Truncation to Subminimal Words in Early French[*]

Katherine Demuth and Mark Johnson

Brown University

Abstract

It has commonly been proposed that there is a stage in development where children's early productions are binary feet, or minimal words. However, the present study of a French-speaking child (1;1-1;8) finds an extended period where both CVC and disyllabic

target words are truncated to CV after initially being produced as reduplicated C_1VC_1V forms. That is, the child appears to regress, failing to produce disyllabic forms that could be produced earlier. This paper proposes an explanation for this apparent regression in terms of segmental-prosodic constraint interaction, where the child's limited segmental inventory, in conjunction with the high frequency of CV lexical items in everyday French, conspire to yield subminimal truncations as 'optimal' at this stage in development. These findings provide support for a growing body of literature showing the importance of both constraint interaction and frequency effects in early production, arguing for a more probabilistic approach to theories of language learning.

1. Introduction

It has long been noted that children omit certain unstressed syllables from their early speech, with words like *banana* surfacing as [ˈnænə], and words like *elephant* being realized as [ˈɛfa] (e.g., Allen and Hawkins 1978, 1980; Echols and Newport 1992; Echols 1993; Gerken 1994; Pater 1997; Kehoe 2000; see Kehoe and Stoel-Gammon 1997 for a recent review). This led Allen and Hawkins (1978, 1980) to propose a universal bias for children's early words to contain a strong-weak (Sw) trochaic foot. This proposal has received renewed attention with recent research showing that children learning a number of unrelated languages exhibit a minimal word stage of development, where early words are both minimally and maximally one binary foot (e.g., Dutch – Fikkert 1994; Wijnen, Kirkhaar and den Os 1994; Spanish – Demuth 2001a; Japanese – Ota 1999; Sesotho – Demuth 1994; Hebrew – Adam 2002). These findings are consistent with the notion that

'unmarked' structures such as core (CV) syllables and minimal words (binary feet) are the first to emerge in children's early grammars (e.g. Fikkert 1994; Demuth 1995; Demuth and Fee 1995; Fee 1996; Gnanadesikan 1996; Pater 1997). It also corresponds with crosslinguistic findings showing that open class lexical items and morphologically derived words (e.g., nicknames, clipped forms) tend to take the form of a binary foot (e.g., Itô 1990, McCarthy and Prince 1994; Scullen 1997), although languages such as Japanese, Spanish, and French also permit subminimal (CV) lexical words in their native vocabulary.

There have been several attempts to explain syllable omission in children's early speech. Echols and Newport (1992) and Echols (1993) offer a <u>perceptual account</u>, observing that stressed and final syllables, which typically contain more salient acoustic information, are retained, whereas others may be omitted. However, it is not clear how the perceptual account handles truncations such as [ˈbænə] for *banana*, where the onset to the initial unstressed syllable is mapped into the output form (see Pater 1997 for a markedness account of onset selection). The child must have perceived the onset to the unstressed syllable if it is mapped into the word form produced. Thus, the <u>perceptual account</u> leaves unanswered questions regarding why children omit certain syllables (or parts of syllables) from their early words.

The <u>articulatory account</u> (MacNeilage 1980; Menn 1983) runs into similar problems. If young language learners are articulatorily restricted in either syllable complexity or the number of syllables per word, we expect these maturational limitations to be found crosslinguistically. Yet findings from early Spanish show that children

produce 3-syllable words with an initial unstressed syllable (e.g., [manˈsana] *manzana* 'apple') several months before English-speaking children (Demuth 2001a; Gennari and Demuth 1997) or German-speaking children (Lleó 2001). It would therefore appear that English- and German-speakers' omission of initial unstressed syllables must be due to non-articulatory factors (see Roark and Demuth 2000 for a frequency-based account).

Finally, the rhythmic production account, which predicts that children will produce stressed syllables followed by an optional weak syllable (S(w)) (Allen and Hawkins 1978, 1980; Gerken, 1994, 1996) again encounters problems with the cases like [ˈbænə]; if children map stressed syllables into their output forms, we would expect the entire stressed syllable of *banana* to surface, yielding [ˈnænə]. The rhythmic production account also suffers from the lack of a developmental proposal for how children eventually move beyond the constraints of a trochaic template. Note that this proposal is largely based on data from English, a language where trochaic-shaped words/trochaic patterns predominate. It is therefore unclear how it generalizes to languages such as Spanish, where many lexical items contain more than a single foot.

In an attempt to address the limitations of these proposals, Demuth and Fee (1995), Demuth (1995, 1996a, 1996b), and Fee (1996) argue for a more abstract prosodic constraints approach to explaining the shape of early words. By appealing to different levels of structure in the prosodic hierarchy shown in (1) (Selkirk 1984; Nespor and Vogel 1986), and to constraint interaction (Prince and Smolensky 1993), this proposal

provides a framework for understanding early minimal words as a developmental stage along the path of increasing prosodic complexity.

(1) The Prosodic Hierarchy

Utt	(Phonological Utterance)	*I hope we find some bananas*
IP	(Intonational Phrase)	*I like bananas*
PP	(Phonological Phrase)	*like bananas*
PW	(Phonological/Prosodic Word)	*bananas*
Ft	(Foot)	*nanas*
σ	(Syllable)	*nas*
μ	(Mora)	*na*

Thus, although some English-speaking children's first prosodic words may be composed of a subminimal monomoraic form like that in (2a), they quickly develop into larger structures containing a minimal word (a bimoraic or bisyllabic foot as shown in (2bi) and (2bii) respectively), and eventually, can take the form of a prosodic word with an unfooted syllable like that in (2c). Thus, over time, children's utterances become more complex, containing several prosodic words within larger phonological and intonational phrases (Demuth 2001b).

(2) Prosodic Word Structures

a. Subminimal Word   b. i.Bimoraic Foot ii. Disyllabic Foot   c. Initial Unfooted Syllable

PW   PW   PW   PW

Ft   Ft   Ft   Ft

σ   σ   σ   σ   σ   σ   σ

μ   μ   μ
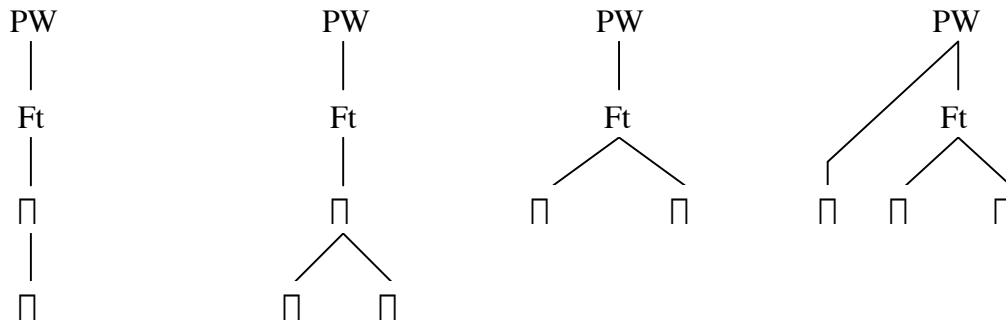
Importantly, the prosodic constraints account also predicts that the shape of early words will be influenced by language-specific factors: if the language being learned has trochaic feet, early words will be trochaic, but if the language has iambic feet, learners' early words will be iambic (Demuth 1996b). Thus, the prosodic constraints account predicts that children's early words will reflect the predominant (high frequency) prosodic structures in the language being learned, with low frequency prosodic structures being acquired later. For example, English language learners tend to acquire coda consonants quickly, while unfooted syllables are often omitted until the age of 2;6 (Kehoe 2000). In contrast, Spanish language learners typically acquire unfooted syllables before they reliably produce coda consonants around the age of 2;3 (Demuth 2001a; Lleó 2003). Thus, young language learners show frequency effects in their early productions (Roark and Demuth 2000). This is consistent with results from infant speech perception studies showing that one-year-old language learners are sensitive to the statistical properties of the phonological structures they hear (e.g., Jusczyk, Cutler, and Rendanz

1993; Morgan 1996; Saffran, Newport, and Aslin 1996; Anderson, Morgan, and White 2003).
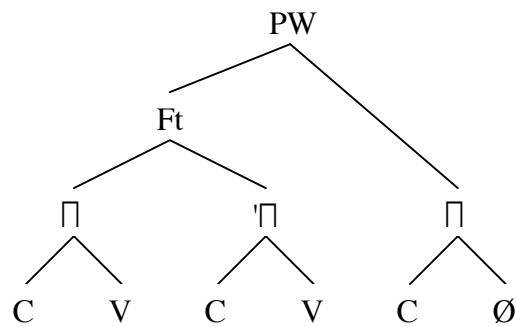
French, with an iambic prosodic word structure that differs from both English and Spanish, presents an interesting opportunity for exploring the viability of these competing proposals regarding the shape of children's early words. In this paper, we provide a case study of a French-speaking child's early words, examining development in terms of constraint interaction and constraint reranking over time (Prince and Smolensky 1993). Section 2 discusses the structure of French syllables and prosodic words, and makes predictions regarding the possible course of French prosodic development. Section 3 presents the data, showing that CV subminimal truncations constitute a surprisingly large portion of the child's early word productions. Section 4 discusses several possible explanations of the data. Sections 5 and 6 show that segmental-prosodic constraint interactions, combined with the relatively high frequency of CV lexical items in everyday French, conspire to yield CV truncations as the most optimal output at this point in the child's developing grammar. The paper concludes by suggesting that our knowledge about the relative frequency of linguistic structures in the ambient language is critical for predicting crosslinguistic differences in developing grammars, and for our theoretical understanding of how language learning proceeds.

2. French Prosodic Structure and Implications for Acquisition

Before examining the acquisition of French, we first review some of the basics of French prosodic structure. There have been various proposals regarding the nature of

French feet and the status of word-final consonants. French typically exhibits lengthening, or stress, on the final syllable in the phonological phrase. It has therefore been considered to have iambic (right-headed) feet (e.g., Hayes 1995). Charette (1991:146) proposes that French has iambic feet, but that word-final consonants are syllabified as onsets to an empty-headed syllable rather than as codas. Since these syllables cannot, by definition, head feet, she argues that they are prosodified at the higher level of the prosodic word, at the level of the foot, as shown in (3).

(3) Iambic Foot with Unfooted Final Empty-headed Syllable

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                        PW
                    ／        ＼
               Ft                  ＼
            ／      ＼                ＼
         σ            'σ               σ
        ／＼          ／＼            ／＼
       C    V        C    V          C    Ø
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Charette's (1991) analysis of French final consonants concurs with proposals by others suggesting that word-final consonants are universally onsets to empty headed syllables (e.g., Harris 1994, 1997; Kaye 1990; Kaye, Lowenstamm and Vergnaud 1990). Others argue for a more moderate version of this proposal, suggesting that the constraint against word-final codas is language-specific (e.g., Piggott 1999; Rose 2000; Goad and Brannen 2003).

Some of the controversy over the status of word-final consonants in French comes from observations about the distribution of French vowels. For example, it has been noted that, in southern French, Québec French, and increasingly in Standard French, lax vowels typically occur in closed syllables and tense vowels typically occur in open syllables. These distributional facts, known as règles de position or Closed Syllable Adjustment (Dell 1973; Selkirk 1972, 1978; Tranel 1984, 1985, 1995), suggest that tense vowels are bimoraic, and that both lax vowels and word-final consonants are moraic, or codas.

However, others provide additional evidence that word-final consonants in French may not be syllabified as codas. First, stress assignment in French is predictable; the last non-schwa will be stressed irrespective of the presence of a final consonant. Second, it is argued that not only word-final singleton consonants, but also consonant clusters with rising sonority, are both onsets to a syllable with an empty nucleus (e.g., [ˈpɔ.ʁ] *port* 'harbur', [ˈsu.pl] *souple* 'supple') (e.g., Dell 1995). The fact that some dialects of French variably exhibit the use of schwa in conjunction with word-final onsets provides further support for the proposal that these consonants are syllabified as onsets.

Although Goad and Brannen (2003) suggest that word-final consonants are prosodified as onsets for all language learners in the initial state, Rose (2000), in a study of two children learning Québec French, finds that one child treated word-final /ʁ/ as a coda. Thus, it remains an open question as to how language learners assign prosodic structure to word-final consonants. We therefore remain agnostic as to the prosodic status of French learners' singleton word-final consonants in the following discussion.

What, then, are the implications for word minimality in French (see Plénat 1993)?

French contains CV lexical items that presumably consist of only one mora of structure

(e.g., [lɛ] *lait* 'milk', [nɔ̃] *nom* 'name'). French therefore permits subminimal words in its

native vocabulary. If singleton word-final consonants are syllabified as codas (CVC),

then the coda could contribute a mora and these lexical items would constitute a binary

foot. However, if word-final consonants are syllabified as onsets to an empty-headed

syllable (CV.C), these words would be monomoraic and would also be considered

subminimal. Some might argue that determiners precede most French nouns, and as

prosodic clitics they combine with subminimal lexical items to yield a disyllabic foot (e.g

(lə+nɔ̃)$_{Ft}$ *le nom* 'the name'). However, this process is not phonologized to the extent that

it is in other languages, where epenthesis occurs with monosyllabic stems to ensure word

minimality when prosodic clitics are not available (e.g., Sesotho - Doke and Mofokeng

1957; Shona - Myers 1987). Thus, French permits CV (and possibly CV.C) subminimal

words in its native lexicon. However, French words derived through morphological

processes (e.g., nicknames, acronyms, clipped forms) tend to take the form of a disyllabic

foot, although CVC forms are also attested (e.g., Kilani-Schoch 1996; Scullen 1997;

Weeda 1992), again raising questions regarding the prosodic status of word-final

consonants.[1] This suggests that productive word formation processes in French may

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[1] Monosyllabic truncations with an open syllable are also permitted, but they must have

an initial consonant cluster (e.g., CCV) (Kilani-Schoch 1996:140).

actually show word minimality effects similar to those found in other languages (see McCarthy and Prince 1994).

Given the prosodic structure of French, and the foregoing discussion of prosodic development in English, Dutch, and Spanish, it is possible to make predictions about the course of prosodic development in French. First, core (CV) syllables are the least marked syllable shape crosslinguistically, and occur at the beginning stages of development even in languages with a high instance of coda consonants. We would therefore expect a stage in development when French-learning children's first words contain only core syllables. We should also expect early CVCV words, where core syllables are combined to form a binary foot. Such forms are sometimes found in English and Dutch when young children approximate CVC targets, their productions taking the shape of either reduplicated C_1VC_1V forms or the CVC target plus an epenthetic final vowel. We might then also expect young French learners to reduplicate or apply epenthesis to CVC targets, resulting in early CVCV outputs. Given the fact that French permits CV lexical items, we would also expect French-learning children to correctly produce CV targets as CV. However, if binary feet have a privileged status in children's early grammars, there might be a tendency to augment these to form a binary foot, either through lengthening of the vowel (CVV) or through reduplication (see Ota 2001 for reports of early augmentation of subminimal words in Japanese). For trisyllabic targets, we would expect early truncation to a binary foot, as happens in English and Spanish (Demuth 2001a; Gennari and Demuth 1997).

Rose (2000) shows that many of these predicted forms appear in his longitudinal study of two children learning Québec French, Clara and Théo. Critically, there was no augmentation of CV targets to form a binary foot. On the other hand, Théo did truncate CVC targets to CV. If CVC targets are only monomoraic, and therefore already subminimal words, truncation to CV would have no impact on foot wellformedness. We might then expect truncation to happen more frequently in a language like French than is typically found in languages like English or Dutch, where children go through a stage in development where their words are minimally and maximally one binary foot.[2] The children in Rose's study also showed early reduplication for disyllabic targets, although several of the early targets were themselves reduplicative forms. In addition, trisyllabic targets were reduced to disyllables, indicating that a binary foot was the maximal form for early prosodic words. Critically, all of these disyllabic outputs had word final stress, showing that French-learning children's early words are iambic. This goes counter to proposals by Allen and Hawkins (1978, 1980) that all children will show evidence of early trochaic feet (see also discussion in Rose 2000). The fact that these children produce early monomoraic words without augmentation also goes against Demuth and Fee's (1995) proposal that children's early words will be composed of binary feet. However, given the fact that French appears to license subminimal prosodic words as part of its lexicon, and that these are apparently not rare, these early forms are consistent with

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[2] Note, however, that Goad and Brannen (2003) suggest that word-final consonants are syllabified as onsets of empty-headed syllables even in languages like English at the early stages of development.

Demuth's (1996b) proposal that children's early word shapes will reflect the those prosodic word structures which are commonly found in the target language.

We turn now to the present study, which shows that the Parisian child under investigation exhibits stages of language development that are similar in many respects to those reported for the children learning Québec French (Rose 2000). However, she differs in exhibiting an extended period of time where she truncates <u>disyllabic</u> targets to subminimal CV after initially having produced them as reduplicated C_1VC_1V forms. Given that such a U-shaped learning curve is completely unexpected, and has not been previously documented for the acquisition of prosodic structure in other languages, it requires explanation.

3. The Data

This study examines longitudinal diary data collected by Deville (1891) of his daughter's acquisition of Parisian French from the onset of her first words until the age of 2 (see also Lewis 1951). Deville was an astute observer of his daughter's language development, inspired originally by Darwin. He took copious daily notes not only on Suzanne's intended word targets and actual productions, but also on the context of her communicative interactions. Thus, despite the fact that the data were recorded in orthographic form, and report only new forms of words, they provide an extremely rich set of data for addressing many questions of current phonological and acquisition interest.

The data examined here represent the earliest stages of Suzanne's linguistic development between the ages of 1;1-1;8, when she was primarily at the one-word stage

of development. The corpus examined contains 220 utterances, with 25 different word types reported at age 1;3 and 50 different word types reported by age 1;4. Since French orthography provides some evidence of vowel quality, it was possible to render the orthographic transcriptions into approximate IPA form (Tai 1999). However, since stress was not marked on these forms, we make no generalizations regarding the placement of stress, nor about the iambic or trochaic status of Suzanne's early outputs.

We now consider the prosodic structure of Suzanne's early words. We predict that, after a brief period of CV truncations, her early disyllabic and trisyllabic targets will be minimally and maximally binary feet, as found in other languages. That is, we expect Suzanne to go through a stage in development where her early productions take the unmarked form of minimal words. It is not clear if this will extend to CV and CVC targets as well.

A summary of Suzanne's attempted word targets over time is presented in Table 1. Half of all word types she attempts are disyllabic words (52%), and a third are monosyllabic (33%), either CV (15%) or CVC (18%). Only 12% are trisyllabic and 2% are quadrasyllabic. Thus, 86% of Suzanne's attempted word target types contain one or two syllables.

[insert Table 1 about here]

It is perhaps not surprising, then, that with a few exceptions, all of Suzanne's early outputs are either CV or CVCV (Table 2). At the earlier stages of development, her few

15

trisyllabic targets are reduced to a disyllabic foot, and word-final consonants are deleted. Word-final consonants and trisyllabic words begin to appear around 1;7. This is similar to the development of early word shapes reported in Rose (2000). Comparing Tables 1 and 2, we also see that Suzanne's CV output forms exceed the number of CV (and CVC) targets she attempts. This means that she is truncating many words that contain a binary foot to CV, creating subminimal words for an extended period of time. In the following sections, we examine the structure of Suzanne's early prosodic words more closely to understand why her early word truncations are maximally, but not minimally, a binary foot.

[insert Table 2 about here]

3.1 Upper Bounds on Prosodic Word Structure

The theory of <u>prosodic constraints</u> predicts that children's early French words will be iambic rather than trochaic. Given that the last syllable in the French word/phrase is stressed, we would also expect this syllable to be mapped into the child's output form. A question remains, however, about how many syllables French-learning children's early words will have: will they be maximally a binary foot, showing an upper bound of two syllables like that found in other languages, or will they be unbounded, permitting the early acquisition of trisyllabic prosodic words?

Although Suzanne attempts only a few trisyllabic words, the examples in (4) show these are generally realized as binary feet, with three syllable words beginning to emerge only around the age of 1;7.

(4) Truncation of trisyllabic targets to a binary foot: σσσ → (C)VCV

Target	Child	Orthography	Gloss	
[dɔmino]	[ɔjɔ] ~ [bɔjɔ]	domino	'domino'	1;4
[ɔmnibys]	[byby]	omnibus	'omnibus'	1;5
[pɔʀtmɔnɛ]	[mene]	porte-monnaie	'change purse'	1;5
[sosisɔ̃]	[tɔti]	saucisson	'sausage'	1;6
[paʀaplɥi]	[api]	parapluie	'umbrella'	1;7
[ʀəgaʀde]	[dade]	regardez	'look!'	1;7
[abaʒuʀ]	[abaʒu]	abat-jour	'lampshade'	1;7
[ɔʀɑ̃ʒe]	[ɔaje] ~ [ɔjaje]	orangé	'orangey'	1;8

Suzanne's grammar prefers words be maximally a binary foot, and this is achieved at the cost of omitting syllables from longer words. This can be captured in terms of constraints (e.g., Prince and Smolensky 1993) by ranking PW=FTBIN (PWs constitute a binary foot)[3]

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[3] We use PW= FTBIN as a shorthand here for the following three constraints: FTBIN (feet are binary at some level of analysis (σ,μ)), ALIGN(FT, L, PRWD, L) (align the left edge of

above MAXI-O (all segments in the input must appear in the output), resulting in the truncation of additional syllables: PW= FTBIN >> MAXI-O.

Note that the final syllable of the target form, or Suzanne's nearest approximation to it, is generally mapped into her output form. This is consistent with findings from much of the literature on early prosodic words, showing the high ranking of the faithfulness constraint which preserves the stressed syllable. This syllable is then either reduplicated to yield a disyllabic foot (e.g., *omnibus* [byby]), and/or segments from elsewhere in the word are mapped into the child's output form (*porte-monnaie* [mene]). The one time when this is not observed is the case of *saucisson* ([tɔti]) where the first two syllables of the word are parsed into the target form, [s] also being realized as the unmarked coronal [t].[4]

Suzanne's early words are therefore maximally a binary foot. This is similar to findings from early English, Dutch, Sesotho, Hebrew, and Japanese and other French-learning children (Rose 2000). Even children's early Spanish shows truncation to binary feet (Demuth 2001a; Lleó 2001). Thus, children learning prosodically different

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every foot with the left edge of the Prosodic Word), and PARSE-σ (every syllable must belong to a foot).

[4] We thank an anonymous reviewer for pointing out that the target in this case might actually be the colloquial form *saucisse* [sosis], in which case there would be no truncation. The same may be true for the target *omnibus,* which is often clipped to *bus* in everyday speech.

languages seem to show a stage of development where their early words are maximally a binary foot.

3.2 Lower Bound on Prosodic Word Structure

We now consider the lower bound on Suzanne's early words. Suzanne's earliest words show variability in form, but at age 1;3 and for the next six weeks, all of her target words are monosyllabic or disyllabic words with no codas (except for the first syllable of *merci*) (see (5)). Interestingly, all of her productions are faithful to the number of syllables in the target word (again, with the exception of *merci)*. This means that Suzanne also produces CV target words as CV (with no epenthetic syllable), thereby violating word minimality effects. This is shown in (5a). Note that the disyllabic forms in (5b) are generally reduplicated C_1VC_1V outputs. The one exception is the target with an onset cluster, which is deleted altogether ([kʀɛjɔ̃] → [ɔjɔ] *crayon* 'pencil').

(5) No Codas, Syllable Faithfulness, Reduplication: CV, C_1VC_1V

	Target	Child	Orthography	Gloss	
a.	[tu]	[tu]	tout	'all'	1;3
	[pɛ̃]	[pa]	pain	'bread'	1;4
	[la]	[na]	là	'there'	1;4
	[ba]	[ba]	bas	'low'	1;4
b.	[mɛʀsi]	[ʃi] ~ [si]	merci	'thank you'	1;3

[kuku]	[tutu]	toutou	'hi!'	1;3
[pupe]	[pepe]	poupée	'doll'	1;3
[dodo]	[dodo]	dodo	'sleep'	1;4
[kʀɛjɔ̃]	[ɔjɔ]	crayon	'pencil'	1;4
[ɔɲɔ̃]	[nɔmɔ̃]	oignon	'onion'	1;4
[ʃapo]	[popo]	chapeau	'hat'	1;4
[letje]	[tete]	laitier	'milkman'	1;4
[bebe]	[bebe]	bébé	'baby'	1;4
[kiki]	[titi]	quiqui	'politeness term' 1;4	
[kafe]	[tata]	café	coffee	1;4
[kuto]	[toto]	couteau	'knife'	1;4

Given that Suzanne shows no attempt to augment her subminimal CV words, we assume that the constraint against epenthesis, DEPI–O (all segments in the output must appear in the input), is ranked above the constraint requiring all prosodic words to contain a binary foot. Thus, Suzanne's earliest prosodic word shapes can be accounted with the following partial constraint ranking: DEPI–O >> PW= FTBIN >> MAXI-O.

Toward the end of the month when she is 1;4, Suzanne begins to attempt a few (C)VC words, shown in (6). However, instead of producing the word-final consonants, she reduplicates, creating disyllabic feet.[5]

(6) Reduplication of (C)VC targets: (C)VC → C_1VC_1V

Target	Child	Orthography	Gloss	
[pɛl]	[pepe]	pelle	'shovel'	1;4
[kan]	[tata]	canne	'stick'	1;4
[bal]	[baba]	balle	'ball'	1;5
[tɑs]	[tɑtɑ]	tasse	'cup'	1;5
[pɔʀt]	[pɔpɔ]	porte	'door'	1;5
[œf]	[tɔtɔ]	oeuf	'egg'	1;5

If the child analyses word-final consonants as codas, we would assume that the pattern in (6) indicates that the constraint NOCODA (no codas permitted) is ranked more highly than DEPI–O, resulting in epenthesis and resyllabification of the word-final target consonant as an onset. Alternatively, if the child treats word-final consonants as onsets to

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[5] We thank Yvan Rose for pointing out that [kan] →[tata] *canne* 'stick' may be a case of velar fronting, and the same may hold of [œf] → [tɔtɔ] *oeuf* 'egg', where the target form may in fact be the colloquial *coco* [koko].

empty-headed syllables, the constraint can best be understood in terms of a prohibition against empty-headed syllables. This can be captured by the syllable structure constraint NUC(LEUS) (syllables must have overt (melodically filled) nuclei) (Prince and Smolensky 1993:85; Rose 2000:75). Note that both have the effect of prohibiting word-final consonants. We therefore combine the two here into the constraint *C]$_{PW}$ (no word-final consonants permitted), remaining agnostic as to the prosodic status of these consonants. Thus, rather than deleting the word-final consonant it is preserved along with a following vowel, indicating that the constraint MAXI-O must now be ranked higher than both *C]$_{PW}$ and DEPI-O (i.e., MAXI-O >> *C]$_{PW}$, DEPI-O).

At the same time that she augments CVC targets, Suzanne faithfully produces CV subminimal targets as CV, with no augmentation, as shown in (7).[6] This confirms that the constraint requiring prosodic words to be binary feet is lowly ranked. The resulting constraint ranking at this point in Suzanne's developing grammar is MAXI-O >> *C]$_{PW}$, DEPI-O >> PW= FTBIN .

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[6] There were two cases at 1;5 years where Suzanne did augment CV target forms, reduplicating *clef* 'key' to [tete] and *thé* 'tea' to [tete] ~ [te]. However, Deville (1891:19-20) reports that both occurred immediately after a disyllabic reduplicated form of the same phonological shape (*sécher* [tete] 'to dry', *côtelette* [tete] 'cutlet', respectively), perhaps inducing 'reduplicative priming'.

(7) No Augmentation of CV Targets

Target	Child	Orthography	Gloss	
[o]	[ɔ]	eau	'water'	1;5
[pje]	[pe]	pied	'foot'	1;5
[fø]	[pø]	feu	'fire'	1;5
[ʃa]	[a]	chat	'cat'	1;5

At age 1;4-1;5, Suzanne uses reduplication to 'repair' CVC targets, but unlike previous proposals for languages like English and Dutch (e.g., Demuth and Fee 1995, Demuth 1996a), this does not appear to be motivated in order to meet word-minimality requirements. This is further confirmed by the fact that, toward the end of this period, she begins to delete word-final consonants altogether, as shown in (8). This means that CVC targets, initially produced as binary feet, are now realized as CV, being more faithful with regard to prohibiting epenthesis, but less faithful in terms of not preservation of the word-final consonant. Suzanne's constraint ranking now has DEPI-O and *C]$_{PW}$ ranked more highly ranked than MAXI-O, resulting in the constraint ranking DEPI-O, *C]$_{PW}$ >> MAXI-O >> PW= FTBIN. These CV truncations persist for several months until word-final consonants slowly begin to appear.

(8) Truncation of CVC targets: CVC → CV

Target	Child	Orthography	Gloss	
[pɛɲ]	[pɛ]	peigne	'comb'	1;5
[bʀɔs]	[bɔ]	brosse	'brush'	1;5
[pɔm]	[pɔ]	pomme	'apple'	1;5
[sɑbl]	[tɑ]	sable	'sand'	1;6
[taʀ]	[ta]	tard	'late'	1;6
[lim]	[pi]	lime	'file'	1;6
[fij]	[pij]	fille	'girl'	1;6
[fʀɛz]	[tɛ]	fraise	'strawberry'	1;7
[vɛʀ]	[ve]	verre	'glass'	1;7
[sɛl]	[te]	sel	'salt'	1;7
[vaʃ]	[va]	vache	'cow'	1;8
[vɛʀ]	[vɛ]	vert	'green'	1;8

At the same time as CVC targets begin to be truncated (8), Suzanne begins to show variability in the production of disyllabic targets. Although a few are faithfully produced as disyllabic words (9), most are truncated to CV (10).

(9) Faithful production of disyllabic targets: σσ → (C)VCV

Target	*Child*	*Orthography*	*Gloss*	
[ʃosɔ̃]	[tɔtɔ̃]	chausson	'slipper'	1;5
[kɔʀse]	[tete]	corset	'corset'	1;5
[pœtit]	[pœti]	petite	'small'	1;5
[kɔkij]	[tɔti]	coquille	'shell'	1;6
[aspɛʀʒ]	[ape]	asperge	'asparagus'	1;7
[bɔnɔm]	[bɔdɔ]	bonhomme	'gentleman'	1;7

(10) Truncation of disyllabic targets to subminimal words: σσ → CV

Target	*Child*	*Orthography*	*Gloss*	
[ʃosɔ̃]	[tɔ̃]	chausson	'slipper'	1;5
[balɛ]	[ba]	balai	'broom'	1;5
[ʒypɔ̃]	[pɔ]	jupon	'petticoat'	1;5
[basɛ̃]	[ba]	bassin	'basin'	1;5
[buʒi]	[bi]	bougie	'candle'	1;5
[madam]	[da]	madame	'Mrs.'	1;6
[kylɔt]	[tɔ]	culotte	'pants'	1;6
[fʀɔmaʒ]	[ma]	fromage	'cheese'	1;6

[salad]	[da]	salade	'salad'	1;7
[ʃifɔ̃]	[tɔ̃]	chiffon	'rag'	1;7
[giɲɔl]	[ɲɔl]	Guignol	'puppet'	1;7
[sɔlda]	[da]	soldat	'soldier'	1;8

For a brief period at age 1;5, even some trisyllabic targets are truncated to CV, preserving only the last syllable (11).

(11) Truncation of trisyllabic targets to subminimal words: σσσ → CV

Target	*Child*	*Orthography*	*Gloss*	
[tablije]	[je]	tablier	'apron'	1;5
[paʀaplɥi]	[pi]	parapluie	'umbrella'	1;5
[dezabij]	[bi]	déshabille	'undress'	1;5

Thus, Suzanne seems to initially progress from producing a limited set of wellformed CV and replicated CVCV words (5) to producing reduplicated well-formed binary feet for CVC targets (6). Then, when she begins to truncate CVC targets to CV words (8), becoming more faithful to DEPI-O but less faithful to MAXI-O, she also begins to show extensive truncation of some disyllabic (10) and trisyllabic (11) targets. How can we explain this 'regression' from producing well-formed binary feet to producing truncated subminimal words? Rather than becoming more faithful to the input, Suzanne appears to

become less faithful, producing more 'marked' subminimal word structures over time. It would therefore appear that MAXI-O is interacting with some other constraint that forces multisyllabic inputs to be reduced to a monosyllable.

What might this other constraint be? In the case of Suzanne's disyllabic truncation of *bougie* to [bi], the onset of the word is mapped into the onset of the truncated form, much in the same way as English *banana* is often produced as [ˈbænə]. The use of [b] as an onset may be due to the preference for mapping a stop rather than fricative into the onset for markedness reasons (see Pater 1997), but it does not explain truncation to a monosyllable. Furthermore, truncations that preserve the entire initial syllable (*balai* → [ba], *basin* → [ba]) are unexpected given the strong tendency to preserve final stressed syllables.

In sum, in this section, we have shown that truncations of CVC words to CV can be handled in terms of constraint interaction, where DEPI-O and *C]_PW are more highly ranked than MAXI-O. However, it is not clear why the truncation of disyllabic words to CV would ever be optimal. We consider possible explanations for this phenomenon in the following section.

4. Possible Explanations for Truncation to Subminimal Words

Suzanne truncates both CVC and disyllabic targets to CV words. Although the CVC truncations can be easily handled in terms of interactions between structural and faithfulness constraints, the truncation of disyllabic targets presents a problem. In this section, we consider possible solutions.

4.1 Prosodic Clitics

Perhaps Suzanne's early utterances are not merely CV, but are in fact /ə/+CV, with a preceding 'filler syllable'. Thus, although the lexical item itself might be subminimal, the entire prosodic word would constitute a binary foot. Such forms have been noted in the speech of some English-speaking children around the age of 1;8 (e.g., Peters and Menn 1993; Pepinsky, Demuth and Roark 2001), and sometimes earlier (Vihman, DePaolis and Davis 1998). Filler syllables are common from the onset of first words in the acquisition of Spanish (e.g., Lleó 1997, 1998, 2001), and are also reported around 1;8 years in the acquisition of French (Bassano, Maillochon, and Eme 1998; Veneziano and Sinclair 2000). French-learning children with cochlear implants also use filler syllables, especially with monosyllabic words, consistent with a binary foot upper bound on prosodic words (Hilaire, Régol, and Jisa 2002). Boysson-Bardies (1996:177-9) reports that, when the child Émilie had a vocabulary of 25-30 words, she started to use filler syllables and reduplication, producing monosyllabic words and previously truncated words as disyllabic forms (e.g., *canard* [kaka] 'duck', *à boire* [a bɥa] 'to drink'). Veneziano and Sinclair (2000:468, 482), in their case study of a girl C between the ages of 1;3 and 2;2, note a dramatic increase in the use of filler syllables (or PAEs (prefixed additional elements)) at the age of 1;7. Before this time, only an occasional filler was used, and 76.1% of all words between the ages of 1;3 and 1;6 were monosyllabic.

Deville (1891:27) likewise notes that prosodic clitics such as determiners are absent from Suzanne's speech until 1;7 years. When closed class items occur with a

lexical item before that point, the entire prosodic unit is either reduced, as in the case of

[dɔ] for *de l'eau*, and/or the lexical item is already monosyllabic, resulting in no

truncation. Examples are provided in (12).

(12) Mulitword targets

Target	Child	Orthography	Gloss	
[a tabl]	[a ta]	à table	'to the table' (dinner's ready)	1;5
[də lo]	[dɔ]~ [də lɔ]	de l'eau	'some water'	1;5
[a bɥaʀ]	[a ba]	à boire	'to drink'	1;5
[paʀ tɛʀ]	[pa te]	par terre	'on the floor'	1;6
[il plø]	[pø] ~ [a pø]	il pleut	'it's raining'	1;7

Thus, although filler syllables may initially be licensed with monosyllabic words, there is

no evidence that they are being used with Suzanne's CV truncations to form a larger

binary foot.

4.2 Compensatory Lengthening

Although both Japanese and French permit subminimal underived words, Itô (1990) and

Scullen (1997) show that both also exhibit word minimality effects on morphologically

derived forms. Interestingly, learners of Japanese show compensatory lengthening when

nasal codas or diphthongs are deleted (Ota 1999:212), and similar findings are reported

for English (Demuth and Fee 1995; Stemberger 1992), Dutch (Fikkert 1994), and German (Kehoe and Lleó 2003a). Thus, children learning these languages show moraic conservation (Hayes 1989), preserving minimal word targets as binary feet even if they cannot produce word-final consonants. Perhaps Suzanne's subminimal truncations are not subminimal after all, but also exhibit moraic conservation, possibly through vowel lengthening.

It is impossible to know, without assessment of acoustic records, if Suzanne's truncations resulted in compensatory lengthening. However, two factors suggest that they did not. First, given Deville's detailed observations, some mention of such a process would likely have been made. Second, Archibald and Carson (2000) make no mention of compensatory lengthening processes in their recent study of three French-speaking children's monosyllabic truncations. Ota (1999:216), however, notes that the three Japanese children in his study augmented subminimal target words until around the age of 2, producing these as binary feet through the use of vowel lengthening. There is no mention of this for either the Québec children in Rose's (2000) study nor the French children in Boysson-Bardies's (1996) study. We have already discussed Suzanne's reduplicative augmentation of *clef* to [tete] and *thé* to [tete], showing that these exceptional cases were preceded by an identical reduplication of a disyllabic word in the previous utterance, perhaps priming these forms. There is no other support for the notion that Suzanne, or other French-speaking children in the literature, systematically augment subminimal words. We therefore suspect that Suzanne's CV targets and CV truncations are in fact CV (and not CV:), constituting subminimal words.

4.3 Vowel Considerations

It is generally assumed that French shows no syllable weight, with stress invariably falling on the final syllable of the word or phrase. However, according to Fónagy (1979), light (monomoraic) final syllables can lose their stress to heavy (bimoraic) non-final syllables (where nasalized vowels are bimoraic - e.g., *bandeau* [ˈbɑ̃.do] 'head-band', *barder* [ˈdaʁ.de] 'to hurl'). There is also a tendency for French lax vowels ([ɛ], [œ], and [ɔ]) to occur in closed syllables and tense vowels to occur in open syllables (Dell 1995, Selkirk 1978); perhaps tense vowels can also be considered as bimoraic for word minimality considerations, just as they are in English. An examination of Suzanne's truncations, however, shows no preference for preserving only 'heavy' syllables, nor for producing CV truncations only with tense vowels.

Alternatively, given that French vowels are usually lengthened in stressed position, perhaps stress itself creates a bimoraic syllable. Under this analysis CV truncations would constitute heavy syllables, or bimoraic feet. Again, this possibility would need to be examined acoustically to determine if the child's CV truncations differ in duration, and therefore number of moras, from well-formed CV subminimal words. Lacking such records, we conclude that Suzanne shows no systematic patterns of syllable preservation that would lead us to reanalyse her CV productions as binary feet.

4.4 Perceptual Considerations

Echols (1993) and Echols and Newport (1992) suggest that both stressed and final syllables in English tend to be preserved in children's early words because they are perceptually more salient. Given that stress in French falls on the final syllable of words/phrases, perhaps there is an additive perceptual effect for preserving the final stressed syllable. Perhaps this effect is so strong that it overrides preservation of other, less perceptually salient syllables, resulting in the production of CV subminimal words.

There are several problems with this account. First, if final stressed syllables have a perceptual advantage, we might expect word-final consonants to also be mapped into Suzanne's early output forms (Kirk and Demuth 2004). However, Suzanne's early words do not have word-final consonants, despite the fact that these consonants are sometimes realized as onsets in her truncated forms (as in *salade* [da]). One might suggest here that [l] is simply replaced by the stop at the same place of articulation. However, truncations of other words containing medial [l] show that voicing of the coronal onset is sensitive to the voicing of the word-final consonant (e.g., *culotte* [tɔ]), indicating that the consonant that is retrained is truly the word-final one. Thus, although perceptual cues (formant transitions) to word-final consonants are less robust than those for onsets (Wright 2001), it would appear that Suzanne is perceiving these consonants, but not regularly producing them. In addition, word-final consonants in French (though not Québec French) are typically released (e.g. Tranel 1995), providing further support for ruling out a perceptual account of their deletion.

In their study of three children learning Québec French (aged 1;3-1;10), Archibald and Carson (2000) also found many truncations to monosyllabic CV and CVC forms. They likewise suggest that the final stressed syllable is preserved in these truncations because it is perceptually salient. They also note that when stress is shifted to the first syllable, as permitted in certain phonological environments in Québec French (Paradis and Deshaies 1990; Walker 1984), truncation to monosyllabic forms disappears.

Thus, there is evidence from other French-speaking children that stressed and final syllables may carry a perceptual (or production) advantage. Why, then, does Suzanne occasionally preserve the word initial onset (*bougie* [bi]), or only the first syllable of a disyllabic word *balai* [ba], *bassin* [ba])? Even if she has an articulatory preference for beginning words with [b], or a tendency to place the least sonorous segment of the word into the onset of her output form, it is not clear why she would truncate these words to monosyllables, nor why she would preserve the first rather than final stressed syllable.

Stress in French is generally understood to entail increased duration. However, Hilaire and Kehoe (personal communication) suggest that some forms of French child-directed speech exhibit a pitch peak toward the beginning of the word (see Di Cristo (1998, 1998) for discussion of similar phenomena in French more generally). This may make other syllables in the word perceptually prominent as well, facilitating their appearance in early production. However, we might then expect both the syllable with the pitch peak <u>and</u> the final lengthened syllable to be realized in Suzanne's output form, as Archibald and Carson (2000) found when stress shifted to the initial syllable in Québec French. Alternatively, it may be that increased pitch facilitates perception, but increased

duration facilitates production. Given recent findings that segments, including codas/word-final consonants, are more faithfully preserved in stressed and final syllables (Echols 1993; Echols and Newport 1992; Kirk and Demuth 2004), it appears that syllables with increased duration are more likely to retain segmental faithfulness in production. Thus, although perceptual factors undoubtedly play an important role in determining the shape of children's early words, it is not clear how perceptual factors can account for Suzanne's subminimal truncations, especially when other disyllabic targets are concurrently produced as binary feet.

This section has considered possible explanations for the presence of subminimal truncations in Suzanne's early speech, including compensatory lengthening, filler syllable, vowel representation, and perceptual factors. None of these provides a satisfactory account of the data. We note, however, that Suzanne's segmental inventory is quite limited, resulting in the early substitution of segments and/or reduplication, both for both CVC and disyllabic targets. However, reduplication and consonant substitution begin to disappear with the onset of subminimal truncation. We turn now to a consideration of segmental effects, and how this interacts with Suzanne's subminimal truncations.

5. Segmental Effects on Subminimal Truncation

A possible explanation for the preservation of unstressed syllables comes from an examination of other French-speaking children. Boysson-Bardies (1996:177-9) reports that the child Émilie exhibited an early preference for certain stops, truncating disyllabic

target words to monosyllables while preserving the preferred consonant and following vowel (e.g., *canard* [ka] 'duck' vs. *chapeau* [po] 'hat'). Adam (2002:64) reports similar findings in the early stages of Hebrew acquisition, where target syllables with the vowels [a] and [u] are selectively mapped into CV output forms, independent of stress. One of the striking characteristics of Suzanne's early speech is her relatively impoverished segmental inventory (Table 3), where the underlined segments were used rarely or inconsistently, and the segments in parentheses were never used during this period. Suzanne's segmental inventory during the period examined in this study therefore consisted primarily of labial and coronal stops, plus /v/, /m/, and /j/.

[insert Table 3 about here]

A reconsideration of the segments used in Susanne's early words shows that she tends to preserve labiality (e.g., [lim] → [pi] *lime* 'file', [fɪj] → [pij] *fille* 'girl', [bʀɔs] → [bɔ] *brosse* 'brush'), though not always when the labial is part of a cluster (e.g., [fʀɛz] → [tɛ] *fraise* 'strawberry'). When the target segments are not part Suzanne's segmental inventory (velar stops, /f/, other coronal and palatal consonants), these are realized as coronal stops (e.g., [sɛl] → [te] *sel* 'salt') (see examples in (11)). These substitution patterns suggest that Suzanne has highly ranked constraints against most segments containing velar and sonorant features, abbreviated here as *F(EATURE).

The question remains, however, as to why some disyllabic targets are realized as disyllables, and why others are truncated to CV. Why does Suzanne not simply delete the offending segment and preserve the nucleus of the syllable? We have seen previous examples of this type of repair in (5b) above ([kʀɛjɔ̃] → [ɔjɔ] *crayon* 'pencil'), so deletion of an offending onset should not be problematic.

As she nears the end of 1;5, Suzanne's grammar appears to progress toward a more faithful mapping between input and output segments, rather then substituting a labial or coronal stop for segments she cannot produce. This can be captured in terms of the constraint IDENT-F(EATURE) (features in the input must appear in the output).

Faithfulness to segmental features, however, is accomplished at the cost of deleting the entire syllable with the offending segment. This is clearly seen in Suzanne's variable productions of the same word, where [ʃosɔ̃] *chausson* 'slipper' is originally produced with two substituted segments – preserving both syllables ([tɔtɔ̃]), but then a few weeks later as only one syllable ([tɔ̃]) (compare examples in (9) and (10)). IDENT-F seems to variably interact with the constraint MAXI-O, initially ranked below it (MAXI-O >> IDENT-F), but gradually becoming more highly ranked (IDENT-F >> MAXI-O).[7] Thus, Suzanne's subminimal truncations involve minimal violation of IDENT-F, violating it only when the word contains no consonants from her segmental inventory. Her partial

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[7] Variation of this type can be formally handled in terms either floating constraints (Demuth 1997; Nagy and Reynolds 1997), overlapping constraints (Boersma and Hayes 2001), or probabilistic constraints (Goldwater and Johnson 2003).

constraint ranking for the period between 1;5-1;8 therefore appears to be *F, DEPI-O

>> *C]$_{PW}$ >> IDENT-F ~ MAXI-O, PW= FTBIN.

We have now shown how Suzanne's outputs can now be handled in terms of constraint interaction. However, there is still the residual question of why truncation to a subminimal word is preferred over having onsetless syllables, for example. That is, what motivates this particular constraint ranking rather than some other? We suggest that this is due to the language-specific distribution of prosodic structures, and the resulting constraint ranking for learners of French. Previous research has shown that crosslinguistic differences in the acquisition of prosodic structures, as well as language-specific learning paths, can be explained in terms of learner sensitivity to the statistical properties of the input they hear (Boersma and Levelt 1999; Demuth 2001a; Kehoe and Lleó 2003a; Levelt, Schiller, and Levelt 2000; Roark and Demuth 2000). In the next section, we explore the possibility that the prevalence of CV lexical items in French plays a role in licensing subminimal truncations in Suzanne's developing grammar.

6. The Distribution of French Prosodic Word Shapes

The French acquisition data examined in this study show a different pattern of development from that found in studies of children's early words in English, Dutch, and Spanish: English- and Dutch-speaking children's early productions may exhibit a brief period of CV words, but then quickly take the form of binary feet (CVC, CVCV). In contrast, Spanish-speaking children rarely show truncations to CV, their early words being composed of binary feet from the onset of production. In addition, trisyllabic words

with an initial unfooted syllable begin to appear in Spanish around the age of 1;8, several months before similar structures appear in English and Dutch (Demuth 2001a; Gennari and Demuth 1997). Roark and Demuth (2000) argue that this is due to the relative frequency of language-specific prosodic word shapes: Most words in child-directed English are monosyllabic binary feet (80%), and the remainder tend to begin with a stressed syllable (Cutler and Carter 1987). Thus, words with an initial unfooted syllable are rare in English, occurring in only 3.8% of all words. In contrast, Spanish has a much more even distribution of prosodic word shapes, with one-third of all words being monosyllabic, a third disyllabic, and the remaining third being three or four syllables in length (e.g., *mu'ñeca* 'doll', *eska'lera* 'stairs'). It is therefore not surprising that trisyllabic words with unfooted syllables should appear early in Spanish-speaking children's speech.

Unlike English, French permits subminimal open class words (see sections 2, 4.2), and many of these are words used in everyday speech (13) (Scullen 1997:102).

(13) Some French Subminimal Words

[po]	pot	'container'
[lɛ]	lait	'milk'
[kle]	clé	'key'
[ʁa]	rat	'rat'
[o]	eau	'water'

[ʁy]	rue	'street'
[fø]	feu	'fire'
[sɑ̃]	sang	'blood'
[nõ]	nom	'name'

Given Suzanne's tendency to produce subminimal truncations, we might expect the frequency of subminimal words in French child-directed speech to be relatively high when compared with other prosodic word shapes. To examine the distribution of prosodic word shapes that a French-speaking child might hear, we selected all files in the CHILDES database that contained French child-directed speech. These included the Grégoire, Philippe, Anais, and Rondal files, spanning the age range from 1;2 – 3;11 years and containing a total of 76,363 adult utterances. From these utterances, all closed class items (e.g., articles, pronouns, prepositions, question words, exclamations, and the words *est* 'is', *oui* 'yes', *non* 'no', *pas* 'not', *et* 'and'*)* were excluded. The open class lexical items that remained were then analyzed for number of syllables using BRULEX (Content, Mousty, and Radeau 1990). Monosyllabic lexical items were also analyzed as being CV or CVC. Approximately ten percent of the words in the corpus were not found in the dictionary. These include primarily names, plural nouns and inflected verbs. These remaining words were hand coded and added to the rest of the corpus, resulting in a total

of 130,259 word tokens.[8] The ten most frequent words in this combined corpus of French child-directed speech were *fait* 'do-3rd sing.'*, bien* 'good/well', *faire* 'to do/make', *maman* 'mother', *plus* 'more/any more', *sais* 'know-2nd sing.', *veux* 'want-2nd sing.', *regarde* 'look-3rd sing./look!'*, alors* 'then', and *encore* 'still/again', each of which occurred over 1,000 times.

A breakdown of the prosodic word shapes found in French child-directed speech is provided in Figure 1. Monosyllabic and disyllabic words account for 92% of all words in the corpus, with monosyllables at 45% and disyllabic words at 47%. Only 7% of the words in the corpus were trisyllabic, and only 1% were words of four or more syllables. Critically, 62% of the monosyllables were CV subminimal words, and only 38% took the form of CVC.[9] These accounted for 28% (CV) and 17% (CVC) of the corpus respectively.

[insert Figure 1 about here]

When compared across all word shapes, almost half of all words the typical young French learner hears are disyllabic feet, and the remainder take the form of CVC or CV.

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[8] All function words, foreign words (English, Spanish), and words unknown to a French native speaker were omitted from these counts, as were all lexical open class words that occurred only once in the entire corpus (approximately 4,000).

[9] The actual percent of CVC forms may be less when running speech and liaison contexts are taken into account.

Thus, CV subminimal open class words are commonly used in everyday French. Even if we recalculate the distribution of word shapes by attaching prosodic clitics (e.g., determiners, pronouns) to create a larger prosodic word, a large proportion of French prosodic words are still subminimal CV forms (Figure 2).[10] That is, hearing a CV subminimal word in French is not a rare event.

[insert Figure 2 about here]

We therefore suggest that the high frequency of CV subminimal words in French and the consequent low ranking of PW=FtBin in this language both contribute to the relative low ranking of MaxI-O in Suzanne's early speech, thereby permitting an extended period of subminimal truncation. This implies that there should be other French-speaking children, like Suzanne, who show an early extended period of subminimal truncation. We have already seen that this is the case (e.g., Boysson-Bardies 1996).

7. Discussion

The French-speaking child in this study exhibits an extended period of development where her early words are maximally a binary foot, yet at the same time, many of her words are subminimal CV forms. Thus, foot binarity sets an upper, but not a lower bound on the shape Suzanne's prosodic words. This goes counter to proposals that children's

[10] This count does not include the hand-tagged ten percent of the corpus that was not in BRULEX.

utterances will exhibit a stage in development where their early outputs are minimally and maximally a binary foot, or minimal word (Demuth 1995; Demuth and Fee 1995).

What, then, is the status of feet in early acquisition? Feet are an important organizational unit in the prosodic phonology of many languages. To the extent that the prosodic words of a language exhibit word minimality effects, we should expect language learners to be influenced accordingly, augmenting their early word productions to produce binary feet even if their grammars do not yet permit word-final consonants or diphthongs. However, if a language does not show word minimality effects, and subminimal words are not rare in everyday speech, we should expect learners to produce subminimal words with no augmentation, and to permit subminimal truncations. The minimal word stage in development, then, is merely a reflection of the distribution of language-specific prosodic word shapes, with the highest frequency word shapes being learned early, and the lower frequency word shapes being learned later (Demuth 1996b).

The results of this study provide additional support for the notion that children's early words reflect the statistical properties of the input: subminimal words are relatively common in French child-directed speech, but words of three or four syllables are rare. This means that words of one or two syllables should be expected to dominate in French-speaking children's early speech (see Paradis, Petitclerc, and Genesee 1997), even to the extent of licensing subminimal truncations. In other words, the child's grammar must already permit prosodic words that are less than a foot, so truncations to one syllable do not incur a heavy cost. As faithfulness constraints become more highly ranked, these subminimal truncations disappear. The results of this study therefore provide additional

support for recent work showing that learners are sensitive to the statistics of the input, and that this plays an important role in shaping early grammars (e.g., Kirk and Demuth 2003; Levelt, Schiller, and Levelt 2000; Roark and Demuth 2000).

The fact that stress falls on the final syllable in French, and stressed and final syllables tend to be preserved in children's early speech, may give some perceptual and production advantage to the preservation of these syllables. However, we suggest that the high frequency of French subminimal words (i.e., the second most common word shape) also licenses the longer use of subminimal truncations than might otherwise be expected. One way to test this hypothesis would be to examine the acquisition of prosodic words in other iambic languages, where the frequency of prosodic word shapes differs from that of French (e.g., Mayan languages – Pye 1983; Archibald 1996). Another test would be to examine the relative frequency of subminimal words in other languages (e.g., Yoruba – Ola 1995; Maranungku – Tryon 1970), to determine the effect that this has on children's developing grammars.

Interestingly, findings from the acquisition of Japanese, another language that permits subminimal words but does not have final stress, shows that Japanese-speaking children augment subminimal word targets, creating binary feet until around the age of 2 Ota (1999). This suggests that subminimal words in Japanese are much less frequent than in French, and this appears to be the case: although Japanese has many common CV words (e.g., [me] 'eye', [ki] 'tree', [te] 'hand'), Ota (2001: 113) reports that subminimal words are usually augmented in Japanese child-directed speech (e.g., [me] 'eye' → [o-meme], [te] 'hand' → [o-tete]). He suggests that the lack of early monomoraic targets

attempted by the Japanese children in his study may be a direct result of the few CV targets children actually hear. The fact that neither subminimal augmentation nor compensatory lengthening are reported in the acquisition of French may be due to the higher frequency of subminimal words in this language. This then has an effect on children's early grammars, resulting in little penalty for truncation to subminimal words.

8. Conclusion

This study examined the development of prosodic words in the early speech of a French-speaking child. It found that she was initially faithful to the target, correctly producing CV and disyllabic reduplicated words. She then went through a brief period during which she reduplicated CVC targets as C_1VC_1V, creating disyllabic feet. During this period she also truncated trisyllabic targets to two syllables, showing that her prosodic words were maximally a binary foot. Shortly thereafter, she began to drop word-final consonants, producing CVC targets as subminimal CV words, and began truncating many di- and tri-syllabic targets to CV as well. This unexpected and 'marked' stage of development lasted for several months before the first word-final consonants and trisyllabic word shapes began to appear.

After considering several possible analyses of the data, we showed that this extended period of subminimal truncation can be understood in terms of segmental/syllabic constraint interactions combined with the distribution of prosodic word shapes in French: the child's segmental inventory is severely limited, consisting primarily of labial and coronal stops. This initially results in pervasive segment substitution and reduplication. However, the child's grammar is also influenced by the

shape of prosodic words in the ambient language, a quarter of which are CV. As she becomes more faithful at mapping input segments into her outputs, she therefore begins to delete problematic segments and the syllables that contain them, resulting in the truncation of disyllabic targets to subminimal CV words. This suggests that the protracted period of subminimal truncation is licensed by the frequency of language-specific prosodic word shapes.

Children's early grammars may therefore be more faithful to the statistics of the input than initially thought, raising questions about proposals for the emergence of the unmarked in early grammars (Demuth 1995; Gnanadesikan 1996; Tesar and Smolensky 1998). If marked phonological structures are relatively frequent (e.g., coda consonants in Germanic languages, subminimal words in French), we should expect these to appear early in children's productions, both as appropriately formed words and as truncations. We have seen that other French-speaking children also have a high proportion of CV subminimal words in their early speech, both as CV targets and CV truncations. Thus, the presence of subminimal truncation in early French appears to be robust. A probabilistic approach to grammatical development, where learners' early grammars encode the high-frequency structures they hear, provides a framework for understanding the course of grammatical development, and how it changes over time. To the extent that high-frequency grammatical constructions are also unmarked, we expect these to be acquired early. However, we also expect high frequency structures to be acquired early even when they constitute marked structures. Stites, Demuth, and Kirk (in press) show that this is

the case with the acquisition of stop coda consonants in English, and we have shown in this study that this is the case with subminimal words in French.

Infant perceptual sensitivity to language-specific frequency effects has been shown at segmental, prosodic, and lexical levels of structure. A growing body of literature now also shows early sensitivities to frequency effects of syllable and word structure in language production (Boersma and Levelt 1999; Demuth 2001a; Kehoe and Lleó 2003b; Kirk and Demuth 2003, 2004; Levelt, Schiller and Levelt 2000; Lleó and Demuth 1999; Roark and Demuth 2000). Further research is needed to investigate how and when young language learners integrate this statistical knowledge into their developing grammars (see Boersma and Hayes 2001; Goldwater and Johnson 2003). This will require a closer examination of the input children hear and the nature of the linguistic units over which they compute their statistics.

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Table 1. Prosodic Shape of Attempted Word Target (Types)

Age	CV	CVC	2 syl	3 syl	4 syl+	Total
1;2	0	1	4	1	0	6
1;3	2	1	4	0	0	7
1;4	5	2	10	2	0	19
1;5	9	12	25	7	0	53
1;6	9	5	16	2	0	32
1;7	8	14	40	7	4	73
1;8	1	5	16	7	1	30
Total	34	40	115	26	5	220

Table 2. Prosodic Word Shapes Produced (Types)

Age	CV	CVC	2 syl	3 syl	4 syl+	Total
1;2	3	1	1	1	0	6
1;3	5	0	2	0	0	7
1;4	5	0	14	0	0	19
1;5	33	0	20	0	0	53
1;6	18	0	14	0	0	32
1;7	27	3	41	2	0	73
1;8	11	0	15	3	1	30
Total	102	4	107	6	1	220

Table 3. Suzanne's segmental inventory (underlined segments were rarely used, and segments in parentheses were never used).

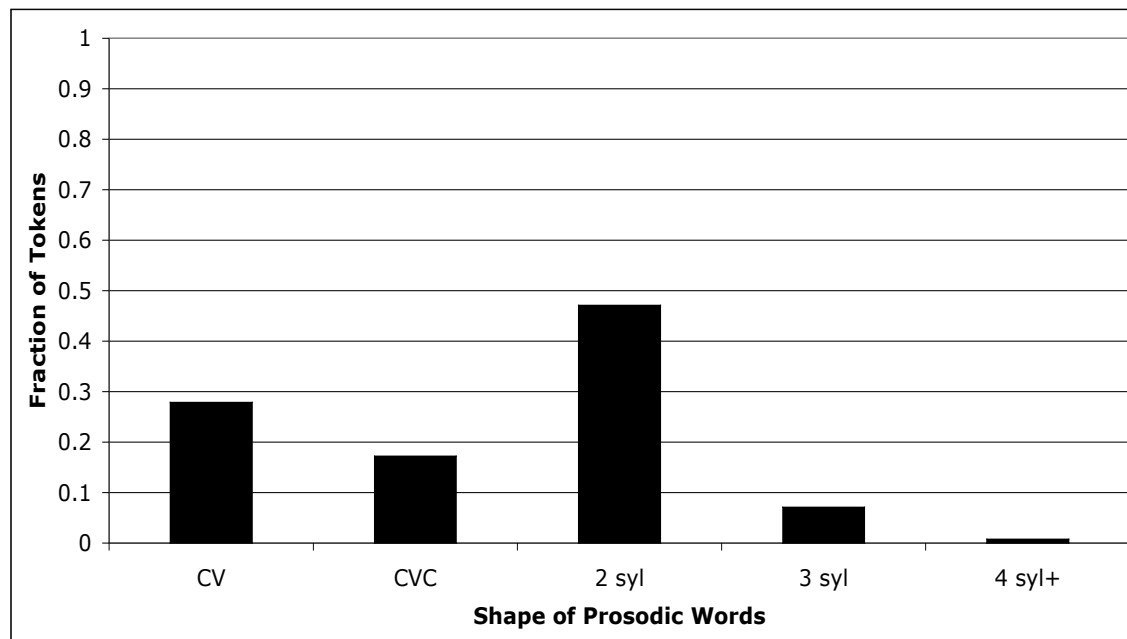|	Labials	Dentals	Palatals	Velars
stops	p,b	t,d		(k),g̲
fricatives	f̲,v	s̲,(z)	ʒ, ʃ	
nasals	m	n̲	ɲ̲	
liquids		l̲		(ʀ)
glides		j,	(ɥ)	(w)

Figure 1. Distribution of Prosodic Word Shapes (Tokens) in French Child-Directed Speech
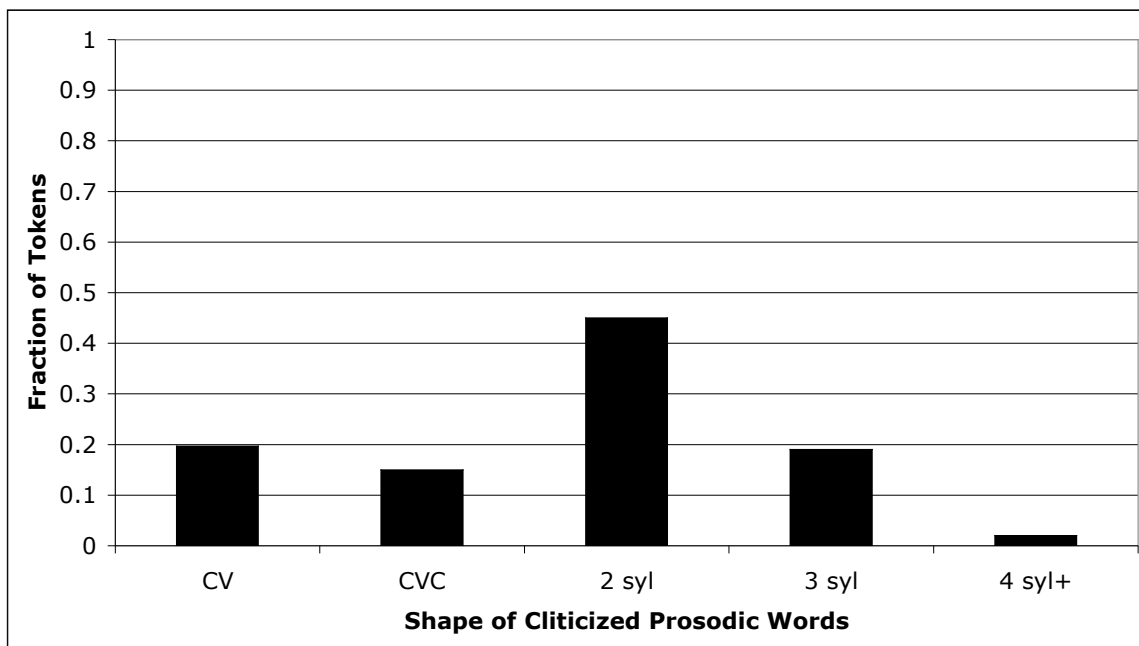
Figure 2. Distribution of Cliticized Prosodic Word Shapes (Tokens) in French Child-Directed Speech