Errors of Omission and Commission in Verbal and Nominal Inflectional Morphemes by Children with SLI: Phonological Effects and Acoustic Analysis

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Abstract

It has previously been shown that inconsistency in the early morpheme productions of typically developing (TD) children and those with Specific Language Impairment (SLI) can be partly explained by the phonological complexity of the coda. However, it is not yet known whether TD and SLI children have similar underlying processes of morpheme acquisition. Of particular interest is the reported later acquisition of syllabic morphemes (e.g. *buses*) in TD children; are these also acquired later by children with SLI? Finally, acoustic analysis was used to study the errors of commission, shedding light on the development of morphological representations.

Index Terms: SLI, morpheme acquisition, phonological complexity, speech acoustics.

1. Introduction

It has long been observed that TD children are variable in their early productions of grammatical morphemes [2, 3]. Some researchers suggest that phonological factors might explain some of this inconsistent morpheme use [4, 5, 7, 8, 11, 17]. These factors include, for example, phonological complexity of the coda and utterance position of the target word (medial/final). Studying the nature of this variability becomes particularly interesting when we compare the results for normal and impaired speech. A number of studies have shown that, like TD children, English-speaking children with SLI can be inconsistent in their use of morphemes marking tense and agreement on verbs [6, 9, 10, 14], as well as in plural marking on nouns [13]. However, the question of whether both TD and SLI children have similar underlying processes of morpheme acquisition remains open. Of particular interest is the reported later acquisition of morphemes in the syllabic condition (e.g. *buses*) in TD children [1, 3]; is this syllabic allomorph also later acquired by children with SLI?

This study therefore focused on the influence of phonological complexity on morpheme production in SLI speech. In order to investigate these issues, the following questions were addressed:

1) Do children with SLI exhibit morpheme acquisition patterns similar to those of TD children? That is, are morphemes more likely to be produced in segmental contexts (e.g. *plays*, *runs*) compared to syllabic contexts (e.g. *watches*), and in simple compared to complex codas (e.g. *sees* vs. *hits*)?

2) If phonological effects are found to be a factor, do these appear in both verbal and nominal morphemes? Or is there something special about tense/agreement, as some researchers suggest [14, 15]?

3) Apart from omissions, are there errors of commission in SLI speech, and can acoustic analysis help us reveal why they take place?

2. Method

2.1. Participants

The participants were 14 monolingual Australian-English-speaking children with SLI who showed difficulties with verbal morphemes of tense/agreement (past tense *-ed*; 3rd person singular *-s*) and/or possessive *-s*. All the participants demonstrated variable morpheme use, producing it correctly in 20–80 % of obligatory contexts. Children were diagnosed as SLI by qualified speech pathologists based on below average performance on standardised tests of language skill and normal performance on tests on non-verbal intelligence. In order to ensure that no motor speech or phonological impairment had an additional impact on morpheme production, all the participants were tested on a non-word repetition task to confirm that they could produce the relevant consonant clusters in a non-morphemic context. The children ranged in age from 4;10 to 5;11 years (M=5;3) at the time of the first testing session. Data were available on one morpheme for 11 children and two morphemes for 3 children. Thus, the analysis included data from 7 participants on past tense *-ed*, 4 participants on the present tense *-s*, and 6 children on the possessive *-s*.

2.2. Data

The data were drawn from speech samples collected using the Grammar Elicitation Test for SLI Children [16]. All children participated in the question–answer elicitation sessions involving picture props. The experimenter described a picture and asked a question: "*This man loves to run. He does it every day. What does he do every day?*" The child would then be encouraged to give an answer like "*The man runs.*"

Analysis included a set of 30 stimuli for each morpheme, plus any additional spontaneous-like responses elicited during the test session. The total number of analysed tokens was 1142 (443 for the past tense *-ed*, 336 for the 3rd person singular *-s*, and 363 for the possessive *-s*). Samples were recorded on Olympus WS650S or SonyICD-UX71F digital voice recorders with internal microphones.

2.3. Analysis

The data were transcribed from the audio recordings, and then sorted depending on whether the morpheme was produced

correctly, omitted, or contained a phonological error. In cases where the presence/absence of the morpheme was not clear for the transcriber (less than 8 % of data), the token was re-examined by a second transcriber, and a final decision was made by consensus.

The data were analyzed according to the error type. Most morpheme errors were errors of omission, so that a verb would be produced as a bare stem (e.g. *She drive the car every day*). In other cases a child would make an error of commission by attempting to produce the morpheme, but incorrectly applying the rules of its use (e.g. *She pickses flowers*).

2.3.1. Morpheme omission

The goal of this study was to examine the extent to which phonological factors might account for the variable use of the grammatical morphemes. Therefore, the target words were grouped according to the phonological complexity of the morpheme: simple coda (vowel + consonant: *cried*), complex coda (consonant + consonant: *climbed*), and syllabic morpheme (creates a new syllable: *added*). See Table 1 for the total number and percent of tokens produced in each phonological condition.

Table 1. *Total number (%) of the morphemes produced as a function of phonological complexity*

Morpheme	Phonological Complexity			Factor Significance
	Simple (*cried*/*cries*/ *May*'s)	Complex (*climbed*/*climbs* /*Brett*'s)	Syllabic (*added*/*watch es*/*Trish*'s)	
Past tense *-ed*	26/36 (72)	198/250 (79)	40/152 (26)	F(2, 12)= 19.854, p<.001
Present tense *-s*	19/33 (58)	145/204 (71)	27/84 (32)	F(2, 6)= 11.051, p=.010
Possessive *-s*	49/79 (62)	90/180 (50)	3/88 (3)	F(2, 10)= 21.876, p<.001

To determine if there was a significant difference in morpheme production across phonological conditions, we carried out Repeated Measures Analysis of Variance for each of the three morphemes with phonological complexity as a repeated measure (simple, complex, syllabic). The results indicated that, for each morpheme, phonological complexity had a significant effect on morpheme production (Table 1).

Post hoc pairwise comparisons with Bonferroni adjustment were used to further analyse performance across the conditions (simple vs. complex, complex vs. syllabic, and simple vs. syllabic). See Table 2 for the respective p-values.

Table 2. *P-values of pairwise comparisons between phonological conditions for each morpheme of interest*

Morpheme	Simple vs. Complex	Complex vs. Syllabic	Simple vs. Syllabic
Past *-ed*	1.000	**.004**	**.011**
Present *-s*	1.000	**.014**	.136
Posses. *-s*	.464	**.011**	**.004**

The results indicated that for two morphemes (past tense *-ed* and possessive *-s*), there was a significant difference in simple vs. syllabic, and complex vs. syllabic conditions. For the 3rd person singular morpheme *-s*. However, no significant differences were found between morpheme production in the simple vs. complex codas in any of three morphemes.

Thus, in the majority of cases, syllabic allomorphs were produced significantly less often than segmental allomorphs (see Figure 1). In contrast to TD children, there was no difference in production between simple and complex codas. Interestingly, similar patterns were observed in nominal as well as in verbal morphemes. This suggests that phonological factors do have a significant effect on suffix production, and that a purely syntactic approach cannot fully account for children's variable use of a particular morpheme.

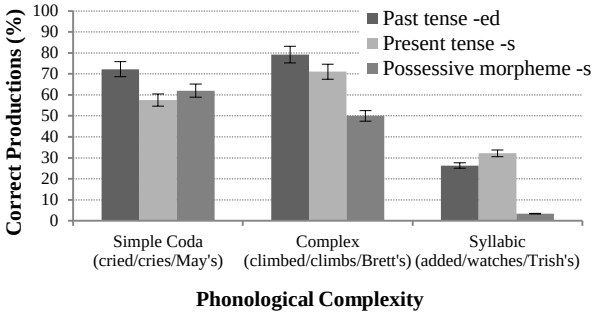

Figure 1. *Morpheme production as a factor of phonological complexity of the coda*

2.3.2. Errors of commission

As shown on Figure 2, the proportions of errors of commissions were much smaller in comparison to those of omission for all three morphemes.

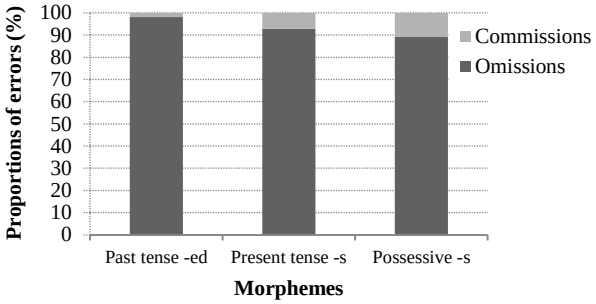

Figure 2. *Proportions of errors of omission and commission across morphemes*

The errors of commission were primarily truncations or overgeneralizations. The number and different types of errors per morphemes are shown in Table 3.

Table 3. *Types of errors of commission and their total numbers for each morpheme*

Morpheme	Type of Error			
	Reduction		Overgeneralization	
	Morpheme reduction: *She twist-t the stick*	Stem reduction: *He ki[ck]s the ball.*	Suffix reduplication: *She pickses flowers*	Schwa insertion: *She laughes all the time*
Past *-ed*	1	0	2	0
Present *-s*	2	2	8	3
Posses.*-s*	15	0	1	0
Total	**18**	**2**	**11**	**3**

An acoustic analysis was performed on the errors of commission to determine if the perceived error was accurate. The acoustic measurements were based on the feature-cue-

based model [18] in which distinctive feature bundles representing speech segments are derived from the acoustic cues of the vocal tract configuration. Each acoustic cue was identified by visual inspection of the waveform, spectrogram and listening to the utterance. Praat software was used for the phonetic analysis.

3. Results

As one can see in Table 3, the majority of errors of commission involved schwa omission in the syllabic allomorph (e.g. *She twisted the stick → She twist-t the stick*) and morpheme reduplication (e.g. *She touchses the fire*). Note that the errors of omission show a tendency for phonological simplification, whereas the errors of commission tend to increase the complexity of the target form.

3.1. Morpheme reduction

Schwa omission takes place when the child attempts to produce the morpheme in the syllabic condition (e.g. *Trish's skirt*). The largest number of tokens were found in the productions of the possessive *-s*. Acoustic analyses of these forms show that, indeed, the suffix vowel is missing. This can be observed on the spectrograms and waveforms of the Figures 3 and 4, where the stem-final consonant is immediately followed by the consonant in the morpheme.

This type of partial realization has also been reported for the syllabic plurals in the speech of TD children [12].

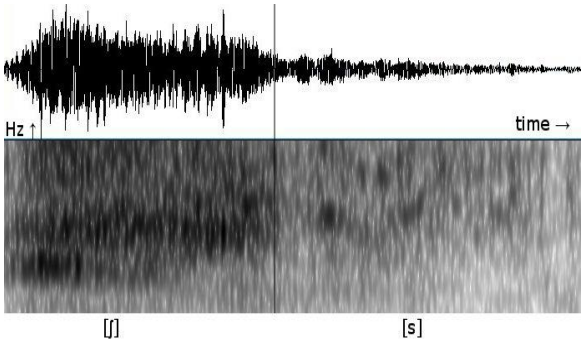

Figure 3. *Acoustic representation of the stem+morpheme boundary in the target word form 'Trish's' ('Trish-s')*

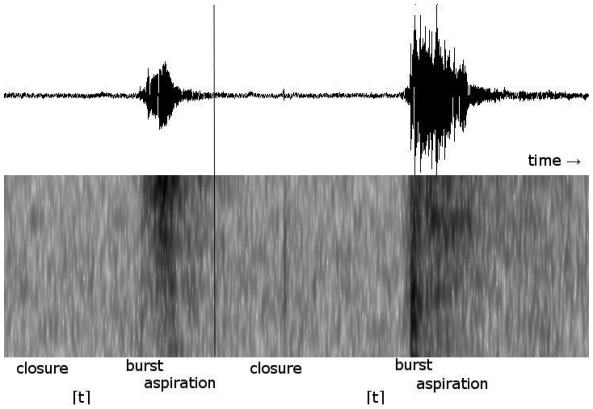

Figure 4. *Acoustic representation of the stem+morpheme boundary in the target word form 'twisted' ('twist-t')*

3.2. Stem reduction

Stem truncations are examples of cluster simplification when the morpheme is produced, but the final consonant of the stem is omitted, as in Figure 5. This process reduces phonological complexity by turning the consonant cluster into a simple coda. This is evidenced in examples such as: *The boy ki*[*ck*]*s the ball* and *Water tur*[*n*]*s to ice*.

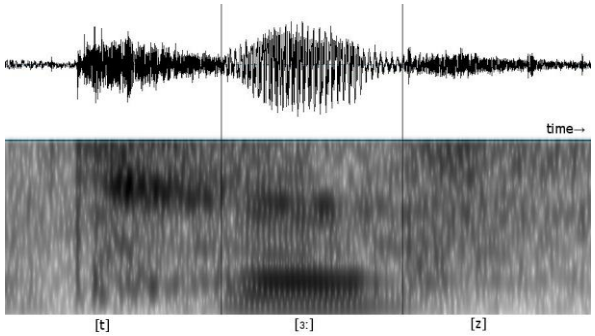

Figure 5. *Acoustic representation of the coda in the target word form 'turns' ('tur*[*n*]s*')*

3.3. Overgeneralization: morpheme reduplication

Morpheme reduplication was observed only in complex phonological conditions: the morpheme was first added to the stem, creating a consonant cluster. This was then followed by the syllabic allomorph (e.g. *touched → toucheded* [tʌʧtəd], *cuts → cutses* [kʌtsəz], *cat's → cats's* [kætsəz]). See Figure 6.

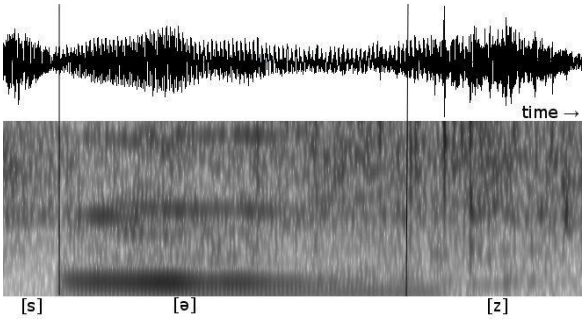

Figure 6. *Spectrogram and waveform of the morpheme representation in the target word form 'picks' ('pickses')*

Interestingly, the choice of the syllabic allomorph is in compliance with the general phonological rules of its use, i.e. schwa is never omitted in these cases (e.g. we find [pɪksəz], but not [pɪkss]). This suggests that the child interpreted the inflected forms such as *picks* and *touched* as verb stems. However, in our data, each participant used those forms along with bare stems of the same words, as in *She touch the fire* and *She touchses the fire* produced by the same child.

3.4. Overgeneralizations: schwa insertion

Schwa insertion involves the erroneous use of the syllabic allomorph. In our data this was found for only one child and one lexical item, but produced several times: '*laughes*' [lɑ:fəz]. It appears here that the child has overgeneralized the

final fricative context in which the syllabic allomorph must apply. The acoustic realization can be observed on Figure 7.

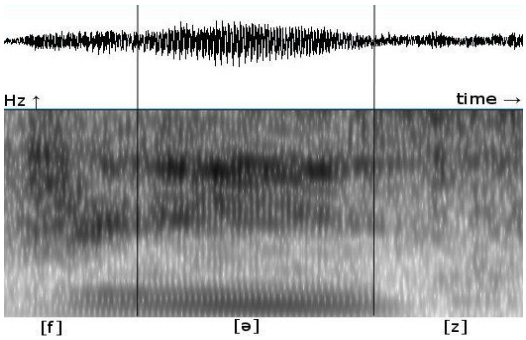

Figure 7. *Acoustic representation of the coda in the target word form 'laughs' ('laughes')*

4. Conclusions

In summary, the results of this study of children with SLI showed that phonological complexity has a significant effect on morpheme production for all three suffixes. In particular, production of the syllabic morpheme was significantly worse, regardless of the morpheme attempted. However, unlike TD children, SLI participants did not show a difference in morpheme productions between simple and complex codas for any of the morphemes. This can be explained by the fact that the SLI children are older and have better articulatory control than the TD 2-year-olds for whom these effects have been previously reported.

Thus, phonological factors appear to have a significant effect on morpheme production for children with SLI, as they do with younger typically developing children. Furthermore, this pattern of poorer syllabic morpheme use was found in both verbal as well as in nominal suffixes, suggesting that a purely syntactic account of children's variability in morpheme production is insufficient.

Although the majority of errors in the data were the errors of omission, SLI children also produced some errors of commission. These included reductions (partially truncated forms like *twist-t*) and overgeneralizations (e.g. suffix reduplications as in *cutses*). Both indicate that the child has some knowledge of the required morpheme, but is struggling with producing the correct form.

5. Acknowledgements

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