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Child Phonology: Whole-word approaches, cross-linguistic evidence

Templates in French

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1. Introduction

As must be clear from the variety of analyses and approaches proposed in the literature on phonological acquisition, there is no straightforward way to establish the format of children's first phonological units or the conditions that shape them, independent of target language. This paper presents a proposal to account for the acquisition of French within a template model. At the outset (Part 1), three issues must be considered, to clarify the basis for the proposed template and the analyses to be provided here: the lexical status of the template (1.1), phonetic continuity vs. typological constraints on the template (1.2), and the function of the template (1.3). In Part 2 we address what the template should be, considering the typological characteristics of French, and in Part 3 we present three longitudinal data sets that illustrate what the early template might be in French and how it evolves and changes with lexical growth.

1.1 Phonological or lexical starting point: why a lexical template?

The first problem that arises in attempting to determine the format of the first phonological units is whether to analyze them as essentially phonological or essentially lexical. Can children categorize the phonological sequences that they hear directly from the input, to construct a representation that will enable them to recover such elements as the syllables or the phonemes that make them up? Or must they necessarily first resort to the lexicon (and thus acquire their phonological knowledge through semantic bootstrapping based on the referential dimensions of the target language)?

The proposal that phonological acquisition is established through a lexical template was originally proposed by Menn (1978), taken up by Macken (1992, 1995), and later further developed by Vihman and her collaborators (Vihman and Velleman 1989, 2000; Vihman *et al.* 1994; Vihman and Croft 2007), within the older framework of the whole-word hypothesis (Ferguson and Farwell 1975; Macken 1979; Menn 1971, 1983; Waterson 1971, 1987). The underlying assumption of this approach, as formulated by Francescato (1968), is that '[c]hildren never learn sounds, they only learn words and the sounds are learnt through words' (p. 148).

Previous analyses of French lead to the conclusion that children construct their phonology on the basis of a small number of templates, shaping a mini-lexicon that allows them to progressively develop the relevant phonological generalizations (Wauquier-Gravelines 2005). Templates can be taken to reflect the formal side of early words.

1.2 Articulatory continuity or typological constraints?

The adoption of the whole-word hypothesis and of a lexical template for the acquisition of French raises the problem of how to model this template for French and how to determine the constraints that apply to the production of the first observable word forms in French data.

Despite being one of the pioneers in the collection and analysis of early word production data in various languages (Vihman and Velleman 1989; Vihman *et al.* 1994 for English; Vihman 1976, Vihman and Vihman 2011 for Estonian; Vihman 1993 for French; Vihman and Velleman 2000 for Finnish; Keren-Portnoy *et al.* 2009 for Italian), Vihman has not emphasized typological constraints as a determining factor for the templates she describes. Her initial focus was on establishing articulatory continuity from babbling to the first words, which suggests for every child an individual developmental scenario that is less likely to be influenced by the target language (Vihman *et al.* 1985).

More recently, Vihman has undertaken more systematic cross-linguistic comparisons of her data (Vihman and Kunnari 2006) and opened a typological line of inquiry by showing that the templates are at least partly constrained by the regularities of the target language (Vihman 2010). After examining some ten or twelve languages, she identifies the following major tendencies (Vihman 2010).

- The templates reflect a limited number of syllabic structures that never exceed two vocalic nuclei: CV, VC, CVC, CVCV, CVCVC.
- Consonant clusters and structures are generally absent.
- The templates are built on the basis of a limited segmental inventory, generally a subset of the inventory of the target language. This limited inventory seems to vary from child to child and relies, in part, on articulatory continuity from babbling to the first words.
- Consonantal variation across the lexical unit is restricted to manner or place only, not both, with full harmony the most common outcome.
- Melodic patterning (or a fixed segmental sequence) is also found within templates, though more rarely: in this case the consonantal sequences may be specified for place but not for manner.
- In the case of melodic patterning, either medial or final position may be specified, but not initial position. Recorded segmental specifications include medial glides [j] or [w], medial glottal or uvular fricatives or [l], and final coronal, velar, fricative or nasal.
- Vowel melodies include <low-high> (but not the reverse), diphthongal specification (<Vi>, <Vu> or both) and final vowel specification (often [i]).

These tendencies are also reflected in the French data presented here, but systematic ambient-language-based contrasts – with English, for example – are also evident. In particular, very few CVC structures are found in French templates compared to data from English, Dutch and Estonian children (Elbers and Ton 1985; Fikkert 1994; Vihman 1976; Vihman and Velleman 1989; Vihman and Vihman 2011) or from bilingual English/French children (Brulard and Carr 2001). While CVC sequences are common enough in high frequency words typically addressed to children in French (e.g., *poule* 'hen', *vache* 'cow', *robe* 'dress', *jambe* 'leg'), the number of words of this type that children attempt to say may be reduced due to resyllabification in continuous oral speech (Adda-Decker *et al.* 2005), as shown in [1].

[1]

la vache [la /vaʃ] => *la vache est au pré* [la/va/ʃe/to/pre]

‘the cow’

‘the cow is in the pasture’

This suggests that the rhythm of French and its strong tendency for a CV-CV-CV syllabification – a tendency which leads, in particular, to fairly systematic resyllabification of the final coda of a word and its attachment to the next word – shapes the word forms produced by French-speaking children, who quite consistently avoid producing codas. As will be shown below (§2), French offers a typologically unique accentual, metrical and prosodic structure, although its segmental phonology is not particularly complex, despite its marked vowel inventory (Carvalho *et al.* 2010). If typological constraints guide the formation of initial word forms in French children, this could be expected to be more evident on the prosodic and rhythmic than on the segmental level. Accordingly, we hypothesize that CV-CV-CV syllabification of the input will constrain the templates produced by French children.

This brings us to another aspect of French that requires attention in the typological definition of templates. This is the fact that in French, unlike English, for example, common nouns seldom occur without a determiner (Veneziano and Sinclair 2000; Bassano *et al.* 2008). Consequently, children are exposed to an input in which bare nouns are rarely heard, so we can expect children’s prosodic templates to incorporate unanalysed pro-clitic determiners or to show some trace of those determiners.

1.3 Template functionality

The third point that requires examination concerns the purpose and functionality of templates in the word production of French-speaking children. The answer to this question lies in our approach to the role of the template at the interface between perception and production.

Experiments with infants show that at around 9-11 months, an age generally corresponding to the transition from canonical to variegated babbling, children can recognize the major prosodic boundaries (Hirsch-Pasek *et al.* 1987; Jusczyk *et al.* 1992; Gerken 1994) and the accentual patterns of their language (Jusczyk *et al.* 1993), and have a holistic representation of lexical labels, which are undoubtedly underspecified phonologically as well as morpho-syntactically (Hallé and Boysson-Bardies 1994). Many perception studies have shown, for example, that children identify function words at an early stage and essentially use them, in association with other salient information, to identify word boundaries and segment the speech signal into blocks (cf. Echols and Marti 2004, Hallé *et al.* 2008). Moreover, Hallé and Boysson-Bardies (1994, 1996) conducted experiments to identify the age of familiar word form recognition. Children aged 11 months were presented with phonotactically matched lists of common and rare words in a headturn preference procedure. The results suggest that at this age there is no analysis or phonological decomposition of lexical units, which are stored either globally or underspecified – particularly as regards the unaccented syllable (Vihman *et al.* 2004). Finally, other studies have demonstrated children’s difficulty, even a few months later, in word recognition and lexical processing tasks (for a detailed review, see Fisher *et al.* 2004), particularly as concerns distinguishing between newly learned minimal pairs, which requires attention to phonological detail (Barton 1978; Stager and Werker 1997).

We also now know that infant speech segmentation is strongly constrained by the rhythm of the target language (Ramus *et al.* 1999), and that speech rhythm is one of the first linguistic properties that infants employ to distinguish languages (Nazzi *et al.* 2000). On this basis,

then, the templates seem to be ‘global’ unanalyzed forms that provide a formal shape for ‘constructions’ in the sense of units with a form-meaning link and can be seen as a way for children to deal with the temporal organization of speech in production: they constitute, at the phonological level of development, a temporary structural response to the metrical structure, the syllabic organization, the rhythm and the stress / accent patterns of input speech. In that sense, the templates reflect in production the units perceived in the input at a very young age (before 8 months). Thus, we can consider the templates as *functionally emergent* units whose format is typologically constrained by the input of the ambient language.

1.4 Outline

We will draw on the three issues that we considered above (format, constraints and functionality) to support the template conception that we propose for French. We begin by presenting the main aspects of French prosody, particularly with a view to countering a common alternative conception that we consider to be misguided, namely, that French is an iambic language, a mirror image of English, in which central status is accorded to the binary foot (§2.1). Contrary to this view, we will provide evidence that the accentual and rhythmic structure of French predicts that the first unit of acquisition is a flat prosodic template (§2.2). Having proposed a model for such a prosodic template for French (§2.3), we will show how data for the early period of word production, to which these premises apply, partially confirm the proposed theoretical model (§3), while data obtained at later stages clearly demonstrate the use of this prosodic template as well as other templatic phenomena (spreading, planar segregation) which can be seen as effective acquisition strategies for a syllabic CV-CV language like French.

The data that we provide to illustrate this analysis come primarily from three sources: (a) a corpus whose collection and analysis was financed by the ESRC project ‘Psychological significance of production templates in phonological and lexical advance: A cross-linguistic study’ (the PSPT Project), made up of longitudinal data from six children aged 17-29 months, (b) longitudinal data from the Claire corpus (Wauquier-Gravelines 2005), and (c) a corpus of elicited and semi-elicited production from 38 three- to five-year-old French children (Braud 1998, 2003).

2. Templates in French: the promise of the input

2.1 What French is not and what it cannot do

A good deal of acquisition research has been carried out within the framework of prosodic phonology (Selkirk 1984; Nespor and Vogel 1986; Fikkert 1994), in which a universal hierarchy is assumed to govern the organization of prosodic constituents, regardless of language, such that all levels are obligatorily represented and nested according to binary logic.

[2]

Phonological Phrase (PPh)

|

Prosodic Word (PWd)

|

Foot (Ft)

|

Syllable (σ)

|

Mora (μ)

This perspective leads to an empirically inadequate analysis of French, however. Indeed, the initial assumption within this approach is that acquisition is achieved in any language through the production of progressively more complex units based on binary metrical feet (trochaic in English and other Germanic languages). Thus, a strictly linear order of acquisition is assumed, which should vary little from language to language. Moreover, this analysis assumes that all languages have binary feet and that children necessarily go through a stage that includes the calculation of a lexical accent (Fikkert 1994; Hayes 1995; Demuth 2001; Demuth and Fee 1995; Rose 2000; Goad and Buckley 2006; Goad and Prévost 2008).

Until Rose (2000), this hypothesis was maintained for Germanic languages almost exclusively, leading to the formulation of the ‘trochaic bias’ hypothesis (Allen and Hawkins 1978, 1980). Gerken (1994), on English, and Fikkert (1994), on Dutch, both assume that children focus on ‘strong-weak’ metrical structure in constructing their first lexical units and perform truncation operations accordingly, while maintaining that the binary foot may be parametrized across languages. Since by no means all languages follow the pattern of lexical stress languages using a trochaic meter, this assumption was subsequently treated within the Principles and Parameters framework, which allows for (binary) alternative paths into language. Hayes (1995) proposes that all children use a binary foot, the head of which is parametrized according to contact input (that is, initial patterns in any target language will be bisyllabic, either trochaic ‘strong-weak’ or iambic ‘weak-strong’), and that the default setting for this parameter is a trochaic foot. Finally, Rose (2000), Dos Santos (2007), Goad and Buckley (2006) and Demuth and Tremblay (2008) have proposed that the acquisition of French is a mirror image of the process in English, and that children go through an iambic foot stage, centering on the last two syllables of the units they produce according to the ‘weak-strong’ pattern.

These proposals appear to implicitly consider French as a language with word-final lexical accent. Very little consideration is given to the prosodic and metrical structure of French, despite the availability of good descriptive accounts (Fonagy 1980; Verluyten 1982;

Dell 1985; Di Cristo 1999). These accounts clearly show that French is not an iambic language with lexical stress, for one good reason: unlike English, French uses the phrase rather than the word as its accentual unit (Dell 1985; Fonagy 1980; Di Cristo 1999).

2.1.1 Stress in French

Functional categories in French do not carry stress, while stress in lexical categories (nouns, verbs, adjectives, adverbs) always falls on the last full syllable, but only when they are produced in isolation: [3], [4], [5].

[3] Monosyllabic words: *lait* ‘milk’, *cœur* ‘heart’, *vache* ‘cow’

[4] Bisyllabic words: *cheval* ‘horse’, *maison* ‘house’, *voiture* ‘car’

[5] Tri/quadrisyllabic words: *crocodile* ‘crocodile’, *éléphant* ‘elephant’,
balançoire ‘swing’, *hippopotame* ‘hippopotamus’

In continuous speech, stress placement varies according to the position of the carrying word within a larger constituent, a syntactic, semantic or phonological phrase (usually considered as a breath group) [6], [7], [8], [9].

[6] *Marie aime son cheval* ‘Mary loves her horse’

[7] *Marie aime son cheval fou* ‘Mary loves her crazy horse’

[8] *Marie aime son cheval fou et orgueilleux* ‘Mary loves her crazy and arrogant horse’

[9] *Marie et son cheval / traversent la forêt au galop* ‘Mary and her horse gallop across the forest’

These examples demonstrate that stress placement in French is determined not on the level of the accented word itself, but higher up, on the level of the larger phrase or utterance that the word is part of. The term ‘iambic language’ is therefore inappropriate for French, given that a stressed constituent-final syllable does not necessarily correspond to the heavy syllable of an iamb, which is a metrical unit. While *cheval* [6] can be considered an iamb, *val fou* [7] cannot.

2.1.2 The foot and the syllable in French metrics

The hypothesis that French is an iambic language is clearly invalidated by metrical structure. In classical meter, the iamb is defined as a metrical grouping of two syllables, the first of which is weak and the second strong. This term has been extended to all forms of metrical structure that contain two syllables in the wS pattern (weak-strong). Thus, iambic verse is composed of a number of iambs, that is, binary feet whose second syllable is stressed or lengthened. A case in point is the famous iambic pentameter, the meter frequently associated with the poetry of English and German, both lexical-stress languages. In French, which is considered a syllable-timed language, the verse is divided not into feet, grouping long and short or stressed and unstressed syllables, but into syllables of the same metrical value (Verluyten 1989). Verlaine's poem *Green* [10], for example, is written in the classical form of alexandrine verses of twelve syllables, all having the same metrical value. A caesura at the hemistich boundary after the sixth syllable (the half point of the verse, producing a 6/6 structure) creates a division into two sets of six syllables with identical metrical structure. In this case, the nucleus of the sixth syllable (*i.e.*, *fleur* [flœR], *cœur* [kœR], *pas* [pa], *beaux* [bo]) provides a phrasal accent that announces the caesura. However, the 6/6 caesura is not essential to the understanding of verses that can be segmented into another structure. One could recite these verses without a break, producing a single 12-syllable constituent, or a

single phonological phrase. This is evident in the third line, which allows for liaison or linking of [z] across the caesura.

[10]

Voici des fruits, des fleurs, des feuilles et des branches

Et puis voici mon cœur qui ne bat que pour vous

Ne le déchirez pas avec vos deux mains blanches

Et qu'à vos yeux si beaux l'humble présent soit doux¹

Verlaine, « Green », *Romances sans paroles* (1874)

[vwa/si/de/frʁi/de/**flœR** // de/fœ/jə/ze/de/**brɑ̃ʃ**

e/pʁi/vwa/si/mɔ̃/**kœR** // ki/ nə/ba/kə/pʁ/vu

nə/lə/de/ʃi/re/**pa** // [z]a/vɛk/vo/dœ/mɛ/**blɑ̃ʃ**/

e/ka/vo/zjœ/si/**bo** // lœ/blə/pre/zɑ̃/swa/**du**]

It has been argued that there is no organizational hierarchy or intermediary structure between the syllables and the large prosodic constituents (the 6-syllable hemistich or even the 12-syllable verse) and that the hemistich or the alexandrine are flat structures, not hierarchical constructions based on a binary-branching prosodic structure (Verluyten 1989). If the foot is taken to be a necessary unit, the alexandrine could be analyzed as having 12 feet, but these would be single feet, that is, 12 syllables.

In short, the fact that French stress placement is phrase-final rather than word-final, as shown above, supports the claim that there is no intermediary structure between the syllable level and the phrase. In most cases French employs unitary feet² (i.e., syllables of equal value in a non-hierarchical constituent on the foot level: Verluyten 1982, 1989; Dell 1985), suggesting that these are attached to larger constituents in a flat structure.

But however questionable the postulation of an iambic foot as a metrical unit in French may be, French does have, as we saw in [6], [7], [8], [9], a final prominence that has been well documented (Fonagy 1980; Dell 1985; Di Cristo 1999; Jun and Fougeron 2000). Should this final prominence be interpreted as the instantiation of a (w)S final foot (an iambic foot)? Some French linguists have indeed interpreted it as reflecting a stressed syllable that would be the strong position of a (w)S foot (Charette 1991), but a good deal of evidence supports an

¹ Here are fruits, flowers, leaves and branches
And here is my heart, which beats only for you.
Do not tear it apart with your two white hands

But may the humble gift, to your lovely eyes, seem sweet. [tr. M. Vihman]

² This has also been argued by Selkirk (1978), who described French as having single feet, while supporting a trochaic (rather than iambic) binary foot to account for the French schwa/0 alternation (*renard*, 'fox' [RƏNAR] can be produced [RnAR] in some variants of French). This rule, postulating a trochaic binary foot in French, has garnered much criticism (Tranel, 1987) and alternative solutions have been proposed to account for the schwa/0 alternation (for an overview, see Scheer, 2004). A significant point of criticism is that the trochaic foot rule assumes that the foot makes an *ad hoc* appearance solely to resolve the schwa/0 alternation, and is based on no accentual parameter; in fact, in most contexts its predication conflicts with French accent structure.

interpretation of the French final prominence as being a domain edge marker belonging to the intonation system in a language without feet (Verluyten 1982; Jun and Fougeron 2000).

Despite this debate, the position that French has an iambic foot is generally taken for granted in acquisition studies, often without further discussion (but see Goad and Buckley 2006, Goad and Prévost 2008, Goad 2011). The insistence on (i) analyzing French as having iambic structures and (ii) considering that French children will consequently systematically produce iambic feet at the early stages (e.g. Demuth and Tremblay 2008) appears to be based on a systematic theoretical bias in favor of the universality of the prosodic hierarchy, although the empirical facts of French must be taken to present important challenges to the theory.

2.2 What French is and what it *can* do

It has also been proposed that French metrical structure is based not only on phrase-final stress but also on a phrase-initial counter-stress, symmetrical to the final stress. The hypothesized phrase-initial stress was originally proposed by Fonagy (1980), and later adopted and developed primarily by Di Cristo (1999), who provides the following description: '[French exhibits] a tendency to accentuate the first syllable of words, which gives rise to the formation of barytone patterns and accentual arcs in which only the initial and final syllables of a phrase are stressed' (my translation).³

According to Di Cristo, the existence of this initial stress in contemporary French is accepted by most prosodists, however they conceptualize the phenomenon. Differences relate to the exact interpretation of the counter-stress (variously regarded as emphatic, an echo or secondary stress). For Di Cristo, both initial and final syllables are, therefore, prosodically strong positions, forming the two pillars of an *accentual arc* within which the metrically-equivalent internal syllables are inserted and eventually reduced relative to the edges of the constituent. Examples [11]-[14] are extensions of [6]-[9] with the addition of Di Cristo's proposed counter-stress.

[11] *Marie aime son cheval* 'Mary loves her horse'

[12] *Marie aime son cheval fou* 'Mary loves her crazy horse'

[13] *Marie aime son cheval fou et orgueilleux* 'Mary loves her crazy and arrogant horse'

[14] *Marie et son cheval / traversent la forêt au galop* 'Mary and her horse gallop across the forest'

2.3 Templates in French: what is the appropriate model for acquisition?

Based on the accentual arc model we may conclude, following Macken (1995), that the units available to children at the production/ perception interface can be schematized as in [15]:

[15]

[,σ (σ)_n 'σ]

This formal structure is initially defined by the constraints that produce the accentual arc structure and that are heard in the French input. It is bounded by two demarcating stresses that

³ '[il y a en français] une tendance à accentuer la syllabe initiale des mots, ce qui donne naissance à la formation de schèmes barytoniques et d'arcs accentuels dans lesquels seules les syllabes initiales et finales d'un groupe de mot reçoivent un accent' (Di Cristo 1999: 185).

correspond to the stress and counter-stress described above: the last syllable (σ) carries the demarcating phrasal stress that delimits the right edge of the unit, while the first syllable (σ) bears the counter-stress. The initial and final syllables define the boundaries of the accentual arc, which thus serve as prosodically strong positions. This structure can be expected to provide the first lexical pattern for phonological development in French. It derives from a prosodic unit that is perceptually available, bounded by stress and counter-stress, and therefore segmentable in the input. Therefore, we expect that it is this abstract phonological structure that is targeted by the production templates that we observe – and see as temporary structural responses to the prosodic characteristics of the input. From this we can develop following predictions: (i) children will first construct the strong syllables, (ii) these will never be truncated and (iii) will undergo little deformation. Between these prosodically strong boundaries there are an open number (n) of intermediary syllables, where n can theoretically contain any number from 0 to infinity. We need to consider that n may be 0: the internal syllable is generally optional at the early stages (cf. § 1.2). Braud (2003) shows that n is consistently ≤ 2 in early production, up to the age of two. Unlike the first and second syllables, the ‘ n -site’ should be less stable and more variable. We also postulate that this prosodic structure will constrain the templates produced at an early stage and will later be the domain of morpho-phonological generalizations.

3. Data and observed template formats

We turn now to a comparison of this schematization of the rhythmic template for French with the evidence provided by three sets of French child data. We focus on the question as to whether or not French children’s early word forms exhibit the kind of systematic patterning that would reflect the typological constraints given by the rhythmic structure of French as we have described it.

3.1 The PSPT project data: six children at the early stage

Case studies have been prominent in the literature on child phonology, but they do not provide the best way to test claims about the typological systematicity of data; it is preferable to compare data from several children of the same age. We rely here on data obtained and analyzed as part of an ESRC project, "Psychological Significance of production templates in phonological and lexical advance: A cross-linguistic study" (the PSPT project), which includes longitudinal data from 6 French children aged 17-29 months. These children (2 girls and 4 boys) were recorded once a month in 30-minute sessions of naturalistic, non-elicited interaction with a parent. Recordings began at the ‘25-word point’⁴ (based on a parental questionnaire and researcher verification in an initial control recording). The data were transcribed and analyzed using PHON (Rose and Mac Whinney, in press). Here we present our findings based on the first five recording sessions, which will enable us to observe the prosodic structure of the first words.

3.1.1 The idiosyncratic character of the first templates

We begin by noting that the data confirm the tendencies identified by Vihman (2010) (cf., §1.2), at least in part. A size constraint on these word forms is clearly evident (they never exceed two vocalic nuclei). These data also confirm the great variability of word forms from

⁴ The recording session in which the child first spontaneously produces 25 or more different word types in 30 minutes.

one child to the next and the existence of idiosyncratic strategies that suggest individual articulatory continuity with babbling and the personal preferences of each child.

To illustrate, Table 1 presents the 28 occurrences of the word *micro* ‘microphone’ produced by Beryl during a single recording session (19 mos.). The data reveal Beryl’s strong preference for the form [aχo] (13 out of 28 tokens). But beyond that, all tokens realize the VCV pattern, with a vocalic a-o melody and a fixed medial consonant consisting of a uvular fricative (14 out of 28 tokens). The remaining patterns are roughly modeled on the main pattern, with two systematic changes: either to the vocalic melody (o-o or a ə-o alternate with a-o), or to the medial consonant (the uvular fricative alternates or (in one case) combines with the velar stop [k]). Table 2 shows that this pattern was also extended to other target words that were selected⁵ (in gray, here and elsewhere) or adapted⁵ to fit this pattern (same session).

MAIN PATTERNS	N TOKENS	OTHER PATTERNS (one token each)
[aχo]	13	[akpo]
[oχo]	2	[pako]
[əχo]	2	[aχko]
[oχo]	2	[koko]
[taχo]		[ahko]
[oko]		[ak ^h o]
		[χo]

Table 1: Beryl’s 28 tokens of *micro* ‘microphone’ (at 19 mos.)

TARGET WORDS	BERYL’S PRODUCTIONS
<i>agneau</i> [aɲo] ‘lamb’	[alo]
<i>bateau</i> [bato] ‘ship’	[ato]
<i>poisson</i> [pwasɔ̃] ‘fish’	[aço]
<i>éléphant</i> [elefã] ‘elephant’	[afo]
<i>crapaud</i> [krapo] ‘toad’	[ako]

Table 2: Beryl’s other word forms reflecting the < aCo > template

⁵ ‘Selected’ words appear to have been chosen by the child for their fit with the template (i.e.: *agneau*, ‘sheep’ [alo] fits the <aCo> template, although with substitution of [l] for /ɲ/). The ‘adapted’ words have been modified by the child to fit the same template (i.e.: *éléphant* ‘elephant’ [elefã] is modified to [afo]). Children’s selected words are close to the adult’s target form, within the constraints of the child’s production skills, while the adapted words may be considerably modified.

At first glance, this result seems to follow an idiosyncratic articulatory logic in the construction of a template, to the extent that the chosen structure is clearly specific to this child whereas uvular fricatives in medial position are not particularly characteristic of French. Thus, the medial /kr/ cluster of *micro*, with its uvular [R], must be supposed to have inspired Béryl's rough phonetic approximation.

3.1.2 Typological characteristics of the first templates

Yet Beryl's template is perhaps less idiosyncratic than it appears, if analyzed on the syllabic level and compared to Vincent's data (at 17 mos.), for example (Table 3).

TARGET WORDS	VINCENT'S PRODUCTION
<i>allo</i> [alo] 'hello (on telephone)'	[alo]
<i>OK</i> [oke]	[oke]
<i>attends</i> [atã] 'wait'	[atã]
<i>ici</i> [isi] : 'here'	[iʃi]
<i>bravo</i> [bravo] 'bravo'	[avo]
<i>voilà</i> [vwala] 'there it is, there you are'	[ala]
<i>avion</i> [avjõ] 'airplane'	[ajõ]
<i>fermé</i> [fɛrme] 'closed'	[ame]
<i>caché</i> [kaʃe] 'hidden'	[aʃe]
<i>encore</i> [ãkɔʀ] 'still'	[atə]

Table 3: Vincent's word forms, the <VCV> template

In fact, Vincent's data also reveal a VCV structure, where the first vowel is frequently central (schwa or a). This suggests that Béryl's apparently idiosyncratic VCV template corresponds to a prosodic structure available to other French children. This hypothesis is confirmed by the data summarized in Figure 1.

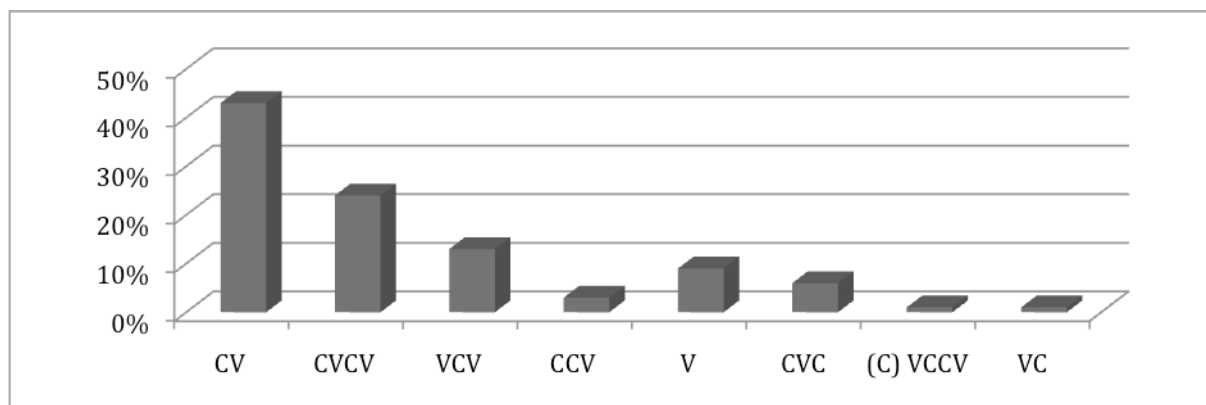


Figure 1: percentages of early syllable structures of word-forms (averaged over five sessions for six children)

Figure 1 shows the percentages of word forms produced by the six children over the course of their first five recording sessions, sorted according to the output syllabic structure. The first structures produced are mainly CV for all six children (the most frequent production form: 43% on average). The CV syllable may derive fully or partially from the final syllable of the target word (e.g., [kɔ:] < [ãkɔ], *encore* ‘still’), less frequently from the initial syllable ([kẽ] < [kanɔ], *canard* ‘duck’), or from segmental reorganization based on both the initial and the final syllable of the target word ([bu] < [bizu], *bisou* ‘kiss’). This CV syllable is not always the one receiving final stress in the adult target (and can therefore still less be characterized as ‘the strong syllable of an iambic foot’).

However, we also note that CVCV and VCV structures are systematically produced at an early stage alongside the CV pattern (unlike the remaining structures, none of which accounts for more than 5% of the tokens produced). The CVCV structure is primarily produced in the case of targets that are reduplicated in the adult language (*doudou* ‘security blanket’, *papa* ‘daddy’, *maman* ‘mommy’), but for non-reduplicated targets (*lapin* ‘rabbit’, *chapeau* ‘hat’) the structure of the child form is more likely to be VCV. The VCV structure is obtained either through selection (*allo* ‘hello’, *attends* ‘wait’) or adaptation (CVCV > VCV: *lapin*, *chapeau*, *fermé* ‘closed’). The tendency to favor some words over others can also be observed longitudinally (Fig. 2). The CV structure arises early as the preferred word form and remains the most used structure throughout the five sessions for all the children. Despite individual variation from one child to the next (Fig. 3), the preferred structures include CV, CVCV and VCV for all but one child. The children can be ranked from Bastien, who primarily used the CV structure and secondarily the CVCV and VCV structures, to Beryl, who made equal use of the CV, CVCV and VCV structures. In all the cases the CV structure is used early and remains the most used by all the children from the first to the fifth session.

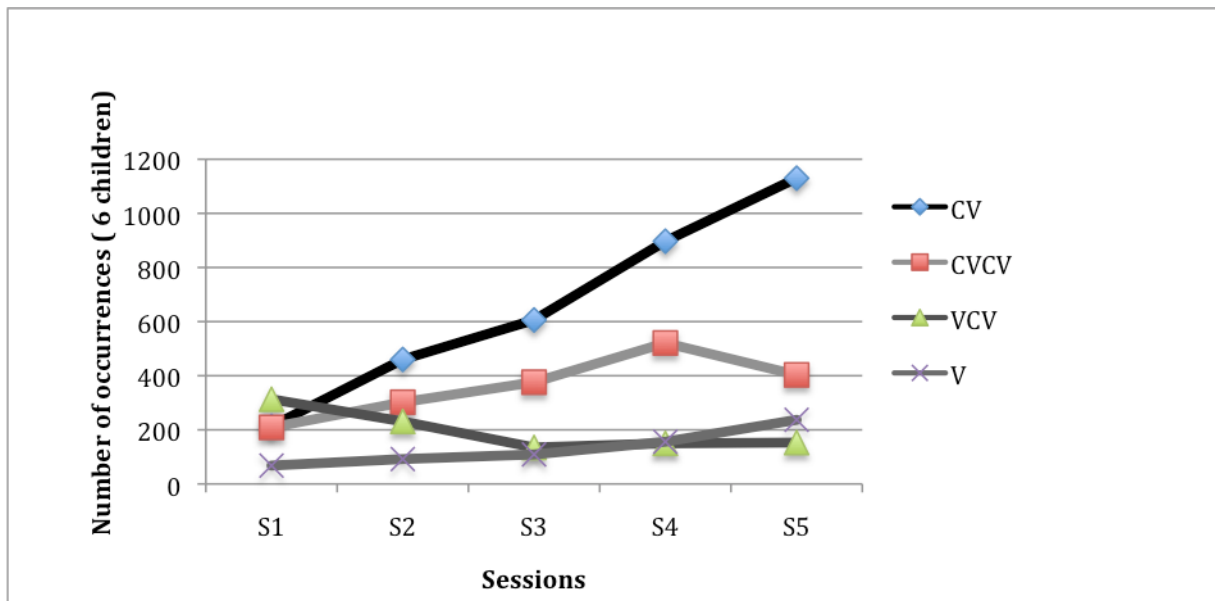


Figure 2: Number of lexical items belonging to each word form: CV, CVCV, VCV, V (averaged over five sessions for six children)

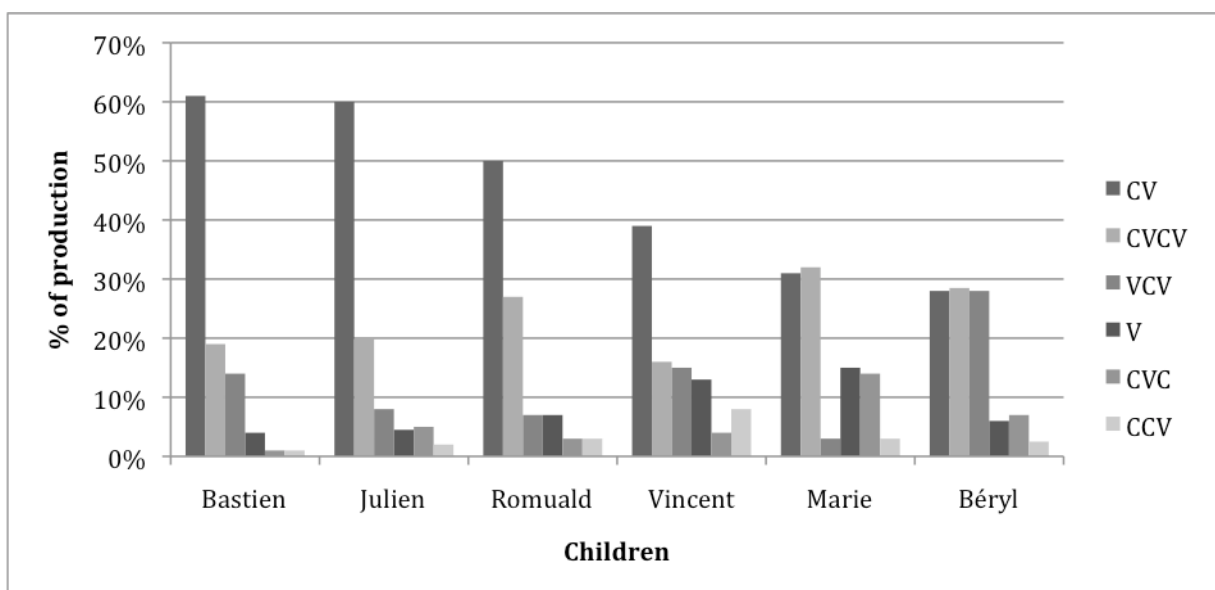


Figure 3: Individual variation in the syllable structures of word-forms (averaged over five sessions)

The generalization that emerges is that the first word structure to stabilize and be frequently produced by French-speaking children is built around a CV syllable and not a binary iambic foot. This is followed by two options that are frequently produced, in parallel, to augment and vary the first CV template:

CV > VCV, where V_1 is mostly a central or front vowel ([a] [ə] [e] [ɛ])

CV > CVCV, where CV is frequently reduplicated. There are also some cases where the two consonants differ but are harmonized (mainly for place).

Both of these patterns express a systematic avoidance of consonant change across the word and a preference for open syllables, word-internally as well as finally. This means that Beryl's [aʁo] word form, which at first looks so idiosyncratic, can be analyzed as the realization of a more general <aCo> template which is itself an instantiation of a <VCV> pattern reflecting one of the main typological characteristics of French (i.e. open syllabification). And, as we saw, the <VCV> pattern can itself be analyzed as a variant of the CV pattern (V + CV), which is by far the most common structure produced by French children.

3.2 Later longitudinal data: truncation and reduplication

Will the typological constraints of the target language have the same effect on the word forms of older children? We present below data from the longitudinal Claire corpus, from sessions taken at the age of 22-25 months, when she had a at a vocabulary level higher than what is reflected at the 25-word point (cumulative lexicon of some 200 words): See Tables 4 and 5, organized by length of the adult target. We focus on Claire's truncations and reduplications and the way they may fit a prosodic template partly (or fully) expressing the typological constraints described above (§1).

3.2.1 Truncation and templates

MONOSYLLABIC TARGET WORDS	CHILD FORMS
<i>la vache</i> [lavaʃ] : 'the cow'	[əja] / [laja]
<i>l'âne</i> [lan] : 'the donkey'	[lətan] ⁶
<i>le pot</i> [ləpo] : 'the pot'	[ləpo]
<i>le chien</i> [ləʃjɛ̃] : 'the dog'	[lətɛ̃]
<i>Claire</i> [kle:ʀ]	[le:]

BISYLLABIC TARGET WORDS	CHILD FORMS
<i>le bébé</i> [ləbebe] : 'the baby'	[ləbebe]
<i>un ballon</i> [ɛ̃/dəbalɔ̃] : 'one balloon'	[abalɔ̃]
<i>deux ballons</i> [dəbalɔ̃] : 'two balloons'	[dəbalɔ̃]

⁶ The [t] in the form produced is provided by a commonly occurring phonological context: the vowel-initial word *âne* is often preceded by a word ending in a liaison consonant (i.e. *petit* [pəti] + *âne* [an] is pronounced [pətitan] 'little donkey'); the child has likely missegmented such cases, representing *âne* as *tâne.

<i>Didou</i> [didu]	[didu] [tidu]
<i>Maman</i> [mamã] : ‘Mummy’	[mamã]
TRISYLLABIC TARGET WORDS	CHILD FORMS
<i>éléphant</i> [elefã] : ‘elephant’	[eã]
<i>un éléphant</i> [ënelefã] : ‘one elephant’	[ɔejã]
<i>deux éléphants</i> [dəzelefã] : ‘two elephants’	[dəeã]
<i>le hérisson</i> [ləʔerisɔ̃] : ‘the hedge-hog’	[ləijɔ̃]
<i>Aurélien</i> [oreljɛ]	[jɛjɛ]
<i>Olivier</i> [olivje]	[oje]
QUADRISYLLABIC TARGET WORDS	CHILD FORMS
<i>la brosse à dents</i> [labʁɔsadã] : ‘the toothbrush’	[anadã]
<i>un médicament</i> [ɛmedikamã] : ‘a medicine’	[apamã]

Table 4. Claire’s word forms (22-23 mos.)

As illustrated in Table 4, one- and two-syllable words are produced without truncation, mostly with a schwa or [lə] [la] [ɛ], which can be interpreted as proto-determiners (Veneziano and Sinclair 2000, cf.1.2). Note that the proto-determiner does not appear with proper nouns in the input and is not reflected in Claire’s forms of these either. In contrast, three- and four-syllable words exhibit partial deletion of segmental material between the proto-determiner and the last syllable (or even the last vowel). Thus, Claire preserves the two edges of the target words according to the proposed template. This is true for long words as well as for monosyllabic words, for the former at the expense of the internal syllables and for the latter as well as for monosyllabic words produced with an initial vowel as a proto-determiner (Veneziano and Sinclair 2000).

3.2.2 Truncation, reduplication and spreading

In the same period Claire developed another strategy for handling three- and four-syllable words, which provides additional confirmation for this analysis (Table 5).

TRI- AND QUADRISYLLABIC TARGET WORDS	CHILD FORMS
<i>le chocolat</i> [ləʃokola] : ‘the chocolate’	[ekola]
<i>le chocolat</i> [ləʃokola] : ‘the chocolate’	[ekokola]

<i>un crocodile</i> [ẽkrokodil] : ‘a crocodile’	[ẽkoti]
<i>un crocodile</i> [ẽkrokodil] : ‘a crocodile’	[əkukudi]
<i>un crocodile</i> [ẽkrokodil] : ‘a crocodile’	[ekokodi]

Table 5: Claire’s reduplication patterns based on tri- and quadrisyllabic targets

Here Claire lengthens her word forms by reduplicating a syllable of the truncated word. She appears to proceed in two steps:

1. Truncate left edge of word but preserve determiner;
2. Lengthen the word by reduplicating the left-most syllable.

For example, for *le chocolat* [ləʃokola] Claire begins by producing [ekola], followed by the string [ekokola], produced by reduplication of the syllable [ko]; for *un crocodile* [ẽkrokodil] she begins by producing [ẽkoti], then omits the beginning of the word to obtain the number of syllables of the target [ekokodi] by reduplicating the penultimate syllable [ko]. Reduplication can be seen here as motivated by the presence of very similar syllables in the adult target word ([kro] and [ko] in [ẽkrokodil]).

In fact, Claire's production aims at the template proposed in [15] and elaborated on the basis of Di Cristo's concept of the accentual arc. This indicates that in target utterances longer than two vocalic nuclei (based on adult targets longer than CVCV), she preserves the initial vowel (the proto-determiner) but reduces the beginning of the content word and shapes a prosodic template with an accented final syllable [‘σ], a counter-stressed first syllable [‚σ] and internal syllables with $n < 2$.

In order to evaluate this interpretation we now turn to a larger data set from children at a still more advanced lexical level (age 2.5-5 years). If the French children are aiming at a prosodic shape that can be formalized as in [15], we should be able to observe the same patterns as their utterances become longer.

3.3 Multisyllabic words and truncations: how do the templates evolve?

We present here data extracted from a comparative corpus of 18 children aged 30-36 months (Braud 1998), followed by data from 3 groups of 20 children aged 3-5 years, which was the basis for a systematic study of truncation and reduplication in French (Braud 2003). To create this database groups of children ranging in age from 2.5-5 years were recorded. Speech was elicited using a picture-naming task, with word length as the experimental variable. The experiment was presented as a game. Children were presented with a picture and asked: *Qu'est-ce que tu vois sur cette image?* ‘What do you see in this picture?’ The following examples were extracted from the data of children aged 2.5 and 3.5 years.

MONOSYLLABIC TARGET WORDS	CHILDREN FORMS
<i>un ours</i> [ẽnurs] : ‘a bear’, <i>un nounours</i> [ẽnunurs] : ‘teddy bear’	[ənunus] / [ẽnunurs]

<i>un os</i> [ɛnɔs] : ‘a bone’	[ɛnonɔs]
TRISYLLABIC TARGET WORDS	CHILDREN FORMS
<i>un arrosoir</i> [ɛnarɔzwar] : ‘a watering-pot’	[ɛRORɔZwar] / [ɛRERɔZwar]
<i>une coccinelle</i> [ɛnkɔksinɛl] : ‘a lady-bird’	[ɛnkokosinɛl]
QUADRSYLLABIC TARGET WORDS	CHILDREN FORMS
<i>un accordéon</i> [ɛnakɔrdeɔ̃] : ‘an accordion’	[ɛRaRaɔ̃]
<i>un épouvantail</i> [ɛnepuvɑ̃taj] : ‘a scare-scrow’	[ɛpupuvɑ̃taj]
<i>un hélicoptère</i> [ɛnelikɔptɛR] : ‘an helicopter’	[ɛnenikɔtɛR] / [ɛninikɔptɛR]
<i>un aspirateur</i> [ɛnaspiratœR] : ‘a vacuum cleaner’	[ɛpasatœR] / [ɛRaataœR] / [ɛRastatœR] [ɛpiRatœR] / [ɛpiRatœR] / [ɛpisRatœR]

Table 6. Truncation and reduplication patterns in older children

In Table 6, as in Claire's data, reduplication and truncation are carried out simultaneously and almost exclusively on words of more than two syllables.

As regards monosyllabic words, the few observed cases of reduplication appear in words that are already lexicalized as reduplicated forms in the adult input and used as terms of endearment in colloquial French. The children apparently do not reduplicate monosyllabic words spontaneously. In fact, Plénat (1984, 1999) has shown that reduplication is systematically used in French to form diminutives and nicknames with a hypocoristic value (e.g., *Guiguite* for Marguerite, *Roro* or *Bébert* for Robert). This is particularly evident in the case of *nounours* and *nonos* 'bear/teddybear', which may be heard as such in the input. Consequently, reduplication of short words, which is already provided in the input, can presumably not be considered as a productive process in French children's early word forms.

If we now consider three- and four-syllable words, we find the same phenomena noted in Claire's output: omission of syllables is not random but conditioned by the prosodic structure of the input. The first and second syllables of the word are quasi-systematically omitted, while the phrase-initial syllable, the proto-determiner, and the final syllable – i.e., the two edges of the Di Cristo's accentual arc – are consistently preserved.

4. Discussion

Let us now examine how the three sets of data shed light both on the hypotheses discussed above and on the predictions we made concerning the way in which the typological constraints of French – the strong tendency for CV-CV syllabification and early initial filler on content words – could be expected to shape the word forms produced by French-speaking children (cf. § 1.2). We will also discuss the relevance of the templatic model we proposed in 2.3 as a challenge to the iambic-foot approach. We argue that there is neither a need nor a justification for postulating an iambic foot, and that a rhythmic template can better cover our three data sets and account for the evolution of the word forms all through the course of development.

4.1 CV-CV syllabification and early word forms

Many studies comparing the acquisition of Romance *vs.* Germanic languages (Fikkert *et al.* 2004), as well as Vihman's (2010) data, show that French children do not tend to arrive at early CVC templates patterns while Dutch, English, German and Estonian children often do. Brulard and Carr (2001) also demonstrate a CVC-pattern in their English / French bilingual child. Thus, omission of codas is not dictated by an age-related or wholly maturational constraint. Nor does it originate from isolated words in the French input, which provide many CVC words of high frequency like *robe* 'dress', *soupe* 'soup', *dame* 'lady', *coq* 'rooster', *vache* 'cow', which commonly occur in child-directed speech. Why then do monolingual French children seem to filter the input to avoid CVC patterns? We assumed that their templatic patterns are influenced by the rhythm and the CV-CV syllabification of French (§ 1.2). More generally, one can assume that the parameters of variation in the children's surface forms in production must be – at least partially – typologically constrained and limited to the underlying structures supported by the rhythmic and syllabic structure of the target language.

The strong generalizations that emerge from our data clearly confirm this assumption. As we have seen, French-speaking children share a preference for open-syllable structures, early vowel stability in the nuclei and an avoidance of consonant clusters. The first word forms to be produced systematically by French-speaking children are built around the CV word structure.

The children's word forms evolve in two ways, in parallel, then, to augment and vary the first CV template:

CV > VCV, where V_1 is mostly a central or front vowel ([a] [ə] [e] [ɛ])

CV > CVCV, where CV is frequently reduplicated. There are also some cases where the two consonants differ but are harmonized (mainly for place).

These regularities correspond to our predictions regarding the typological constraints that French input imposes on the first templates. The rhythmic features of French, a syllabic language that favors CV-CV syllabification (sometimes even at the expense of word boundaries, as in the case of *liaison* sequences: see 2.1.2), lead children to construct their initial templates on the basis of the CV syllable and to prefer open structures.

4.2 Status of the initial filler: Does it support the binary foot?

Another aspect of the data is also interesting, although harder to interpret: The presence of low or mid vowels as V_1 in VCV structures is tricky. For certain words – like [apɛ̃] or [apo] (*lapin*, *chapeau*) – one is inclined to analyze V_1 as the first-syllable vowel of the corresponding target word (see also Veneziano and Sinclair 2000). This leads one to analyze the adaptation as CVCV > VCV and to suppose that the child has omitted the onset consonant of the target. In other cases ([aχo], [oχo], [əχo], [oko], [taχo] for *micro*), another analysis is possible, based on an operation that enables the generation of [a + χo], [o + χo], [ə + χo], [o + ko], [ta + χo], which can then be analysed as [vowel + (velar obstruent + o)], in which the vowel does not correspond to V_1 in the target but rather to the vowel of some (unspecified) determiner. Accordingly, *micro* is reduced to the final syllable [χo] or [ko], and the first vowel of each form becomes analyzable as the trace of a proto-determiner. In these cases, one has to reconsider Bérly's adaptations as CVCV > CV > V + CV, and assume that

she completely truncated the initial syllable (*micro* is encoded as [χo] or [ko]), and then produced this syllable with an initial vowel that reflects the presence of a determiner in the adult input. This interpretation is corroborated by the fact that the mother's input for *micro* was always produced with a determiner (*le micro* 'the microphone', *c'est le micro* 'it's the microphone'). This would be true for any French speaker, since content words are seldom produced without a determiner in any context. Moreover, Bassano *et al.* (2008) have proposed that the systematic presence of prenominal fillers in the early stages of French L1 acquisition can be analyzed as representing determiners or proto-determiners. Our data confirm the widespread presence of prosodic positions filled by fillers that could represent the proto-determiners. These fillers can be taken to reflect another typological characteristic of French adult input: the systematic expression of determiners before common nouns.

The VCV word forms thus conform to the theoretical template in [15], which includes the boundaries (the final syllable on the right edge of the template and the proto-determiner as the nucleus of the initial syllable on the left edge, with truncation of the first syllable of the target word) and a zero value for the *n* index. Based on two case studies (Tim and Mary), Demuth and Tremblay (2008) propose a different analysis for VCV structures. They argue that determiners appear more quickly and more frequently with monosyllabic words (forming an iambic foot due to prosodic constraints) than with longer words (bi- tri- or quadrisyllabic). This analysis is debatable, however. Indeed, as shown by Vihman, children exhibit strict limits on the size of the early units produced, whatever the target language, so that the size of the early units may be constrained by more general psycholinguistic limitations (such as working memory). But even if the early presence of CVCV and VCV sequences is taken to be the result of a prosodic constraint, there is no indication that it must necessarily be due to the use of a binary branching structure. It is equally possible that children access a flat templatic structure whose prosodic length is restricted and which varies from child to child. The fact that the first V vowel in VCV structures can simultaneously be interpreted as a full vowel of the internal syllable of the target word (*lapin* > [apɛ̃]), or as a clitic proto-determiner (*un micro* > [aχo]), supports this view (see also Veneziano and Sinclair 2000). This means that the VCV structure found in child production need not be interpreted as an iambic (w)S foot, which can in any case account for it only in part. The alternative interpretation proposed here accounts for the data in a more comprehensive way.

Finally, as Claire's output shows (like Marie's but unlike Tim's, at roughly the same age: see Demuth and Tremblay 2008), vocalic fillers or initial vowels are present even in bisyllabic and trisyllabic units. It appears, therefore, that much variability can be observed from one child to the next, as Demuth and Tremblay themselves note elsewhere. This fact could be attributed to individual differences in access to the prosodic hierarchy, as assumed by Demuth and Tremblay.

4.3 From early CV and VCV word forms to the accentual arc

At the later stages, when children reach a point in development that allows for more than two vocalic nuclei, the limits of a prosodic template can be set to allow development and to include more internal syllables. We can now consider the following developmental scenario, progressing from CV and /or VCV patterns by the adjunction of internal CV structures: the children use the same pattern to expand the template with internal syllables, particularly through reduplication of the penultimate syllable, along with gradual diversification of the segmental material. We express this proposal formally in [16], which reflects the earlier stages (with no more than one internal syllable, *n* = 1) and [17], which includes later stages as

well ($n > 1$).

[16]

[CV] > [VCV]

> [₁V(CV)₁'CV]

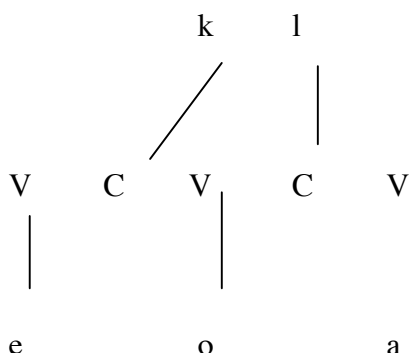
[CV] > [CVCV]

[17]

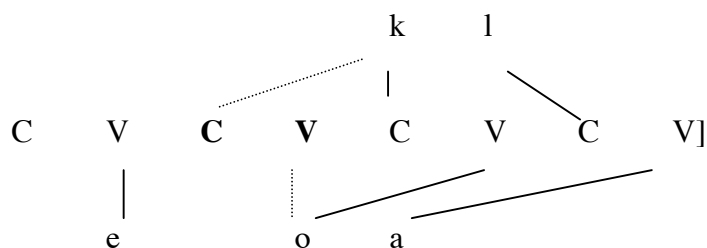
[CV] > [VCV] > [₁V(CV)₁'CV] > [₁V(CV)₂'CV] > [₁V(CV)₃'CV]

Moreover, lengthening and segmental diversification do not appear to occur at the same time. Children seem to first lengthen the initial structure through the addition of syllabic positions that they fill with a reduced set of the consonants and vowels to be found in the adult target; they then diversify at a later stage. For example, *un aspirateur* ‘a vacuum cleaner’ ([*ẽnaspiratœR*]: cf. Table 6), a quadrisyllabic word, is first produced with three syllables, reproducing a subset of the vowels and consonants of the target ([*ẽRastatœR*]: [*ẽ*, *a*, *œ*], on the one hand, and [*s*, *t*, *R*], on the other). The word is then lengthened and segmentally diversified ([*ẽpisratœR*]: [*ẽ*, *i*, *a*, *œ*] and [*p*, *s*, *t*, *R*]) until the adult target ([*ẽnaspiratœR*] is obtained: [*ẽ*, *i*, *a*, *œ*] et [*n*, *p*, *s*, *t*, *R*]). The child’s lexical representations may be regarded as prosodically conditioned templates: *chocolat* is the result of the redistribution of two, then three consonants and two vowels [*o*], [*a*]), based on a progressively elaborated template with two basic strong positions, marked by the final stress on the right edge and a counter-stress on the left edge. The proposed sequence for the word *chocolat* is illustrated in [18]-[20].

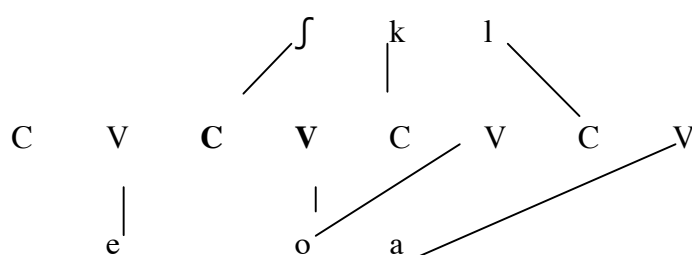
[18] [₁eko'la] : V₁CVCV



[19] [ɛkoko¹la] : lengthening



[20] [ɛʃoko¹la] : diversification



This representation assumes that in children's early production consonants and vowels are stored on two separate tiers ('planar segregation') as proposed by Menn (1978) and Macken (1995), within the autosegmental phonology framework.⁷ This makes it possible to formally express the autosegmental dimension of children's productions as regularly observed in phonological development (consonant/vowel dissociation, reduplication, onset/nucleus dissociation, spreading, harmonies).

5. Conclusion

This chapter has examined in more detail a hypothesis previously proposed for French (Braud and Wauquier-Gravelines 2004; Wauquier-Gravelines 2005), offering a formal, rhythmically-determined template that subsumes a wide variety of structures observable in child output, grounded in a rich empirical base. The approach rests on the premise that children's first units are conditioned by systematically expressed typological constraints in addition to individual and idiosyncratic constraints. The idea is not to reduce the variety of all observable facts to a single referential template that would serve as a unique underlying representation for all child forms, but rather to propose a formalization of a prosodic template that predicts the development of the prosodic structure of French.

We have shown that the analysis of French prosody invites us to discard the premise that the L1 phonological acquisition of French requires the postulation of early iambic units. We have proposed an alternative theory, based on Di Cristo's (1999) concept of the accentual arc, according to which French-speaking children's early word forms reflect this structure through

⁷ This phenomenon is also evident in the acquisition of the syllabic onset in French (Wauquier, 2010).

a template that consists primarily of the two pillars of the arc, a pattern which later evolves by the addition of syllabic structures in medial positions of the template.

The proposed developmental scenario assumes a flat, non-branching structure into which children gradually add CV units corresponding to the syllabification pattern commonly present in French input speech, which favors open structures even at the expense of word boundaries. It is argued that the basic unit employed by French children is the CV syllable rather than the binary foot. Our three sets of data trace a developmental course from early word forms (PSPT project) to later ones (Claire and Braud corpora) and demonstrate that children begin with open CV and VCV structures and deploy in parallel planar segregation between consonantal and vocalic melodies to progress by the addition of internal CV structures towards the adult target shape of the words. Finally, the proposed template and developmental scenario allow us to account for the presence of early determiners with nominal units in child output, reflecting another typological characteristic of French input.

To conclude, we can assume that the universal early sensibility to rhythm will be reflected in production and that the shape of the early word forms produced will also be guided by this sensitivity to speech rhythm and speech timing. Accordingly, the templates are output forms that can be considered as temporary structural and typologically constrained responses to the temporal organization of speech with respect to its accentual pattern and the salient rhythmic and segmental features of the target language.

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