

Highly-articulated Representations in Early Grammars: Evidence from English and French*

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0. Introduction

Since the advent of Optimality Theory, we have observed two trends in phonological theory, namely a de-emphasis on the structural relations that hold within and across segments, as well as phonetic evidence being used to explain phonological alternations. In this paper, without denying that phonetic factors are central to some aspects of phonological patterning, I argue, based on consonant harmony and metathesis data from English- and French-learning children, that the most explanatory approach to phonology is one based primarily on highly-articulated representations and headedness in constituent structure.

In brief, consonant harmony involves a featural agreement relation at a distance between two consonants. For example, in (1a), the harmonized output for an input like *duck* will surface as [gʌk] or as [dʌt], depending on which feature neutralizes the other in the child's phonology. Metathesis also involves a relation at a distance between consonants, but without feature neutralization. Metathesis instead yields a reversal in the ordering of the features found in the target word. Taking again the input *duck*, its metathesized output will be pronounced [gʌt] by the child, as in (1b).

(1) Consonant feature harmony versus metathesis: an example

- | | |
|----------------------------|----------------------------|
| a) Consonant harmony: | b) Metathesis: |
| • Input: <i>duck</i> [dʌk] | • Input: <i>duck</i> [dʌk] |
| • Output: [gʌk] / [dʌt] | • Output: [gʌt] |

A unified account of patterns such as these found in data on developmental English and French will be proposed, which builds on the differences that exist between these two languages at the level of their respective prosodic organization. As we will see, these differences have consequences on how licensing relationships between consonantal place features and heads of prosodic constituents (foot, prosodic word) take place in these target languages.

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The paper is organized as follows. In section 1, I introduce the consonant harmony and metathesis patterns observed in the outputs of English-learning Amahl (Smith 1973) and French-learning Clara (Rose 2000). In section 2, I outline the relevant theoretical background and assumptions on which the analysis, detailed in section 3, is based. The account builds on Goad's (2001) suggestion that licensing might play a role in consonant harmony. I propose an analysis of consonant harmony based on the constraint LICENSE, and extend this analysis to cases of place feature metathesis. A brief conclusion is offered in section 4.

1. Data

In this section, I introduce the relevant consonant harmony and metathesis data from Amahl and Clara. In the interest of space and clarity, I will focus only on the interaction between Dorsal and Coronal in the children's grammars.¹

Starting with Amahl, we can see, in (2a), that Coronal undergoes Dorsal assimilation in CVC and CVCV [Cor...Dor] words. Conversely, as can be seen in (2b), no assimilation is found in [Dor...Cor] words.

- (2) Amahl's consonant harmony patterns (Smith 1973)
- | | | | | |
|--------------------------------|------------------|------------|---|----------|
| a) [Cor...Dor]: Dorsal harmony | <i>duck</i> | [dʌk] | → | [ɟʌk] |
| | <i>chocolate</i> | [ˈtʃɔklɪt] | → | [ɟʃɔki:] |
| b) [Dor...Cor]: No harmony | <i>get</i> | [get] | → | [ɟet] |
| | <i>greedy</i> | [ˈɡri:di:] | → | [ɟi:di:] |

Clara's outputs differ from Amahl's in two respects. The first regards the trigger and target features. As can be seen in (3a), in Clara's outputs, it is Dorsal which assimilates to Coronal in [Dor...Cor] CVCV words.

- (3) Clara's CVCV words (Rose 2000)
- | | | | | | |
|--|----------------|---------|---|----------|---------|
| a) [Dor...Cor]: Coronal harmony | <i>gâteau</i> | [gato] | → | [tæ'to] | 'cake' |
| | <i>couleur</i> | [kulœʁ] | → | [tʊ'lœʁ] | 'color' |
| b) [Cor...Dor]: No target inputs of this shape. ^a | | | | | |
| a. This accidental gap is presumably an artifact of the relative rarity of target words of this shape in French. | | | | | |

The second difference between Amahl and Clara concerns the shape of the words where consonant harmony is attested. As can be seen by comparing (3) with (4), consonant harmony is observed in Clara's CVCV words only. In CVC [Dor...Cor] words in (4a), no harmony is found, even though it would be expected in light of the data in (3a). Finally, in CVC [Cor...Dor] words, in (4b), we find a pattern of place metathesis between the two input place features.

- (4) Clara's CVC words (Rose 2000)
- | | | | | | |
|----------------------------|---------------|--------|---|-------|------------|
| a) [Dor...Cor]: No harmony | <i>goutte</i> | [ɡʊt] | → | [ɡʊt] | '(a) drop' |
| | | | | → | [ɡʊtʰ] |
| b) [Cor...Dor]: Metathesis | <i>sac</i> | [sɑk] | → | [kɑt] | 'bag' |
| | <i>tigre</i> | [tʃiɡ] | → | [kɪn] | 'tiger' |

¹ See Rose (2000, chapter 4) for a more complete analysis which includes the feature Labial as well as a comparison with another English-learning child, Trevor (Pater 1996, 1997).

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In short, by comparing Amahl's and Clara's outputs, we find interesting contrasts. First, trigger and target features are predictable on a child-specific basis only. Second, the domain of application of consonant harmony varies across languages. While consonant harmony is found in Amahl's CVCV and CVC words, it is found in Clara's CVCV words only. Finally, place metathesis is observed in Clara's [Cor...Dor] CVC words.

Based on these differences, I will demonstrate that a unified account of consonant harmony and metathesis must refer to highly-articulated prosodic representations at both the level of the foot and the level of the prosodic word.

2. Theoretical framework

In this section, I outline the theoretical background and assumptions necessary before a satisfactory account of the patterns introduced above can be proposed. As already mentioned, much importance will be attributed to prosodic representations, which are at the core of the arguments proposed below. All aspects of the representations to be discussed are assumed to be provided by Universal Grammar (UG) as part of the child's innate linguistic competence. In order to regulate both the mapping between inputs and outputs and the licensing relations allowed in surface forms, I appeal to constraints on phonological representations, cast within Optimality Theory (OT; e.g. Prince and Smolensky 1993), which are assumed to be part of the UG endowment as well (Gnanadesikan 1995).

2.1. Prosodic representations

In the analysis provided below, I integrate a set of prosodic representations, taking as a starting point the view that constituent structure is organized into the prosodic hierarchy in (5), after Selkirk (1980a,b) and McCarthy and Prince (1986).

- (5) Prosodic hierarchy
 Prosodic word (PWd)
 |
 Foot (Ft)
 |
 Syllable (σ)

I support the view that head-dependency relationships hold at every level of constituent structure: every branching constituent must have a head and a dependent. In addition, I assume that the relationships which take place within any category of the prosodic hierarchy in (5) are subject to the Locality condition, defined in (6), which follows the spirit of, for example, Itô (1986), Kaye (1990), and Kaye, Lowenstamm, and Vergnaud (1990).

- (6) Locality condition
 A relation is bound within the domain delimited by the highest category to which it refers.

According to the definition in (6), any relationship referring to a given prosodic domain (e.g. the foot) cannot extend beyond that domain.

The way that segmental information takes place in the hierarchy in (5) is central to the analysis detailed below. Positing the structural difference between

English and French which is relevant to the analysis requires a combination of assumptions concerning (a) the syllabification of word-final consonants, and (b) its implication for higher levels of prosodic organization in English and French. I will address these issues in turn.

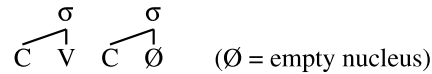
Many scholars analyze word-final consonants in the same fashion as consonants which must be syllabified word-internally outside the onset constituent, that is, as rhymal dependents (codas). This position, however, is controversial. For example, the tenets of Government Phonology (e.g. Kaye 1990, Kaye, Lowenstamm, and Vergnaud 1990, Charette 1991, Harris, 1994, 1997) hold that word-final consonants should *always* be syllabified as onsets.

Adopting a less radical position, Piggott (1999) argues that word-final consonants can be syllabified in two ways across languages: as onsets, or as codas. Piggott demonstrates that languages such as Selayarese (Mithun and Basri 1986) display a distribution of word-final consonants which matches that of word-internal codas, in the sense that they cannot license place features (they are restricted to glottal stop and placeless nasal consonants). Word-final consonants in this language are thus argued to be real codas. Piggott further argues that languages such as Diola Fogy (Sapir 1965) have a distribution of word-final consonants which is more diversified than that of word-internal codas. On the one hand, word-internal codas in Diola Fogy are restricted to the first halves of geminate nasals and sonorants that are homorganic with the following onset. From this distribution, we can infer that, similar to Selayarese, the codas of Diola Fogy cannot license place features. On the other hand, in contrast to what is observed in Selayarese, consonants with any place specification (Labial, Coronal, Dorsal) can surface word-finally in Diola Fogy. From this behavior, Piggott argues that Diola Fogy's consonants are syllabified word-finally as onsets.

Because two syllabification options are available across languages, one of these options must be universally unmarked, that is, the option that will be first entertained by a child acquiring a language with word-final consonants. Briefly addressing this issue, Piggott (1999:180) suggests that the syllabification of word-final consonants as onsets represents the unmarked case.

In the field of child language, Goad and Brannen (2000) demonstrate that word-final consonants pattern according to Piggott's suggestion: the child initially syllabifies word-final consonants as onsets, independently of the syllabification constraints of the target language. This is illustrated in (7).²

(7) CVC word in early grammars



The relationship between the syllabification in (7) and higher prosodic structure (foot, prosodic word) is at the core of the analysis proposed below. Concerning foot structure, based on the stress differences observed between English and French nouns, I assume that while the English foot is left-headed, the French foot is right-headed, as illustrated in (8).³

² Rose (2000) argues that this hypothesis holds only in contexts where word-final consonants bear place specifications, which is the case for the contexts discussed in this paper.

³ Throughout the paper, the head of a given branching constituent will be represented by a vertical line linking it to its mother node.

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(8) English and French foot structure

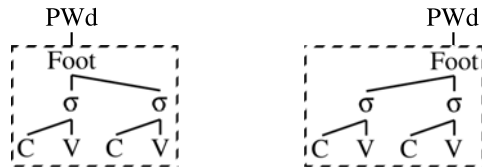
- a) English (left-headed) b) French (right-headed)



The distinction depicted in (8) has consequences for the way that word-final consonants are linked to prosodic structure. In order to illustrate this point, I will compare the full prosodic structure of CVCV and CVC words in English and French. First, the footing of CVCV words in these languages is straightforward: all segments are dominated by the foot, as illustrated in (9).

(9) Full prosodic structure of CVCV words in English and French

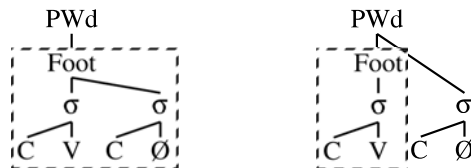
- a) CVCV in English b) CVCV in French



The prosodification of CVC words, however, raises an interesting issue. Starting with English CVC words, I propose that these words are syllabified exactly like CVCV words and that the only distinction between English CVC and CVCV word shapes regards the (non-)realization of the final nucleus, as illustrated in (10a) (cf. (9a)). In the case of French CVC words, however, since (a) stress, which is always word-final in this language, must be realized on the only overt vowel in the word, and (b) the French foot is right-headed, I propose, following Charette (1991), that the final onset of French CVC words falls *outside* the foot, and is licensed directly by the prosodic word, as in (10b) (cf. (9b)).

(10) Full prosodic structure of CVC words in English and French

- a) CVC in English b) CVC in French



As we will see in section 3, the claim schematized in (10) that word-final consonants are prosodified within the foot in English but outside the foot in French enables a straightforward explanation for the contrasts observed between Amahl's and Clara's place feature interaction patterns. Before I elaborate on this, it is first necessary to introduce the constraints which are relevant to the analysis.

2.2. Constraints

As mentioned above, in order to constrain input-output faithfulness, as well as the licensing relationships which take place between output features and heads of prosodic constituents, I assume the general framework of OT.

Concerning faithfulness relations between inputs and outputs, I appeal to correspondence constraints as proposed by McCarthy and Prince (1995). The constraints relevant to the analysis are defined in (11).

- (11) Faithfulness constraints
- a) MAX(F): Every input feature F has an output correspondent.
 - b) LINEARITY(Pl, PCat): The precedence structure relative to Place specifications in the output is consistent with that of the input, and vice versa, in a given prosodic category PCat.

While MAX(F), in (11a), ensures preservation of input material in output forms, LINEARITY(Pl, PCat), in (11b), regulates precedence Place structure between inputs and outputs, in a given prosodic category PCat.

The constraints in (11) will interact with feature licensing constraints. Assuming the Licensing Principle of Itô (1986), I propose that the aspect of licensing which is violable regards the licenser of a particular feature. In order to incorporate licensing into the general setup of OT, I appeal to the LICENSE constraint in (12), which is inspired by Itô, Mester, and Padgett (1995), Piggott (1996, 1997, 2000), and Rose (1999).

- (12) LICENSE(F, PCat): A feature F must be licensed by the head of a prosodic category PCat.

In line with Rose (1999) and Piggott (2000), I argue that LICENSE is fulfilled if and only if a segment in the *head* of PCat contains F, as schematized in (13a) and (13b). In other words, the dependent position of PCat plays no role in prosodic licensing. This implies that a feature which fails to be anchored to the head of PCat violates LICENSE, as illustrated in (13c).

- (13) LICENSE(F, PCat) relations
- a) Well-formed
 - b) Well-formed
 - c) Ill-formed
- PCat

PCat

*PCat

Tudanca Montañés, a dialect of European Spanish, provides us with independent evidence supporting LICENSE in adult languages. This evidence comes from a vowel centralization harmony triggered by the masculine gender suffix /-o/, which takes place between this vowel and the stressed syllable. Importantly, as demonstrated by the examples in (14), the central harmony triggered by /-o/ must (a) target the stressed vowel, but (b) never extend to the left of the stressed syllable.

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- (14) Centralization in Tudanca Montañés (Hualde 1989)^a
- | | | |
|----------------|----------------------------|-----------------|
| [o'regænu] | (*[o: <u>r</u> e.gæ.nu]) | 'oregano' |
| [anti'gwisimɔ] | (*[an.ti.'gwɪ.sɪ.mɔ]) | 'very old (m.)' |
| [aham'bræu] | (*[<u>æ</u> .hæm.'bræ.u]) | 'hungry (m.)' |
| [se'kælu] | (*[s <u>ɛ</u> .'kæ.lu]) | 'to dry him' |
- a. Ill-formed vowels are underlined.

To account for this system, Rose (1999) appeals to the domination of both LIC([lax], PWd) and MAX([lax]) over NOSPREAD, a general constraint against feature spreading. This analysis is summarized in the tableau in (15).⁴

- (15) [lax] harmony in Tudanca Montañés (after Rose 1999)

Input: /oreganu/	LIC([lax], PWd)	MAX([lax])	NOSPREAD
a) [o'reganu]:	*! ([u])		
b) [o'reganu]:		*!	
c) [o'regænu]:			**

In (15a), we can see that the input-like candidate incurs a fatal violation of LIC([lax], PWd): the feature [lax] of input /u/ is not licensed by the head of the prosodic word (parallel to (13c)). The two remaining candidates both satisfy LIC([lax], PWd), through feature deletion, in (15b), or feature spreading, in (15c). While (15b) fatally violates MAX([lax]), (15c), the optimal form, simultaneously satisfies the two highly-ranked constraints and only incurs violations of lower-ranked NOSPREAD.

In the next section, I analyze the child language data introduced in section 1 in a similar fashion.

3. Analysis

In this section, I propose an account of Amahl's data in (2) and extend the basic approach in light of the patterns found in Clara's CVCV and CVC words in (3) and (4), which are explained in a unified fashion. The analysis proposed, similar to the account of the Tudanca Montañés patterns in (15), relies on the interaction between licensing and faithfulness constraints and demonstrates the effects of the structural distinctions between CVCV and CVC words in English and French discussed in section 2.1.⁵

3.1. Amahl's CVCV and CVC words

The constraint ranking proposed for Amahl is given in (16). This ranking is supported in (17) and (18), where Dorsal harmony in [Cor...Dor] words and the absence thereof in [Dor...Cor] words are exemplified.

⁴ In the interest of space, no structures were included for the input forms and output candidates. To alleviate this notational limitation, feature sharing relations are represented by underlining of the segments containing the shared feature in the candidates, and the segments incurring licensing violations are indicated alongside the violation marks in the tableaux.

⁵ While additional constraints are necessary in order to encode additional generalizations (e.g. absence of harmony between vowels and consonants; cf. Levelt 1994), for the sake of space and clarity, I will restrict the number of constraints to the ones defined in section 2.2 (see Rose 2000 for additional discussion).

- (16) Amahl's constraint ranking
 LIN(Pl, PWd), LIN(Pl, Ft) » MAX(Dor) » LIC(Dor, Ft) » MAX(Cor) »
 LIC(Cor, Ft)

As we can see in (17), Dorsal harmony is correctly predicted by (16) for [Cor...Dor] input words such as *duck*. The target-like candidate in (17a), which fails to license Dorsal in the head syllable of the foot, fatally violates LIC(Dor, Ft). Place metathesis, in (17b), incurs fatal violations of the two LINEARITY constraints. Coronal harmony, in (17c), is punished because it violates MAX(Dor). Despite violating Coronal faithfulness, the Dorsal-harmonized form in (17d) satisfies the higher-ranked Dorsal faithfulness and licensing requirements of Amahl's grammar.

- (17) Amahl's [Cor...Dor] words

Input: <i>duck</i> [dʌk]	LIN (Pl, PWd)	LIN (Pl, Ft)	MAX (Dor)	LIC (Dor, Ft)	MAX (Cor)	LIC (Cor, Ft)
a) [dʌk]:				*! ([k])		
b) [gʌt]:	*!	*!				* ([t])
c) [dʌt]:			*!			
d) [ɟʌk]:					*	

Turning now to [Dor...Cor] words such as *get*, in (18), we can see that the low ranking of LIC(Cor, Ft) in (16) correctly predicts disharmony: the target-like candidate in (18a) can surface as optimal.

- (18) Amahl's [Dor...Cor] words

Input: <i>get</i> [gɛt]	LIN (Pl, PWd)	LIN (Pl, Ft)	MAX (Dor)	LIC (Dor, Ft)	MAX (Cor)	LIC (Cor, Ft)
a) [gɛt]:						* ([t])
b) [dɛk]:	*!	*!		* ([k])		
c) [dɛt]:			*!			
d) [gɛk]:					*!	

Finally, since the domains circumscribed by the foot and the prosodic word are the same in English CVC and CVCV words (see (9a) and (10a)), the predictions made by the ranking in (16) hold for Amahl's outputs of both shapes (cf. Clara below).

In the next subsection, I continue the exemplification of the proposal from Clara's outputs. Recall that harmony is observed in Clara's CVCV [Dor...Cor] words only. Both the absence of consonant harmony in CVC [Dor...Cor] words and the metathesis pattern found in CVC [Cor...Dor] words will provide additional support for the prosodic approach developed so far.

3.2. Clara's CVCV words

The contrast observed between Clara's CVCV and CVC [Dor...Cor] words ((3a) versus (4a)) is predicted by the ranking proposed in (19).

- (19) Clara's constraint ranking
 LIN(Pl, Ft) » LIC(Dor, Ft), LIC(Cor, Ft) » MAX(Cor) » MAX(Dor) »
 LIN(Pl, PWd)

Clara's Coronal harmony observed in CVCV words such as *gâteau* [gɑto] 'cake' is exemplified in the tableau in (20). As can be seen in (20a), linearity is enforced in CVCV words, because both consonants are prosodified within the foot in French words of this shape (see (9b)). The target-like candidate in (20b) fails to license its Dorsal feature in the head of the foot. Dorsal harmony, in (20c), fatally violates Coronal faithfulness, which has precedence over Dorsal faithfulness. The Coronal-harmonized candidate in (20d) is thus selected as optimal.

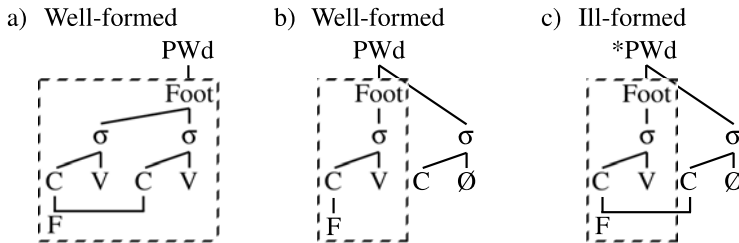
- (20) Clara's [Dor...Cor] words

Input:	LIN (Pl, Ft)	LIC (Dor, Ft)	LIC (Cor, Ft)	MAX (Cor)	MAX (Dor)	LIN (Pl, PWd)
a) [dæko]:	*!		* ([d])			*
b) [gæto]:		*! ([g])				
c) [gækɔ]:				*!		
d) [dæto]:					*	

3.3. Clara's CVC words

In order to explain the absence of consonant harmony in Clara's CVC words, I appeal to the principle of Locality in (6). Given Locality, no foot-based relation can take place between the two consonants of French CVC words, because, recall from (10b), word-final onsets are prosodified outside the foot in French. Consequently, a consonant-to-consonant relation in CVC French words would lead to the impossible configuration in (21c).

- (21) LICENSE(F, Ft) relationships



In order to regulate the licensing of word-final consonants in French, I introduce the two LICENSE(F, PWd) constraints underscored in (22).

- (22) Clara's constraint ranking (revised)
 LIN(Pl, Ft) » LIC(Dor, Ft), LIC(Cor, Ft) » MAX(Cor) » MAX(Dor) »
LIC(Dor, PWd) » LIN(Pl, PWd) » LIC(Cor, PWd)

This ranking predicts that the coronal consonant of an input like *goutte* [gut] '(a) drop', in (23), can surface word-finally without triggering metathesis, because of the fact that LIC(Cor, PWd) is at the bottom of the constraint hierarchy. As a result,

the feature Coronal can happily surface word-finally in Clara’s outputs, as in the optimal form in (23d). In contrast to this, the harmonizing candidates in (23a) and (23b) both violate higher-ranked MAX requirements. Finally, (23c), which displays metathesized Dorsal in word-final position, fatally violates LIC(Dor, PWd); Dorsal fails to be realized in the head of the prosodic word (the stressed syllable) in this candidate.

(23) Clara’s CVC [Dor...Cor] words^a

Input:	LIN (Pl, Ft)	MAX (Cor)	MAX (Dor)	LIC (Dor, PWd)	LIN (Pl, PWd)	LIC (Cor, PWd)
<i>goutte</i> [got] a) [gok]:		*!				
b) [dɔt]:			*!			
c) [dɔk]:				*! ([k])	*	
d) [gɔt]:						* ([t])

a. Because of space limitations, the constraints LIC(Cor, Ft) and LIC(Dor, Ft), which are vacuously satisfied in French CVC words, were removed from this tableau and the following one ((24)).

The situation is different in (24), where an input [Cor...Dor] CVC word must undergo metathesis. As it was the case in (23), the two harmonizing candidates, (24a) and (24b), both fatally violate the feature faithfulness requirements of Clara’s grammar. In (24c), LIC(Dor, PWd) is fatally violated by the word-final [k]. If metathesis applies, however, Coronal ends up in the word-final position, in (24d), where it surfaces without violating highly-ranked constraints.

(24) CVC [Cor...Dor] words

Input:	LIN (Pl, Ft)	MAX (Cor)	MAX (Dor)	LIC (Dor, PWd)	LIN (Pl, PWd)	LIC (Cor, PWd)
<i>sac</i> [sak] a) [sat]:			*!			
b) [xak]:		*!				
c) [sak]:				*! ([k])		
d) [kas]:					*	* ([s])

As we can conclude from the above demonstration, the behavior of Clara’s CVC words can be explained through a combination of (a) highly-articulated representations, which enable us to establish a structural distinction between non-final and final onsets with regard to how these onsets are linked to higher prosodic structure in French, and (b) a set of constraints governing feature licensing by the relevant prosodic head, similar to the analysis proposed for Tudanca Montañés. The comparison between French and English CVC words further supports this approach. The different behaviors observed in word-final consonants, which participate in consonant harmony in English but do not in French, are explained through the fact that these consonants belong to different prosodic domains in the two languages; they are prosodified within the foot in English but outside this constituent in French. Finally, while consonant harmony violates faithfulness requirements in order to satisfy higher-ranked licensing constraints, place metathesis is viewed, under the current proposal, as a strategy available to the child to ensure

that licensing requirements are satisfied, but without violating the grammar's feature faithfulness constraints.

4. Conclusion

The examples discussed in this paper cast new light concerning the structural relationships that take place between segmental features and constituent structure in early grammars. Without reference to the syllabification of word-final consonants as onsets of empty-headed syllables, and the consequence of their prosodification within the foot in English versus outside the foot in French —such a distinction can only be made by using fully-fleshed prosodic representations—, it would have been very difficult to provide a unified account of the data covered in this paper. These data therefore constitute compelling evidence in support for the view that reference to highly-articulated representations is central to the characterization of the relationships that take place within and across levels of representation in developing phonologies.

Cast in the broader context of research on acquisition, it is also important to mention that only a comparison between iambic and trochaic languages could unveil the contrasts from which the approach detailed in section 3 derives. This demonstrates that only a larger empirical base, from cross-linguistic investigations of child language data, will help us to better understand the various processes observed in language acquisition. In addition to assessing the validity of the current proposal, a comparison of the acquisition data currently available with more target languages would contribute to a better understanding of the factors governing the shapes of early grammars.

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