Markedness and the Development of Prosodic Structure*

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1. Introduction

It has long been noted that children's early words are truncated in form, and that those forms show a certain degree of variability in shape. In this paper I argue that children's early word productions can best be understood in terms of output constraints on surface form. First, I show that children's early grammars allow for the emergence of the unmarked form of syllables (Core Syllables) and prosodic words (Minimal Words), and that these can be thought of as different stages of prosodic development. I then demonstrate how the prosodic development of children's early words can be naturally accounted for in terms of prosodic constraints on output form, where parsing of segmental input into output forms becomes more highly ranked over time. I conclude by showing how a given constraint ranking can provide an account of variability in form at a given point in time, whereas a shift in constraint ranking is needed to account for development over time. In so doing, I demonstrate how the process of language acquisition can be thought of as an optimization problem, and how Optimality Theory (Prince & Smolensky 1993) might be adapted to provide for a theory of both competence *and* performance.

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2. Stages in the Development of Prosodic Structure

Much of the work on early phonological development has focused on issues at the segmental level (e.g. Yeni-Komishian, Kavanagh & Ferguson 1980, Ferguson, Menn, & Stoel-Gammon 1992). Only recently have researchers begun to examine the form of children's early words from the perspective of developing prosodic structure, focusing specifically at the level of syllables and words (Demuth 1994, 1995a; Fee 1994, in press).[1] Demuth (1994) identifies four stages in the development of prosodic structure for English and Dutch, and suggests that similar stages of development may be found in the acquisition of all languages. These Stages are presented in Table 1.

Stage I.	Core Syllables - CV
	(No vowel length distinctions)
Stage II.	Minimal Words/Binary Feet
a.	Core Syllables - CVCV
b.	Closed Syllables - CVC
c.	Vowel length distinctions - CVV
Stage III.	Prosodic Words - larger than a binary foot
Stage IV.	Prosodic Words - target form

Table I. Stages in the Development of Prosodic Structure

Interestingly, Stage I contains the unmarked form of *syllables* - that is, Core (CV) syllables. Similarly, Stage II is characterized by the unmarked form of *prosodic words* - that is, Minimal Words, composed of binary feet (cf. Broselow 1982, McCarthy & Prince 1990, 1991, 1993b). Stage III is composed of prosodic words that are larger than just a binary foot. Target words are eventually produced at Stage IV. The first three stages are illustrated in following examples from Dutch (Fikkert 1994), and similar stages are found in English (Fee & Ingram 1982, Fee 1994, in press).

(1) Stage I - CV

	Child	Adult Target		
a.	[ka:], [ka]	/kla:r/	klaar	J (1;4-1;5)
b.	[da:], [da]	/da:r/	daar	
c.	[ti:], [tɪ]	/dɪt/	dit	

(2) Stage IIa - (C)VCV

a.	['a:pə]	/a:p/	aap	T (1;4-1;6)
b.	['bo:tɔ]	/bo:t/	boot	
c.	['tɛinə]	/trɛin/	trein	N (2;5-2;7)
d.	['tœyna]	/toyn/	tuin	

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1 Waterson (1971, 1987) was one of the first to consider prosodic aspects of early acquisition. Others have taken a 'rhythmic' approach, where it has been proposed that children's early utterances are composed of sequences of Strong-(weak) trochaic feet (Allen & Hawkins 1980, Gerken 1991, 1993, Gerken & McIntosh 1993, Wijnen, Kirkhaar & den Os 1994). Although descriptively adequate in characterizing certain aspects of later, sentence-level rhythmic phenomena, it lacks explanatory adequacy at the earliest, word-level stages of acquisition. A more abstract phonological account is therefore needed for both descriptive adequacy and explanatory coverage at the onset of early words.

	e.	['bo:mɩ], ['bo:mi:]	/ba'lɔn/	ballon	C (1;10)
	f.	['fiafə]	/ʃiː'rɑf/	giraf	
	g.	['nɛnɛ]	/koː'nɛin/	konijn	T (1;5)
	h.	['ʋɑfɑ]	/ʃiː'rɑf/	giraf	

(3) Stage IIb - CVC

	a.	[teif], [deːs]	/'deːze/	deze	J (1;6-1;7)
	b.	[puːs]	/puːs/	poes	
	c.	[paːs]	/paːrt/	paard	
	d.	[aːp], [ɑp]	/aːp/	aap	

(4) Stage IIc - VV~VC$_{son}$

	a.	[tɛi]	/trɛin/	trein	J (1;10-2)
	b.	[tyː]	/stuːl/	stoel	
	c.	[daː]	/daːr/	daar	
	d.	[boː]	/boːm/	boom	
	e.	[mɑm], [mɔm]	/maːn/	maan	
	f.	[œʋ]	/œyl/	uil	
	g.	[hɑm]	/haːn/	haan	
	h.	[bɔm], pɔm]	/boːm/	boom	

(5) Stages II and III (σσ'σ)

	a.	['fɔm]	/ˌteːlə'foːn/	telefoon	R (1;10-2;1)
	b.	['tɩfoːm]			
	c.	[ˌmiːkə'foːn]	/ˌmiːkroː'foːn/	microfoon	
	d.	['hoːtɑ]	/'oːliːˌfɑnt/	olifant	J (2;1-2;4)
	e.	[fɑut]			
	f.	['oːfɑ'fɑn]			

Stage I of prosodic development is a sub-Minimal Word - that is, a CV form only, where vowel length is not distinctive (Fikkert 1994). This is shown in (1) above. Then there is a stage where (C)VCV structures are used, as shown in (2). This is the beginning of the Minimal Word Stage (Stage IIa), where words now have the structure of binary feet. For children leaning languages that have only open syllables, this will be the Minimal Word Stage. However, for children learning languages that have closed syllables, the (C)VCV stage may be realized only briefly as means for producing Minimal Words when coda consonants cannot yet be represented. However, once children can represent coda consonants, Minimal Words take the form of CVC structures, as shown in (3). This is Stage IIb. Shortly afterwards, children begin to control vowel length, producing CVV Minimal Words, as shown in (4). This is Stage IIc. Finally, children's words begin to take the form of prosodic words which are larger than a binary foot, as shown in (5). This is Stage III.

Development in the shape of children's early words is therefore a principled, not random, process. And, although there may be variation in the shape of early words at any one point in time (i.e. both Stage IIa and IIb may be coextensive), that variation is only of a particular sort. In other words, children's early words seem to exhibit an increasing ability to handle more complex prosodic structures over time. Any theory of acquisition must be able to account for these facts. Demuth (1995a) captures this development in terms of the Prosodic Hierarchy (Selkirk 1984, Nespor & Vogel 1986), as illustrated in Table 2.
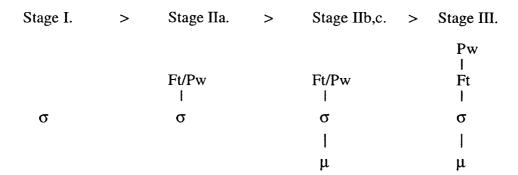
Stage I.	>	Stage IIa.	>	Stage IIb,c.	>	Stage III.
						Pw
						|
		Ft/Pw		Ft/Pw		Ft
		|		|		|
σ		σ		σ		σ
				|		|
				μ		μ

Table 2. The Development of Prosodic Representations

There are certain problems with this structural account, however, in terms of both descriptive and conceptual adequacy. First, if the prosodic hierarchy is available as part of Universal Grammar, it is not clear why children would initially use only part of that representation. Second, although children's development of prosodic structure has been characterized here in terms of 'stages', these stages are partially overlapping rather than discrete. In other words, at any one point in time, there may be a certain amount of variation in the form that a certain word will take, as shown in (5) above. Thus, any theory of acquisition must be flexible enough to account for this type of variation in output form. This is difficult to achieve with the representational approach, where once a given structure comes 'on line', all subsequent productions should have access to it, and can be expected to take that form. Finally, it is not clear, given the representational approach, what 'triggers' children's eventual access to different levels of prosodic structure. If children hear all of the segments of an input form, and have access to the prosodic hierarchy as part of Universal Grammar, why do they not produce fully formed prosodic words from the onset of speech?[2] Do children not perceive certain (unstressed, unfooted) syllables, and therefore not produce them? Demuth (1995a) argues that this is not the case. Rather, there is ample evidence that children perceive weak syllables even though they don't produce them. I therefore assume that, by the time children begin to speak, lexical representations for the words they hear are segmentally (if not morphologically) wellformed. Do children then have a different lexical representation as their output form, as suggested by Kiparsky & Menn (1977)? Again, I suggest that this is not the case. Rather, I argue that children have one lexical representation that serves both as an input and output form at the segmental level of analysis. The shape of children's early words must then be affected by certain surface constraints on output form, where unmarked structures are the first to emerge.

In the following section I show how a constraint-based approach to early word production provides a natural means of understanding the early stages of prosodic development.

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[2] A parallel problem is found with positing impoverished initial structural representations in syntax, based on the absence of functional categories. This has led to a flurry of recent debate, where theorist fall roughly into two groups along 'limited early structure' (VP only) vs. 'early full structure' (IP (& CP)) lines (cf. Meisel 1992, Lust, Suñer, & Whitman 1994 for various views). Demuth (1995b) provides an optimality theoretic perspective on these issues (see also Grimshaw 1994).

3. A Constraint-based Theory of Prosodic Development

I propose that the shape of children's early words might best be accounted for in terms of wellformedness conditions on linguistic structures, where a given output form is 'optimal' for a certain ranking of linguistic constraints. Specifically, I assume that the initial output states for children learning all languages will be realized in terms of unmarked prosodic structures, and that these will change during the course of development in accord with language-particular realizations of phonotactic and prosodic constraints. I therefore make the following assumptions concerning unmarked prosodic structures and their 'emergence' at the early stages of acquisition:

(6) Acquisition Assumptions

       a. Core Syllables (CV) are the unmarked form of syllable structure provided by Universal Grammar (Clements & Keyser 1983, Maddieson 1984, Steriade 1982).

       b. Minimal Words (binary feet) are the unmarked form of Prosodic Words provided by Universal Grammar (McCarthy & Prince 1993).

       c. Following Jakobson (1941/68), we predict that children will move from unmarked to more marked prosodic structures in the course of acquisition.

       d. Stages of acquisition can be characterized by a set of constraints (Prince & Smolensky 1993), where unmarked values emerge first, and where development involves the reranking of constraints over time.

Furthermore, in accord with optimality theoretic assumptions (Prince & Smolensky 1993), I assume that the following also hold:

(7) Optimality Theoretic Assumptions

       a. Constraints are all available as part of Universal Grammar

       b. A full set of phonological representations (segmental, prosodic) is 'available' as part of Universal Grammar

       c. Constraints can be violated (i.e. they are 'soft' constraints)

(7a) states that the set of linguistic constraints that characterizes natural language is available, in principle, to any language learner, as part of Universal Grammar. Thus, though certain constraints may play no active role in a particular language, they might be found at certain stages of language development. In fact, it has often been assumed, as part of the Continuity Hypothesis (e.g. Pinker 1984), that all stages in the learning of a target language will involve only structures available as part of natural language. Furthermore, (7b) states that all phonological representations (e.g. all levels of the Prosodic Hierarchy) are also available as part of Universal Grammar, and should in theory be accessible to early language learners. In other words, children don't have to *learn* the Prosodic Hierarchy, but they will have to determine *if and how different levels of that structure are instantiated* in the language being acquired. Finally, (7c) states that constraints are not 'hard' or absolute, but rather soft - that is, they can be violated, at least to a certain degree. It will be shown that this allows for a certain amount of variability in output form. Accounting for variability in children's early productions, especially at the phonological and morphophological level, has been one of the most serious challenges for theories of language acquisition. In the rest of this section I will show that a constraint-based approach to the problem of early words allows for just the right amount of constrained variability in the surface forms that words can take.

Given the markedness considerations in (6) and the optimality theoretic assumptions in (7), what does an initial grammar actually look like in terms of constraints and their relative rankings, and how do constraints come to be reranked over time? The constraints that are relevant to the realization of prosodic words are given in (8).

(8) FTBIN   Feet are binary at some level of analysis (σ, μ)

     FILL   Syllable positions are filled with segmental material

     *COMPLEX   Consonant clusters are not allowed

     ALIGN   Align (category 1 with edge 1, category 2 with edge 2)

     NO-CODA   Syllables may not have codas

     PARSE-SEG   Underlying segments are parsed (into syllable structure)

     ALIGN$_{PrWd}$ (Lex^0, L/R, PrWd, L/R): Binary foot = unmarked form of PrWd

The most important constraints for the problem at hand are the last three: NO-CODA, where syllables cannot have a coda, thereby yielding the unmarked (CV) form of syllables, PARSE-SEG, where the segments of the target word should be parsed into segments in the output form, and ALIGN$_{PrWd}$, where the unmarked form of a prosodic word is realized as a binary foot, or a Minimal Word (cf. McCarthy & Prince 1993). We will see that the other constraints play a role at Stages I and IV, to be discussed at the end of this section.

To demonstrate how a constraint-based approach to acquisition would work, I take as a possible target form the three syllable Dutch word *olifant* /'o:li:,fɑnt/ 'elephant', and consider the possible surface forms it might take at Stages IIa, IIb, and III. To do this, I consider some actually attested forms from the Dutch corpus - the forms in (5d-f) - repeated in (9). Although these forms coexisted at a certain point in development (discussed in (15) below), each of these forms is also typical of the word shapes found at different stages of development. I therefore take these forms, along with the hypothetical Stage I form [fɑ], and the final target form (Stage IV) as the types of forms that children might output at a given stage of development. In other words, these are potential 'candidate' forms which might be generated by the child's grammar (the GEN function) at a certain point in development. I will then show how some of these candidate forms are disallowed by the constraint ranking at a given point in time, and how others are 'optimal'.

(9)   Stage I   [fɑ]   /'o:li:,fɑnt/   'elephant'
      Stage IIa   ['ho:tɑ]
      Stage IIb   [fɑut]
      Stage III   ['o:fɑ'fɑn]
      Stage IV   ['o:li:,fɑnt]

At Stage IIa, early words are maximally and minimally composed of binary feet, and coda consonants have not yet appeared. The NO-CODA constraint and ALIGN$_{PrWd}$ constraint must be ranked fairly high. Specifically, they must be ranked more highly than the constraint PARSE-SEG, which is violated several times. At this point the prosodic word is equivalent to a binary foot. That is, the unmarked form of prosodic words has emerged. Note also that the unmarked form of prosodic words can emerge at this point precisely because PARSE-SEG is ranked very low - otherwise this would not be an optimal form.

(10) Stage IIa: NO-CODA, ALIGN$_{PrWd}$ .... >> .... PARSE-SEG

(PRWd = unmarked $\approx$ binary FT)

Given these constraints, and this particular ranking of constraints, the optimal output will then be CVCV in shape - a binary foot with no codas (a bisyllabic foot). Other possible forms that the child might generate at this point will be less optimal, as shown in (11).[3]

(11) Stage IIa - CVCV Minimal Words

NO-CODA, ALIGN$_{PrWd}$ .... >> .... PARSE-SEG

/ˈoːliːˌfɑnt/			NO-CODA	ALIGN$_{PrWd}$	PARSE-SEG
i.	[fɑ]				******
ii. ☞	[ˈhoːtɑ]				****
iii.	[fɑut]		*!		****
iv.	[ˈoːfɑˈfɑn]		*!	*	*
v.	[ˈoːliːˌfɑnt]		*!	*	

The hypothetical form in (i) is unacceptable as it violates the unmarked (binary foot) form of PRWd. The form in (iii) is unacceptable at Stage IIa because it violates NO-CODA. The forms in (iv) and (v) violate both NO-CODA and the unmarked form of PRWd. Thus, at Stage IIa, the form in (ii) is optimal, even though it violates PARSE-SEG several times.[4] At initial stages of development, PARSE-SEG must be ranked very low.

At Stage IIb, Minimal Words are still being used, but coda consonants now appear. I suggest that the NO-CODA constraint has therefore been demoted, now reranked below PARSE-SEG, or at least ranked lowly enough so that it will no longer exert any effect.

(12) Stage IIb: ALIGN$_{PrWd}$ ... >> ... PARSE-SEG ... >> ... NO-CODA

(PRWd = unmarked $\approx$ binary FT)

Interestingly, such a ranking of constraints allows for variation in the surface realization of Minimal Words. That is, both CVCV and CV(V)C forms are 'optimal' outputs for the constraint ranking provided in (12) - both are minimal words and violate PARSE-SEG to the same degree. In other words, the ranking of constraints provided in (12) allows for the possibility of free variation in output for a given input form, i.e. both (ii) and (iii) are optimal forms. This is precisely the type of free variation that is frequently attested at various stages of acquisition.

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[3] This presumes that onsets are obligatory, but this and the exact specification of particular segments is irrelevant to the present discussion of prosodic structure. See Rice & Avery (1993) for a discussion of the acquisition of segments from a perspective that is similar to the prosodic approach taken here (although yet to be formalized from an OT perspective).

[4] I have calculated the number of PARSE-SEG violations as a function of how many C's and V's occur in the output form - that is, how may *segments* actually surface. Those segments may bear little relation to the actual segmental/featural content of the input form. Although this is also a problem to be accounted for in any theory of acquisition, I take it to be partially independent of the prosodic issues discussed here.

(13) Stage IIb - CVCV ~ CVC Minimal Words

ALIGN$_{PrWd}$ . . . >> . . . PARSE-SEG . . . >> . . . NO-CODA

/ˈoːliːˌfɑnt/		ALIGN$_{PrWd}$	PARSE-SEG	NO-CODA
i.	[fɑ]	*!	*****	
ii. ☞	[ˈhoːtɑ]		***	
iii. ☞	[fɑut]		***	*
iv.	[ˈoːfɑˈfɑn]	*!	*	*
v.	[ˈoːliːˌfɑnt]	*!		*

But children eventually come to produce words that are larger than a Minimal Word. That is, they come to produce prosodic words that are larger than a binary foot. At some point, then, the *unmarked form for prosodic words no longer serves as a upper bound on the shape of children's words*, and words begin to assume the form of larger prosodic units. Note that this is initially accomplished without any reranking of constraints, thereby also permitting *free variation* between Minimal Words (Stage II) and larger Prosodic Words (Stage III), as attested in (5) above. At this point, however, PARSE-SEG must still be ranked *very low*: Only in this way can both Minimal Words and larger prosodic words *both* be 'optimal' output forms. Furthermore, the major prosodic difference between candidate (iv) and (v) is that (v) has a word final consonant cluster. It would therefore appear that the constraint *COMPLEX is highly ranked (though unordered with respect to ALIGN$_{PrWd}$), thereby disallowing the form in (v) as a possible optimal form at this time. This is shown in (14) and (15).

(14) Stage II ~ III: *COMPLEX, ALIGN$_{PrWd}$ . . .>> . . .PARSE-SEG . . .>> . . .NO-CODA

(15) Stage II ~ III - Minimal Word/Prosodic Word Variation

*COMPLEX, ALIGN$_{PrWd}$ . . >> . . PARSE-SEG . . . >> . . . NO-CODA

/ˈoːliːˌfɑnt/		*COMPLEX	ALIGN$_{PrWd}$	PARSE-SEG	NO-CODA
i.	[fɑ]		*!	*****	
ii. ☞	[ˈhoːtɑ]			***	
iii. ☞	[fɑut]			***	*
iv. ☞	[ˈoːfɑˈfɑn]			*	*
v.	[ˈoːliːˌfɑnt]	*!			*

Eventually, however, children's words begin to approximate the input form to a greater degree. This point in development is characterized by the higher ranking of PARSE-SEG. Minimal Words will then violate PARSE-SEG to a greater degree, rendering them 'less optimal'. At this point *COMPLEX must still be ranked higher than PARSE-SEG, but PARSE-SEG is not critically ranked with respect to ALIGN$_{PrWd}$. This is shown in (16) and (17).

(16) Stage III: *COMPLEX . . . >> . . . PARSE-SEG, ALIGN$_{PrWd}$ . . . >> . . . NO-CODA

At this point, although the form in (iv) still violates PARSE-SEG to a small degree, it is more optimal than the forms in (ii) and (iii), and the form in (v) is ruled out due to the constraint against consonant clusters.

(17) Stage III - Higher ranking of PARSE-SEG[5]

*COMPLEX . . >> . . PARSE-SEG, ALIGN$_{PrWd}$ . . . >> . . . NO-CODA

/ˈoːliˌfɑnt/		*COMPLEX	PARSE-SEG	ALIGN$_{PrWd}$	NO-CODA
i.	[fɑ]		*****!	*	
ii.	[ˈhoːtɑ]		***!		
iii.	[fɑut]		***!		*
iv. ☞	[ˈoːfɑˈfɑn]		*		*
v.	[ˈoːliːˌfɑnt]	*!			*

Children's forms will increasingly approximate the input/target forms over time, both in the number of segments parsed, and in the actual featural content that those segments take. In the case of the target form in (v), this can be accomplished quite simply by the demotion of *COMPLEX. Once this has been ranked below PARSE-SEG, the form in (v) will be the most optimal.

(18) Stage IV: PARSE-SEG, ALIGN$_{PrWd}$ . . . >> . . . NO-CODA, *COMPLEX

(19) Stage IV - Demotion of *COMPLEX

PARSE-SEG, ALIGN$_{PrWd}$ . . . >> . . . NO-CODA, *COMPLEX

/ˈoːliˌfɑnt/		PARSE-SEG	ALIGN$_{PrWd}$	NO-CODA	*COMPLEX
i.	[fɑ]	*****!	*		
ii.	[ˈhoːtɑ]	***!			
iii.	[fɑut]	***!		*	
iv.	[ˈoːfɑˈfɑn]	*!		*	
v. ☞	[ˈoːliːˌfɑnt]			*	*

In sum, the prosodic shape of children's early words can be captured in terms of output, or production constraints, characterized by the early emergence of the unmarked structures (Core Syllables and Minimal Words), the low initial ranking of PARSE-SEG, and the higher ranking of PARSE-SEG over time.

But what of the initial, sub-Minimal Word stage, where CV forms are attested at Stage I? If the unmarked form of prosodic words (Minimal Words) is given as part of Universal Grammar, and is the first to emerge, why should there ever be a stage of development that does not conform to a binary foot?

There are several possible explanations for the existence of Stage I. First, even though the unmarked form of prosodic words is given as part of Universal Grammar, the

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5 Given the stress pattern of form (iv), with two main stresses, rather than a main and secondary stress, one might wonder if this actually constitutes two prosodic words rather than one. Although this might be the case for this particular word, another child at this stage shows that a similar Stage III word is in fact one prosodic word - cf. the *microfoon* /ˌmiːkroˈfoːn/ 'microphone' example in (5c), produced as [ˌmiːkəˈfoːn]. Interestingly, this form is prosodically identical to the target, with the single exception of the onset cluster in the medial syllable. In other words, the constraints and the ranking provided for Stage III in (16) and (17) are precisely those that account for the form in (5c). It would thus appear that *COMPLEX applies to both onsets and codas, and that it is late to be demoted in the grammar of both these children.

actual instantiation of Minimal Words/binary feet in a given language is subject to variation. That is, feet can be iambic or trochaic, quantity sensitive or quantity insensitive. If children's early words reflect aspects of language particular instantiations of foot structure, as suggested in Demuth (1995a), rather than a default trochaic foot (e.g. Allen & Hawkins 1980), then we might expect a pre-foot stage of early word production where children could be agnostic as to language particular details of foot structure. That is, children's early words might take the unmarked form of syllables (Core Syllables) as an early strategy for avoiding the issue of how to construct early binary feet. Although this might appear to be ad hoc in principle, similar 'avoidance' patterns have been found in the acquisition of segmental structure (Vihman, Ferguson, & Elbert 1986). In other words, Stage I might simply represent the onset of word production, while avoiding language particular instantiations of foot structure.[6]

An alternative explanation might be couched in terms of the constraints NO-CODA and FILL. Many of children's early target words in both English and Dutch consist of CVC forms. However, given the initial high ranking of the NO-CODA constraint, children are left with being able to produce CV syllable shapes only unless they have access to FILL, thereby creating a second syllable (CVC + V) and a Minimal Word. Application of FILL would therefore provide a means of forming Minimal Words when NO-CODA is ranked high. But suppose applying FILL comes at a 'cost' if it entails parsing a segment into the output that is not part of the input. That is, parsing input material into the output is cost free, but epenthetic processes are generally avoided if alternatives exist. At least some children (learning both English (Fee 1994) and Dutch (Fikkert, p.c.)) seem to avoid FILL constructions (Stage IIa), thereby providing some support for this hypothesis.

Whatever the reason behind the existence of Stage I, we can characterize this stage as one where PRWd is left underspecified with respect to foot binarity. That is, the initial unmarked form a prosodic word is a syllable, not a binary foot!

(18) Stage I: NO-CODA, ALIGN$_{PrWd}$ .... >> .... PARSE-SEG

(PRWd = unmarked $\approx \sigma$)

This means that Stage I will violate Exhaustivity, where prosodic words dominate feet, and feet dominate syllables: However, cases where prosodic words directly dominate a syllable have been documented elsewhere (cf. McCarthy & Prince 1993a,b, Prince & Smolensky 1993, Ola 1994). It therefore appears that there is independent linguistic motivation for such structure. Words at Stage I therefore emerge as follows:

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[6] Furthermore, in the Fikkert (1994) data on Dutch, there appeared to be no Stage I words that were used for trisyllabic or larger targets. In other words, children at Stage I appear to avoid targets that are larger than a foot - possibly to avoid violating PARSE-SEG to an extreme extent.

(19) Stage I - CV Sub-Minimal Word

NO-CODA, ALIGN$_{PrWd}$ .... >> .... PARSE-SEG

/'o:li:,fant/		NO-CODA	ALIGN$_{PrWd}$	PARSE-SEG
i. ☞	[fɑ]			*****
ii.	['ho:tɑ]		*!	***
iii.	[faut]	*!	*	***
iv.	['o:fɑ'fɑn]	*!	*	*
v.	['o:li:,fɑnt]	*!	*	

In sum, it appears that a constraint-based approach to the problem of early word production can account for the Stages I, II, III and IV of prosodic word development. It does so through the emergence of the unmarked in conjunction with initial, intermediate, and final rankings of constraints. Furthermore, it allows for stages during which multiple forms may coexist, permitting restricted amounts of free variation as 'optimal' forms for a given constraint ranking.

4. Discussion

In this paper I have explored the possibility of using a constraint-based approach to the prosodic development of early words. This approach has several conceptual advantages over a representational view, where children might be seen to gradually gain access to different levels of prosodic structure over time. I detail some of these advantages below, and their implications for a theory of acquisition.

First, it is presumably the case that the levels of structure contained in the Prosodic Hierarchy are provided as part of Universal Grammar. In principle, then, children should be able to produce full-blown prosodic words as well as sub-syllabic bits of moraic structure from the onset of early word production. That they do not therefore calls for an explanation. Demuth (1995a) demonstrates that neither perceptual nor articulatory explanations can provide an adequate account for the shape of early words. Rather, it appears that children's early words reflect a growing ability to produce wellformed prosodic units which take principled linguistic shapes. I suggest that these early word forms can best be understood in terms of output constraints on surface (postlexical) representations. That is, underlying lexical representations are wellformed, yet surface output representations are initially constrained, beginning with the unmarked form of prosodic words (Core Syllables and Minimal Words), and gradually building to larger output structures. Variation in prosodic structure may occur when two forms are compatible with the same ranking of constraints (i.e. the coocurrence of CVCV and CVC Minimal Words). In such cases of free variation, both forms are equally 'optimal'.

But why do children's early words map so little of the input segmental representation onto the output form? That is, why do early words violate the Faithfulness condition to such a great degree? Note that the early emergence of the unmarked is in direct conflict with PARSE-SEG: It allows for early words to consist of minimally wellformed prosodic units at the expense of parsing segments into the output. I hypothesize that the transition from babbling to first words involves an increase in cognitive complexity, where minimal linguistic units are all that the child's linguistic processor can output at the onset of first words. Only gradually does the child develop the cognitive capacity and planning capability to faithfully parse all of the input into output forms, creating larger prosodic words, and this is carried out in a principled manner. It would therefore appear that all children learning all languages begin with a similar constraint ranking that allows for the emergence of the unmarked first. For children learning languages containing only open syllables, few constraints will need to be reranked, and the target grammar will be reached

relatively quickly. However, for those learning languages with complex prosodic and phonotactic structures, adult-like word forms will take much longer to be acquired. In such cases we should also expect a greater amount of individual variation, with some children approximating adult grammars much sooner than others.

In sum, this paper outlines a constraint-based approach to prosodic development that explains the shape of early words in terms of *output constraints on surface form*. Furthermore, it creates a mechanism for handling the problems of *free variation* at a given point in time, and *individual variation* amongst speakers. Finally, it allows for a theoretical understanding of both *continuity* and *gradual change* in the course of language development. In so doing, it attempts to provide a more accurate descriptive account of early prosodic development along with a theoretical understanding of what that process involves.

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