Minimal Prosodic Words in Early Phonological Development

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It has long been noted that children's early words often differ in syllabic shape from the adult target form. Perception and production proposals fail to account for the variation in shape that a given word may take, and neither provides a framework for understanding how children's word shapes develop over time. In this article we demonstrate how a more abstract, phonological account of children's early words can provide a unified treatment of these phenomena. Drawing on recent developments in Prosodic Phonology we show that Dutch and English-speaking children's early words take the form of linguistically wellformed units of the Prosodic Hierarchy, and that children's ability to use these prosodic units develops systematically over time. Most interestingly, we find that children go through an early stage of prosodic word development where words are minimally and maximally a Minimal Prosodic Word, or binary foot.

1. Introduction. Ever since the earliest studies of child language, researchers have noted that the shape of children's early words often differs from the adult target. Sometimes early words have an extra syllable (viz. dog > [dada]), and sometimes they are truncated in form, with certain unstressed syllables missing (viz. banana > [nænə]).[1] Little is know about how and why children produce these types of early words. This is partly due to an early emphasis on segments within theoretical phonology (e.g. Chomsky & Halle 1968) and the subsequent research focus on segmental rather than prosodic aspects of early phonological development (cf. papers in Yeni-Komshian, Kavanagh & Ferguson 1980, Ferguson, Menn & Stoel-Gammon 1992). This focus has also resulted in a lack of data needed to address these questions, that is, phonetically transcribed longitudinal data from children between the ages of 1-3.

Nonetheless, a few proposals have been offered for why children's early words take the (often bisyllabic) shapes that they do. One of these is the 'rhythmic production

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[1] We restrict ourselves here to a discussion of monomorphemic word forms. Many of the issues discussed in this study will also apply to morphologically complex forms, though some of the details may differ.

constraint' where Allen & Hawkins (1978, 1980) proposed that children's early word forms universally take the shape of trochaic (strong-weak) feet. Evidence from the acquisition of both English (cf. Gerken 1991, 1994) and Dutch (Wijnen, Krikhaar & den Os 1994) seems to support such a proposal, though these data generally come from children older than those examined in the present study. Others have observed that children tend to omit non-final unstressed syllables, and have suggested that this is due to the low perceptual salience of these forms rather than a production problem (e.g. Echols & Newport 1992, Echols 1993).

In this article we argue that neither the perception nor the production proposals provide an entirely accurate description of the shapes of children's earliest words. Most critically, neither provides a theoretical explanation for why this particular stage of development should exist, nor how children eventually move beyond it. We attempt to remedy this situation by developing an explanatory account for the shape of children's early words. We do so by focusing on the development of word-level prosodic structure in children's early speech. Drawing on recent developments in Prosodic Phonology (Selkirk 1984, Nespor & Vogel 1986), we suggest that children's early words take the form of linguistically motivated units of the Prosodic Hierarchy, and that these units become prosodically more complex over time. That is, we propose that children's early words are linguistically wellformed Minimal Prosodic Words, or binary feet (Fee 1992, Demuth 1992, in press-a,b). In so doing, we demonstrate how a more abstract, phonological account of children's early word shapes provides a natural explanation of both inter- and intra-speaker variation in the shape of early words, as well as a framework for handling change over time. Finally, our findings provide a theoretical framework for exploring the prosodic structure of early words crosslinguistically.[2]

The article is organized as follows: In section 2 we briefly discuss issues relating to prosodic structure. In section 3, using longitudinal and cross-sectional spontaneous speech samples from Dutch, we identify Core Syllable and Minimal Word stages of Development. In section 4 we show that the same developmental stages are found in English. In section 5 we explore the transition between Minimal Words and larger

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[2] Other researchers have also noted that prosodic phenomena are important for understanding the course of acquisition (e.g. Waterson 1971, 1987), and that children's early productions are generally attempts at whole-word targets (Macken 1979). Peters (1977,1985) also children may differ in extracting and producing either larger or smaller prosodic units (Gestalt vs. Analytic strategies). Further research will be needed to determine why some children's earliest utterances contain primarily higher-level prosodic structures (e.g. phonological phrases), whereas other children seem to focus on the lower-level phonological word structures discussed here.

prosodic structures in both languages. In section 6 we discuss some of the theoretical implications of our findings. We conclude in section 7 with suggestions for further research.

2. Prosodic Structure. Since the development of autosegmental phonology (cf. Goldsmith 1990), phonologists have shown that many phonological processes take place at a level above that of the segment. One of the earliest developments in prosodic phonology was the realization that words are composed of hierarchically arranged levels of prosodic structure. These are represented in terms of the Prosodic Hierarchy (Selkirk 1984, Nespor & Vogel 1986).

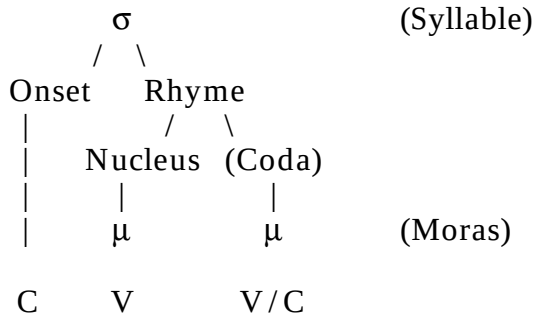
(1) The Prosodic Hierarchy

Pw	(Phonological Word)
|	
Ft	(Foot)
|	
σ	(Syllable)
|	
μ	(Mora)

The Prosodic Hierarchy formalizes the insight that phonological words are composed of feet, which in turn are composed of syllables. Furthermore, syllables may be composed of sub-syllabic units called moras. Although there is some controversy over the phonological status of moraic structure (cf. Hyman 1985, Hayes 1989, Sloan 1991, Kager 1989), it is generally recognized that sub-syllabic structure does exist, and that this structure plays a role in phonotactic processes including stress assignment and word shape in many languages. In this study we are primarily concerned with issues of syllable complexity and its implications for word shape. We therefore use the term mora in the most general sense - as a unit of subsyllabic structure.

Moras are contained in the rhyme of a syllable. The nucleus of the syllable constitutes a mora, and the coda (if there is one) also counts as a mora, as illustrated below.

(2) Syllable Structure



Typically, codas may consist of either consonants or vowels (resulting in a long vowel or diphthong), and this will vary subject to language-particular phonotactic constraints. This means that syllables can potentially be composed of one or two moras. Languages like English permit both monomoraic and bimoraic syllables - that is, codas are optional. However, Bantu languages like Swahili and Sesotho do not permit codas, and syllables are only monomoraic at the lexical level. Spanish lies in between, with a restricted class of consonants permitted in coda position. One of the tasks for the language learner is to determine if bimoraic syllables are permitted in the language being learned, and if so, what types of segmental information can appear in the coda.

Feet, in turn, are constructed of syllables. Although there has been some debate about the nature of feet, we follow Hayes (1995) in assuming that bounded feet are binary at some level of analysis. That is, feet can be composed of two syllables, yielding a bisyllabic foot (3a), or one syllable composed of two moras, yielding a monosyllabic bimoraic foot (3b).

(3) The Structure of Binary Feet

a. Bisyllabic Foot

b. Monosyllabic Bimoraic Foot

In languages like English and Dutch, where codas are permitted, both bisyllabic and monosyllabic bimoraic feet are found. However, in languages like Sesotho, where codas are not permitted, only bisyllabic feet are found.

Interestingly, phonologists have recently begun to find that binary feet play an important role in the structure of words, and that this is true crosslinguistically. Specifically, words - or generally open class lexical items (as opposed to closed class grammatical function items) - must contain at least a binary foot (Broselow 1982, McCarthy & Prince 1986, 1990, 1991, 1994, 1995). That is, words must minimally contain at least two syllables or two moras to be prosodically wellformed. Lexical items that conform to this shape are called Minimal Prosodic Words (henceforth Minimal Words). In English, words (including pronouns) must be at least bimoraic - that is, they are Minimal Words, as shown in (4). Note that the licit monosyllabic forms in (4i) all have a coda consonant, diphthong, or tense vowel (which is long, or bimoraic), while comparable forms with only a short vowel (4ii) are unattested. Note furthermore that the formation of nicknames, or hypocoristics, is a productive process that conforms to this bimoraic Minimal Word (4if,g).

(4) Minimal Words in English

	i. Bimoraic Foot		ii. Monomoraic Foot
a.	/si/	'see'	*/sɪ/
b.	/go/	'go'	*/gɔ/
c.	/mai/	'my'	*/ma/
d.	/ma:/ '	Ma'	*/ma/
e.	/ɪt/	'it'	*/ɪ/
f.	/ɛd/ <	Ed < Edward	*/ɛ/
g.	/lu/ <	Lou < Lewis	

Dutch also has monosyllabic bimoraic Minimal Words. Fikkert (1994) shows that the words in (5i) are prosodically wellformed, whereas that in (5ii) is not.

(5) Minimal Words / Maximal Syllables in Dutch

	i. Bimoraic Foot			ii. Monomoraic Foot
a.	/te:/	thee	'tea	*/tɛ/
b.	/tɛi/	tij	'tide'	
c.	/tɛl/	tel	'second'	
				iii. Ternary Branching Rhyme
d.	/tɛmpo:/		'tempo'	*/te:mpo:/
e.				*/tɛimpo:/
f.				*/tɛlmpo:/

Dutch also has an upper bound on the maximal amount of structure that a syllable can contain (unless the syllable is word-final, and additional segments extraprosodic). That is, Dutch medial syllables must minimally and maximally contain a binary branching rhyme; this accounts for the ungrammaticality of the word shapes in (5iii) (cf. van der Hulst 1985, Kager 1989, Fikkert 1994).

Other languages, such as the southern Bantu language Sesotho, also show Minimal Word effects (Doke & Mofokeng 1957). However, as there are no underlying long/short vowel distinctions, no diphthongs, and no codas, Minimal Words in Sesotho must have two syllables. Although most open class items do contain at least two syllables, a few do not. In the case of monosyllabic verbs like *ho-ja* 'to eat', the infinitival marker *ho* combines with the monosyllabic verb stem *ja* 'eat' to form a prosodically wellformed Minimal Word (6ia). However, in the imperative, the verb stands alone, and is therefore monosyllabic and prosodically ill formed (6ii). Another syllable must be added to the verb stem to make it a licit Minimal Word: This can be done by epenthesizing a vowel either to the beginning or end of the word, as shown in (6ib) and (6ic) respectively.[3]

(6) Minimal Words in Sesotho

	i. Bisyllabic Foot		ii. Monosyllabic Foot	
a.	/ho-já/	'to eat'		
b.	/ejá/	'eat!'	*/ja/	'eat!'
c.	/jáa/	'eat!'		

In sum, languages exhibit Minimal Word effects, where a word must contain at least a binary foot. Languages vary in how they fulfill this requirement: Those that permit branching rhymes, such as English and Dutch, may be composed of either a monosyllabic bimoraic foot or a bisyllabic foot. However, for languages like Sesotho that do not permit branching rhymes, the Minimal Word must be composed of a bisyllabic foot.

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[3] Disyllabic high toned verb roots in the imperative take a High-Low tonal pattern on the first two syllables of the verb stem. That the form in (6ib) takes a Low-High tonal pattern indicates that the epenthetic /e/ was added after the tone melody had been assigned, indicating that epenthesis for the purposes of constructing Minimal Words is an output condition realized at the level of phonetic form - that is, when words are actually pronounced. (<o> and <e> are high mid vowels.)

Given the robust crosslinguistic existence of Minimal Words, we might expect children's earliest words to also be Minimal Words. That is, we might expect the transition between babbling and first words to be marked by the emergence of Minimal Word structures. In fact, both Demuth (in press-a) and Fee (1992) have identified a Minimal Word stage in the development of children's early words. However, both Fee (1992) and Fikkert (1994) also report the early presence of CV forms - a stage in the development of early words that precedes the Minimal Word stage. It would therefore appear that Minimal Words, or binary feet, represent only one stage, albeit an important one, in the prosodic development of children's early words. That is, the Minimal Word stage of development must be understood in the larger context of developing prosodic structures, in accord with the Prosodic Hierarchy.

In the next sections we show that both Dutch- and English-speaking children go through a stage where early words are first sub-minimal, then minimally and maximally a Minimal Word. Furthermore, children's Minimal Words exhibit some variation in shape: Some are composed of bisyllabic feet, even to the extent of adding an epenthetic vowel/syllable, whereas others are monosyllabic bimoraic feet. We then briefly show how children's early word shapes move beyond the Minimal Word stage to a stage of stress feet and then larger prosodic words. Finally, we discuss the theoretical implications of these findings, both in terms of phonological development, and for a theory of acquisition.

3. Prosodic Structure in Early Dutch. In the following two sections we examine the structure of children's early words. We take a longitudinal, developmental perspective from the time of children's earliest words to the point at which word shapes approximate the intended adult target. In so doing, we focus on the development of prosodic, rather than segmental structure.[4] The very nature of this study requires 1) longitudinal data beginning at the onset of first words and lasting till around the age of 3, preferably from several children, 2) data coded with careful attention to phonetic detail, sophisticated enough to encode distinctions in vowel quality and vowel length, and 3) data from more than one language, where the prosodic structure of syllables and feet differ to some degree.

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[4] Although a theory of the development of segmental structure will eventually be needed to complement the present work in a comprehensive theory of phonological acquisition, we suggest that the acquisition of segments is a partially independent problem, and leave it to the side for the moment (see Demuth in press-c for discussion along these lines).

In this study we examine data from two corpora that fulfill the above requirements. The first is data from Fikkert (1994) - a longitudinal, semi-cross-sectional study of eight children acquiring Dutch.[5] The second is English data from three different sources (see section 4). Although some language particular details effect some of the sub-stages of development found for each of these languages, we show that the development of prosodic structure follows the same basic patterns.

3.1. Core Syllables. Dutch-speaking children's earliest words are monomoraic, containing neither coda consonants nor consistent use of vowel length (Fikkert 1994). Although some tokens optionally contain a long vowel, Fikkert notes that vowel length is not used contrastively at this point. We call this Stage I, or the Sub-Minimal Word stage, where early word forms are generally CV in shape.[6] Although the examples in (7) are all drawn from child J, Fikkert reports they are also typical of the other Dutch-speaking children at the earliest stages of word production.

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[5] The data from Fikkert's (1994) study are drawn from three boys - Tom, Jarmo, and Robin, and three girls - Elke, Noortje, and Catootje. Only the children's first initials have been used here.

Child	Ages	Sex
T	1;0.10 - 2;2.2	M
J	1;4.18 - 1;11.8	M
R	1;5.11 - 2;4.28	M
E	1;6.4 - 2;4.29	F
N	1;7.25 - 2;11.0	F
C	1;10-12 - 2;7.4	F

Fikkert (1944) identifies several stages in the development of the Dutch stress system. In that the development of a stress and the development of prosodic words necessarily interact, many of the stages identified in this study are similar to those discussed by Fikkert (1994). However, the stages of development discussed here are organized in a slightly different way, focusing on developments in prosodic structure.

[6] All of the Stage I Dutch and English words examined in this study had onset consonants, including glottal stops for vowel-initial targets. Further research will have to determine if all children learning all languages obligatorily use onsets at this point. For the prosodic issues discussed here the status of the onset is not important. Rather, Stage I captures the fact that the rhyme is simple rather than complex (branching), containing only one mora. We will continue to call Stage I the Core Syllable Stage, though it might more accurately be called the Sub-Minimal Word Stage, and will occasionally be referred to as such.

(7) Stage I - CV

	Child	Adult Target		
a.	[ka:], [kɑ]	/kla:r/	klaar	J (1;4-1;5)
b.	[da:], [dɑ]	/da:r/	daar	
c.	[pu:]	/pu:s/	poes	
d.	[ti:], [tɪ]	/dɪt/	dit	
e.	[ka:], [kɔ]	/tɔk/	tok	

Note also that many of the target words at this stage are monosyllabic forms. That is, there are few bisyllabic or multisyllabic words attempted during Stage I.

3.2. Minimal Words. Subsequent to Stage I, monosyllabic targets are briefly realized as bisyllabic forms by some children (though not by child J). Thus, there are examples of monosyllabic targets with a suffixed vowel, as in (8).[7] It appears that these children cannot yet produce coda consonants, and must realize target coda consonants as the onset to a second syllable. That syllable must have a nucleus, and this is realized as an epenthetic vowel. Words at this point are wellformed bisyllabic Minimal Words. We call this Stage IIa.

(8) Stage IIa - (C)VCV - Epenthesis (σ > ˈσσ)

	Child	Adult Target		
a.	[ˈa:pə]	/a:p/	aap	T (1;4-1;6)
b.	[ˈbo:tɔ]	/bo:t/	boot	
c.	[ˈpi:ja:]	/be:r/	beer	

Interestingly, some children apply this same epenthetic strategy to some bisyllabic words that take word-final stress. In this case, the stressed syllable (or at least the stressed vowel) of the target word is parsed into the first syllable of the child's word, and the word-final consonant of the target becomes the onset of a second syllable, yielding a bisyllabic Minimal Word - also Stage IIa.

[7] It appears that, at least for the Dutch-speaking children examined here, Core Syllables (i.e. syllables with obligatory onsets) are no longer required at the Minimal Word stage. This is seen in (8a), (10c), and (11f).

(9) Stage IIa - (C)VCV - Epenthesis (σˈσ > ˈσσ)

	Child	Adult Target	
a.	[ˈnɛnɛ]	/koːˈnɛin/	konijn T (1;5)
b.	[ˈʊɑfɑ]	/ʃiːˈrɑf/	giraf
c.	[ˈmɔmə], [ˈbɔmə]	/bɑˈlɔn/	ballon R (1;7)
d.	[ˈboːmɪ], [ˈboːmiː]	/bɑˈlɔn/	ballon C (1;10)
e.	[ˈɦɑfə]	/ʃiːˈrɑf/	giraf

The inability of some children to produce /l/ at this point requires that a different consonant be used as the onset of the words in (9c) and (9d). Rather than substituting any consonant for the onset, both children select /b/, the onset of the target word (or a nasal variant thereof) to be the onset of their word, even though /b/ is drawn from a different, unstressed syllable.

But Fikkert (p.c.) reports that not all Dutch-speaking children go through Stage IIa, and that, for those who do, this stage lasts only a short time. Most Dutch-speaking children, like child J, quickly develop the ability to produce coda consonants, moving directly from Stage I to Stage IIb - the stage at which Minimal Words come to be bimoraic through the use of a coda consonant.[8]

(10) Stage IIb - (C)VC

	Child	Adult Target		
a.	[puːs]	/puːs/	poes	J (1;6-1;7)
b.	[paːs]	/paːrt/	paard	
c.	[aːp], [ɑp]	/aːp/	aap	
d.	[teif], [deːs]	/ˈdeːze/	deze	
e.	[bɑf], [bɑ]	/bɑl/	bal	

Vowel length is beginning to be more consistently marked at this point, but is not yet fully controlled, as seen in (10c). Note furthermore that, given a bisyllabic target in (10d), J produces only a monosyllabic form. That is, J seems to have a strong preference for monosyllabic bimoraic Minimal Words even when the target is bisyllabic.

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[8] We might expect this to occur more rapidly in languages that have a higher frequency of word-final codas (e.g. Dutch and English) than in languages with more restricted coda use (e.g. Spanish). Preliminary evidence from the acquisition of Spanish indicates that this may be the case (Gennari 1995).

In (9) above we saw that two other children substituted /l/ with another segment in the word - /b/ or its nasal equivalent /m/. J also has difficulty with /l/, and in (10e) uses two different strategies to deal with the problem: In the case of [bɑf] he has substituted /f/ in the place of /l/, whereas with [bɑ] he has omitted /l/ altogether, thereby producing a sub-Minimal Word. Fikkert (p.c.) notes that, even once children start producing Minimal Words, CV-forms - or sub-Minimal Words, occasionally persist. We suggest that such forms may primarily occur in cases like (10e), where segmental difficulties prose problems for prosodic/Minimal Word requirements. The child is then faced with competing requirements at different levels of phonological structure, and may sacrifice one for the sake of the other.

A few months after he comes to control the use of coda consonants, Fikkert (1994) observes that child J begins to exhibit control of vowel length. Recall that word-internal syllables in Dutch can contain at most a binary branching rhyme - that is, either a long vowel, diphthong, or coda consonant. Interestingly, Fikkert (1994) shows that J goes through a stage where, even in word-final position, he allows only a long vowel/diphthong, or a coda consonant, but not both. In other words, he appears to allow only a binary branching rhyme, in accord with the more restrictive form of Dutch syllable structure.

(11) Stage IIc - VV~VC_{son}

	Child	Adult Target		
a.	[tɛi]	/trɛin/	trein	J (1;10-2;0)
b.	[ty:]	/stu:l/	stoel	VVC_{son} > VV
c.	[da:]	/da:r/	daar	
d.	[bo:]	/bo:m/	boom	
e.	[mɑm], [mɔm]	/ma:n/	maan	VVC_{son} > VC_{son}
f.	[œʊ]	/œyl/	uil	
g.	[hɑm]	/ha:n/	haan	
h.	[bɔm], pɔm]	/bo:m/	boom	
i.	[pɑv], [bɑl]	/bɑl/	bal	VC_{son} > VC_{son}
j.	[bɑm]	/bɑm/	bam	
k.	[pɔm]	/bɑˈlɔn/	ballon	
l.	[bo:], [bɑu]	/bɑl/	bal	VC_{son} > VV

Note that all the forms in (11) are well-formed monosyllabic bimoraic Minimal Words. Even those forms that contain an /l/ are prosodically well-formed; vowel length or a substituted consonant are used in (11b,l) and (11i) respectively such that the requirements for Minimal Words are met. There is even one instance of the use of /l/ in (11i), indicating that the child is beginning to have more control over segments. Note also that the bisyllabic target in (11k) is reduced to a monosyllable. Again, J demonstrates his preference for monosyllabic bimoraic Minimal Words, even at the cost of not parsing target segments. Fikkert (1994) reports that similar stages of development are found with the other children in her study.

In sum, Dutch-speaking children's earliest words are sub-Minimal Words. Children then pass through a Minimal Word Stage of development, where word forms take a binary branching foot as both a lower and upper bound on the shape of early words. There is some flexibility, however, in the shape that these binary feet can take: Before vowel length is controlled and coda consonants are produced, only bisyllabic feet are used (Stage IIa), at least by some children. Once coda consonants can be produced, Minimal Words can take the shape of monosyllabic bimoraic feet (Stage IIb), and many Dutch-speaking children seem to prefer this form. Finally, vowel length is controlled, and Minimal Words can be produced as monosyllabic bimoraic feet with a long vowel or diphthong (Stage IIc). These stages are summarized below:

(12) Stages in the Development of Prosodic Structure

Stage I. Core Syllables - CV
No vowel length distinctions

Stage II. Minimal Words / Binary Feet
a. Core Syllables - (C)VCV
b. Closed Syllables - (C)VC
c. Vowel length distinctions - (C)VV

In the next section we will show that these same stages are found in the early acquisition of English.

4. Prosodic Structure in Early English. The data from children acquiring English come mainly from children between the ages of 1;0 and 2;0 and provide evidence of the first two stages of prosodic acquisition - the Core Syllable stage and the Minimal Word

stage.[9] In what follows, children acquiring English will be referred to by both initials to distinguish them from the Dutch children discussed above.

4.1. Core Syllables. All of the children acquiring English in this study used CV forms at the onset of early words. Some forms from three of the children are presented in (13).

(13) Stage I – CV(V/C)

	Child	Adult Target		
a.	[bʌ], [bʊʔ]	/bʊk/	'book'	EW (1;4)
b.	[gʊ], [gʊː]	/gərl/	'girl'	
c.	[mæ], [mɛ], [mʌ]	/mæn/	'man'	
d.	[bɑ]	/'bɑDəl/	'bottle'	JV (1;6–1;8)
e.	[da]	/dɑl/	'doll'	
f.	[ba]	/pai/	'pie'	
g.	[du], [duː], [gu] [guː], [gus], [dʊs]	/ʤus/	'juice'	PJ (1;8)
h.	[dʌ], [dɪk]	/dʌk/	'duck'	
i.	[bo], [bɑ], [boː]	/bɑl/	'ball'	
j.	[biː], [bi]	/'bebi/	'baby'	

Core Syllable forms occurred mainly for monosyllabic targets; however, (13d,j) show that some children also realized bisyllabic targets in this way. PJ's forms for 'juice' and 'duck' (13g,h) and EW's form for 'book' (13a) demonstrate that CV forms at this stage may vary with forms containing a coda consonant. The forms in (13b,g,i,j) show that, like Dutch-speaking children, most English-speaking children do not use vowel length contrastively at this stage, with the result that productions of a single target may contain either long or short vowels. Coda consonants were also not yet controlled, resulting in occasional but nonsystematic use of codas at this time.

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[9] The English data are taken from both published diary studies and language samples collected and analyzed by the second author. The children, their ages, sex, number of words analyzed, and the authors of the studies are given below:

Child	Ages	Sex	No. of Analyzed Words	Source
PJ	1;8–2;0	F	199	not previously published
AS	2;2–2;10	M	2,037	Smith (1973)
JV	0;11–2;0	F	330	Velten (1943)
EW	1;4	M	46	not previously published
MH	1;7	M	84	not previously published

4.2. Minimal Words. The Dutch data demonstrated that after an initial period of producing words as CV forms, children move on to the Minimal Word Stage. Three substages were identified in the Dutch data: An initial period (Stage IIa) where Minimal Word shape is met with bisyllabic forms, and two further substages where Minimal Words can be filled by bimoraic monosyllables containing coda consonants (Stage IIb) or long vowels (Stage IIc). English-speaking children show similar patterns of development, each discussed below.

Some English-speaking children produced occasional bisyllabic forms for monosyllabic targets as shown in (14).

(14) Stage IIa - (C)VCV - Epenthesis (σ > σσ)

	Child	Adult Target		
a.	['bæpʌ]	/bɑks/	'box'	EW (1;4)
b.	['mɛnə]	/wel/	'whale'	PJ (1;10)
c.	['dɛdi]	/'tsɪk/	'chick'	
d.	['fowə]	/strɑ/	'straw'	PJ (1;11)
e.	['tsu:si], [ʤu:'si:]	/ʤus/	'juice'	

Each of these words is a licit Minimal Word by virtue of having a branching foot. In parsing the segmental structure of the target into this Minimal Word, the coda consonant of the target becomes the onset of the second syllable and an epenthetic vowel fills the rhyme of the second syllable. Stress can fall on either syllable, although the preference seems to be towards stress-initial forms.

EW and PJ had the highest proportions of open syllable word forms of the English-speaking children. Fee (1994) suggests that these children have adopted one possible strategy in the realization of Minimal Words. These children actively attempt multisyllabic targets, whereas other children tend to avoid them. Furthermore, the children who attempt multisyllabic targets tend to produce bisyllabic targets as bisyllabic forms (rather than reducing them to monosyllabic forms) more often than other children (see Klein (1981) for similar observations). Fee (1994), using the findings of Fee and Ingram (1982), argues that one reason some children may have a preference for multisyllabic forms is that they are not as successful as other children at achieving coda consonants and consequently must produce bisyllabic forms in order to produce a Minimal Word structure.

In addition to producing bisyllabic Minimal Words for monosyllabic targets, PJ also produced bisyllabic Minimal Words for bisyllabic and trisyllabic targets, as shown below.

(15) Stage IIa - (C)VCV

	Child	Adult Target	
a.	['gɛdi], ['kɛni]	/'kændi/	candy' PJ (1;10)
b.	['bɑnə], ['modə]	/'mɑnstər/	'monster'
c.	[bæbæ]	/'bɑDəl/	'bottle'
d.	['pɪsæ]	/pə'trɪʃə/	'Patricia'

As these data demonstrate, there is a good deal of segmental variability in the phonetic shape of the child's forms at this stage. However, regardless of the number of modified segments and the number of syllables in the target word, the child's forms all surface with two syllables - that is, well-formed Minimal Words.

The other English–speaking children studied never increased the syllable count of the target word. We therefore conclude (as also suggested by Fikkert, p. c.) that the initial substage of Stage II (Stage IIa) may not occur for all children, and if it does, it is relatively short in duration. This variability in the occurrence of Stage IIa may be due to the language–particular phonotactic characteristics of both Dutch and English, where closed syllables are extremely frequent.

By 1;11 PJ had begun to attempt some coda consonants, with words such as 'juice' no longer surfacing as bisyllabic forms. At this point both MH and PJ used monosyllabic bimoraic Minimal Words (Stage IIb).

(16) Stage IIb - (C)VC ($\sigma > \sigma$)

	Child	Adult Target		
a.	[rɑʔ]	/wɑk/	'walk'	MH (1;7)
b.	[dʌ], [dʌʔ]	/dɑg/	'dog'	
c.	[ɪʔ], [ɛʔ]	/ɛg/	'egg'	
d.	[du:s], [ʤu:s], [ʤu:]	/ʤus/	'juice'	PJ (1;11)
e.	[bi:s], [be:]	/bidz/	'beads'	
f.	[to:s]	/tost/	'toast'	
g.	[su:], [sʊ], [sup]	/sup/	'soup'	

As seen in (16a-c), glottal stops were MH's predominant coda consonant and were used consistently to replace target velars. A number of authors have noted that children frequently use glottal stops as codas before they can make consistent segmental contrasts in this syllable position (e.g. Shriberg & Kwiatkowski 1980, French 1989). Glottal stops may then be the default consonant in coda position when children first begin to produce forms of this complexity. PJ, on the other hand, was most successful at producing targets with coda /s/. Words containing codas that she could not produce were sometimes produced with a lengthened vowel; however, the variability in the forms in (16b,g) demonstrate that vowel length and vowel quality are not yet fully controlled. As a result, Sub-Minimal Words are still occasionally produced.

Like the Dutch-speaking child J, several English-speaking children reduced bisyllabic targets to CVC forms, as shown in (17). This was true even where the target word contained a bisyllabic trochaic foot, as in (17a,b).

(17) Stage IIb - (C)VC

	Child	Adult Target		
a.	[bɑt]	/'pɑkət/	'pocket'	JV (1;6)
b.	[bɛʔ]	/'bɛri/	'berry'	MH (1;7)
c.	[gɛn], [gɛŋ]	/ə'gɛn/	'again'	

In all cases, the vowel of the stressed syllable appears in the child's form. Note, however, that in (17a) the coda consonant of the unstressed syllable appears in the child's form.

The data in (16) and (17) demonstrate that children acquiring English, like those acquiring Dutch, make systematic use of coda consonants before they are able to consistently represent vowel length or, in the case of English, tense/lax distinctions. PJ began to control vowel length by 2;0, systematically using both tense and lax vowels in the appropriate contexts (Stage IIc). She also lengthened the vowel if she was not able to produce the coda consonant of the target - a process of 'compensatory lengthening'. Critically, the lax vowel in (18e) is lengthened, thereby retaining Minimal Word structure.

(18) Stage IIc – CVV

	Child	Adult Target		
a.	[mo:]	/mor/	'more'	PJ (1;11)
b.	[si:]	/fɪ/	'fish'	PJ (2;0)
c.	[fu:]	/frut/	'fruit'	
d.	[bo:]	/bot/	'boat'	
e.	[ʔɪ:]	/ɪt/	'it'	

PJ moved very quickly from Stage IIb to IIc: At 1;11 tense and lax vowels were sometimes used interchangeably (see (16g)), but once she discovered that vowels could be bimoraic, the tense/lax contrast and vowel lengthening were used very consistently. MH used the tense/lax contrast consistently by the age of 1;7. Some of his bimoraic forms contained coda consonants, while the remaining CV forms contained mostly tense vowels or diphthongs. His variable productions for the word 'egg' demonstrate his knowledge of bimoraic syllables.

(19) Stage IIb,c – CVC ~ CV_{tense}

	Child	Adult Target		
a.	[ɛg]	/ɛg/	'egg'	MH (1;7)
b.	[ɪʔ]			
c.	[ɛʔ]			
d.	[ʔe]			

Again, each of these forms is a Minimal Word either because it contains a coda consonant (19a,b,c), or because it contains a tense vowel (19d). The fact that (19d) was the only form with a tense vowel and was also the only form without a coda consonant demonstrates that MH had control of both types of bimoraic Minimal Word structures.

At 2;2 AS rarely deleted coda consonants (20d-f). However, in the few cases where he did, the vowel was always tense (20a-c). In each of the target forms where the coda was dropped, the coda consonant was /z/. This suggests that when AS had difficulty with this coda consonant, he preserved a Minimal Word by using a tense vowel.

(20) Stage IIb,c – CVC ~ CV_{tense}

	Child	Adult Target		
a.	[di]	/tsiz/	'cheese'	AS (2;2)
b.	[nu]	/noz/	'nose'	
c.	[pi]	/pliz/	'please'	
d.	[bi:t]	/pə'lis/	'police'	AS (2;2–2;5)
e.	[ge:p]	/ə'skep/	'escape'	
f.	[bu:n]	/bə'lun/	'balloon'	

Note also that AS avoids the use of an /l/ onset to his preserved stressed syllable in both (20d,f), selecting an onset from the unstressed initial syllable in the target word. This is exactly the same phenomenon seen with child J in the Dutch in examples (9c,d). Interestingly, AS uses a long tense vowel and a coda consonant in (20d-f) - evidence that he is beginning to move beyond simply a Minimal Word. As shown in the next section, AS is in transition at this point to larger prosodic structures.

In sum, by 1;6–1;8 most of the English-learning children in this study are using bimoraic syllables with some coda consonants, and bimoraic forms with tense vowels appeared shortly thereafter. Even once competence with a particular prosodic form has been achieved children occasionally produced forms of lesser prosodic complexity due to segmental difficulties with the target form.

In the forgoing sections we have shown that both Dutch-speaking and English-speaking children begin word production with the use of monosyllabic monomoraic forms, or sub-Minimal Words. Some words produced at Stage I contain a long vowel, but vowel length is not contrastive at this point, resulting in some free-variation (see Rice in press). At the next stage of development children begin to use Minimal Words. If they still cannot represent subsyllabic structure, Minimal Words must take the form of a bisyllabic foot. Control of subsyllabic (moraic) structure appears first in the form of coda consonants, and then with the control of vowel length and diphthongs. Despite individual differences in preferring (C)VCV, (C)VC, or (C)VV forms for either monosyllabic or bisyllabic targets, children at this point in development are consistently producing prosodically wellformed Minimal Words. The prosodic structure of these stages can be summarized as in (21).

(21)

Stage I. Sub-Minimal Word	Stage II. Minimal Word	
	Bisyllabic Foot	Monosyllabic Bimoraic Foot
σ	F / \ σ σ	F | σ / \ μ μ
CV	a. (C)V(C)V	b. (C)VC c. (C)VV

The stages identified above can be naturally captured in terms of the Prosodic Hierarchy. At Stage I children's words are restricted to syllables only. Then children begin to use feet. For some children those feet are initially composed only of two core syllables, that is, they cannot yet represent complexity at the level of the syllable. Furthermore, this binary foot is the maximal form that a prosodic word can take. This is the beginning of the Minimal Word Stage - Stage IIa. At Stage IIb,c children begin to demonstrate access to moraic structure within the rhyme, and their Minimal Words can now take monosyllabic form, with either long vowels or coda consonants. It is only later, at Stage III, that children's prosodic words can be composed of more than one foot. One way to think of this type of development is in terms of children having 'access' to different units of the Prosodic Hierarchy, where only syllables are present at Stage I, feet are present at Stage IIa, and finally moras become available at Stage IIb,c. At Stage III, syllable structure becomes more complex and words begin to take forms which are larger than just a foot. In other words, children's prosodic representations become more complex over time, as illustrated in (22).

(22) Development of Prosodic Representations

Stage I.	>	Stage IIa.	>	Stage IIb,c.	>	Stage III.
σ		FT		μ		Pw

In sum, children's early words, although showing a certain amount of inter- and intra-speaker variation in shape, appear to be composed of well-formed prosodic units, as captured by the Prosodic Hierarchy. Between approximately the ages of 1;6 and 2, their words take the form of Minimal Words, surfacing as minimally and maximally a binary foot. In producing these words it appears that children perceive all the segments of the target form, but are operating under both phonotactic and prosodic constraints that

limit the shape of their output in a systematic fashion. Critically, children seem to draw segments from various parts of the target form in creating their Minimal Words, often taking the onset from an unstressed syllable and pairing it with the rhyme of a stressed syllable. This flexibility and creativity in the construction of early words is not captured by previous perception and production accounts for the shape of early words. The prosodic account developed here, along with the notion of 'parsing' segments into the output form, allows for such types of creativity as well as the constrained types of variation it incurs (see also Archibald 1995, Demuth in press-b, Rice in press).

But why should a Minimal Word stage exist? First, Minimal Words can be thought of a 'unmarked' prosodic word structures, and may be the starting point for children learning the word structure of any language. Second, Minimal Words seem to occur during the period when children are using primarily one- and two-word utterances, before they begin to systematically use larger prosodic units such as phonological phrases and intonational phrases. The Minimal Word stage may therefore provide children with a 'holding' place for learning more about syllable structure and stress assignment in quantity sensitive languages. The transition to the higher-level prosodic word structures is then marked by greater complexity at the level of the syllable, the overgeneralization of stress placement, more attempts at larger phonological word targets, and the use of larger phonological phrases.

The majority of children's target words seen above were monosyllabic and bisyllabic forms. These children seem to avoid using larger prosodic words until a later stage of acquisition - perhaps realizing that their prosodic skills are initially limited. Interestingly, similar types of 'avoidance' have been reported in the literature on the acquisition of segments (Schwartz & Leonard 1982, Macken & Ferguson 1983, Vihman, Macken, Miller, Simmons & Miller 1985), indicating that this may be a wide-spread characteristic of language development. In the following section we briefly examine larger multisyllabic words and show that Minimal Words are also found at the initial stages of producing trisyllabic and quadrisyllabic targets, before children move on to Stage III (Stress Feet) and Stage IV (Phonological Words). Even at these later stages of acquisition there is evidence that children perceive the segments of the syllables they omit, and that the forms they produce cannot be captured simply by means of a linear 'trochaic foot' parse. Rather, we suggest that the construction of Stress-Feet is also a prosodically governed process (see also Fikkert 1994).

5. Beyond Minimal Words. In the preceding sections we showed that both Dutch-speaking and English-speaking children pass through a stage where their early words

can best be characterized in terms of Minimal Words. In this section we briefly discuss the transition between Minimal Words and larger prosodic structures, where words begin to contain more complexity at the level of the syllable and the level of the word. Although our focus in the following discussion is on the development of prosodic structure, the relevance of stress in the creation of feet will play an increasingly important role.[10]

Consider the following forms from child J.

(23) Stages IIIa > IIIb - One Stress-Foot > Two Stress-Feet

	Child	Adult Target		
a.	[faut]	/ˈoːliːˌfant/	olifant	J (2;1-2;4)
b.	[ˈhoːta]			
c.	[ˈoːfaˈfan]			

We have already seen that J produces Minimal Words, and that his Minimal Words between 1;6 and 2 years tend to be monosyllabic bimoraic forms (cf. examples in 10 and 11). In (23a,b) he again produces binary feet for the trisyllabic target form. Interestingly, however, these binary feet take two different shapes: In (23a) J uses a monosyllabic bimoraic foot, as he did earlier in (10) and (11). Note, however, that [faut] also includes an extrasyllabic consonant, unlike J's earlier Minimal Words. It therefore appears that he is beginning to parse more of the surface segmental material into his output forms, a step toward moving beyond the Minimal Word stage. In addition, he produces the final syllable of the trisyllabic target - the one with secondary stress, rather than the first syllable with primary stress. The content of the form in (23a) would not be predicted by either the trochaic foot hypothesis (Allen & Hawkins 1980, Gerken 1991), nor by Echols & Newport's (1992) perceptual hypothesis: Both would predict that the stressed syllable of the target should be included in the child's output. However, under the prosodic approach outlined here, what is important is that the output form be at least a Minimal Word, which it is.

In contrast, the form in (23b) would appear to satisfy both the trochaic foot hypothesis (Allen & Hawkins 1980, Gerken 1991) and Echols & Newport's (1992) hypothesis that stressed and final syllables are those that appear in children's early truncated forms, except that the shape of each syllable differs from the target form. Here we see that the

[10] See Kager (1989) for a treatment of stress placement in Dutch, and Fikkert (1994) for a treatment of how Dutch-speaking children acquire stress.

stressed initial syllable (albeit with an epenthesized onset consonant) and part of the final syllable are included in the child's production. Note, however, that the coda consonants of the final syllable are missing - even though the final /t/ was included in (23a). Furthermore, J seems to have 'regressed' to the Core Syllable stage, adding an epenthetic /h/ to the onset of the word. In other words, there appears to be a trade off in the shape that J's prosodic words take at this point: A monosyllabic binary foot can be produced with complexity at the subsyllabic level, or bisyllabic foot can be produced with less complexity at the subsyllabic level - i.e. as Core Syllables. We suggest that the forms in both (23a,b) illustrate J's attempts to parse more of the target word into his output form - a sign that he is beginning to move beyond Minimal Words. Specifically, the bisyllabic form in (23b) seems to be a move toward the use of Stress-Feet, Stage III. In (23c) J appears to be producing two binary feet, rather than just one; the first as a bisyllabic form, the second as a monosyllabic form - this time with a coda consonant! That is, J can now produce larger prosodic words, but he apparently produces them as a series of binary Stress-Feet. Fikkert (1994) notes this as a general pattern found in her study.

Data from some of the other children Dutch-speaking illustrate similar transitions between Minimal Words and more complex prosodic structures. Fikkert (1994) shows that child N went through a stage where her monosyllabic targets were produced as bisyllabic forms with an epenthesized final vowel (24a-d). These forms might appear to be Minimal Words at Stage IIa, where an epenthetic vowel was added to avoid use of a coda consonant. However, N's production of bisyllabic targets at the same age shows that she <u>can</u> use coda consonants (24e,f). This means that her use of epenthetic vowels in the monosyllabic targets must be due to a preference for using bisyllabic Stress-Feet. We suggest that this represents the beginning of Stage III, where the emergence of Stress-Feet is initially consistent with the form of Minimal Words, then later begins to diverge. One step in this direction is to give equal stress to both initial and final syllables of stress-final targets in (24e,f). N then reverts to the epenthetic strategy in (24g), alternating between a Stress-Foot form, and a Stress-Foot plus extrametrical (unfooted) syllable - the beginning of larger Phonological Words (Stage IV).

(24) Stages IIIa > IV - Stress-Feet > Phonological Words

	Child	Adult Target		
a.	[ˈtɛinə]	/trɛin/	trein	N (2;5-2;7)
b.	[ˈtœynɑ]	/toyn/	tuin	
c.	[ˈkikə]	/dɪk/	dɪk	
d.	[ˈtɛijə]	/te:/	thee	
e.	[ˈpɑˈpɔm]	/bɑˈlɔn/	ballon	
f.	[ˈkɑˈkɛin]	/koːˈnɛin/	konijn	
g.	[ˈtɛinɑ] ~ [tɔˈtɛinə]	/koːˈnɛin/	konijn	N (2;7-2;8)

As has long been realized in the acquisition literature, and as Fikkert (1994) shows in examples like (24e-g), extrametrical syllables present specific problems for children, and there seem to be several strategies for dealing with them. One is to omit them altogether, as in the first form in (24g). Another is to stress each syllable of the foot equally, creating a quantity insensitive trochaic foot as in (24e,f). Finally, children come to permit extrametrical syllables, as in the second form in (24g) (Stage IV).

Quadrisyllabic targets are also constructed in this way.

(25) Stages IIIa > IIIb > IIIc - Stress-Feet

	Child	Adult Target		
a.	[ˈmaːmɑu]	/ˌliːmoːˈnaːdə/	limonade	N (2;3)
b.	[ˈmiːmoːˈmaːtə]			N (2;8)
c.	[ˌmiːmoːˈmaːtɑ]			N (2;9)

N produces one Stress-Foot in (25a) (Stage IIIa). Fikkert (1994) shows that N then moves on to producing two Stress-Feet, each with a primary stress in (25b) (Stage IIIb). Finally, she moves to the form in (25c), with two feet, but only one primary stress per word. Thus, N eventually comes to represent /ˌliːmoːˈnaːdə/ as one prosodic word with only one primary stress (Stage IIIc).

AS was the only English-speaking child studied who consistently attempted targets longer than two syllables. His progression through Stage III (Stress–Feet) and Stage IV (Phonological Words) is very similar to the Dutch patterns presented above. As shown in (20), AS often reduced multisyllabic targets to monosyllabic Minimal Words during the first half of the third year. However, as shown in (20d-f), he was already moving beyond the stage where Minimal Words were his maximal forms. At the same time AS produced many trisyllabic targets fairly consistently as bisyllabic forms, indicating a

transition from Minimal Words to Stress-Feet similar to that seen with Dutch-speaking J in (23b).[11]

(26) Stages III > IV - Stress-Feet > Phonological Words

	Child	Adult Target		
a.	[e:di]	/'edriən/	'Adrian'	AS (2;2)
b.	['bægi:]	/'bælkəni/	'balcony'	
c.	['ma:do], [də'ma:do]	/tə'mato/	'tomato'	AS (2;3)
d.	[ba:di:]	/tsə'pati/	'chapatti'	AS (2;4)
e.	[beito], [be:to], [deito]	/pə'teto/	'potato'	AS (2;4–2;6)
f.	[da:mə]	/pə'ʤaməz/	'pyjamas'	AS (2;5)
g	[mɛmbɛ]	/rə'mɛmbər/	'remember'	AS (2;7)
h.	[ba:nə]	/bə'nanə/	'banana'	AS (2;8)

In forms such as (26b,c) AS used a trochaic stress pattern. Elsewhere he used equal stress for both syllables. We suggest that he may be beginning to use Stress-Feet (Stage III) at this time. The trisyllabic form in (26c) appears to be the first case of a word containing an extrametrical syllable, showing that AS was beginning to move to larger Phonological Words (Stage IV). The data in (26) show that the stressed syllable of the target word is generally parsed into the initial syllable in the child's form. However, in (26e,h) the onset of the initial unstressed syllable appears in the child's form. Again, this is reminiscent of the patterns found in Dutch (see (9c,d) and (11k)).

In the first half of the third year some of AS's productions of trisyllabic targets contain four syllables.

(27) Stage IIIc - Stress Feet

	Child	Adult Target		
a.	['ɛbininin]	/'ɛləfənt/	'elephant'	AS (2;3)
b.	['mu:gəga:baik]	/'motərbaik/	'motorbike'	
c.	['du:dənində]	/lu'sɪndə/	'Lucinda'	AS (2;5)

[11] Smith (1973) marked stress on some of AS's bisyllabic words, while on others stress was not indicated. We assume that in words where stress was not marked AS used equal degrees of stress on both syllables within a word, similar to that seen with the Dutch child N in (24e,f).

In each of these forms stress fell on the initial syllable and the phonetic content of the extra syllable was taken from adjacent segments. During this stage, stress began to be consistently produced, and only syllables belonging to feet were realized. AS appears to be at a stage where he stresses the first foot in the word, and creates a bisyllabic foot with any remaining syllables (Stage IIIc).

By 2;9 AS no longer reduced trisyllabic forms, producing word-initial extrametrical syllables in (28a-c,f).

(28) Stage IV – Phonological Words

	Child	Adult Target		
a.	[lu:'tində]	/lu'sɪndə/	'Lucinda'	AS (2;8)
b.	[pə'da:məd]	/pə'ʤaməz/	'pyjamas'	AS (2;9)
c.	[ti'mɛmbə]	/rə'mɛmbər/	'remember'	
d.	['ɛfələnt]	/'ɛləfənt/	'elephant'	
e.	['tɛli:bu:n]	/'tɛləfon/	'telephone'	
f.	[bə'nanə]	/bə'nanə/	'banana'	AS (3;0)

Although AS was still making many segmental errors at this point, he was able to consistently replicate the prosodic structure of multisyllabic targets. These data demonstrate that between 2;8 and 3;0 AS begins to consistantly produce prosodically well-formed Phonological Words (Stage IV).

In sum, children eventually move beyond the Minimal Word stage to produce words of greater prosodic complexity. The next stage appears to be one where (at least some) children prefer bisyllabic trochaic feet, even when their earlier Minimal Words were monosyllabic bimoraic forms. It is apparently at this stage (around the age of 2-2;6 years) that children become more conscious of stress patterns, and try to make their early words conform to Stress-Feet (see Fikkert 1994). This is true even at the cost of producing forms with extra syllables or syllables with less complexity. We call this Stage III. As Fikkert (1994) also notes, prosodically complex words at this point are composed of two Stress-Feet - even to the point of having more than one primary stress per word. This requirement - that all feet have primary stress - is gradually relaxed, and children begin to produce only one stress per prosodic word. It is only later that children begin to permit unfooted (extrametrical) syllables - Stage IV. These later stages of development are summarized below.

(29) Later Stages in the Development of Prosodic Structure

Stage III. Stress-Feet
- a. One Stress-Foot
- b. Two Stress-Feet - each with primary stress
- c. Feet - one primary stress per word

Stage IV. Phonological Words
Extrametrical syllables permitted

Given that stress systems begin to play a more important role in the realization of these later stages of prosodic word development, we expect that the stages outlined in (29) may not hold crosslinguistically. We therefore present them here as relevant for the later prosodic development of Dutch and English, and as a working guide for the exploration of prosodic development in other languages.

In this section we showed that Minimal Words provide the basis upon which further prosodic development takes place. We suggest that the Minimal Word stage of phonological development has been overlooked because it generally occurs before the age of two, and detailed longitudinal transcriptions of this period are not abundant. In contrast, the presence of readily available data between 2 and 3 years, plus evidence for Stress-Feet (Stage III) has lead researchers to claim that (trochaic) feet have a privileged status in children's early grammars. However, the Dutch and English data presented here show that Minimal Words play a significant role at initial stages of prosodic development, and that Stress-Feet only become more relevant once children have learned more about syllable structure and stress assignment, and begin to attempt more multisyllabic targets. Furthermore, the construction of Stress-Feet maintains the same types of creative processes found in children's use of Minimal Words, showing that even 'trochaic feet'are prosodically licensed in a number of different ways.

6. Discussion. In this study we have shown that Dutch-speaking and English-speaking children's early word shapes are not randomly ill-formed, but follow a systematic course of development. Furthermore, this course of development is prosodically constrained, and can be easily accounted for in terms of the Prosodic Hierarchy. That is, children's early words are prosodically wellformed linguistic units. These prosodic units become more complex over time, but do so in a systematic and predictable fashion.

There have been several attempts to understand the connection between children's early productions and their underlying representations. Macken (1980) proposed the

'one lexicon' model, where children's input representations were (sometimes) distorted, resulting in similar distorted output forms. Such a model would be consistent with the Echols & Newport (1992) and Echols (1993) view that issues of perceptual salience play an important role in determining the shape of children's early words. We argue against such a model based on the Dutch and English data presented here, which provide evidence that children perceive the segments of unstressed syllables, and often producing them (especially onsets) if phonotactically or prosodically 'required'. Such evidence is consistent with previous studies indicating that children perceive the segments and unstressed syllables they omit (e.g. Gerken, Landau, & Remez 1990, Petretic & Tweney 1977, Shipley, Smith, & Glietman 1969). Our findings are therefore somewhat more consistent with a 'two-lexicon' model (e.g. Kiparsky & Menn 1977, Menn 1983, Menn & Matthei 1992), where the output is distinct from the input form. However, like the 'one lexicon' model, we maintain that children have only one lexical representation, but that various 'prosodic constraints' operate on children's early output forms.

Fee (1992) and Demuth (in press-a) consider the possibility that children's early word productions are restricted due to a lack of early access to the full Prosodic Hierarchy. Under such a view, children's prosodic words would initially be composed only of a syllable, and would then gradually develop more articulated prosodic structures, finally arriving at a fully developed Prosodic Hierarchy (30).

(30)

Stage I.	>	Stage IIa.	>	Stage IIb,c.	>	Stage III.
Pw[12] | σ		Ft=Pw | σ		Ft=Pw | σ | μ		Pw | Ft | σ | μ

Under such a view, children's output forms would be constrained due to a lack of access to linguistic structure, much in the way that some have proposed for early stages in the acquisition of syntax (cf. Guilfoyle & Noonan 1988, Lebeaux 1989, Radford 1990).

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[12] See Ola (1994) for discussion of Minimal Word effects in Yoruba, where a monomoraic syllable can be licensed as a prosodic word, provided that it contains an onset. We propose that this may be the case at Stage I.

Alternatively, Demuth (in press-b) adopts an optimality theoretic approach (Prince & Smolensky in press, McCarthy & Prince 1994), proposing that children have early access to the full Prosodic Hierarchy, but can only exploit part of it due to the initial high ranking of constraints which yield unmarked prosodic structures such as Core Syllables and Minimal Words (see also Gnanadesikan 1995). Under such a proposal children's early lexical representations would be 'filtered' through highly ranked grammatical constraints that would restrict the shape of output forms. Over time, constraints would be reranked in accord with the grammatical requirements of the language being learned. Most critically, the 'faithfulness' constraints such as PARSE (parse all of the segmental input into the output) would become more highly ranked over time. This type of proposal has the advantage of 1) capturing that fact that Core Syllables and Minimal Words appear early in the course of all children's word productions, regardless of the language being learned, 2) capturing that fact that children rarely attempt multisyllabic words until they are ready to move beyond the Minimal Word stage and are able to parse more syllables / feet into their output forms, and 3) allowing for certain constrained types of inter- and intra-speaker variation in the segments used to satisfy these prosodic constraints.

We offer these proposals as theoretically grounded explanations for the presence of the Minimal Word and the other prosodic patterns identified here, and as a possible framework for understanding the processes of phonological and syntactic development more generally (see Demuth in press-c for further discussion).

7. Conclusion. In this article we have shown that children's early words take the shape of prosodic units in the Prosodic Hierarchy. We have identified four major stages of prosodic development - the Core Syllable stage, the Minimal Word stage, the Stress-Foot stage, and the Phonological Word stage.

(31) Stages in the Development of Prosodic Structure

Stage I. Core Syllables - CV
No vowel length distinctions

Stage II. Minimal Words / Binary Feet
a. Core Syllables - (C)VCV
b. Closed Syllables - (C)VC
c. Vowel length distinctions - (C)VV

Stage III. Stress-Feet
- a. One Stress-Foot
- b. Two Stress-Feet - each with primary stress
- c. Feet - one primary stress per word

Stage IV. Phonological Words
Extrametrical syllables permitted

Although we have restricted our present discussion to data from Dutch and English, we suggest that similar stages of prosodic development may be found in the acquisition of other languages as well. Preliminary evidence indicates that a Minimal Word stage may exist in languages as prosodically diverse as K'iche' Maya, Sesotho, Spanish, and Hungarian (Demuth 1992, in press-a, Fee 1994). Further research will need to determine the crosslinguistic robustness of the other stages identified here.

These findings have important implications for our understanding of phonological development, both within the prosodic domain and more generally. First, we showed that children's early words are prosodically wellformed linguistic units. Furthermore, we showed that this is true even in cases of inter- and intra-speaker variation. That is, the types of variation found at each stage of acquisition are prosodically constrained. Second, we showed that children's earliest words contain Core Syllables and Minimal Words - both unmarked prosodic structures found in all languages. It therefore appears that markedness may play a role not only in the acquisition of segments (Jakobson 1948/68, cf. Ingram 1976, Ferguson & Macken 1981, Locke 1983), but also in the acquisition of prosodic structure (Demuth in press-b). Finally, we showed that children go through a Minimal Word stage of development where words are composed of a binary foot, and where segments may be drawn from both stressed and unstressed syllables. The Minimal Word stage persists for several months, forming an upper bound on the shape of children's early words. We suggest that the Minimal Word stage may function as a constrained learning space for further language-specific exploration of segments, syllable structure, and determination of syllable weight for the assignment of stress. We therefore predict that children learning languages with complex syllable structure, as well as languages with quantity-sensitive stress systems, might remain at the Minimal Word stage for longer than children learning languages with less syllable complexity and/or quantity insensitive stress systems. Minimal Words therefore constitute a critically important stage in children's development of prosodic structure, but may exist for a longer or shorter time depending on the word-level prosodic structure of the language being acquired.

The picture that emerges from this prosodic account of early words is that children perceive the segmental and syllabic content of their target words even when this information is missing in their output forms. Furthermore, the segmental and syllabic content of children's Minimal Words, though largely drawn from stressed syllables, shows greater flexibility than previously thought. It would appear that children's output forms are constrained in some way, perhaps due to an impoverished Prosodic Hierarchy (Fee 1992, Demuth in press-a), or perhaps due to grammatical constraints on output form (Demuth in press-b). We conclude that the construction of Minimal Words is essentially a mapping process between different levels of phonological structure, where segments may be drawn from any part of the target word, or added epenthetically, as needed to satisfy both lower and upper bounds on prosodic structure: It is only later - at least in languages like English and Dutch - that (trochaic) Stress-Feet become more important.

In sum, the prosodic approach to the acquisition of early words provides a unified, phonologically grounded account for the structure of early words. Though applied here only to monomorphemic words, it also provides a framework for investigating the development of multimorphemic forms, both in isolation, as well as in larger phonological phrases. Finally, we hope that the prosodic insights presented here, once combined with current theoretical work on the acquisition of segments, will provide a more comprehensive view of children's early phonological development.

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