the parent or observed by an SLP during the summer program. All of the children spoke English as their primary language, by parent or teacher report.

2.2. Stimulus materials

Stimuli were 32 randomly ordered sentences comprising a two-word sequence of an imperative verb followed by a proper name. The names comprised two trisyllabic proper names with a w-s-w stress pattern (“Lucinda” and “Cassandra”) and two disyllabic s-w names (“Cindy” and “Sandy”), such that the second syllable of a trisyllabic name was the same as the first syllable of the paired disyllabic name. In addition to being near minimal word pairs, the proper names were chosen with two other issues in mind. The onsets of the stressed syllables in both the trisyllabic name and the disyllabic name must have phonetic characteristics that make it easy to identify in the waveform or spectrogram. No proper name minimal pairs could be found which contained a voiceless stop or affricate onset in the stressed syllable; therefore, the voiceless alveolar fricative /s/ was chosen as the stressed syllable onset of all four of the proper names. In this way also, both stressed onsets of the reduced forms were identical, which reduced the risk of any duration difference being affected in some way by the name onset. Examples of the stimulus sentences are given in Table 2. Full stimuli appear in Appendix A.

Each of the four names occurred with eight different verbs. Half of the verbs were monosyllabic (e.g., “feed”) and half were disyllabic (e.g., “carry”). Verbs were chosen on the basis of frequency (high frequency), familiarity to children (as young as 2 years of age), and the following phonetic properties. First, the verbs each must contain a stop or fricative onset in order to facilitate recognition in the waveform for proper duration measurements. Second, each verb must also contain a stop, sonorant or tense vowel offset, in order to be maximally distinct from the

Table 2
Sample stimuli sentences for disyllabic and trisyllabic proper names

	Disyllabic target names	Trisyllabic target names
Monosyllabic verbs	Feed Sandy	Feed Cassandra
	Feed Cindy	Feed Lucinda
Disyllabic verbs	Carry Sandy	Carry Cassandra
	Carry Cindy	Carry Lucinda

following strident proper name onset. Verb Syllable Number was varied, because the study with younger children with NL on which the current study is based revealed more omissions from sentences with disyllabic than monosyllabic verbs. Thus, we predicted that children with SLI would make more omissions with disyllabic verbs than monosyllabic verbs.

Our main prediction, however, was that, if children with SLI, unlike children with NL, simply delete unfooted syllables and their segmental content, the duration of the constant portion of the sentence (the verb onset to the name onset) should be equivalent in each member of the sentence pair. If, however, children with SLI are similar to their younger counterparts with NL, the utterances containing the unpronounced weak syllable (e.g., "_cinda") should show a longer verb-to-name duration than those containing the original trochaic form (e.g., "Cindy").

The inclusion of the two trisyllabic names and their disyllabic counterparts allowed for another prediction. The initial syllable of "Lucinda" contains a tense vowel, whereas the initial syllable of "Cassandra" contains an unstressed schwa. Syllables containing a tense vowel versus a lax vowel exhibit an inherent length difference when they are produced (Klatt, 1975; Lehiste, 1970). The previous study of children with NL revealed that the phonological properties of the two names resulted in different patterns of omissions and other phonological errors (Carter, 1999; Carter & Gerken, submitted for publication). We wanted to determine if children with SLI would exhibit different numbers and types of errors with the two names.

To review, there were three factors of interest. The first and main factor was Name Prosody, that is, whether the target proper name was reducible ("Cassandra," "Lucinda") or non-reducible ("Sandy," "Cindy"). The second factor was Verb Syllable Number, that is, whether the target verb was monosyllabic ("feed") or disyllabic ("carry"). The third factor was Name Type, that is, whether the target name contained a tense vowel in the projected omitted syllable ("Lucinda," or "_cinda" once reduced) or a reduced vowel ("Cassandra," or "_sandra" once reduced).

2.3. Procedure

Children were asked to imitate the stimuli sentences through the following play scenario. In the course of a 45-min session, the experimenter asked the child if he or she would like to play a game. If the child agreed, the experimenter introduced the child to a set of stuffed animals and four dolls, each given one of the four proper names of interest. Then the experimenter explained that in this game, the child would help create short stories to act out with the animals and dolls. The experimenter told each participant that in order to act out the story, the child and experimenter would direct the animals to carry out their respective tasks. For example, the experimenter would say "Tell the zebra to feed Cassandra. Can you say that? Feed Cassandra." If the child imitated the target sentence, then the animals carried out the task, and the experimenter moved on to the next sentence. If the child did not respond, the experimenter would repeat the request up to two times and then move on to a new sentence. Each child was asked to produce all 32 items, and missed items were presented again at the end of the game. All sessions were audiotaped with a portable Sony DAT recorder (TCD-D8). All responses to the test sentences were transcribed during the session by the experimenter. Upon completion of the session, the child was given a small stickerbook.

3. Results

After the session, the sentences were transcribed from the audio record by the experimenter and a second coder, naïve to the purpose of the experiment. 97% of the item transcriptions were agreed upon, and any disagreements about the transcriptions were discussed and resolved by consensus. Utterances with unresolved disagreements were not used in the analysis.

Transcribed responses were coded as falling into one of six possible response categories. For disyllabic target names ("Sandy," "Cindy"), responses were coded into Disyllabic Target Correct (the child correctly imitated the simple disyllabic trochaic name, 95%), and Other (5%). For trisyllabic target names ("Cassandra," "Lucinda"), responses were coded into Trisyllabic Target Correct (the child correctly imitated the trisyllabic proper name, retaining the initial syllable, 31%), Initial Syllable Omitted (the child omitted the initial weak syllable from the trisyllabic target, 34%), Non-initial Syllable Omitted (the child omitted a syllable other than the initial syllable, 10%) and Other (25%). Each of the Other categories contained response failures and responses that differed from the target by two or more phonemes (e.g., [YσΘ ≅ ν ↔ τ]). Two sets of analyses were performed on the data, one based on acoustic properties of children's productions and the other based on phonological properties.

Beginning with the acoustic analyses, the main purpose of the present study was to look for an acoustic trace of the omitted syllable, similar to that found with children with NL. Therefore, the categories relevant to the acoustic analysis were Disyllabic Target Correct and Initial Syllable Omitted, because responses falling into these two categories formed the near-minimal pairs that either contained or lacked the omitted initial syllable. Acoustic analyses using the Macintosh software package Sound Edit 16 (version 2) were performed on these two categories.

A series of duration measurements were taken from the onset of the verb to the onset of the proper name (including the pause if one existed). The rationale for taking duration measurements from the verb onset to the name onset was that the verb represents the constant element in each sentence pair, and by measuring the duration of the constant element between the minimal pairs, any difference in its duration is attributable to the omitted syllable. Reliability coding of the duration measurements yielded 87% agreement by a second coder within 25 ms. Any measurement differences greater than 25 ms were resolved through replay and discussion with a third coder.

Since each of the eight verbs contained either a voiceless stop or fricative onset, the phonetic onset (either burst or frication) was readily noticeable for most of the verbs in the waveforms. If the onset was not visible on the waveform, the experimenter counted the point at which the onset was auditorily detected. The onset of the proper name, which in the cases of both the non-reduced disyllabic forms (‘‘Cindy,’’ ‘‘Sandy’’) and the predicted reduced disyllabic forms (‘‘_cinda,’’ ‘‘_sandra’’) was /s/, was highly visible as energy in the waveforms of the utterances. For a portion of the participants' imitations, no silence existed between the verbs and the onsets of the proper names. In these cases, the word juncture was defined as the contrast between the stop, sonorant or tense vowel offset of the verb, and the following strident proper name onset.

Two analyses were performed on the verb-to-name durations between reduced and non-reduced utterances. The first analysis was an attempt to replicate the main acoustic finding of the Carter and Gerken study with children with NL, that is, a main effect of Name Prosody such that verb-to-name durations were longer for utterances containing a reduced disyllabic name than for utterances containing a non-reduced disyllabic name. Twelve of the 14 children omitted initial syllables in both monosyllabic and disyllabic verb contexts, and the data from these 12 children were subjected to a two-way repeated measures ANOVA with Name Prosody and Verb Syllable Number as within-subjects factors. The ANOVA showed a main effect of Name Prosody ($F(1, 11) = 11.25$, $P < 0.01$). As predicted based on the performance of younger children with NL, participants' verb-to-name durations were longer for reduced ‘‘_cinda’’ and ‘‘_sandra’’ forms (mean duration = 578.88 ms) than for non-reduced ‘‘Cindy’’ and ‘‘Sandy’’ forms (mean duration = 447.04 ms). Results are shown in Table 3. This finding replicates the main finding of the original study with NL children (Carter & Gerken, submitted for publication) and indicates that children with SLI, when they omit initial weak syllables similarly to NL children, also produce a measurable acoustic trace of the omitted syllable. No main effect of Verb Syllable Number ($F(1, 11) = 0.55$, $P = 0.48$) and no interaction ($F(1, 11) = 0.42$, $P = 0.53$) were found.

The second acoustic analysis was performed to determine if there were differences in the traces left for the two names (Cassandra vs. Lucinda). A two-way repeated measures ANOVA with Name Prosody and Name Type as within-subjects factors was performed on the verb-to-name duration data from the

Table 3
Mean verb-to-name durations (ms) and standard error for reduced and non-reduced names in monosyllabic and disyllabic verb contexts, for 12 participants who omitted initial syllables in monosyllabic and disyllabic verb contexts

	Reduced names (_sandra and _cinda)		Non-reduced names (Sandy and Cindy)	
	Mean duration	S.E.	Mean duration	S.E.
Monosyllabic verbs	560.61	70.84	441.45	32.11
Disyllabic verbs	597.14	54.85	452.64	21.51

10 of the 14 children who omitted initial syllables from both trisyllabic target names. It was not possible to perform a three-way ANOVA with Verb Syllable Number also included, because only 6 of the 14 children omitted initial syllables in both verb contexts and from both names. Results are shown in Table 4. The main effect of Name Prosody from the first analysis held up in this ANOVA as well ($F(1,9) = 11.06$, $P < 0.01$). However, there was no main effect of Name Type ($F(1,9) = 0.88$, $P = 0.37$) and no interaction ($F(1,9) = 1.1$, $P = 0.32$).

The results of the acoustic analyses fully replicated the findings with children with NL. Both populations showed a longer duration of verb onset to name onset when preceding proper names from which the initial syllable was omitted. The acoustic trace that the children leave is found regardless of the number of syllables in the verb and the phonological properties of the target name.

The second purpose of the present research was to determine whether the same phonological patterns observed in 2-year-olds with NL would also obtain for children with SLI. In order to compare phonological data, the response categories for trisyllabic targets were examined. Fig. 1 shows the percent of response types for trisyllabic targets of the children with SLI compared to those of the children with NL (Carter & Gerken, submitted for publication). These data show that children with SLI produced the trisyllabic target slightly more often than children with NL, and the error distribution differed in two ways. First, children with SLI made fewer initial syllable omissions than the children with NL. Second, children with SLI also omitted syllables other than the initial syllable. We will return to this difference below. Children with SLI produced responses that fell into the Other category at the same rate as children with NL.

Table 4
Mean verb-to-name durations (ms) and standard error for reduced and non-reduced names separated by Name Type, for 10 participants who omitted initial syllables from both name contexts

Name Type	Reduced names		Non-reduced names	
	Mean duration	S.E.	Mean duration	S.E.
Lucinda (tense vowel)	537.71	52.23	430.39	24.56
Cassandra (schwa vowel)	608.52	73.53	431.10	24.36

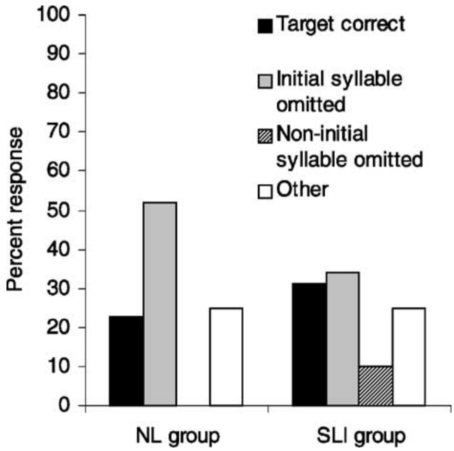

Fig. 1. Percentage of response types for trisyllabic targets for children with SLI and children with NL (Carter & Gerken, submitted for publication).

In Carter (1999) and Carter and Gerken (submitted for publication), it was found that children with NL omitted initial syllables from "Cassandra" significantly more often than from "Lucinda," and omitted initial syllables from disyllabic verb contexts significantly more often than from monosyllabic contexts. These findings indicate that both local and global factors affect omission rates. A detailed examination of the Initial Syllable Omitted category was performed in the present study to compare the response behavior of the children with SLI with the results of the children with NL. Data were separated by the two factors Name Type (tense vowel vs. schwa in the projected omitted syllable) and Verb Syllable Number (monosyllabic vs. disyllabic), and results are shown in Table 5. A two-way repeated measures ANOVA with Name Type and Verb Syllable Number as within-subjects factors revealed a significant main effect of Name Type ($F(1, 13) = 4.58$, $P < 0.05$). Children omitted the initial syllable from "Cassandra" (32%) more frequently than from "Lucinda" (18%). With regard to Verb Syllable Number, children omitted the initial syllable in disyllabic verb contexts (33.5%) more frequently than in monosyllabic verb contexts (16.5%). The two-way ANOVA revealed this difference to also be significant

Table 5
Percent of initial syllables omitted, by Name Type (tense vowel vs. schwa in omitted syllable) and Verb Syllable Number (monosyllabic vs. disyllabic) for all 14 subjects

Name Type	Monosyllabic verbs (%)	Disyllabic verbs (%)	Mean (%)
Lucinda (tense vowel)	9	27	18
Cassandra (schwa vowel)	24	40	32
Mean	16.5	33.5	

($F(1,13) = 46.97$, $P < 0.01$). Thus, the findings with normally developing children were replicated with the children with SLI, and suggest a robust effect of the local factor vowel quality, and the global factor number of syllables in the utterance.

Interestingly, a difference was found for SLI children from NL children, in that when failing to imitate the trisyllabic target correctly, children with SLI exhibited omissions of syllables other than the initial syllable. Non-initial syllable omissions occurred almost solely for the target "Lucinda," and not for "Cassandra" (there were only two omissions of a non-initial syllable with the target "Cassandra"). Various disyllabic outputs were produced by children for "Lucinda," as shown in 3a–3c (with the sample verb "feed"). Although individual variability existed, including a variety of segmental substitutions, there were two main generalizations that can be made across the data in the Non-initial Syllable Omission category. First, the initial vowel /u/ was consistently preserved. Second, main stress was consistently shifted from the original position (medial syllable) leftward to the initial syllable, creating a trochaic disyllabic foot. Thus, although children with SLI showed other omission patterns besides a straightforward omission of initial syllables, their outputs still resulted in a disyllabic trochaic form:

(3a) fid lúsm
(3b) fid lúsə
(3c) fid súnə

In summary, children with SLI showed similar results to those found in children with NL, in that a schwa vowel in the initial syllable predicted more syllable omission than a tense vowel, and a disyllabic verb preceding the weak initial syllable predicted more syllable omissions than a monosyllabic verb. Additionally, children with SLI omitted fewer weak initial syllables, and instead also omitted non-initial syllables. When they did omit non-initial syllables, the initial vowel was preserved, and their omissions resulted in a disyllabic trochaic form, as is typically found in children with NL (Demuth, 1996; Fee, 1996; Gerken, 1996).

4. General discussion

There were two main purposes of the present research. The first purpose was to investigate whether children with SLI leave an acoustic trace of omitted initial weak syllables, as has been shown for children with NL. Our findings show that children with SLI, like children with normally developing language, did in fact leave a trace of initial syllables that they omitted. These findings indicate an awareness of at least a partial representation of the input they are receiving. As in children with NL, the acoustic trace was not affected by Verb Syllable Number or the particular target name. We have hypothesized that the acoustic trace of the omitted syllables reflects a timing slot left by children as they plan their utterances. We have also hypothesized that leaving this slot is a first step toward including the full syllable. Regardless of whether this hypothesis is correct, the current data suggest that children with NL and SLI omit weak syllables based on a similar mechanism.

The second purpose of the present research was to look for phonological similarities and differences between outputs of utterances containing omissions between children with SLI and normally developing children. Children with SLI showed similar patterns to NL children with regard to properties affecting their initial syllable omissions. However, their response pattern overall varied from that of children with NL, and contained an additional type of response, in which they omitted a non-initial syllable. Regardless of this second type of omission pattern, the most common error output the children with SLI exhibited was a disyllabic trochaic foot, a more familiar prosodic shape than the trisyllabic w-S-w form presented to them. Results indicated that the most common way to create the more optimal prosodic shape was to omit the initial unfooted syllable (as NL children do). However, it was also possible to create the common disyllabic pattern by preserving the initial syllable, shifting main stress onto it, and omitting a subsequent syllable or combination of segments from the word, as in, for example, [lusɪn] or [lusə].

There are several possible reasons why children who were attempting to preserve the initial syllable did so with "Lu-" and not with "Ca-". One reason may be that since the syllable "Lu-" is intrinsically longer in duration than "Ca-" and contains an unreduced vowel vs. the [ə] of "Ca-" it may be able to attract and carry additional stress more readily. A second possible reason is that the children with SLI have had more exposure to their language (by being on average 2–3 years older than the NL group), and consequently may have more receptive and expressive experience with less frequent prosodic structures.

This phonological difference and its noticeable effect on omissions suggests one possible future direction to take this research, which is to look for other phonological factors that may affect omission rate of the initial (or other) syllable, for example by controlling for vowel quality and consonant type. A second possible direction to pursue is an acoustic study of the omission of articles and other grammatical morphemes, such as determiners (4a, McGregor & Leonard, 1994, p. 175), pronouns (4b, McGregor & Leonard, 1994, p. 175), and auxiliary verbs (4c, Leonard, 1989, p. 182), which are omitted by both populations (Sadrzadeh, 2002):

(4a) The girl kissed him. → _ girl kissed him.
(4b) He called the dog. → _ called the dog.
(4c) Those men are sleeping. → Those men _ sleeping.

We have presented two groups of children showing very similar, yet different patterns. The children with SLI are not simply older versions of the 2-year-olds. What are the possible reasons for differences in performance? Two possibilities for their prosodic differences are a difference in their internal representations of the words, or a difference in motor patterns. With respect to word representations, 4- and 5-year-old children with SLI know more words than the normally developing 2-year-olds studied by Carter and Gerken. Thus, differences in the phonological patterns produced by the two groups might be influenced by differences in the size and structure of their lexicons.

With respect to motor patterns, one recent piece of research comes from Goffman and Smith (Goffman, 1999; Goffman & Smith, 1999), who have looked at spatio-temporal stability and amplitude modulation in multisyllabic words, across adults, normally developing children and children with SLI. They have found that in speech production, children's repeated attempts at the same target show more varied speech movements than those of adults, and that children with SLI show even more variability than normally developing children. In particular, stability of their multisyllabic sequences at the word level showed greater variation, suggesting that organization of multimovement sequences is particularly difficult for these children. Children with SLI also had more difficulty in amplitude modulation across iambs, suggesting that although they do mark a prosodic distinction from trochees, these children with SLI did not have a fully developed capacity for modulation. Therefore, motor deficits may influence children's capacity to produce modulated and coordinated movements that are required for prosodic distinctions. Perhaps we can look to motor and planning deficits in future studies, in regard to differences in children with SLI.

In conclusion, results showed that children with both normally developing language and with SLI often employed a disyllabic trochaic default when attempting to produce trisyllabic words, although the two groups arrived at this word structure through different methods, that is deletion of initial syllables as well as non-initial syllables. Results also showed that children (with both NL and SLI) do leave a trace of the initial syllable that they omit, indicating at least a partial awareness of the full lexical representation of the input. Finally, the study highlights the importance of a combination of analyses (phonological, instrumental) when studying issues of child language production, since what we as adults *hear* may miss something crucial in the signal.

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Appendix A. Continuing education

1. English-speaking children with normally developing language most often tend to omit:
   (a) strong syllables.
   (b) weak syllables that precede main word stress.
   (c) strong syllables that follow main word stress.
   (d) weak word-final syllables.
   (e) weak syllables that follow main word stress.

2. This study employed the following type of linguistic analysis:
   (a) acoustic-phonetic.
   (b) syntactic.
   (c) phonological.
   (d) a and c.
   (e) all of the above.

3. The results of the phonological analysis showed that
   (a) children with SLI showed the same distribution of errors as the children with NL showed.
   (b) children with SLI made fewer weak initial syllable omissions than did the children with NL.
   (c) children with SLI showed a different pattern of errors than the children with NL, however their errors resulted in disyllabic trochaic forms, similarly to the children with NL.
   (d) b and c.
   (e) none of the above.

4. The children with SLI in this study left a trace of the initial syllables that they omitted. This finding
   (a) replicates the results from a similar study on normally developing children.
   (b) suggests that these children are aware of a partial representation of their language input.
   (c) was not affected by Verb Syllable Number or the target proper name.
   (d) is a good example of why researchers should not simply rely on their own perceptions of children's productions, but instead should use a combination of analyses to study them.
   (e) all of the above.

5. The acoustic-phonetic analysis of this study supports the view that
   (a) when children omit a weak syllable(s) from a multisyllabic word in order to create a simpler trochaic foot, they delete the entire syllable(s).

(b) children with SLI have a different pattern of phonological errors than children with normally developing language.
(c) children leave a trace of the weak syllables that they omit.
(d) children do not perceive weak initial syllables.
(e) children with SLI carry different internal representations of multi-syllabic words.

Appendix B

Stimulus lists 1 and 2

List 1	List 2
Carry Cindy.	Cover Cassandra.
Feed Cassandra.	Pat Sandy.
Bother Cassandra.	Bother Lucinda.
Follow Sandy.	Feed Cindy.
Cover Cindy.	Shake Sandy.
Pat Lucinda.	Carry Sandy.
Shake Cindy.	Turn Lucinda.
Cover Lucinda.	Shake Cassandra.
Turn Sandy.	Bother Cindy.
Follow Cassandra.	Follow Lucinda.
Feed Sandy.	Follow Cindy.
Shake Lucinda.	Feed Lucinda.
Bother Sandy.	Carry Cassandra.
Turn Cassandra.	Turn Cindy.
Carry Lucinda.	Pat Cassandra.
Pat Cindy.	Cover Sandy.
Carry Cassandra.	Feed Sandy.
Shake Sandy.	Bother Cassandra.
Follow Lucinda.	Cover Lucinda.
Cover Sandy.	Shake Lucinda.
Bother Cindy.	Bother Sandy.
Pat Cassandra.	Turn Cassandra.
Carry Sandy.	Shake Cindy.
Feed Lucinda.	Feed Cassandra.
Cover Cassandra.	Carry Cindy.
Bother Lucinda.	Follow Cassandra.
Follow Cindy.	Turn Sandy.
Turn Lucinda.	Pat Lucinda.
Pat Sandy.	Cover Cindy.
Feed Cindy.	Carry Lucinda.
Turn Cindy.	Pat Cindy.
Shake Cassandra.	Follow Sandy.

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