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Some differences between English plural noun inflections and third singular verb inflections in the input: the contributions of frequency, sentence position, and duration*

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ABSTRACT

Grammatical inflections such as the English plural noun *-s* and third person singular verb *-s* are acquired at different points in time by young children. This finding is typically attributed to factors such as relative semantic salience or the distinction between lexical and functional categories. In this study input frequency, sentence position, and duration were examined as possible contributing factors. In both conversations with and stories aimed at young children, noun plural inflections were found to be more frequent than third singular verb inflections, especially in sentence-final position. Analysis of the speech of four mothers reading stories to their two-year-old children confirmed that duration differences also exist in the input. Because fricatives were lengthened in sentence-final position and plural nouns were much more likely to appear in these positions than were third singular verb forms, plural nouns were significantly longer than third singular inflections on average. The possible implications of these findings for language learnability theories and accounts of grammatical deficits in specific language impairment are discussed.

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INTRODUCTION

Beginning at least with Brown's (1973) classic study of grammatical morpheme acquisition in the speech of Adam, Eve, and Sarah, we have had evidence that the grammatical morphemes of English emerge at different times and are mastered at different rates. Among the most reliable differences between morphemes is the difference between the plural noun *-s* (e.g. 'dog*s*,' 'cat*s*') and third person singular verb *-s* (e. g. 'dig*s*,' 'hit*s*') inflections. Plural noun inflections are earlier attainments than third person singular inflections.

There are several kinds of explanations for this finding. One is that plural nouns have greater semantic salience than third singular verb inflections. That is, differences between one and more than one object seem easier to identify and therefore hypothesize as relevant for linguistic expression than the agreement between the verb and its subject according to person and number. Child language researchers have suggested that there is a hierarchy of grammaticizability (e.g. Pinker, 1984; Slobin, 1985). Notions high on this hierarchy are those that appear in many of the world's languages and have clear semantic correlates. It is reasoned that when deciphering the features that are relevant to the language they are hearing, young children will hypothesize the number of nouns before the conjunction of person and number on verbs.

A second type of explanation is based on the distinction made in the principles and parameters framework (Chomsky, 1981, 1986) between lexical categories and functional categories. Examples of lexical categories are Noun (N) and Verb (V) and their maximal projections NP and VP. Examples of functional categories are Inflection (INFL or I) and Complementizer (COMP or C) and their maximal projections (IP, CP). Some investigators (e.g. Radford, 1990) have argued that in the earliest stages of grammatical development, the grammars of English-speaking children contain lexical categories only. Thus, in a young child's utterance *birds eat worms*, it would be assumed that IP and INFL are not present and the verb is nonfinite in nature. It can be seen from this example, though, that noun plurals can be incorporated into early grammars. This is because this inflection is associated with the lexical category N.

Other investigators do not adopt such a radical position regarding the early absence of functional categories. However, they do assume that English-speaking children are slow to identify the specific exemplars of functional categories, especially those associated with INFL (e.g. Leonard, 1995).

There are other factors that probably make the acquisition gap between plural noun and third singular verb inflections especially large in English. The inflection paradigm for English verbs is highly irregular. In many languages, if the paradigm contains an inflection for third singular, there are also inflections for third plural, first singular, and so on. The fact that this is

not true for English could mean that the grammatical function of third singular *-s* is not hypothesized until much later than in most languages, expanding the developmental gap between this morpheme and plural noun *-s*.

In this study, we determine whether additional factors might contribute to the developmental differences between these two morphemes of English. One such factor is input frequency. Although the relative importance placed on frequency of input varies across language learnability theories, this factor is usually incorporated in some way. For example, according to the learnability theory of Pinker (1984), children must register the presence of an inflection in the input, hypothesize its grammatical function, and place the inflection in a paradigm. Subsequent encounters with that inflection change the strength of its representation in the paradigm. Presumably, if an inflection occurs frequently, its grammatical function will be hypothesized sooner, and its representation in the paradigm will be strengthened to some threshold level more quickly. In the present study, we examine whether differences in the frequency with which plural nouns *-s* and third person singular *-s* occur in the input coincide with the known developmental differences between these two inflections.

A second factor of interest in this study is the acoustic property of duration. Investigators of crosslinguistic differences in grammatical development have long posited that many grammatical morphemes of English may be acquired later than their counterparts in other languages because of their acoustic characteristics (e.g. Slobin, 1985; Gleitman, Gleitman, Landau & Wanner, 1988). Duration is one of these characteristics. Many English grammatical morphemes are word-final consonants or weak syllables that rarely or never appear in sentence positions in which significant lengthening occurs. Hence, these morphemes are rather brief and, consequently, less salient perceptually.

The contribution of duration to the developmental differences between plural noun inflections and third singular verb inflections has probably been discounted because these inflections are seemingly identical in their segmental composition. However, there are some good reasons to believe that duration might play a role.

Among the learning advantages that nouns hold over verbs is the fact that, in English, nouns often appear in clause- and sentence-final positions whereas verbs usually appear in clause- and sentence-medial positions (e.g. Goldfield, 1993; Tardif, Shatz & Naigles, 1997). This is attributable in large part to the subject-verb-object order of English along with the tendency for new (as opposed to given) information to appear in object position where it is expressed in nominal rather than pronominal form. The distributional difference between nouns and verbs might also apply to nouns with plural inflections and verbs with third singular inflections.

If plural noun inflections appear much more frequently in clause- and sentence-final positions than third singular verb inflections, the former could benefit from the fact that fricatives are significantly lengthened in these positions. Klatt (1976) reported that word-final fricatives appearing in these utterance positions were from 40 to 100 ms longer than the same word-final fricatives that appeared in other utterance positions. Longer durations do not guarantee that the fricative becomes more salient perceptually. However, differences in segment duration of 25 ms are detectable by listeners in sentence contexts (Klatt & Cooper, 1975).

The question of whether plural noun inflections are significantly longer than third singular verb inflections has implications not only for understanding the sequence of acquisition of these two morphemes, but also for accounts of the grammatical deficits in children with specific language impairment (SLI). These children show significant deficits in their language ability, yet they show age-appropriate scores on nonverbal tests of intelligence, normal hearing, and no obvious signs of neurological impairment. In English, children with SLI often show an especially serious deficit in the use of grammatical morphology.

According to one recent account of these grammatical morpheme problems, children with SLI have great difficulty fully processing brief grammatical morphemes (Leonard, Eyer, Bedore & Grela, 1997). It is assumed that these children are capable of perceiving word-final consonants and weak, non-lengthened syllables, but their limited processing capacity is burdened when such forms play a morphological role. In these instances, the children must perform additional operations such as discovering the grammatical functions of the forms and placing the forms in the proper cell of a morphological paradigm. These operations must be performed while the rest of the sentence is being heard. The additional operations coupled with the brevity of the morphemes will sometimes result in incomplete processing of the morphemes. As a result, a larger number of exposures will be required before these brief morphemes are established in the children's grammars.

Apart from the deficiencies attributable to these children's slow intake of relevant data due to processing limitations, no fundamental problems in the children's grammars are assumed in this account. As with normally developing children, children with SLI are assumed to hypothesize the function of plural noun *-s* before that of third person singular verb *-s* and therefore to acquire the former before the latter, even though the development of both will proceed more slowly than is true for typical children, due to the processing challenges that these brief forms present to children with SLI.

If, however, the two forms are not equivalent in their durational characteristics for reasons noted above, it might be that the same variable that is causing these children extraordinary problems with brief morphemes is also

contributing to the developmental differences between these two morphemes. In fact, this might help explain why comparisons between children with SLI and younger control children matched according to mean length of utterance (MLU) have produced mixed results for the use of plural noun *-s* inflections. In some studies, higher percentages of use have been seen for the MLU control children (e.g. Leonard *et al.*, 1997), whereas in other studies, differences have not achieved statistical significance (e.g. Oetting & Rice, 1993). In contrast, group differences (favoring the MLU-matched children) in the use of third singular verb inflections have been more consistent in the literature. This outcome would be expected if plural nouns were more likely than third singular forms to benefit from lengthening thanks to their frequent appearance in sentence-final position.

In this study, we begin with evidence showing that plural noun inflections occur more frequently than third singular verb inflections across sentence positions and that the frequency difference is even more striking in sentence-final position. We then demonstrate that these inflections have significantly greater durations in sentence-final position than in non-sentence-final positions. Finally, we compare the durations of the two types of inflections when these inflections show their usual distribution according to sentence position.

ANALYSIS 1: FREQUENCY OF OCCURRENCE AND SENTENCE POSITIONS OF THE TWO INFLECTIONS

Child-directed conversational speech

We first examined the corpora of Conti-Ramsden & Dykins (1989) available through CHILDES (MacWhinney, 1995). These samples contain utterances produced by mothers and fathers to their preschool-aged children with SLI. As can be seen in Table 1, we identified 285 plural noun tokens and 55 verb tokens inflected for third person singular. These numbers represent only the [z] and [s] allomorphs of these inflections, which constituted the great majority of the plural noun and third singular inflections in the samples. The [əz] allomorph was not examined because it is syllabic and the lengthened status of sentence-final syllabic grammatical morphemes is already documented (e.g. Swanson & Leonard, 1994.) The two types of inflections clearly differed in their frequency of occurrence. In addition, their sentence position distribution was markedly different. As shown in Table 1, of the tokens with plural noun inflections, 148 or 52% appeared in sentence-final position. This was true for only 9 or 16% of the tokens with third singular verb inflections. Thus, plural nouns were more than three times as likely as third singular inflections to occur in final position. Furthermore, this difference in rate does not take into account the fact that plural nouns were much more

frequent than third singular verb forms. In sheer frequency, plural nouns were 16 times more likely to appear in sentence-final position (148 vs. 9).

Stories read to children

Conversational speech is not the only kind of input that children receive. Often, stories are read to them. We inspected 18 commercially-available story books designed for toddlers and preschoolers (see Appendix) for instances of plural nouns and third singular verb inflections with the allomorphs [z] and [s]. Across all books, we found 233 tokens with plural noun inflections, 94 or 40% in sentence-final position, and 19 tokens with third singular verb inflections, 1 or 5% occupying the final position of a sentence. As can be seen in Table 1, although the percentages of both plural nouns and third singular verb inflections in sentence-final position were somewhat lower than was seen for child-directed conversational speech, the differences between the two morphemes for sentence-final position were even greater. Plural nouns were 8 times more likely than third singular verb inflections to appear at the end of sentences. Using frequency as the metric (94 vs. 1), the differences were even greater.

Clearly, the sentence position differences reported for nouns and verbs apply as well to nouns inflected for plural and verbs inflected for third person singular. We turn now to the question of whether such differences translate into differences in the duration of these two types of morphemes.

ANALYSIS 2: DURATION DIFFERENCES IN STORIES READ TO CHILDREN

Materials

To examine the duration of the two inflection types, we employed audio-recordings obtained by Swanson & Leonard (1994). In that study, mothers read five specially written stories to their two-year-olds. The stories were designed to examine the durations of function words in sentence-initial, -medial, and -final position in the mothers' speech. The mothers were not aware of the purpose of the study. Apart from the locations of function words, the stories were generally modelled after available stories intended for two-year-old children. At the time of the Swanson & Leonard study, noun and verb inflections were not a focus of attention; consequently the sentence positions in which they occurred were not controlled.

Examination of the five stories revealed 85 instances of plural nouns and 131 instances of third singular verb inflections with the allomorphs [z] and [s]. The number of third singular inflections was quite high, due to the fact that the stories were written in present tense. Forty-two or 49% of the tokens with plural nouns occurred in sentence-final position; 9 or 7% of the tokens with third singular inflections appeared in that position. These differences

TABLE 1. *Frequency of occurrence (and percentages) of plural noun inflections and third singular verb inflections in conversations and stories*

	Conversations		Stories	
	All positions	Final position	All positions	Final position
Plural nouns *-s*	285 (48%)	148 (52%)	233 (60%)	94 (40%)
Third singular verb *-s*	55 (84%)	9 (16%)	19 (95%)	1 (5%)

between plural noun and third singular verb inflections in sentence-final position fell approximately midway between the earlier findings for child-directed speech and the findings for commercially-available story books. Consequently, we considered them appropriate for the duration analysis phase.

Analysis procedure

For this phase of analysis, we randomly selected the recordings from four of the mothers. All 864 productions containing a plural noun inflection or third singular verb inflection were digitized at a sampling rate of 20 kHz on a Kay CSL Model 4300. Low-pass filtering – performed automatically by CSL during the digitization process – served to avoid aliasing effects.

Fricative onset and offset were determined from a simultaneous CSL display consisting of an audio waveform, energy contour, and wide-band spectrogram (300 Hz) with a scale of 0 to 8 kHz. Spectrograms were demarcated in time following conventional acoustic segmentation rules (Klatt, 1976; Kent & Read, 1992). The onset of the inflection was taken as the point of the appearance of frication noise and the initial rise of the intensity curve in the high frequency range. The declination of the energy contour and the final trace of frication noise in the audio waveform and wide-band spectrogram were considered the offset of the segment. When the segment was followed by another word in the same clause and the above criteria were not sufficient to identify the offset, the segment was assumed to continue up to the point where the initial segment of the following word was audible. The durations from the onset to the offset points were then computed through customized software. A total of 41 tokens (4.7% of the data) could not be used because the child's voice or a noise overlapped with the speaker's production, or the speaker misread the word (eliminating or changing the inflection) in the text. The total number of noun plural and third singular verb inflections remaining for analysis was 823.

Measurement reliability

To assess reliability, 90 or about 11 % of the 823 productions were randomly selected from four mothers. For intrajudge reliability, the fricative durations in these productions were remeasured after 2 months following the initial measurement. For interjudge reliability, a second individual who is experienced in acoustic analyses independently measured the fricative durations. Intra- and interjudge fricative duration measurements had mean differences of 1.0 ms and 2.3 ms. The correlation for each was 0.94 and 0.93, respectively.

Sentence position effects

To confirm that the two types of inflections differed in duration as a function of sentence position, we selected 13 words that occurred in both sentence-final and non-final positions in the stories. We then compared the durations of the inflection in the two positions, pooling the data from the four speakers. It should be noted that for this analysis, sentence position was the only basis for classification; plural nouns and third singular verb inflections were grouped together if they shared the same sentence position (final or non-final). The comparison involved 85 tokens in sentence-final position and 156 tokens in non-final position. The position effect was highly significant, $t\,(239) = 14.62$, $p < 0.001$. Means (and *SD*s) for sentence-final and non-final position were 136.53 ms (50.40) and 69.55 ms (20.04), respectively. The differences for sentence position are illustrated in Fig. 1.

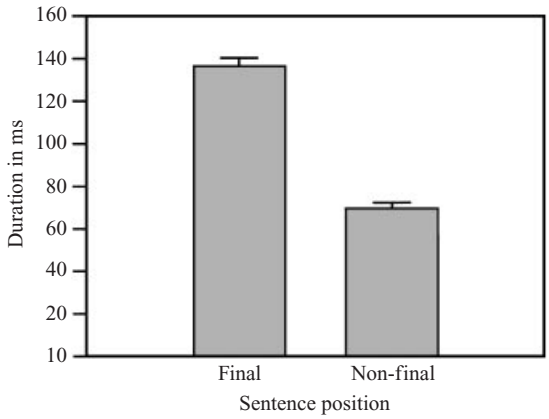

Fig. 1. Mean durations and standard errors for *-s* inflections in words that occurred in both sentence-final (85 tokens) and non-sentence-final (156 tokens) position, collapsed across inflection type.

We then re-examined the same 13 words to determine whether the words with plural noun inflections and those with third plural verb inflections showed the expected distribution according to sentence position. In fact, we found a disproportionately high percentage of verb tokens with third singular inflections occupying sentence-final position. Seven or 24 % of these inflected verbs were in sentence-final position. Earlier, we saw that percentages between 5 and 16 are more customary. For plural nouns, 16 or 47 % appeared in sentence-final position, a percentage in keeping with expectations.

Given the unusually high percentage of third singular verb inflections in sentence-final position for this particular set of words, the resulting comparison of the two inflection types according to duration was a conservative test. Nevertheless, when the durations of plural noun inflections and third singular verb inflections were compared (collapsed across sentence position), significantly greater durations were seen for plural nouns, $t\ (239) = 4.27$, $p < 0.001$. Means (and *SD*s) for plural noun and third singular verb inflections were 104.63 (54.40) and 79.75 (30.71), respectively. These findings are illustrated in Fig. 2.

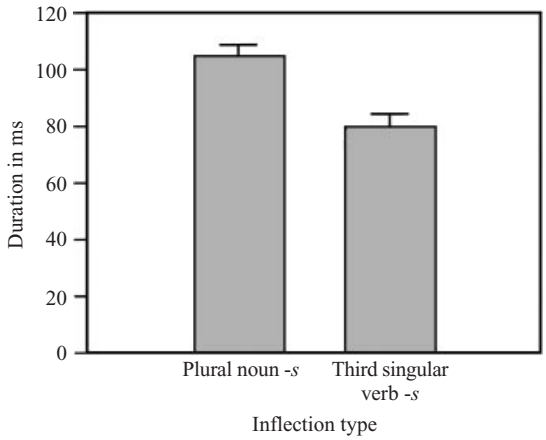

Fig. 2. Mean durations and standard errors for noun plural inflections (130 tokens) and third person singular verb inflections (111 tokens), collapsed across sentence position.

We then asked whether plural noun inflections would show longer durations on average than third singular verb inflections when sentence position was free to vary. For this analysis, all tokens with [z] or [s] plural noun and third singular verb inflections were included. Because there were at least 200 data points for each speaker, separate analyses were run for the four speakers. Fig. 3 provides a summary of the duration data. It can be seen

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from the figure that plural noun inflections had longer durations than third singular verb inflections for each speaker. Statistical analysis for each speaker revealed a significant difference, $ts \geqslant 4.66$, all $ps < 0.001$. The similar findings across speakers suggest that the duration differences between the two inflection types are quite robust.

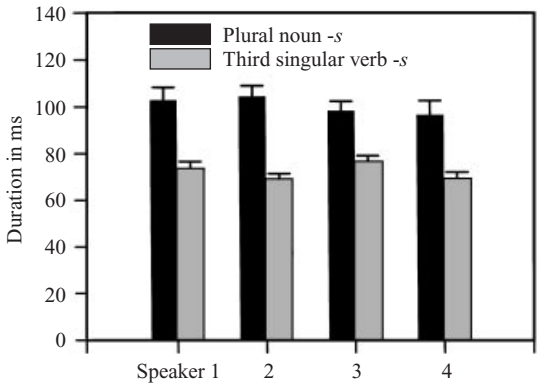

Fig. 3. Mean durations and standard errors for all tokens of plural noun and third person singular verb inflections for each of the four speakers, collapsed across sentence position.

DISCUSSION

In this study, we have shown that: (1) in conversation with and stories directed at young children, plural noun inflections are more frequent than third singular verb inflections; (2) plural noun inflections are much more likely to appear in sentence-final position than third singular verb inflections; (3) the phonetic forms used for plural noun and third singular verb inflections are significantly longer in sentence-final position than in non-sentence-final position, at least in stories read to two-year-olds; and (4) these asymmetries in sentence position and duration result in significantly longer durations for plural noun inflections than for third singular verb inflections.

It is possible that the frequency differences between plural noun *-s* and third singular verb *-s* contribute to the developmental differences between these two types of inflections independent of the factor of duration. Furthermore, if sentence-final position is a more salient position for children for reasons other than (or in addition to) duration, frequency could loom as an even larger factor. In this position, the frequency discrepancy between the two types of morphemes is especially large.

A less obvious though potentially important role of frequency effects rests in the fact that plural noun inflections are more likely than third singular verb inflections to benefit from lengthening. Thanks to the especially lopsided frequency differences between these two types of inflections in sentence-final

position, average durations for plural noun inflections were approximately 100 ms; those for third singular verb inflections were around 72 ms.

It is difficult to know if segments of 100 ms are more readily perceived and maintained by children than segments of 72 ms. There is little question that infants and young children can discriminate duration differences in speech stimuli that are similar to the average differences between plural noun and third singular verb inflections (see Jusczyk, 1997 for a recent review). The question is whether segments of 100 ms or greater are more likely to be registered by young children, thus permitting earlier analysis of the grammatical functions served by these segments. We think it is reasonable to assume an affirmative answer to this question. Such an assumption seems to be in line with operating principles proposed by earlier authors that highlight the importance of perceptually salient material for storage and grammatical analysis (Peters, 1985; Slobin, 1985).

We have emphasized the possible contribution of frequency and duration to the earlier acquisition of plural noun inflections than third singular verb inflections. However, the greater salience arising from higher frequency and longer durations of the inflections on plural nouns could influence acquisition in a second way. Young children might use grammatical morpheme information to aid their learning of new lexical items. Hearing 'the watch,' for example, the child might conclude that the new word 'watch' is a noun; if the phrase were 'is watching,' the child might conclude that the new word is a verb. Grammatical morphemes that are acquired earlier in association with particular lexical categories such as nouns and verbs are likely to be put to earlier use in identifying new instances of these grammatical categories. If plural noun inflections are registered earlier – helped in part by their higher frequency and longer duration – they could be used to identify new nouns. To be sure, third singular verb inflections appearing in sentence-final position on occasion and their resulting longer duration could mislead the child into interpreting the word's grammatical category inappropriately. However, provided that there are strong statistical tendencies associated with each grammatical category – such as the statistical tendency for inflections tied to nouns to occur more frequently in sentence-final position than inflections linked to verbs – children appear to use the information in spite of the imperfect relationship involved. For example, Cassidy & Kelly (1991) found that children were more likely to treat a new word as a noun or a verb depending on the number of syllables it contained. These biases conformed to statistical tendencies for English nouns and verbs, but many exceptions exist.

The findings of this study also have implications for recent proposals concerning the grammatical morpheme limitations of children with SLI. According to Leonard and his colleagues (e.g. Leonard, McGregor & Allen, 1992; Leonard *et al.*, 1997), grammatical morphemes consisting of weak

syllables that often appear in clause- and sentence-final position are less likely to cause extraordinary problems for these children because in these final positions, significant lengthening occurs. For example, in Italian, verb inflections are often word-final weak syllables but, because they often occur in clause- or sentence-final position due to the flexible word order of the language (see Tardif *et al*., 1997 for a recent example), they can benefit from significant lengthening (Farnetani & Fori, 1982). The findings of the present study suggest that investigators advocating duration as a factor in the grammatical deficits of children with SLI should also consider clause- and sentence-final fricative lengthening when predicting which grammatical morphemes will give children with SLI special difficulty.

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APPENDIX

THE CHILDREN'S STORY BOOKS REVIEWED FOR THE STUDY

Brett J. (1989). *The mitten*. New York: G. P. Putnam.
Brown, M. (1975). *Goodnight moon*. New York: Harper & Row.
Carle, E. (1974). *The very hungry caterpillar*. New York: Puffin.
Carle, E. (1984). *The very busy spider*. New York: Philomel.
Carle, E. (1990). *The very quiet cricket*. New York: Philomel.
Freeman, D. (1978). *A pocket for Corduroy*. New York: Viking.
Kalan, R. (1981). *Jump*, *frog*, *jump*! New York: Viking.
Lucky Book Club (1967). *The gingerbread man*. New York: Scholastic.
Martin, B. & Archambault, J. (1985). *Here are my hands*. New York: Scholastic.
Martin, B. & Archambault, J. (1989). *Chicka chicka boom boom*. New York: Simon and Schuster.
Martin, B. & Carle, E. (1983). *Brown bear*, *brown bear*, *what do you see*? New York: Henry Holt and Company.
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Peek, M. (1985). *Mary wore her red dress*. New York: Clarion.
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Raffi (1988a). *Down by the bay*. New York: Crown.
Raffi (1988b). *Wheels on the bus*. New York: Crown.
Shaw, C. (1947). *It looked like spilt milk*. New York: Harper Collins.