

The Prosodic (Re)organization of Determiners

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1. Introduction

Researchers have long known that children variably produce grammatical morphemes in spontaneous speech (e.g., Brown, 1973). Thus, a given child on a given day may supply a determiner (such as the article *a* or *the*) or a tense morpheme (such as the past tense marker *-t/d*) in some utterances but not in others. This has typically led researchers to propose that children's syntactic representations are immature or syntactically underspecified (e.g., Wexler, 1994; Rice, Wexler, & Cleave, 1995). However, in a series of elicited production experiments, Gerken (1996) showed that English-speaking 2-year-olds were more likely to produce determiners (in this case definite articles) when these could be prosodified as part of a Strong-weak metrical foot. Thus, children were more likely to produce a determiner in sentences like (1a) (where *the* can be prosodified as part of a Strong-weak metrical foot with the preceding monosyllabic verb) than in sentences like (1b) (where *the* remains unfooted following a disyllabic verb, which is already a foot).

- (1) a. Tom [pushed the]_{Ft} [zebra]_{Ft}
 S w
 b. Tom [pushes]_{Ft} the [zebra]_{Ft}
 S w w

These findings are interesting for several reasons. First, these results suggest that children's variable production of some grammatical morphemes may be more systematic than typically assumed. Second, these results indicate that some of the variability in early morpheme production may be due to *prosodic constraints*, rather than due to either a lack of syntactic representations or to non-linguistic, processing factors (Valian, 1991).

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Third, similar findings have been noted in other languages with very different prosodic structures, suggesting that such results may be very robust. For example, in a recent quantitative analysis, Demuth & Ellis (in press) found that noun class prefixes in the Bantu language Sesotho were much more likely to be produced if they preceded a monosyllabic nominal stem (e.g., *le-ru* ‘cloud’) than if they preceded a disyllabic nominal stem, which already constitutes a foot of structure (e.g., *le-tsasti* ‘sun’). Importantly, these children also demonstrate knowledge of which gender/class the noun belonged to when the noun class prefix was omitted. This was evident when the noun was followed by the appropriately inflected nominal modifier (e.g., *(le)-tsasti le-na* ‘day that’ (i.e., ‘that day’)) (Demuth, 1988). Thus, noun class prefixes were not being omitted due to the child’s uncertainty about which of the 11 noun classes the noun belonged to.

These prosodic effects last in Sesotho until around the age of 2;3, when noun class prefixes start to be more reliably produced with nominal stems of 2 syllables or more. The acquisition of French determiners shows a similar pattern, with determiners being more consistently used with monosyllabic nouns several months before they consistently appear with disyllabic and trisyllabic nouns (Tremblay, 2006; Tremblay & Demuth, in press; Demuth & Tremblay, in press).

These findings suggest that it should be possible to make predictions about the course of determiner acquisition given the prosodic structure of a given language. However, the Sesotho and French findings come from analyses of longitudinal spontaneous speech corpora, whereas the previous English findings came from cross-sectional, elicited production studies (Gerken, 1996). The goal of the present study was therefore to determine if English-speaking children show the same tendency to prosodify determiners as part of a trochaic foot in spontaneous speech productions. If so, this would provide further support for the notion that some grammatical morphemes are variably produced depending on the prosodic context in which they appear.

2. Study 1: Children’s production of Footed vs. Unfooted determiners

2.1 Method

To investigate this issue we examined the spontaneous productions of five 1-2-year-old children (3 girls, 2 boys) from the Providence Corpus, focusing on the period when determiners were being acquired (MLU 1.3-3). All interactions were between parent (usually mother) and child during daily play and other activities in the home. Both parent and child wore radio microphones, and all sessions were audio- and video-recorded for later analysis. The files were then downloaded onto a computer and transcribed using CHAT conventions (MacWhinney, 2000). Children’s utterances were then phonetically transcribed, with ten percent of each session being retranscribed by another trained transcriber. Inter-coder reliability for segments was 86%.

Using methods employed by Vihman & McCune (1994), we identified all target nouns used in contexts where a determiner should be present. Target determiners were then coded as potentially occurring in either Footed (1a) or Unfooted (1b) contexts. We then calculated the percent of determiners produced in each context. We predicted that the children would show earlier use of determiners in Footed as opposed to Unfooted contexts, and that the use of Unfooted determiners would gradually increase over time.

2.2 Results

Four of the children (Naima, Ethan, Violet, William) showed the expected pattern, producing significantly more determiners in Footed as compared to Unfooted contexts. These results are shown in Table 1. Note that the Unfooted determiners constitute the majority of contexts in which target determiners appear. Note also that the higher rate of production of Footed determiners is not due to frequency effects.

Table 1. Number (percent) production of Footed vs. Unfooted Determiners

NAIMA	Footed	Unfooted	Significance	Total
1;4.18	9/15 (60)	5/54 (9)	$p < 0.001$	14/69 (20)
1;5.11	9/12 (75)	2/73 (3)	$p < 0.001$	11/85 (13)
1;6.10	18/21 (86)	8/62 (13)	$p < 0.001$	26/83 (31)
1;7.10	94/99 (95)	24/42 (57)	$p < 0.001$	118/141 (84)

ETHAN	Footed	Unfooted	Significance	Total
1;5.17	3/14 (21)	4/141 (3)	$p < 0.01$	7/155 (5)
1;6.21	18/32 (56)	9/154 (6)	$p < 0.001$	27/186 (15)
1;7.14	11/14 (79)	3/63 (5)	$p < 0.001$	14/77 (18)
1;8.22	4/5 (80)	6/25 (24)	$p < 0.05$	10/30 (33)
1;9.27	16/19 (84)	19/35 (54)	$p < 0.05$	35/54 (65)

VIOLET	Footed	Unfooted	Significance	Total
1;8	2/5 (40)	3/35 (9)	$p < 0.05$	5/40 (13)
1;9	6/8 (75)	6/95 (6)	$p < 0.001$	12/103 (12)
1;10	29/33 (88)	18/49 (37)	$p < 0.001$	47/82 (57)
1;11	32/37 (86)	16/46 (35)	$p < 0.001$	48/83 (58)
2;0	21/22 (95)	26/41 (63)	$p < 0.01$	47/63 (75)

WILLIAM	Footed	Unfooted	Significance	Total
2;1	20/27 (74)	17/54 (31)	$p < 0.001$	37/81 (46)
2;2	13/14 (93)	4/25 (16)	$p < 0.001$	17/39 (44)
2;3	41/49 (84)	12/37 (32)	$p < 0.001$	53/86 (62)
2;4	47/53 (89)	24/37 (65)	$p < 0.01$	71/90 (79)

LILY	Footed	Unfooted	Significance	Total
1;9.25	3/5 (60)	23/51 (45)	<i>n.s.</i>	26/56 (46)
1;10.08	19/33 (58)	54/74 (73)	<i>n.s.</i>	73/107 (68)
1;11.07	46/53 (87)	48/62 (77)	<i>n.s.</i>	94/115 (82)
2;0.11	60/65 (92)	55/75 (73)	$p < 0.01$	115/140 (82)

Thus, the majority of the children in this study supported our prediction that determiners would be produced earlier and with more accuracy in Footed as opposed to Unfooted contexts. However, one child (Lily) showed no effect of prosodic context, producing determiners in both contexts with the same accuracy. Interestingly, she produced Unfooted determiners at a higher rate earlier than the other children, and Footed determiners at a lower rate. Only at 2;0.11 (MLU 2.1) did her production of Footed determiners increase and a significant difference between the two contexts emerge. Coders had also noted that Lily's determiners tended to be 'stressed'. This suggests that she was initially producing determiners as separate 'Prosodic Words' rather than as Footed or Unfooted prosodic clitics. To explore this possibility further we conducted an acoustic analysis of Lily's determiner productions in Study 2.

3. Study 2: Acoustic analysis of Lily's determiner productions

3.1 Method

To further explore why Lily was initially producing all her determiners the same way, and why this changed around 2 years, we first identified all the tokens of determiners that were produced in target Footed and Unfooted contexts at 1;10.8, and 2;0.11 (henceforth Time 1 and Time 2). We then extracted all sound files for each of these tokens where the word following the determiner began with a stop, fricative, or affricate (i.e., a non-sonorant consonant). This would allow for clearly measuring the onset of the following noun. We then listened to each sound file and discarded any with poor acoustics or overlapping speech. This resulting in a total of 52 utterances analyzed at Time 1 (15 Footed and 37 Unfooted), and 47 utterances analyzed at Time 2 (21 Footed and 26 Unfooted).

Recall that our hypothesis was that Lily was initially treating all determiners as separate prosodic units. If so, this would mean that she was not prosodifying her early 'Footed' determiners as part of a metrical unit with the preceding word. To investigate this possibility we conducted three different acoustic

(durational) measurements and compared these at Time 1 and Time 2 to see if there was any change in prosodic organization. Consider the contexts in (2).

- (2)
- | Footed Context | Unfooted Context |
|----------------|------------------|
| [it's a] [bag] | a [dog] |
| ↑ ↑ | ↑ |
| a. b. | c. |

First, we predicted that the duration between 'Footed' determiners and the preceding word, indicated in (2a), would shorten between Time 1 and Time 2. This would indicate that these determiners were initially produced as separate prosodic units, and had subsequently undergone prosodic incorporation into a foot. We also measured the durational difference between the 'Footed' determiner and the following noun (2b). Although we did not expect any change in this duration, we anticipated that it might increase if the duration between the determiner and the preceding word decreased by a large amount. Finally, for determiners appearing in target 'Unfooted' contexts, we predicted no change in duration between the determiner and following noun (2c), since there was no change in behavior during this time. It therefore served as a control, ensuring that any changes in duration would not be due merely to an increase in speaking rate.

3.2 Results

The results indicated that there was a significant shortening in mean duration from Time 1 to Time 2 between the determiner and preceding word in Footed contexts (2a) ($t(31) = 5.929, p < 0.001$). There was also a non-significant increase from Time 1 to Time 2 in the mean duration between the determiner and following noun in Footed contexts (2b) ($t(32) = -2.020, p = 0.052$). Critically, there was no difference in mean duration between the determiner and the following word in Unfooted contexts (2c) ($t(59) = 0.504, p = 0.616$), ensuring that the changes found in the other contexts were not merely artifacts of increased speaking rate.

These findings therefore strongly support our hypothesis that by the age of 2, Lily's grammar had undergone prosodic reorganization, though only for Footed determiners. That is, she had begun to treat Footed determiners as prosodically incorporated metrical units. Her Unfooted determiners remain as prosodically independent entities.

4. Discussion

The present study confirms that for many English-speaking children, the early use of determiners is *prosodically licensed*. That is, determiners are much more likely to be used in children's early speech when these appear in prosodically 'available' contexts. For many children this will entail the earlier

production of both lexical and functional material that can be metrically prosodified as part of a disyllabic foot. That this occurs in prosodically very different languages (e.g., Sesotho (with penultimate duration/trochaic feet), French (with final duration/iambic feet), English (with stress/trochaic feet)), suggests that this is a robust phenomenon (cf. Allen & Hawkins (1978, 1980) for further support of such a position). However, some of our research on Spanish indicates that this may be an artifact of prosodic word structure in each of these languages. Both English and French have very few trisyllabic lexical items, and Sesotho has predominantly disyllabic verbal and nominal stems. Thus, children learning these languages are exposed to a high frequency of monosyllabic and/or disyllabic word forms. We suggest that this has an effect on the size of the 'prosodic window' these learners can handle at early stages of development. In contrast, learners of a language like Spanish are exposed to a much higher frequency of trisyllabic and even quadrasyllabic words (e.g., *manzana* 'apple', *escalera* 'stairs') (Roark & Demuth, 2000). Lleó & Demuth (1999) suggest that this is why they exhibit the use of 'proto-determiners' from the earliest stages of acquisition (see also Lleó, 1997, 1998, 2001; Demuth, 2001).

Some studies indicate that English-speaking children begin to acquire unfooted syllables as part of lexical items around the age of 2;6 (e.g. Pater, 1997). However, it is as yet unclear exactly what the relationship is between children's acquisition of initial unstressed (unfooted) syllables in a word like *banana*, and the unfooted determiner in an utterance like *the dolly*. It is therefore interesting to note that, at 2 years, Lily produced her first full form of the name *Manuela*. Prior to that time she had always truncated the research assistant's name to *Wela*, omitting the initial weak unfooted syllable. Tremblay & Demuth (in press) suggest that both of the French-speaking children they studied showed prosodic reorganization of their determiners as they began to be able to produce larger and more prosodically complex lexical items. Such a view suggests that developments at the level of the lexicon may force the development of higher-level prosodic structures.

Consider the Prosodic Hierarchy in Figure 1 (Selkirk, 1984; Nespor & Vogel, 1986).

Utt	(Phonological Utterance)	<i>I saw the inspector give the boy a banana</i>
IP	(Intonational Phrase)	<i>I saw the inspector</i>
PP	(Phonological Phrase)	<i>the inspector</i>
PW	(Prosodic Word)	<i>inspector</i>
Ft	(Foot)	<i>pector</i>
σ	(Syllable)	<i>pec</i>
μ	(Mora)	<i>pe</i>

Figure 1. The Prosodic Structure of Grammatical Function Items

Using the Prosodic Hierarchy, Selkirk (1996) outlines the possible prosodic structures available for grammatical function items, as shown in (4). We suggest that children's early determiners may initially be prosodified with in the Foot (4c), but that they later become prosodified as proposed for adult grammars, at higher levels of the Phonological Phrase (4b). This is obviously an issue for further investigation.

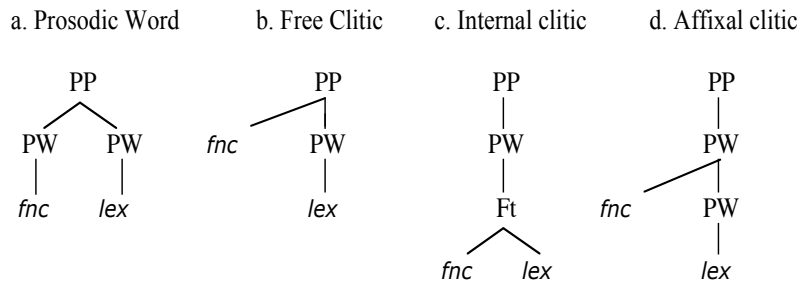


Figure 2. The Prosodic Structure of Grammatical Function Items

We have argued here for a prosodic explanation for the variability in children's early production of determiners. That is, determiners will be produced earlier in those contexts where they are prosodically licensed. Further support for this position comes from some of the individual variation found, where one child underwent prosodic reorganization during the course of the study. Could there, however, be an alternative, non-linguistic explanation of the data presented here? For example, perhaps the contexts in which determiners were more likely to be produced (the Footed contexts) were shorter than the contexts where Unfooted determiners were attempted.

To evaluate this possibility we compared the number of words in target Footed and Unfooted contexts. We found that the length of the target Footed contexts were longer than the Unfooted contexts for all the children. We then considered the length of the utterances in which determiners were actually produced. Again, the length of the utterances with Footed determiners was longer for all the children, except for one where there was no difference. Thus, there appears to be no support for a non-linguistic explanation of the findings.

5. Conclusion

The goal of this paper was to investigate the possibility that some of the variability found in children's spontaneous production of determiners would be due to prosodic licensing effects. Thus, we predicted that, as found in Gerken (1996), children would be more likely to produce determiners in contexts where these could be metrically prosodified as part of a disyllabic foot. To carry out this study we examined longitudinal spontaneous production data from 5 children aged 1;4 – 2;4. We found that 4 of the children showed exactly the pattern predicted, exhibiting a high early use of determiners in prosodically licensed contexts. The fifth child showed a different pattern, indicating that she was not prosodically licensing Footed determiners until the age of 2. This was confirmed with acoustic (durational) measurements, showing prosodic reorganization of the child's grammar at this point in time. Further analyses ruled out possible non-linguistic (length effect) explanations of the data.

The findings from the present study therefore provide further crosslinguistic support for the hypothesis that some of the variability found in children's early production of grammatical morphemes is systematic and predictable, and that this is due to linguistic, not non-linguistic factors. Specifically, it shows that children's early use of determiners is subject to phonological, or prosodic constraints. This suggests that children may have earlier syntactic knowledge of certain grammatical morphemes than typically thought. This raises important questions for theories of syntactic development, as well as methodological issues for designing syntactic experiments.

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