Demuth, K. 1996. The prosodic structure of early words. In J. Morgan & K. Demuth (eds.), *Signal to Syntax*: *Bootstrapping from Speech to Grammar in Early Acquisition*. Mahwah, N.J.: Lawrence Erlbaum Associates. pp. 171-184.

11 The Prosodic Structure of Early Words

Katherine Demuth
Brown University

Within the past few years researchers have begun to examine children's early word productions as a source of evidence regarding how and when linguistically meaningful prosodic representations are constructed (Demuth, 1992, 1993, 1994; Fee, 1992; Fikkert, 1992, 1993; Wijnen, Kirkhaar, & den Os, 1994). In this chapter I show that children's early productions, while often ill-formed from a segmental, syllabic, or morphological point of view, are nonetheless prosodically well-formed. I demonstrate how early 'errors', as well as the growing sophistication in children's productions over time, can be understood by appealing to recent developments in phonological theory, specifically those dealing with the prosodic organization of words (e.g. Selkirk, 1984; Nespor & Vogel, 1986; Hayes, 1987; McCarthy & Prince, 1986, 1990, 1991). Viewed in this way it appears that children's input representations are well-formed, but that they actively exploit different levels of prosodic structure, using these to organize their early speech productions.

The chapter proceeds as follows: First I present some of the commonly found early word structure 'errors' found in English, Dutch, Sesotho, a southern Bantu language, and K'iche' Maya. I then review some of the proposed perceptual and articulatory explanations regarding the 'telegraphic' nature of early speech, and show that these cannot account for the crosslinguistic findings regarding the shape of early words. In the next section I discuss recent work in prosodic phonology and morphology, and show that children's early word-formation 'errors' conform to language-particular instantiations of what I call the Minimal Word Constraint. Finally, I sketch a Prosodic Model of Production to account for the shape of children's early words, and for the gradual move toward adult-like forms.

THE SHAPE OF EARLY WORDS

Language acquisition researchers have long noted that children tend to omit closed class grammatical function items in early speech (Bloom, 1970; Brown, 1973). More recently, however, it has been observed that children do not

consistently omit all function items, but rather that some function items, as well as other 'weak' (unstressed) syllables, only appear in certain contexts (Demuth, 1992, 1994; Gerken 1991; Gerken & McIntosh, 1993; Peters & Menn, 1993; Pye, 1983; Wijnen, Kirkhaar & den Os, 1994). Furthermore, this variability in the early production of certain 'weak' syllables is found not only in English, but in languages as different as Dutch, Sesotho, and K'iche'. I briefly review some of these findings below.

Echols & Newport (1992) note that English-speaking children tend to include stressed syllables and final syllables in their early speech productions. Gerken (1991, 1993) provides a metrical explanation for these facts, showing that children's utterances tend to be organized into strong-weak disyllabic feet, and that this holds not only at the word level, but at the sentence level as well. Although stressed syllables are undoubtedly important at a perceptual level, prosodic constituency of a strong-(weak) trochaic foot appears to play a critical role in the organizational of (at least) English-speaking children's early words and utterances. This prosodic perspective helps capture the fact that children at the early stages of language development frequently omit certain types of functional morphology (be they prefixes or suffixes) and other pretonic unstressed syllables. Typical examples of children's utterances at the one word stage are given in (1), where Echols & Newport (1992:206) report that stressed and final syllables are generally preserved.

(1)	Child	Adult Target
	[raisə]	eraser
	[èlfʌn]	elephant

Fee & Ingram (1982) also report that some English-speaking children's early words exhibit the use of a reduplication strategy to form disyllabic forms from monosyllabic words (C_1V_2 → $C_1V_2C_1V_2$). Note that both the examples in (1) and the reduplication strategy result in disyllabic word forms.

Somewhat similar findings come from children at the same MLU learning Dutch, but the characterization of their early words is somewhat more complex. Given a word like *andere* 'other', with a SWW (strong-weak-weak) stress pattern, children will produce a SW disyllabic form, but the weak syllable may be either the medial or the final, contrary to predictions by Echols & Newport (1992) that stressed and *final* syllables are the ones preserved. Consider the following Dutch examples from Wijnen, Kirkhaar & den Os (1994):

(2)	Child	Adult Target	
	['sikhʌys]	ziekenhuis	'hospital'
	['o:xɑnt]	olifant	'elephant'
	['AnRə] ~ ['Andə]	andere	'other'

Furthermore, Dutch-speaking children have a tendency to transform monosyllabic words into a trochaic foot, either by inserting a vowel between two coda consonants (CVCC → CVCVC), or by adding a vowel to a closed syllable ((C)VC → CVCV). These epenthetic processes are shown in (3).

(3)

Child	Adult Target	
[ˈjoeRək]	jurk	'dress'
[ˈmɛlək]	melk	'milk'
[ˈomə]	oom	'uncle'
[ˈbálə]	bal	'ball'

Thus, Dutch-speaking children have both apocope (deletion) and epenthesis (addition) strategies for transforming early words into disyllabic, trochaic feet (see Fikkert (1993) for more detail).

Early words in Sesotho are also disyllabic, even though Sesotho has no word-level stress. Connelly (1984:73-74) reports that early words in the southern Bantu language Sesotho are typically disyllabic. Consider the following examples, where syllable boundaries are marked by '.', and morpheme boundaries between noun class prefixes and nominal stems are marked by '-':

(4)

Child	Adult Target	
ta.te	n.ta.te	'father'
tim.pa	ma.-sim.ba	'chips'
tee.te	che.le.te	'money'

Sesotho has no word level stress, only penultimate lengthening at phrase boundaries (Doke & Mofokeng, 1957). However, penultimate lengthening works somewhat like stress in that both assign *prominence* to a syllable. Productions in the one-word stage in Sesotho can therefore be represented by a strong-weak trochaic foot, just like that shown for English and Dutch. Children's utterances at the two-word stage, however, where both words are part of the same noun phrase, show that even words that are not phrase final nonetheless surface as disyllabic, as seen in (5) (from Demuth (1988:313).

(5)

Child	Adult Target	
ko.lo sa.-ne	se.-ko.lo sa.-ne	'school that'
po.nko la.-ne	le.-pho.qo la.-ne	'green corn stalk that'

Note that the agreement form on the child's demonstrative pronouns (*sa-*, *la-*) takes the appropriate morphophonological shape even though the nominal

class/gender prefix (*se*-, *le*-) is missing on the noun itself. This will become important in the following section.

The examples in (5) indicate that the disyllabic foot has an importance in Sesotho which is independent of syllabic prominence *per se*, and that preservation of disyllabic feet is a more general word-level phenomena.

The one-word stage in K'iche', however, looks very different from equivalent stages of English and Dutch. K'iche' has word final stress, and young children's first words are monosyllabic, as shown in (6) (Pye 1992:303-4).

(6)

Child	Adult Target	
lom	jolom	'head'
met	lemet	'bottle'
kop	chikop	'animal'
'ik	wa'ik	'eat'

In sum, the foregoing examples show that there is some variation across languages in the shape of early words. In particular, they show that it is not only stressed and final syllables that are retained (e.g. Dutch (2), Sesotho (5)), nor is a trochaic bias universal (e.g. K'iche' (6)). Rather, the shape of early words appears to vary across languages, but in a restricted fashion. I suggest that the shape of early words is constrained by principles of universal grammar, but also varies according to the prosodic characteristics of word structure in the language being learned. If this is true, then children's initial words provide evidence for the early construction of prosodic representations. In the following sections I provide evidence for these proposals. First, however, I consider some of the traditional proposals that have been given for the shape of early words and show that these cannot account for the crosslinguistic data presented above.

PERCEPTUAL AND ARTICULATORY PROPOSALS FOR THE SHAPE OF EARLY WORDS

Several proposals have been offered to account for the omission of certain (unstressed) syllables/words and the presence of strong-weak trochaic foot structures observed in early child speech. Most appeal to perceptual or articulatory factors, though there have also been recent proposals regarding the syntactic impoverishment of early grammars (see Demuth, 1994 for a review). In the following section I consider some of the proposed explanations for the shape of early words, and show that they cannot account for data like those presented in (1) - (6).

Perceptual Constraints

Given the increased pitch, amplitude and duration of English stressed syllables, plus the occurrence of vowel reduction in English unstressed syllables, it has been proposed that children's omission of unstressed syllables might be due to the low perceptual salience of such items (e.g. Gleitman & Wanner, 1982; Echols & Newport, 1992). However, several factors indicate that this is not the case. First, it has been shown that children understand connected discourse better when it includes stressless grammatical function items than when those items are omitted or replaced with nonsense elements (Petretic & Tweney, 1977; Shipley, Smith & Gleitman, 1969). Furthermore, the variable appearance or omission of functional items in children's speech suggests that the problem is not perceptual: English-speaking children consistently select the grammatically appropriate form of the auxiliary in tag questions, even when the auxiliary in the main clause is omitted (e.g. *That making noise, isn't it?* - Radford, 1994), and Sesotho-speaking children consistently select the appropriate agreement form for demonstratives and possessives, even when they omit the class/gender prefix on the noun, as shown in (5) (Demuth 1992, 1994). Furthermore, it is not always the case that children omit entire syllables: Rather, two syllables are often reduced to one, with parts of each syllable (onsets, nuclei, codas) remaining in the resulting syllable form. For example, in Sesotho the preverbal subject marker *ke-* and the future tense marker *-tla-* frequently surface as one syllable *ka-*, where the onset consonant from the first syllable is joined with the vowel nucleus from the second. Similar examples of syllabic 'merger' have been reported in early Dutch - e.g. *microfoon* > [mi'kRon] 'microphone' (Wijnen, Kirkhaar & den Os, 1994). Such cases indicate that children *perceive* the segments of the syllables they omit. In short, the data from children's early productions are compatible with the possibility that children already have adult-like segmental representations, and use this knowledge in the construction of early words. If this is true, then an alternative explanation must be found for the omission of syllables in early speech.

Articulatory Constraints

Given English-speaking children's apparent bias for producing disyllabic trochaic feet, Allen & Hawkins (1980) proposed that the omission of syllables in early child speech has an articulatory explanation, where children's productions are limited to two (strong-weak) syllables. Such a proposal has at least two problems. First, it is inconsistent with the fact that prior to the onset of first words children generally babble in sequences of syllables, showing no disyllabic upper bound on the forms they produce (e.g. Menyuk, Menn & Silber, 1986; Vihman, 1976). That is, there seems to be no principled articulatory prohibition on, say, trisyllabic forms at the babbling stage. Second, Allen & Hawkins (1980) propose that the trochaic nature of early speech is universal - applicable to the early stages of development in all languages. This

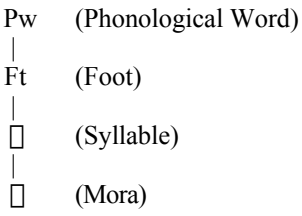
proposal obviously runs into problems with the early monosyllabic structures of stress-final languages like those of K'iche' shown in (6). Rather, it would appear that the prosodic structure of K'iche' itself may influence the monosyllabic nature of children's early words.

In short, neither perceptual nor articulatory explanations capture the crosslinguistic findings on the shape of children's early words. In the next sections I draw on recent developments in prosodic phonology to show that there is a unified, prosodic explanation for both the variable omission of grammatical function items and other weak syllables in early child speech, and the apparent constraint on maximally disyllabic forms. In other words, the shape of children's early words provides evidence of both access to universal grammar and a sophisticated prosodic awareness of the language being learned.

THE MINIMAL WORD

Research in the area of prosodic phonology has begun to identify hierarchical prosodic domains in language, both at the level of the word, and at higher phrasal and utterance levels (e.g. Nespor & Vogel, 1986; Selkirk 1984). In the following discussion I restrict comments primarily to word-level phenomena. Consider the Prosodic Hierarchy in (7) (Selkirk 1980a, 1980b).

(7) Prosodic Hierarchy



The Prosodic Hierarchy captures the fact that the phonological word is composed of at least one binary foot, where a foot is composed of either two syllables (e.g. CVCV) or two moras (e.g. CVV, CVC). Note that a long vowel (including tense vowels and diphthongs) or a closed syllable counts as two moras and constitutes a foot, even though only one syllable is involved. Thus, monosyllabic English content words such as *buy*, *dog*, and *see* are all bimoraic forms that constitute a well-formed foot.

Recent work in prosodic phonology has demonstrated that there is abundant crosslinguistic motivation for a prosodic unit found to consist minimally of a binary foot, and that this 'minimal word' is the prosodic unit to which different prosodic and morphological processes apply (cf. Broselow, 1982; McCarthy & Prince, 1986, 1990, 1991; Prince, 1980, - see McCarthy & Prince (in press) for review). This means that, crosslinguistically, open class items (nouns, verbs, adjectives, adverbs) must contain sufficient phonological information, i.e. at

least a binary foot composed of two syllables or two moras, to be classified as a legitimate word. In Sesotho, evidence for the minimal word comes from both the verbal and nominal domain. This can be seen most readily by examining imperative verbs which generally take the bare stem form as in (8a). However, if the verb stem is monosyllabic, as in (8b), the imperative must affix an extra vowel to make the form disyllabic: This can be done either by prefixing an epenthetic '*e*-', or by lengthening the final vowel of the stem.

(8)	*Infinitive*		*Imperative*	
a.	ho-reka	'to buy'	reka	'buy!'
b.	ho-ja	'to eat'	e̲ja ~ jaa̲	'eat!'

Given the crosslinguistic evidence for the minimal word, and given the fact that this minimal word is a binary foot, the crosslinguistic findings on children's early word structures take on new significance. Recall that the majority of words produced in early English, Dutch, and Sesotho were disyllabic forms. Children showed two types of 'strategies' in producing such forms: Syllables were either deleted (processes of apocope - e.g. English (1), Dutch (2), and Sesotho (4, 5)), or syllables were added (processes of epenthesis - e.g. Dutch (3)). In both cases, children used adult input forms (i.e. full lexical representations) to create their own disyllabic output form. It would therefore appear that children's early words are sensitive to what I have called the Minimal Word Constraint (Demuth, 1992, 1994). A similar proposal has been independently advanced by Fee (1992) on the basis of evidence from the acquisition of English and Spanish.

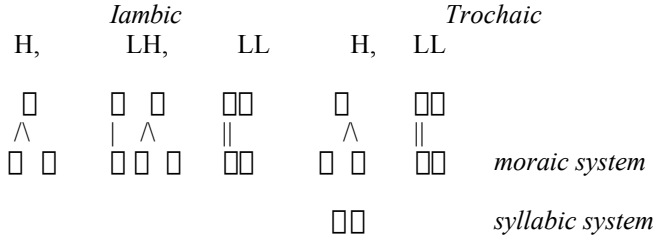
The proposal that children's early words respond to the Minimal Word Constraint raises several questions. First, how does one explain the monosyllabic nature of early words in K'iche'? Second, how do Dutch-speaking children recover from 'overgeneralizations' where an extra syllable is added to a monosyllabic target form, as in (3)? And finally, how does one account for the fact that children eventually come to produce adult-like target forms? In the following sections I show that the answer to the first question comes from the realization of possible foot structures, while the last two questions can be handled by appealing to a theory of learning that allows for the progressive relaxation of prosodic constraints.

THE REALIZATION OF FEET

Crosslinguistic research on metrical foot structure has shown that feet can be realized by any of the following configurations, where phonological weight is quantified as either heavy (H = 2 moras) or light (L = 1 mora) (Hayes, 1987; McCarthy & Prince, 1986). Note that there are many moraic systems, where the 'weight' of a syllable, or syllable quantity, plays a critical role in stress assignment. In contrast, languages where there is no word-level stress, and

where quantity is irrelevant to the construction of feet, can be represented by two syllables only.

(9) Possible Foot Types



Note that both iambic and trochaic feet may be composed of just one heavy syllable (i.e. two moras), thereby still constituting a binary foot. Thus, the early CVC forms found in K'iche' constitute a binary foot, and conform to the Minimal Word Constraint. Note also that both iambic and trochaic feet can be composed of two light syllables. In the iambic case the right-most mora would be the head of the foot, while in the trochaic case the head would be the left-most. If a language is stress sensitive, it would be these right-most and left-most heads that would receive stress respectively (e.g. L'L = iambic, 'LL = trochaic).

Note further that it is only trochaic feet that can be oblivious to weight. That is, a form that is composed of two syllables, where the language does not consider weight in the construction of feet (i.e. is quantity insensitive), will receive a trochaic interpretation by default. Such is the case for languages like Sesotho, where no lexical stress is assigned. In other words, the trochaic syllabic foot is the 'default' form used for the construction of feet.

The metrical structures of English, Dutch, and Sesotho are trochaic (cf. Selkirk, 1984, van der Hulst, 1984, and Kager, 1989; Doke & Mofokeng, 1957 respectively), whereas the structure of K'iche' is iambic, with final stress. Given the typology of feet in (9), one can now see why early words in English, Dutch, and Sesotho are disyllabic, but those in Maya K'iche' are not: The minimal word in early English and Dutch appears to be a stress sensitive disyllabic foot. In Sesotho, stress is not a lexical phenomena, nonetheless disyllabic feet are constructed by default. In contrast, the minimal word in K'iche' allows for one heavy, monosyllabic foot, resulting in the monosyllabic stressed syllables seen in (6). In other words, the shape of children's early words appears to be constrained by the prosodic realization of foot structure in the language begin learned.

Given the high perceptual salience of stress, with increased duration, amplitude, and pitch excursions, one might predict that children learning languages with lexical stress would pass the default syllabic stage and move directly to the stress sensitive assignment of trochaic or iambic feet. But the

correct realization of lexical stress in languages like English and Dutch is also sensitive to syllable weight, that is, they are 'quantity sensitive' languages. Furthermore, the characterization of heavy syllables is subject to language variation: Whereas open syllables (e.g. CV) are generally light, closed syllables (CVC), syllables with branching coda (CVCC), or syllables with long or tense vowels (CVV), may or may not be considered 'heavy' in a given language. For example, in English only syllables with a branching coda (e.g. CVCC) are considered heavy enough to influence the placement of stress. Children must therefore learn what constitutes a heavy syllable for a given language and the role these syllables play in the construction of minimal words (see Fee, 1992). Fikkert (1993) and Wijnen, Kirkhaar & den Os (1994) attribute changes in the structure of early words to children's developing awareness of what constitutes a heavy syllable in Dutch. Thus, children's early word structures may change as they learn more about how syllable weight is realized in a given language, all the while conforming to the minimal word constraint.

It is now possible to make predictions about the course of acquisition. First, trochaic syllabic structures may be used as a first pass at organizing prosodic words, a default possibility given by Universal Grammar. Second, for languages in which lexical stress is assigned, children will easily determine that stressed syllables are the heads of feet, and will organize their early words as either iambic or trochaic accordingly. Finally, for those languages where syllable weight plays a role, we expect to find some reorganization in the syllables that occur in children's early words. This is found not only in Dutch, but also in English, where disyllabic CVCV forms gradually give rise to bimoraic CVC forms (Fee, 1992). These three 'stages' of development are outlined below:

(10) The Early Development of Prosodic Words

	Linguistic Awareness	*Shape of Minimal Words*
Stage 1.	Default (UG)	Trochaic syllabic feet
Stage 2.	Stress sensitivity	Iambic or Trochaic feet
Stage 3.	Weight sensitivity	Reorganization of syllables included in feet

Given the perceptual salience of stress, it may be that children learning languages where stress is relevant will pass the 'default' Stage 1 and move directly to the stress-sensitive Stage 2. Stage 3 will only be reached once the language particular encoding of what constitutes a heavy syllable has been learned.

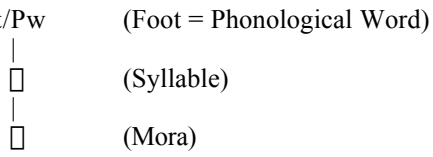
FROM MINIMAL WORDS TO PHONOLOGICAL WORDS

In the foregoing sections samples of early words from several different languages were presented. In each case the shape of the early words is consistent with the possibility that children have early access to the notion binary foot, or Minimal Word. Why should children's early words conform to a Minimal Word? There are at least two possibilities: First, there is emerging evidence from the perception literature that infants are aware of both prosodic structure at the phrasal level (Jusczyk, Kemler Nelson, Hirsh-Pasek, Kennedy, Woodward, & Piwoz, 1992) and rhythmic structures at the word level (Mehler, Dehaene-Lambertz, Dupoux & Nazzi, this volume; Morgan, in press). In attempting their first words children may give priority to rhythmic well-formedness, even at the cost of sacrificing semantic content. Second, Fee (1992), Fikkert (1994) and Wijnen et al. (1994) have found that children using Minimal Words demonstrate a growing awareness of the language particular relationship between stress and syllable weight, and that this also influences the shape of early words. It might be that the Minimal Word stage provides a constrained learning space for children, where they can gradually resolve language particular instantiations of foot structure including head direction (iambic vs. trochaic), parsing direction (right > left, left < right), stress, and weight.[1]

But children eventually move beyond the Minimal Word stage to produce word structures that are more adult-like. Why and how does this take place? I suggest that the answer may relying on the notion of changing prosodic representations, where change would be triggered by children's growing awareness of prosodic structure at the level of the foot.

One possibility for the move from Minimal Words to phonological words is that children's prosodic hierarchy changes. It could be that children's early prosodic hierarchy may differ from that of the adult, being more like that in (11), where the Prosodic Word and the Foot are collapsed into one, undifferentiated level of structure.[2]

(11) Child's Initial Prosodic Hierarchy



If children's early representation of phonological words is identical to the foot, or Minimal Word, it is no surprise that the Minimal Word is also the *Maximal Word* that is prosodically licensed. Later, as children's prosodic awareness develops, the structure of the phonological word becomes more fully articulated, allowing inclusion of extrametrical syllables and the possibility of more than one foot. At this later stage of development children begin to produce words

with more than two syllables and to include closed class grammatical function items into their phonological words. In other words, the phonological word is no longer constrained to being only a Minimal Word, or foot. Rather than constituting the *maximal upper bound* on the shape of phonological words, the Minimal Word Constraint now assumes its role as a truly *minimal constraint* on the shape of phonological words, as it does in adult grammars. The progressive development of representations within the Prosodic Hierarchy is presented in (12), where the foot at Time 1. is the maximal form a phonological word can take, whereas the foot at Time 2. is the minimal form a phonological word can take.

(12) Prosodic Model of Production

Time 1.		*Time 2.*
Ft/Pw	>	Pw | Ft

In sum, children begin with word structures that are well-formed from a prosodic point of view given the nature of the initial Prosodic Hierarchy. As their linguistic awareness of the Prosodic Hierarchy increases, so do the possible word structures they employ. Children's early grammars therefore contain only a subset of the possible prosodic structures provided by Universal Grammar. Given that the Minimal Word is a universal unit found in all languages, it is not surprising that children's first words take this shape. Children must then learn, on a language by language basis, the higher level prosodic structure of words, and this takes place after issues of quantity sensitivity and stress assignment have been determined.

DISCUSSION

In this chapter I have shown that children learning languages as different as English, Dutch, Sesotho, and K'iche' all have early sensitivity to the prosodic structure of words. I suggest that this sensitivity comes in part from Universal Grammar, which provides children with the linguistic notion of the Minimal Word as a binary foot. This accounts for the fact that minimal word structures are created in the early speech of children in all of the above languages, either through processes of epenthesis (syllable addition) or apocope (syllable deletion). However, I also show that part of children's early sensitivity to prosodic structure is language particular, thereby accounting for the early trochaic structures in English, Dutch and Sesotho, but the early iambic structures in K'iche'.

These findings are interesting in light of previous perception and production/articulation proposals regarding the nature of early words.

Perception proposals cannot account for the variable inclusion of weak syllables in Dutch (3), the appearance of correct agreement forms on nominal modifiers in Sesotho (5), nor the case of 'merger' reported in both languages. Similar arguments to this effect have been made for K'iche' (Pye, 1983) and English (Gerken, 1993). Production/articulatory constraint proposals are also problematic in suggesting that the limit on a maximally binary structure is an articulatory one: Such a proposal is incapable of explaining why in K'iche' this limit is one syllable and not two, and it would predict that in Sesotho, with no lexical stress, any two syllables could satisfy the binarity constraint. Rather, the evidence presented here points strongly to the fact that children's early words are not randomly truncated forms, but well organized Minimal Words. Early Minimal Words therefore provide evidence of children's construction of prosodic representations - representations which are sensitive both to the properties of Universal Grammar, and to language particular instantiations of foot structure.

If these proposals are correct, several questions arise. First, if children's input representations are segmentally well-formed, why do their output forms adhere to the Maximal Word Constraint? Do they go through a transduction process as proposed by Kiparsky & Menn (1977)? Second, how do children eventually come to produce words of more than one or two syllables? I suggest that both questions can be answered by appealing to the prosodic hierarchy, where children's initial prosodic structure equates the phonological word with the foot. Whether children at this stage actually have an 'impoverished' version of the prosodic hierarchy, or whether they employ this simplified hierarchy to create a constrained linguistic space from which to investigate interactions between foot construction, syllable weight, and the assignment of stress, we do not know. It does appear, however, that young children's early word productions are prosodically well-formed, and that they use this stage of development to learn more about the prosodic structure of the language being acquired.

I conclude, therefore, that the child is an active participant in the construction of early words, exploiting language particular properties of prosodic structure, while at the same time being constrained by the universal properties of Minimal Words. Given recent developments in Optimality Theory (Prince & Smolensky, 1993), where languages are hypothesized to differ primarily in the ordering and satisfaction of constraints, we might see the acquisition of phonological words as one in which 'constraints' on the realization of prosodic structure are reorganized over time. That is, while both foot and phonological word structures are initially satisfied by the Minimal Word Constraint, the phonological word eventually comes to be ranked higher than the foot, and must be satisfied accordingly.

ACKNOWLEDGMENTS

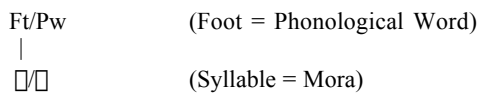
Earlier versions of this paper were given at the 17th Boston University Conference on Language Development, Johns Hopkins University, and McGill University. I

thank those audiences, Jane Fee, Paula Fikkert, and Jim Morgan for fruitful comments and discussion.

NOTES

[1]See Dresher (this volume), for further discussion of these issues, and Dresher & Kaye (1990) for a parameterized computational model for learning stress systems.

[2]A fuller treatment of these issue might also posit the syllable and the mora as undifferentiated at the earliest levels of structure, as suggested by Fee (1992). Thus, a more constrained prosodic hierarchy for young children might look something like the following:



REFERENCES

Allen, G. & S. Hawkins. (1980). Phonological rhythm: Definition and development. In G. Yeni-Komshian, J. Kavanagh & C. Ferguson (eds.), *Child Phonology*, Vol. 1, 227-256.

Bloom, L. (1970). *Language development: Form and function in emerging grammars*. Cambridge, MA: MIT Press.

Broselow, E. (1982). On the interaction of stress and epenthesis. *Glossa*, **16**, 115-132.

Brown, R. (1973). *A first language: The early stages*. Cambridge, MA: Harvard University Press.

Connelly, M. (1984). *Basotho children's acquisition of noun morphology*. PhD dissertation. Cochester: University of Essex.

Demuth, K. (1988). Noun Classes and Agreement in Sesotho Acquisition. In M. Barlow & C. Ferguson (eds.), *Agreement in Natural Languages: Approaches, Theories and Descriptions*. CSLI: University of Chicago Press. pp. 305-321.

Demuth, K. (1992). Accessing functional categories in Sesotho: Interactions at the morpho-syntax interface. In J. Meisel (ed.), *The Acquisition of Verb Placement: Functional Categories and V2 Phenomena in Language Development.* Kluwer Academic Publishers: Dordrecht. pp. 83-107.

Demuth, K. (1993). Issues in the Acquisition of the Sesotho Tonal System. *Journal of Child Language*, **20**, 275-301.

Demuth, K. (1994). On the 'underspecification' of functional categories in early grammars. In B. Lust, M. Suñer & J. Whitman (eds.), *Syntactic theory and first language acquisition: Cross-Linguistic perspectives*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Doke, C. M. & Mofokeng, S. M. (1957). *Textbook of Southern Sotho grammar*. Cape Town: Longman.

Dresher, E. & J. Kaye. (1990). A computational learning model for metrical phonology. *Cognition*, **34**, 137-195.

Echols, C. & Newport, E. (1922). The role of stress and position in determining first words. *Language Acquisition*, **2**, 189-220.

Fee, E. J. (1992). Exploring the minimal word in early phonological acquisition. Proceedings of the 1992 Annual Conference of the Canadian Linguistics Association. To appear.

Fee, E. J. & D. Ingram. (1982). Reduplication as a strategy of phonological development. *Journal of Child Language* **9**, 41-54.

Fikkert, P. (1992). The acquisition of Dutch stress. Paper presented at the 17th Conference on Language Development, Boston University.

Fikkert, P. (1993). *On the acquisition of prosodic structure*. Ph.D. dissertation, University of Leiden.

Gerken, L. A. (1991). The metrical basis of children's subjectless sentences. *Journal of Memory and Language*, **30**, 431-451.

Gerken, L. A. (1993). Young children's representation of prosodic structure: Evidence from English-speakers' weak syllable productions. *Journal of Memory and Language.* **32**.

Gerken, L. A. & B. McIntosh. (1993). The interplay of function morphemes and prosody in early language. *Developmental Psychology*, **29**, 448-457.

Gleitman, L. & E. Wanner. (1982). The logic of language acquisition. In E. Wanner & L. Gleitman (eds.), *Language acquisition: The state of the art*. Cambridge: Cambridge University Press.

Hayes, B. (1987). A revised parametric metrical theory. In J. McDonough & B. Plunkett (eds.), *Proceedings of NELS 17*, pp. 274-289). Amherst, MA: Graduate Linguistic Student Association, University of Massachusetts.

Jusczyk, P., Kemler Nelson, D., Hirsh-Pasek, K., Kennedy, L., Woodward, A., & Piwoz, J. (1992). Perception of acoustic correlates of major phrasal units by young infants. *Cognitive Psychology*, **24**, 252-293.

Kiparsky, P. & L. Menn. (1977). On the acquisition of phonology. In J. Macnamara (ed.), *Language learning and thought*. New York: Academic Press. pp. 47-78.

Kager, R. (1989). *A metrical theory of stressing and destressing in English and Dutch*. Dordrecht: Foris Publications.

McCarthy, J. & A. Prince. (1986). Prosodic morphology. Ms, University of Massachusetts and Brandies University.

McCarthy, J. & A. Prince. (1990). Foot and word in prosodic morphology: The Arabic broken plural. *Natural Language and Linguistic Theory*, **8**, 209-283.

McCarthy, J. & A. Prince. (1991). Prosodic minimality. Paper presented at the University of Illinois Conference *The Organization of Phonology*.

McCarthy, J. & A. Prince. (in press). Prosodic morphology. In J. Goldsmith (ed.), *Handbook of Phonology*. Oxford: Blackwell's.

Menyuk, P. Menn, L., & Silber, R. (1986). Early strategies for the perception and production of words and sounds. In P. Fletcher & M. Garman (eds.), Language Acquisition. Cambridge: Cambridge University Press. pp. 198-222.

Morgan, J. (in press). Converging measures of speech segmentation in preverbal infants. *Infant Behavior and Development*.

Nespor, M. & Vogel, I. (1986). *Prosodic phonology*. Dordrecht: Foris Publications.

Peters, A. & Menn, L. (1993). False starts and filler syllables: Ways to learn grammatical morphemes. *Language* **69**, 742-778.

Petretic, P., & Tweney, R. (1977). Does comprehension precede production? The development of children's responses to telegraphic sentences of varying grammatical adequacy. *Journal of Child Language*, **4** 201-209.

Prince, A. (1980). A metrical theory for Estonian quantity. *Linguistic Inquiry*, **11**, 511-562.

Prince, A. & P. Smolensky. (1993). Optimality Theory: Constraint Interaction in Generative Grammar. Ms., Rutgers University, New Brunswick, and University of Colorado, Boulder.

Pye, C. (1983). Mayan telegraphese: Intonational determinants of inflectional development in Quiche Mayan. *Language*, **59**, 583-604.

Pye, C. (1992). The acquisition of K'iche' Maya. In D. Slobin (ed.), *The Cross-Linguistic Study of Language Acquisition*, vol 3. Hillsdale, N.J.: Lawrence Erlbaum Associates. pp. 221-308.

Radford, A. (1994). Tense and agreement variability in child grammars of English. In B. Lust, M. Suñer & J. Whitman (eds.), *Syntactic theory and first language acquisition: Cross-Linguistic perspectives*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Selkirk, E. (1980a). Prosodic domains in phonology: Sanskrit revisited. In M. Aronoff & M-L. Kean (eds.), *Juncture*. pp. 107-129. Saratoga. CA: Anma Libri.

Selkirk, E. (1980b). The role of prosodic categories in English word stress. *Linguistic Inquiry*, **11**, 563-605.

Selkirk, E. (1984). *Phonology and syntax: The relation between sound and structure*. Cambridge, MA: MIT Press.

Shipley, E., Smith C., & Glietman, L. (1969). A study in the acquisition of language: Free responses to commands. *Language*, **45**, 322-342.

van der Hulst, H. (1984). S*yllable structure and stress in Dutch*. Dordrecht: Foris Publications.

Vihman, M. (1976). From prespeech to speech: On early phonology. In *Stanford Papers and Reports on Child Language Development*, **12**, 230-44.

Wijnen, F., Krikhaar, E., & den Os, E. (1994). The (non)realization of unstressed elements in children's utterances: Evidence for a rhythmic constraint. J*ournal of Child Language* , **21**, 59-83.