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The interrelation between prosodic patterns and phonemic inventory: A comparative study of challenges and learning strategies in early English language acquisition*

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Abstract This paper serves as a hands-on introduction to analysing transcribed child data by examining the interrelation between prosodic patterns and phonemic inventory in detail. The particular approach of this study combines and compares prosodic structures, templates, feature strategies, and the consonant system of four children below two years of age in order to identify production challenges and systematic learning strategies. Each child's 25-word-point and a later session around the age of 1;6 were analysed. The results concur with previous findings of English children and provide support for the assumption that the 25-word-point is a critical marker for the beginning of systematicity.

For full analyses and appendices please visit: https://cambridge.academia.edu/JuliaSchwarz.

1 Introduction

Research in *phonological development* aims to explain how children learn the sounds of their ambient language and how they structure this knowledge. These efforts date back to the 1940s, when Russian scholar and linguist Roman Jakobson published *Kindersprache, Aphasie und allgemeine Lautgesetze* (1969). As one of the leading structuralists among the Prague School, Jakobson believed in a universal order of phoneme acquisition, a concept that is still influential today. He analysed child data inductively, a method which has been improved through audio- and video-recordings in the second half of the 20th century (Vihman 2014:251).

Jakobson compares his findings from diary studies to the language of aphasics and as a result emphasizes 'contrast' in both the unfolding system of the child and adult phonology (cf. Vihman 2014:249). For instance, Jakobson draws on cross-linguistic findings in the first half of the 20th century which suggest that palatal

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sounds are always acquired after dentals (1969:60). However, he also notices the great variability of the point in time at which children master velars, which may be shortly after the dentals or they may still be absent in eight- or nine-year-old school children (1969:61). This variability still poses problems when trying to define developmental 'stages'. Jakobson's idea of universal principles in early phonological development influenced researchers from Pačesová (1968) to Wauquiers-Gravelines (2005), who tried either to support or to reject these basic principles (cf. Vihman 2014:250).

A major focus of studies within the past 40 years has been the emergence of systematicity—rather than a universal acquisition order—in early vocal productions. While some of Jakobson's phonemic sequences have been found to be relatively accurate (Ferguson & Farwell 1975), the existence of universal stages was rejected by researchers in the last decade (Menn & Vihman 2011:282). It is now known that the ambient language already affects production at the stage of babbling at 10 months (Boysson-Bardies, Halle, Sagart & Durand 1989).

In contrast to Jakobson, both Charles A. Ferguson and Carol B. Farwell (as well as Labov & Labov 1978) emphasize the connection between phonetics and phonology (Vihman 2014:175). In their paper 'Words and sounds in early language acquisition' (1975), Ferguson & Farwell point out three surprising features in early words that are still of interest (as cited in Vihman 2014:175):

1. increasing inaccuracy of words after a period of relative accuracy among the first words,
2. phonological selection for early target words,
3. high variability of child word forms.

William and Teresa Labov report the same findings in their detailed case study of their daughter (1978), and most other researchers agree with these results. While generative phonologists argue that phonology is innate (Chomsky & Halle 1991, first published 1968), Ferguson and Farwell's results suggest that 'children learn words from others, construct their own phonologies, and gradually develop phonological awareness' (1975:437). The emergence of phonology from phonetics was supported by Marilyn Vihman and Shelley Velleman, who analysed data acoustically from five children each acquiring one of three languages (2000). From their findings they conclude that

> selection on phonological ground reflects the child's unconscious matching of own patterns to input, and consequent tendency to produce (…) just those patterns that are relatively close to pre-existing babbling patterns from his or her repertoire. (Vihman & Velleman 2000, p. 334)

In their 1975 paper, Ferguson and Farwell did not yet provide an answer as to *how* children develop their own phonological system and phonetic structures. After learning how to produce sounds in general—especially during the period of babbling—children have to master the phonological rules of their language. McCune & Vihman present evidence that stable production of at least two supraglottal consonants (stops/nasals) in babbling or words for several months is vital to the beginning of referential word use (2001:680).

Although the child is thought to be somewhat restricted motorically at least during the first two years of life, phonetic prerequisites—'producing consistent vocal forms at will'—are not the only constraint, Vihman argues: besides articulatory conditions, a phonological memory has to develop (2014:36). The development of a phonological memory along with the extension of the output lexicon must be dependent on certain mechanisms or strategies. Using the term 'strategy' rather than mechanism may seem unusual at first. However, it emphasizes the active dimension of language acquisition, which includes such strategies as practice, selection, and adaptation, to name but a few.

Once the child has developed the phonetic prerequisites at least partially, word learning increases cumulatively. According to Paul Bloom, word learning is 'a certain mental representation or concept that is associated with a certain form' (2000:7). Besides maturation of memory and attention, Bloom believes that phonetic practice plays a vital role in this drastic increase. In fact, it would be difficult to argue that practice is not an important contributor since it is the most basic strategy for any form of learning. Moreover, knowledge of some words boosts learning others. Vihman gives two reasons for this effect:

> (1) Learning a few often-used content words will aid segmentation of adult input, putting function words into relief as the 'noisy bits' in between known words (Bortfeld, Morgan, Golinkoff & Rathbun 2005); (2) as has recently come to be understood, familiarity with phonotactic structure—a cumulative effect of lexical learning—supports new word learning (Storkel 2001; Edwards, Beckman & Munson 2004). (Vihman 2014:36)

Using familiarity with structures is part of a wider association strategy: infants have been found to make use of statistical learning—grouping elements together based on the likelihood of their co-occurrence—in many ways (Thiessen:35). First evidence comes from a study by Saffran, Aslin & Newport (1996), who show that 8-month-old children are able to segment words from continuous speech by using statistical cues from adjacent speech sounds.

Statistical learning can be regarded as a strongly systematic strategy. Phonological systematization is also stressed by Smith (1975), who defines four universal biases: systematic simplification, cluster reduction, consonant harmony, and grammatical simplification. David Ingram, too, mentions simplification, especially of syllable structures, in his chapter 'Phonological patterns in the speech of young children' (1979). He adds a few further structuring strategies for children found between 1;6 and 4;0, including substitution of sounds (134 ff.). Fricatives, for example, are often replaced with stops, and velar and palatal consonants are sometimes replaced with alveolar sounds. Moreover, segments within a word have often been found to be assimilated (137).

However, Ingram also stresses that each child constructs his or her own individual system (1979:145). Since Ferguson and Farwell's findings of relative accuracy in first words followed by a period of inaccuracy, interest in individual strategies has led to more findings in child data. One of the most prominent observations about systematic, yet individual development is that of 'template formation' (Macken 1995; Macken 1996; Vihman & Velleman 2000). The term template describes a production pattern that is characteristic of a specific child (Vihman 2014:176). As Vihman and William Croft define it in the abstract of their paper 'Phonological development: toward a 'radical' templatic phonology' (2007), a template results from abstracting or 'inducing' well-practiced forms that derive from both babbling (i.e. production practice) and adult words (i.e. input patterns). These forms may be selected and thus very similar to the adult word, or adapted, typically resulting in a poor match between child form and adult target and a growing level of the child's own systematicity. Frequent adaptation of a preferred structure result in an 'active template'. Features of templates may include specific word shapes, metathesis, consonant or vowel harmony, and truncation (Vihman 2014:176), among others. As a twin study by Catherine Smith shows, templates often 'do not reflect a restriction in the production of individual consonants … but of word forms' (2011). This supports a whole-word approach to phonological acquisition.

In summary, current research suggests that templates and other phonological strategies are specific to individual children and thus not always predictable or replicable. The establishment of a phonological system seems to be an individual process that—due to great variability between children and even within the same child—is still not completely understood. However, systematicity and some universal tendencies in phonological development have been found cross-linguistically. Through further investigating these structural developments, phonological rules may be formulated leading to a better understanding of language acquisition.

2 Data

There are two preferred approaches to study infants' phonological productions: either through a diary study, often conducted by linguistic researchers on their own children, or through data collections of several children, all recorded and transcribed in the same way. While a diary study is able to capture a large quantity of a child's earliest words and his or her development over time (Vihman 2014:331), a data collection has the advantage that children can be compared in a more objective way as they have been recorded in a uniform manner. The latter allows for general conclusions on phonological challenges and strategies (Vihman 2014:331) and thus has been chosen for this study.

The data for this study, provided by Professor Marilyn Vihman (University of York), derives from recordings of 59 monolingual English infants from the Yorkshire area. Recordings were made in naturalistic 30-minute-sessions in the home with a parent, collected weekly until the child had adopted two vocal motor schemes[1] (VMS) and then monthly. The sessions were transcribed individually by trained native or near-native speakers, who are associates of the University of York. Transcriptions were formed into word lists, including adult targets, which were determined by context and form, as well as any variants that the child uttered for a target. Moreover, some word forms were classified as imitated or modelled.[2]

From this sample, 16 children were classified as the most advanced learners, i.e. they reached the 25-word-point (25wp) before 18 months of age. The 25wp describes the first half-hour session in which the child spontaneously produces at least 25 distinct adult target words. Using 'word points' for comparison instead of age is preferable because children of the same age can be at different developmental stages (Vihman 2014:331). The number of mastered words from the child's output lexicon, however, can be compared to children of the same level with somewhat more reliability.

For the specific purposes of this study, four of the 16 most advanced children were chosen since a final session recorded two months after the 25wp (around 18 months) had been recorded and transcribed for them. This allows for comparison of learning strategies of apparently advanced learners at the 25wp and beyond. The infants' relatively high proficiency compared to other children of their age makes it more likely to find successful learning strategies and as such will facilitate conclusions about the interrelation of prosody and phonology in early language acquisition.

At the 25wp, signs of systematicity and in some children even templates have been found to emerge: 'Templates can generally be observed only some time after a child's first 20–50 words have been produced but before the child has achieved an expressive lexicon of as much as 200 words' (Vihman fc.:ch. 2). After this time, words become more accurate and templates fade. Through comparison with parental reports, the words produced in half-hour sessions have been found to represent about half of a child's vocabulary (Vihman & Miller 1988; Vihman fc..:ch. 2). Therefore, the 25wp of four children was considered first and then compared to the latest recorded sessions of the children, which are all around the 50–65wp and 18 months of age.

The variants for a target can be imitated (i), modelled (m), or spontaneously produced. All of these were included in the analysis although some researchers have found imitated forms to be phonetically more accurate, a sign that imitated forms may not be part of a child's independently emerging system (Ferguson & Farwell 1975:422). However, Ferguson and Farwell argue for the inclusion of imitated word forms:

> For one thing, a very high percentage of what a one-year old says is imitated, so that there is very little purely spontaneous data. Furthermore, a study of the forms collected shows that a separation of imitated from spontaneous forms, where the two can be compared, does not correspond in any straightforward way to a separation of different

[1] stably and consistently used consonants

[2] a delayed imitation, sometimes including an intervening turn

> forms of the same word. Finally, even children this young can repeat or imitate things said by adults at some distance of time – five minutes or more – despite considerable intervening speech, so that no simple definition of imitation is feasible. (Ferguson & Farwell 1975:422)

Thus excluding imitated and modelled forms would limit the data so that a reliable analysis with enough word forms would not be possible for a child at the single-word-stage. For this reason most data was included. However, onomatopoeia without a clear target form were excluded, for example *drinking noise*, *kissing noise*, *monkey noise*, as they cannot be related to a single, reliable input shape. Such onomatopoeic words, in contrast, that clearly relate to an adult target form and that are common in infant directed speech (IDS) were included, for example *miaow*, *woof woof*, *quack quack*, *moo*.

3 Method

Each data set was analysed separately, i.e. the transcriptions of a single child were considered in isolation. Both the 25wp and final session of each child are summarized in one chapter to ease the comparison and allow for conclusions on their development. Five major aspects are included in the analysis: the prosodic structures, the most common structures referred to as patterns, identified templates within these patterns, the child's developed phonology, and the variability of word forms.

The classification of prosodic structures primarily serves as a grouping method that simultaneously gives information about a word's syllable structure. The term prosodic structure in this context refers to the sequence of consonants (C) and vowels (V). This classification has been used in several studies (Waterson 1971; Vihman 2016). After identifying the prosodic shape for each variant word form, the data was analysed quantitatively with a particular focus on common prosodic patterns and adaptation. Based on Vihman's approach to 'form-to-target-matches' (Vihman fc.:ch. 2), each child word form was categorized as either 'selected' (s) or 'adapted' (a). In contrast to Vihman's approach, however, the child's actual production abilities were not taken into account at this stage, resulting in only a limited amount of accurate words being regarded as selected. A word form or variant was thus classified as selected if it was

a. easy to identify the adult target,

b. the prosodic structure was near identical to the target word

c. consonants did not differ significantly from the target, disregarding devoicing, for example.

While the classification as selected was relatively strict above the syllable level, it allowed for changes in vowel selection and minor changes below the syllable level. This method is useful as it helps to identify word forms and phonemes that do not pose major problems. Glottal stops in initial and final position were mostly ignored when classifying a word as selected. Consonant harmony, however, was counted as adapted if it did not match the target. In the closer qualitative analysis of common patterns and templates, adapted forms were further investigated as to whether the child made changes voluntarily. This means the child's actual resources were taken into account.

For the quantitative comparison of structures not individual variants were used, but so called word types. A word type comprises all variants for a single target word that have the exact same prosodic structure but different phonemes in the consonant and vowel slots (cf. Vihman fc.:ch. 2). For example, the variants [bæbai] and [bɛːbeɪ] for the target word *baby* belong to one single word type as they have the same prosodic structure <CVCVV> and the same meaning (Cara, 25wp). In contrast, the word form [mbɑːbe] for the same target counts as a separate word type as it has a different prosodic structure (<CCVCV>).

When grouping patterns together, all three variants, [bæbai], [bɛːbeɪ], and [mbɑːbe], would belong to the same disyllabic <CVCV> pattern: In order to identify common patterns in the children's data, minor structural differences were disregarded. Diphthongs were not distinguished from monophthongs when classifying patterns as they do not seem to draw a strong or good distinction for any of the children. Moreover, consonant clusters were mostly ignored when identifying common patterns.

In the next step, remarkable features such as consonant harmony or the use of a specific consonant within the most common prosodic structures were identified to reach conclusions about possible templates. A template may combine prosodic shapes and striking phonological features. For the classification of features within templates the following abbreviations were used (table 1).[3]

Table 1 Abbreviations for features within patterns and templates

feature	*abbreviation*
Plosive	P
Nasal	N
Fricative	F
Glottal stop	ʔ
Consonant harmony	C_1VC_1V
Either / or	C/C
Consonant optional	C_o

As suggested by Vihman, both overuse of a pattern as well as adaptation can serve as classification criteria for templates (2016:73). Nonetheless, template identification is difficult in so far that both selected and adapted forms can belong to a template. Therefore, the number of adapted forms alone cannot determine whether a pattern can be regarded as a template or not. At the same time, however, adapted word

[3] Some abbreviations concur with those used in Vihman fc. and other prominent papers on phonological development.

forms make a template apparent. In conclusion, the most reliable classification of a template is if

a. the child produces a significant number of types for a pattern,

b. many adapted forms occur within a pattern,

c. the pattern is special in some way compared to children of the same acquisition stage.

The percentage of word types gives a good indication as to whether a pattern might be a template or not. 25% is used as the guideline for template identification in the analysis. However, a clear distinction between preferred structures and active templates is not always possible. Furthermore, a 'templatic strategy' may be as much reduced as to a distinctive consonant in a specific position of different word forms with variable shape.

In order to capture such strategies, the child's consonants were analysed independent from patterns or templates. Not all phones that the children produced were included in the consonant charts and quantifying tables. Instead, the focus was put on identifying an emerging phonological system of the English language. Moreover, vowels were neglected as they are extremely variable and a reliable transcription of them is difficult. As a result, only 25 different consonants were analysed based on the English IPA chart printed in Roach (2010). This set compounds the consonant inventory of Standard British English, with no distinction being made between clear [l] and dark [ɫ], and including /w/ and the glottal stop /ʔ/, which is typically frequent in early vocal productions. The affricates /tʃ/ and /dʒ/ were treated as separate consonants from /ʃ/ and /ʒ/. Moreover, in contrast to aspiration, [h] in word final position was treated as a full consonant. This classification is debatable since it is problematic to transcribe aspiration reliably.

In addition to these steps, the variability of types and variants was assessed in order to reach conclusions about the degree of production stability.

4 Analysis

Comparative studies on the onset of systematicity, which most likely occurs from the 25wp onwards, are still rare. The investigation of four children—Cara, Flora, Ella, and Ivy[4]—between the 25wp and the 60^{+}wp aims to fill this gap. In addition, the approach tries to relate phonological abilities to structural strategies including template formation. Table 2 gives an overview of the four children: the age is given in the standard abbreviated form[5] (in bold face) as well as in days, and both the number of target words that were included in the analysis (in bold face) as well as the total number of targets are displayed.

4 The structure of the paper retains this ordering.

5 Years;Months.Days

Table 2 Age and number of target words considered in the analysis/recorded in total of the four children included in the study

name	*age at 25wp*		*target words*		*age at final s.*		*target words*	
	Y;M.D	*days*	*incl.*	*total*	*Y;M.D*	*days*	*incl.*	*total*
Cara	**1;5.12**	529	**24**	27	**1;6.10**	558	**63**	66
Flora	**1;4.26**	513	**36**	43	**1;6.26**	574	**46**	50
Ella	**1;4.09**	496	**33**	38	**1;6.20**	568	**57**	62
Ivy	**1;5.19**	536	**35**	35	**1;6.24**	572	**46**	50

4.1 Cara

Cara's session at the 25wp and her final recording, which will be referred to as her 60^{+}wp, were analysed and compared. Cara reaches her 25wp at 1;5.12 at which she attempts 27 adult target words. 24 of these were included in the analysis, selected by the criteria described previously. From the final recording at 1;6.10, 63 out of 66 target words were considered.

4.1.1 Prosodic structures

At the 25wp Cara produces 21 prosodic structures, which can be seen in table 3.

The number of word types is given in the second column and a single type may comprise several variants. In total, Cara utters 60 different variants. For the adult target *banana*, for example, Cara adapts the word to two disyllabic structures and produces four variants in total (table 4). Hence, she has two distinct word types for *banana* with two variants for each type.

At the 60^{+}-word-point, Cara produces a larger variety of structures (table 5). Furthermore, consonant clusters—a challenge in early vocal production and not familiar from babble—increase after the 25wp. Noticeably, the four most common prosodic structures from the earlier session, <CV> , <CVC> , <CVCV> , and <CVV> , are also among the five most frequent structures at the 60^{+}wp (cf. table 3 and 5).

In the earlier session 27 out of 60 variants (.45) were found to be selected whereas 33 out of 60 variants (.55) were adapted. A slight change of this distribution can be found at the 60^{+}wp, where .57 variants were classified as selected and .43 as adapted. Cara also shows a slight preference for open syllables in both sessions with only .36 types ending in a closed syllable at the 25wp and .35 at the 60^{+}wp.

4.1.2 Patterns

It was found that, without summarizing any structures, the four most common prosodic structures from the earlier session, <CV> , <CVC> , <CVCV> , and <CVV> , were also among the five most common structures at the 60^{+}wp. The same can be said about the patterns that have been identified at the 25wp, which extend the structures above by disregarding minor differences such as diphthongs and consonant clusters within one group. Three general shapes are particularly frequent

Table 3 Structures, types, adaptation, and variants at Cara's 25wp

prosodic structure	*n/types*	*n/selected*	*n/adapted*	*n/variants*
CVV	5	3	6	9
CV	4	4	0	4
CVC	4	7	4	11
CVCV	4	6	3	9
CVCC	3	0	4	4
CVCVV	3	3	1	4
CVVCV	2	0	4	4
CCC	1	0	1	1
CCCVV	1	0	1	1
CCV	1	1	0	1
CCVC	1	0	2	2
CCVCV	1	1	0	1
CV CVC	1	0	1	1
CVCCC	1	0	1	1
CVCCV	1	1	0	1
CVCVCVC	1	0	1	1
CVCVVCVVCCV	1	0	1	1
V VVC	1	0	1	1
VC	1	0	1	1
VCVCVCV	1	0	1	1
VVCVVV	1	1	0	1
total: 21	39	27 (.45)	33 (.55)	60

Table 4 Structures and variants for 'banana' (60⁺wp)

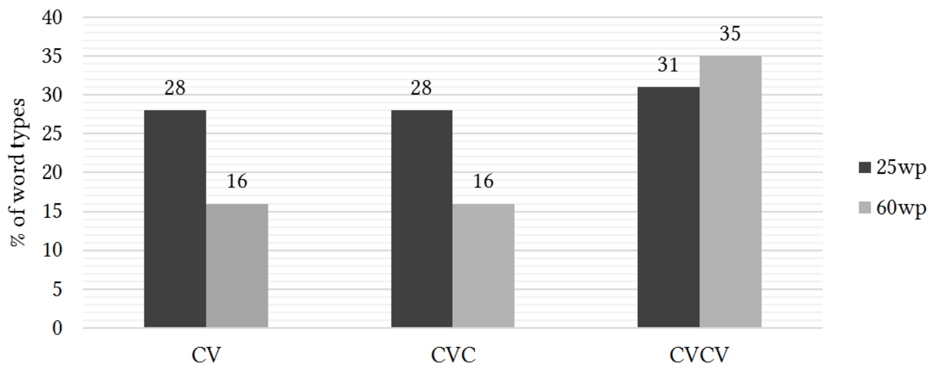
structure	*word forms*	
CVCV	mɪnːəʰ	mɛːnəʰ (x2)
CVVCV	meɪnə	meɪnɛʰ

Table 5 The five most common prosodic structures at the 60⁺wp and total numbers

prosodic structure	*types*	*selected*	*adapted*	*variants*
CVCV	15	34	12	46
CVC	9	9	2	11
CVCVV	8	14	1	15
CVV	7	7	7	14
CV	6	10	0	10
total: 67	141	130 (.57)	100 (.43)	230

among Cara's structures: open monosyllables (<CV(V)>), closed monosyllables (<CVC>), and open disyllables (<CVCV>) (figure 1).

Figure 1 Cara's most frequent patterns at 25wp and 60^{+}wp in comparison



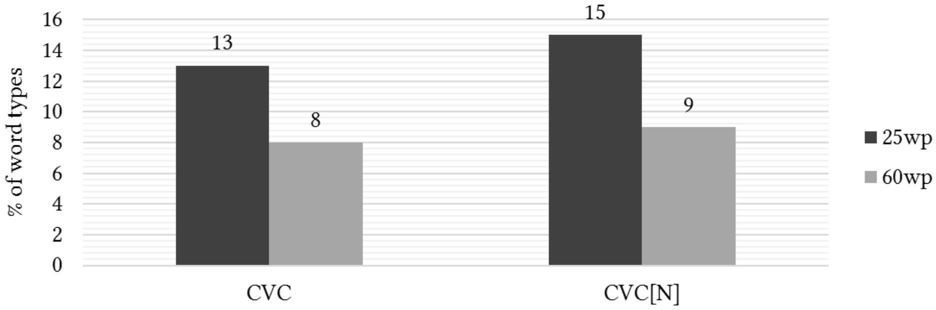
In total, these three structures account for .87 types at the 25wp. The same patterns account for .67 of all types at the 60^{+}wp. The percentage of word types drops for all patterns except for <CVCV> . However, this has to be interpreted carefully. First, Cara's number of different structures increases between the two sessions, which results in a lower percentage of targets attempted with one pattern. Secondly, the three patterns at the 60^{+}wp have been found independently, as they are nevertheless the most common patterns. Thirdly, since one single session is limited in its capacities, some variation will occur naturally.

4.1.3 Templates

As outlined earlier, a template can only be identified with certainty if it occurs in a larger number. In addition to this, adaptation and uncommon features serve as suitable indicators. Therefore, only two of Cara's three favourite patterns can be regarded as templates at this stage without seeing her further development. First, her <CVCV> pattern can be classified as a template since she attempts the highest number of target words with it (.31 at 25wp and .35 at 60wp), which suggests high familiarity. Moreover, some adapted forms can be identified. The token *there you are* already appears at the 25wp [deəwɛː] and does not change significantly until the 60^{+}wp [dɛːwɛːː]. Both are classified as adapted due to syllable reduction. The token *red* (60^{+}wp, <CVCV>) is adapted and produced as [wɛdɪ], most likely because Cara cannot produce /d/ in final position. While most open disyllables feature consonant harmony at the 25wp, differing consonants in the onset slots are more common in the later session.

Secondly, Cara's <CVC> pattern seems to be a successful active template. Fewer targets are attempted with the <CVC> pattern (.28 at 25wp and .16 at 60^{+}wp) than with the open disyllable, but 8 out of 11 word types at the 25wp are adapted and 11 out of 24 at the 60^{+}wp. More importantly, however, the pattern seems to be very specific, with more than half of the categorized variants ending in a nasal as figure 2 shows.

Figure 2 Cara's closed monosyllables with and without final nasal in comparison



Most of the words that end in a nasal also include a glottal stop and/or a supra-glottal plosive in a word final cluster. Table 6 shows the distribution of variants among the resulting <CVC$_o$ʔ$_o$P$_o$N> pattern at the 60^{+}wp.

Table 6 <CVC> with word final nasal at 60^{+}wp

final consonant(s)	*target word*	*s/a*	*variants*	
N	*snail*	a	naːɪmnnː	
PN	*grandpa*	a	mbɛdn̩ (m)	beɪdn̩
	cat	(a)	(ə)kʰaːːtn	
	water	s	wɛtn̩ː(i)	
	tidy (up) (i)	s	tɛːːdn̩ːː (haːpʰ)	
	Kate	a	keɪtn	
ʔPN	*broken (i)*	s	pʰeʔkŋ	
	cat	a	kʰaʔːtn	kʰɛʔtn (m)
	light	a	nɛʔtn	
	[Makka] Pakka	a	pʷɛʔdn̩ː	
	potty (i)	a	pʷɪʔtn̩ː	pʰəʔtn̩mː
ʔN	*blanket*	a	pʰɛʔn̩ː	

The word forms differ significantly from the targets, as none of the target words has a final cluster. It should be noted that consonant clusters in general—final and initial—are particularly frequent in Cara's transcriptions. At the 25wp, .10 of her variants have an initial cluster and .14 in her final session.

4.1.4 Phonology

Cara's consonants are compared to the Standard British consonant set outlined in the methodology section. The consonant given as table 7 shows the consonants of this set that Cara produces at the 25wp and 60⁺wp.[6] Phonemes that are not part of this set are not listed.

Table 7 Cara's consonant inventory at 25wp and 60⁺wp

p	b					t	d				k	**g**	ʔ
	m						n					ŋ	
							r						
		f	v	θ	ð	**s**	z	ʃ	ʒ				h
								tʃ	dʒ				
w										**j**			
							l						

grey: consonants produced in less than .05 of all variants in both sets
bold: consonants not produced or restricted at 25wp, but advanced at 60⁺wp

At the 25wp, Cara does not produce 11 consonants of this set in her word forms and two only once. This means that 52% of these consonants are not being produced.

Cara's phoneme inventory at the 60⁺wp is relatively similar to that of the earlier recording. As the chart shows, of all supraglottal consonants plosives and nasals pose the least problems, whereas affricates and fricatives seem to be particularly difficult. Fricatives are neither strictly avoided nor dropped. Instead, Cara substitutes them mostly with stops in initial position and nasals in final position, e.g. [daʊ] for *stone* and [dæːn̪] for *crash* (both 25wp). This replacement is also used for /l/ and /r/ although these are attempted less. Moreover, /l/ in within-word clusters is often dropped.

Fricatives are attempted slightly more often in the later session and the fricative /s/ improves remarkably from not being attempted at the 25wp to .15 variants containing the sound in the later session. Furthermore the voiced velar plosive /g/ is produced only in initial position at the 25wp (.07), but in all positions at the 60⁺wp (.13), and the production of /j/ increases from being uttered in only one variant at the 25wp to 15 words (.07) in the later session.

4.1.5 Variability

At the 25wp, most variants for a single target lexeme are similar to each other. Table 8, for example, displays Cara's variants for *car* at the 25wp. Despite attempting the word in three different prosodic structures, the phones are very similar resulting in only marginally different forms. Some onomatopoeia seem to have a somewhat greater variability (cf. variants for *miaow*, table 9).

Towards the 60⁺wp the variability of word forms for some targets increases slightly (cf. *spidey*, table 10).

Most words, however, are still similar to their target, disregarding syllable omission and minor vowel changes. Some phones are usually shared between variants, but prosodic shapes can vary significantly as table 11 demonstrates.

[6] Full tables with examples can be found in appendices I and II.

Table 8 Cara, 25wp, ‘car’

structure	*word form*	*s/a*
CCV	kxɑː	s
CV	kʰɑː (i)	s
CVCV	kʰɑːxɑ	a

Table 9 Cara, 25wp, ‘miaow’

structure	*word form*	*s/a*
CVCVV	wɪjaʊːː	s
CVV	wɛːu	a
CVV	weʊ	a
CVV	pʰeʊʰ	a
VCVCVCV	əwɛːhʊhʊ	a

Table 10 Cara, 60^{+}wp, ‘spidey’

structure	*word form*	*s/a*
CCCCVV	əʊkʰʊ pːdn̪teɪ	a
CCCVCVV	kmbædeɪ	a
CCVCVV	m̪pʰɛdeːɪ (m)	(s)
CVCVV	pʰɛːdeɪ	s
CVVCVVC	paɪdeiç (i)	s
VCCVCV	ɪmpʰaːdɪːː (m)	a

4.1.6 Discussion

The increase of Cara's target words between 1;5.12 (27 words) and 1;6.10 (66) is remarkable. Within less than one month she more than doubles the number of attempted target words within a single half-hour session. Likewise, the numbers of structures, types, and variants increase immensely (cf. tables 4 and 5).

Cara's strategy behind this remarkable achievement is the application of two patterns: <CVCV> and <CVC[N]> . These structures are the most common ones at the 60^{+}wp together with open monosyllables. While the <CVCV> template shows consonant harmony mostly of nasals and plosives at the 25wp (table 11), the combination of consonants is more flexible in the later session.

Table 11 Consonant harmony of Cara's <C$_1$VC$_1$V> pattern at the 25wp

target	*s/a*	*variants*			
baba	s	baba	bəba^{h}		
baby	s	bæbai	bɛːbeɪ		
banana	a	mɪnːə^{h}	mɛːnə^{h}	meɪnə	meɪnɛ^{h}
car	a	k^{h}ɑːxɑ			
mama	s	məːma^{h}	mæmæː	mɛmə	mɛmːɛ^{h}
there you are	a	(deəwɛː)	deʊp^{h}ə̥	(dɪːwaʊ)	

Through this template and the open and closed monosyllables <CVVo> and <CVC> Cara extends most of her vocabulary. This also explains the increase in adapted words and higher variability at the 60^{+}wp as Cara is trying to match the high volume of new target words with her well-practiced patterns. Because of her active templates, Cara does not have to increase her consonant production range in order to attempt new and phonetically challenging words. Word combinations, for example, are reduced to fit into her templates (e.g. *there you are*, table 11). Furthermore, she has the chance to practice more complicated word shapes such as disyllables and longer words as well as forms including consonant clusters.

4.2 Flora

From Flora's 25wp at 1;4.26, 36 target words from a total of 43 targets were included in the analysis, suggesting a significant increase from the session before when Flora produced less than 25 words. Her final session was recorded exactly two months later, within which she attempted 50 targets. 46 target words were included in the analysis.

4.2.1 Prosodic structures

33 different prosodic structures are identified at the 25wp, 80 different types, and 138 variants (table 12).The majority of Flora's words are clearly selected (.72), whereas less than a third are classified as adapted to some extent.

This does not change significantly in the final session with .68 words being selected and .32 adapted. Likewise, the number of different prosodic structures as

Table 12 Prosodic structures at 25wp

prosodic structure	*types*	*selected*	*adapted*	*variants*
33	80	100 (.72)	38 (.28)	138

well as production types do not increase considerably (table 13). However, Flora produces 207 variants in the final session, 69 more than at the 25wp. This high number is surprising since the increase of target words is low.

Table 13 Prosodic structures at 50wp

prosodic structure	*types*	*selected*	*adapted*	*variants*
35	91	140 (.68)	67 (.32)	207

The most significant change can be seen in the ratio of open and closed syllables. While only .35 word types are closed syllables at the 25wp, this increases to .56 types in the final session. Moreover, Flora's vowel onset is somewhat restricted, with .14 word types beginning with a vowel at the 25wp and only .08 types at the 50wp.

4.2.2 Patterns

In both sessions, Flora produces only a few consonant clusters with differing consonants, but a variety of double consonants and diphthongs. Again, both of these are considered minor distinctions and thus disregarded when grouping together the most common prosodic patterns.

The most common structural patterns that can be identified within the 25wp are based on the most common prosodic structures: open and closed monosyllables, based on a <CV> shape and <CVC> shape, and open and closed disyllables, based on <CVCV> and <CVCVC> .

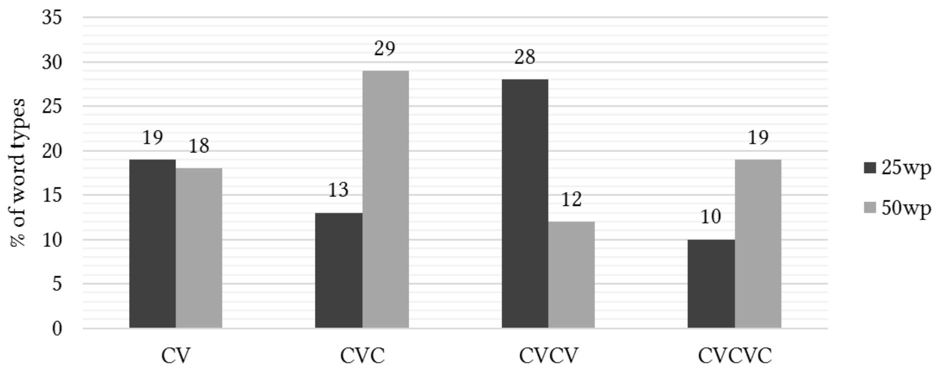
These four patterns account for .69 types. Some target words do not show a stable prosodic pattern yet; for example, the target word *yeah* from Flora's 25wp is attempted with all four patterns (table 14). Nevertheless, they are relatively similar in phonemic selection and prosodic sequences.

Table 14 Variants for 'yeah' at 25wp

patterns	*variants*				
CVC	jɛh (x2)	jʌh (x2)	jʌˑh	hjɛh	njəh
	jɛʌh				
CV	jʌː(h)	jə	jʌˑ	jɑː	jɛː (i)
	jɛː	ja (i)	hjɛ(h)(i)	djɛː	hjɛ
	ʔnɛ	jɛːʌ(i)	jɛə		
CVCV	ʔɪjʌː	ʔɔʔjɛ			
CVCVC	jʌːʔʌh				
VC_oV	ɪjɛː	ɪə			

The four structures identified at the 25wp are also the most common structures in the final session. In the final session the derived patterns include .78 of all word types, a strong indicator for the growing importance of these patterns. Figure 3 gives the percentage of word types attempted with each of the four most common patterns.

Figure 3 Flora's most frequent patterns at the 25wp and 50wp in comparison

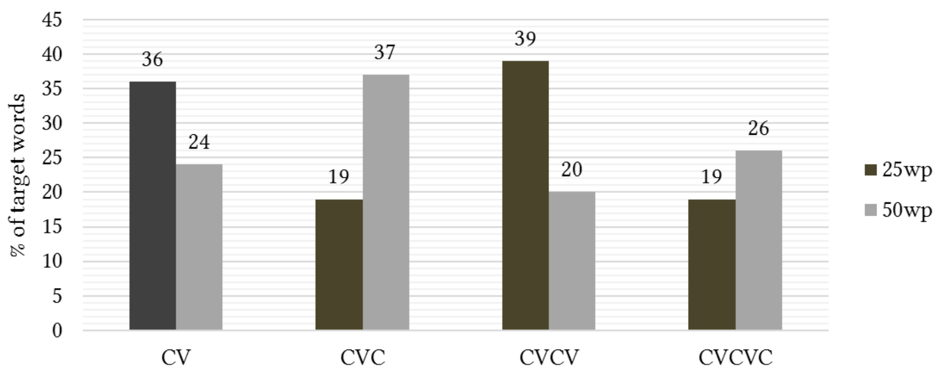


The two patterns with closed syllables increase in number between the 25wp and the 50wp. In contrast to these, the patterns with open syllables decrease. However, the percentage of word types attempted with open monosyllables does not decrease significantly from the 25wp (.19) to the final session (.18). Open disyllables decrease the most.

4.2.3 Templates

Despite this regression of open disyllables, <CVCV> seems to be a very important pattern at the 25wp. Figure 4 shows that the highest number of different target words is attempted with words that have a <CVCV> structure, independent from whether the produced pattern matches the target or not.

Figure 4 Flora's percentage of target words attempted with four patterns



This suggests that the <CVCV> pattern may be Flora's first template. The template can be specified even further: it was found that most variants in both sessions show consonant harmony, creating a $<C_1VC_1V>$ template. In some cases this leads to only minor changes of the target word forms, e.g. *teddy* produced as [dɑːdɪː]. Mostly, however, it represents an oversimplification or adaptation of a more complex token (table 15).

Table 15 Examples for oversimplification and adaptation of complex target words to a $<C_1VC_1V>$ template

word point	*target*	*a/s*	*variants*	
25wp:	*Thank you*	a	t^{h}ɪtʊː	tətəʊ
	quack quack	a	bɛɹɛ	bawə (i)
	woof woof	s	wʌʔwʌ	
	sit down (i)	a	t^{h}itaʊ	
	night night (i)	a	nənaːɪ	
	Martha (i)	s	wəɸʌː	
final:	*peek-a-boo*	a	bɪxbɔ	pik^{h}poː (i)

While the majority of these adaptations are still recognizable as belonging to their target word, Flora also begins to adapt words more strongly to her disyllabic template at the 50wp. Table 16 displays two 'animals' that Flora attempts to produce with harmonizing consonants. While Flora's word form for *lion* is strongly adapted, her production of *monkey* is highly accurate.

Table 16 Adaptation and selection of two animals to $<C_1VC_1V>$ at 50wp

target word	*s/a*	*word form*
lion	a	jæːjəʊː
monkey	s	məŋkɪ

It remains a surprising fact that the $<C_1VC_1V>$ template decreases between the 25wp and the final session despite a high number of adapted words and consonant harmony in both sessions. A possible explanation would be that Flora has mastered open syllables before the 50wp and is now attempting more challenging patterns, i.e. closed syllables.

The closed monosyllable shows the highest increase (see figures 3 and 4) and as such adopts a templatic position within the production patterns of the 50wp. Some of the consonants show harmony, but this is probably related to consonant harmony in the target words and not as significant as in the $<C_1VC_1V>$ template. Adapted word forms are mostly altered due to phonemic challenges such as word initial clusters. The initial cluster of *snake* for example is reduced and results in the word forms [tæik^h] and [næɪk]. This form of adaptation is most likely due to production difficulties and thus cannot be regarded as 'real' or conscious adaptation to a template.

Application of the closed disyllable also increases, but does not reach the .25 word type mark. Similar to the open $<C_1VC_1V>$ pattern, the closed disyllable also shows a strong tendency towards consonant harmony, resulting in the pattern $<C_1VC_1VC_2>$. Table 17 displays examples for harmonizing consonants in the first two onset slots.

Table 17 Examples for Flora's $<C_1VC_1VC_2>$ pattern at 50wp

target word	*s/a*	*word form*
(put the) bib on	s	(bɪdɪ)bɪbən
cuddles	a	tʰədəs
lion	a	jæjən
off	s	ʔʊːʔɔːɸ
rabbit	a	bæbɪtʰ

4.2.4 Phonology

Flora's phonemic inventory at the 50wp is similarly restricted as at the 25wp. At the 25wp, eleven phonemes are not produced or are produced less than three times. Overall, velar plosives, /r/, affricates, and most fricatives except for /h/ are strongly restricted at the 25wp (table 18).

Table 18 Flora's consonant inventory at 25wp and 50wp

p	b					t	d				k	g	ʔ
	m						n					**ŋ**	
							r						
		f	v	θ	ð	**s**	z	(ʃ)	ʒ				h
								tʃ	dʒ				
w										j			
							l						

grey: consonants produced in less than 3 of all variants in both sets
(brackets): very small number of variants including this consonant
bold: consonant not produced or restricted at 25wp, but advanced at 50wp

Consonant production in initial and final position seems to be more difficult than word internal production since all the sounds that Flora can produce at the 25wp occur at least within the word, but not always in initial or final position. However, there is some advance from the 25wp to the 50wp. The biggest advance without doubt is Flora's production range of consonants in final position. At the 25wp, Flora mostly produces fricatives and glottals (/h/; /ʔ/; /x/; /ç /; /s/) in word final position except within one imitated and one selected word (table 19).

At the 50wp, in addition to fricatives, Flora produces more nasals and stops (/p/; /t/; /k/; /ʔ/). In general, the production of /s/, /f/, and /ŋ/, which are more restricted at the 25wp, increases.

Table 19 Flora’s variants with final consonants at 25wp

target word	*variants*					
yeah	hjɛh	njəh	jʌh	jʌˑh	jɛh	jʌːʔʌh jɛʌh
look	lɔʔlɔʔ	ʔalɔʔkx				
baby	pʰɪbɛːh	pʰipɛʔɛh	pʰɪpeɪç	pɪbɛːɪh	pʰipɛɪs	pɪpɛɪç
beepbeep	pipɪpʰ (s)					
daddy	tatix					
teddy	dadiç					
quackquack	bɛɹəʔ	wawaʔ	aβaʔ			
ball	pa:l (i)					

4.2.5 Variability

In both sessions, most of Flora’s words are selected and even most adapted forms are still clearly referable to their target. This results in relatively accurate word forms. Flora’s <CVCVC> pattern, however, has many adapted forms and seems to be somewhat more experimental. Moreover, both selected and adapted words show consonant harmony.

For a range of target words many similar variants are produced. The general sound inventory for a target shows higher consistency than prosodic shape. Although all variants for Flora’s target *baby* at the 25wp are disyllabic, the exact structure varies (table 20).

Table 20 All prosodic shapes and some variants for ‘baby’ at 25wp

structure	*s/a*	*variants*		
CCCVCVV	a	ʔmpʰɪpɛi(ç)		
CVCV	s	pɪbi (i)	pʰɛːpʰɪ (i)	
CVCVC	s	pʰɪbɛːh (i)		
CVCVCVC	a	pʰipɛʔɛh		
CVCVV	s	bɪbɛi (x2)	pibɛi (x3)	bɛbæi
CVCVVC	a	pʰɪpeɪç	pɪbɛːɪh	pʰipɛɪs
CVCVVV	s	pɪpɪɛi		
CVVCVV	s	pɛɪpæɪ		
CVCVV	a	(ɔpɪɸ)pʰɪpɛɪ		

The prosodic structures for Flora’s variants of the token *keys* at the 50wp are even more variable. When trying to say *keys*, Flora replaces the initial consonant /k/, which she does not produce in initial position at the 50wp and in only two variants for the same target (*tickle tickle tickle*) at the 25wp. While all the variants for *keys* end in [i] + F, the initial consonant is replaced by different sounds and combinations (table 21).

Furthermore, word forms for the same targets do not change significantly across the 25wp and final session. While some other children change the forms that they

Table 21 Prosodic structures and variants for ‘keys’ (all adapted; 50wp)

structure	*word form*	
C(C)VC	tsiç	(i)
CCVC	nt^{h}is	(i)
CVC	(ç i)t^{h}iç	
CVCVC	mətiʃ	(m)
VCVC	ɪt^{h}is	(i)

produce for a target over the time, the word forms that Flora produces are relatively stable over different phases and word points, but they become slightly more accurate (table 22).

Table 22 Variants with open monosyllables of the same target words

target word	*examples from 25wp*	*examples from 50wp*
yeah	jɛə	jʌː
ball	pɔ	boː
there	t^{h}ɛ(h)	dɛ
ooh	ʔəʊ	ʔɔ
no	ndæʊ	nəʊ

4.2.6 Discussion

Flora’s data indicates limited progress in the two months between the 25wp and the final recording. Only 10 more target words are included in the analysis of the last session and the number of different structures and word types also do not rise considerably.

Remarkable, however, is Flora’s high level of accuracy in both sessions as roughly .7 of her variants are selected. Adaptations are moderate and reflect systematic oversimplifications of complex target words and word combinations. Flora’s choice of word patterns can be regarded as systematic, too. The four patterns <CV> , <CVC> , <CVCV> , and <CVCVC> cover nearly .8 of her word types in the final session. As such Flora slowly extends her vocabulary through familiar and well-practiced word shapes, i.e. she selects words that match her templates and phonemic abilities.

According to the growing challenges in word shape, Flora uses different stable patterns and templates. Open syllables (.65) and particularly her <C_1VC_1V> template (.28 types) are the most important structures at the 25wp. However, the number of closed syllables increases in the final session (.56), and so do the patterns <CVC> and <$C_1VC_1VC_2$> . This seems to reflect not only advances in prosodic production, but also phoneme production in final position. Although fricatives and approximants are still not well established at the 50wp, Flora makes gradual progress by slowly extending familiar patterns and the position of mastered consonants.

4.3 Ella

At 1;4.09, Ella attempts 38 different target words of which 33 fulfil the criteria for a reliable analysis. From her final session at 1;6.20, 57 from 62 targets were chosen.

4.3.1 Prosodic structures

At the 25wp, Ella attempts 33 target words with 124 different variants, which can be grouped together into 44 prosodic structures and 89 types (table 23). Only 40 variants are classified as selected (.32), whereas 84 variants are adapted (.68). Open and closed syllables are fairly evenly distributed with .42 types ending in an open syllable and .58 types in a closed syllable.

Table 23 Prosodic structures at 25wp

prosodic structure	*types*	*selected*	*adapted*	*variants*
44	89	40 (.32)	84 (.68)	124

In Ella's final recorded session the proportional distribution of open and closed syllables changes significantly with only .19 types and .16 of all variants ending in an open syllable. At the 60^{+}wp, Ella produces 147 identifiable variants for these target words, 61 different structures, and 115 word types. In contrast to the 25wp, the number of selected and adapted words is equally distributed (table 24).

Table 24 Prosodic structures at 60^{+}wp

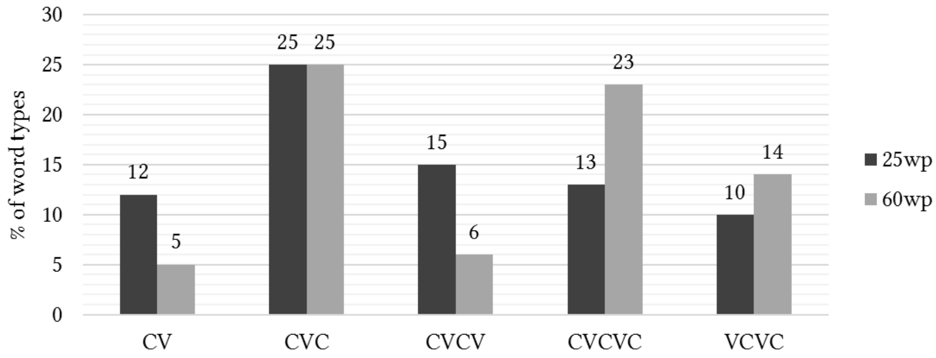
prosodic structure	*types*	*selected*	*adapted*	*variants*
61	115	75 (.51)	72 (.49)	147

4.3.2 Patterns

Most of the structures that Ella produces at the 25wp occur in relatively small numbers. From the ungrouped prosodic structures, <CVC> , <CVVC> , and <CVCV> are the most common structures with each accounting for 5 word types (.06). If being grouped into larger patterns disregarding minor differences, <CVC> displays the strongest production pattern, with .25 types and .42 targets being attempted. Four more patterns are included in the analysis despite a relatively low representation at the 25wp: <CV> , <CVCV> , <CVCVC> (mostly ending in a fricative), and <VCVC> . Together they account for .75 of all word types.

The same patterns were found in the final session, accounting for .73 of the word types. The distribution of these patterns, however, changes. Figure 5 shows the percentage of word types attempted with each pattern.

Figure 5 Ella’s most frequent patterns at the 25wp and 60⁺wp in comparison



At the 60^{+}wp, the importance of closed syllables within the five patterns seems to increase as <CVC> and <CVCVC> account for the most word types (.25 and .23) and the most attempted target words (.35 and .37). In contrast, the number of patterns with open syllables decreases, which corresponds with the sinking numbers of open syllables overall. <VCVC> is the smallest pattern in number at the 25wp, but the third strongest pattern at the 60^{+}wp (.14 types).

4.3.3 Templates

Ella’s <CVC> pattern, her most prevalent pattern in the study, is built with a range of different stops, nasals, and fricatives, especially at the 60^{+}wp. Due to the high number of word forms produced with this pattern in both sessions (.25) it is likely to serve as the first template with a closed syllable, a challenge reported for many children.

The choice of final consonants within Ella’s closed disyllables, in contrast, is remarkably restricted. Ella’s closed disyllables almost reach the .25 criterion for template identification at the 60^{+}wp. Most of her disyllables are adapted to a <CVCVC> pattern that ends in a fricative (including fricatives not part of the target language) or a glottal stop. Only very few selected words end more accurately in a nasal or plosive. This tendency towards fricatives and glottal stops in final position can already be observed at the 25wp and becomes even more apparent at the 60^{+}wp. Table 25 gives 10 examples for disyllables with fricatives or glottal stop in word final position at the 60^{+}wp.

The overall increase of closed syllables may also account for the increase of Ella’s <VCVC> pattern, which shows no sufficient indication for being a ‘real’ template.

4.3.4 Phonology

Ella’s phonemic production is comparatively advanced, but somewhat restricted in word initial and final position. Both at the 25wp and the 60^{+}wp, seven consonants are produced only once or less in an identified word. Only few—mostly voiceless—consonants are well established in all positions at the 25wp, including /p/; /k/; /f/;

Table 25 Examples from Ella's <CVCV[F/ʔ]> template at 60⁺wp

structure	*target word*	*s/a*	*variants*		
CVCVC	*birdies*	s	bʷaːdiz		
CVCVC	*daddy*	a	tadiç		
CVCVC	*draw*	a	tərɔʔ	dəʷɔʷin (i)	
CVCVC	*HaaHoos*	s	haːhuz		
CVCVC	*in there*	a	gunæʔ		
CVCVC	*jammies*	a	damiç		
CVCVC	*key*	a	kəjiç	kəɬiç	kəjɪʃ
CVCVC	*more*	a	mɑʔʷiç		
CVCVC	*mummy's*	s	mʊmis	mʊmiʃ	mamiʃ
CVCVC	*purse*	a	pəʔɪs		

/s/; /ʃ/; /j/; /ʔ/ and to some degree nasals. This suggests that voicing is the biggest challenge of motoric control for this child.

Production difficulties in both sessions particularly include final voicing of plosives, the alveolar trill, and the production of some fricatives (table 26).

Table 26 Ella's consonant inventory at 25wp and 60⁺wp

p	b					t	d				k	**g**	ʔ
	m						n					ŋ	
							r						
		(f)	v	θ	ð	s	**z**	ʃ	ʒ				h
								tʃ	dʒ				
w										j			
							l						

grey: consonants produced in less than .05 of all variants
(brackets): not produced at 60⁺wp
bold: low number at 25wp, but advanced at 60⁺wp

Despite still having some difficulty with final voicing at the 60⁺wp, Ella's tendency for devoicing decreases. Furthermore, the number of plosives and nasals increases significantly. Surprisingly, the voiceless labiodental fricative is not produced in the final session and no reason for this regression was found. However, Ella makes frequent use of the fricatives that she has mastered in both sessions as well as some fricatives that are not part of the English target inventory, especially /ç /.

The most remarkable finding in Ella's phonology is the fact that her production range of final consonants does not increase. Although closed syllables increase from the 25wp to the 60⁺wp, the production of final consonants hardly changes (table 27).

Table 27 Ella's word final consonants stably produced at both 25wp and 60^{+}wp

p		t		k	ʔ
m		n		ŋ	
		s z	ʃ		
		l			

/m/: not in final position at 25wp, but three variants at 60^{+}wp

4.3.5 Variability

While most of Ella's variants for one target are similar to each other and to the target itself, some variants are strongly adapted and variable in themselves, e.g. her word forms for *plate* (table 28).

Table 28 Variants for 'plate' at 25wp; all adapted

structure	*target word*	*s/a*	*variants*		
CVCVC	*birdies*	s	b^{w}aːdiz		
CVCVC	*daddy*	a	tadiç		
CVCVC	*draw*	a	tərɔʔ	də^{w}ɔ^{w}in (i)	
CVCVC	*HaaHoos*	s	haːhuz		
CVCVC	*in there*	a	gunæʔ		
CVCVC	*jammies*	a	damiç		
CVCVC	*key*	a	kəjiç	kəɬiç	kəjɪʃ
CVCVC	*more*	a	mɑʔ^{w}iç		
CVCVC	*mummy's*	s	mʊmis	mʊmiʃ	mamiʃ
CVCVC	*purse*	a	pəʔɪs		

This creates a distinction between words that are stable due to high familiarity and words with high variability among less familiar and potentially more difficult target words. At the 60^{+}wp, Ella attempts even more difficult target words and word combinations, for example character names from a popular kid's series (*Upsy Daisy*, *Tombliboos*, *Makka Pakka*). These targets tend to be longer and do not fit directly into one of the patterns. As a result, many different variants for these tokens are produced, of which some are strongly adapted.

Four target words are attempted in both sessions: *bed*, *bye (bye)*, *Michelle*, and *mummy('s)*. The word forms attempted for these early words remain stable across the 25wp and 60^{+}wp (cf. table 29, variants for *bed*).

Table 29 Ella's variants for 'bed' at 25wp and 60^{+}wp

25wp:	bɛt' (i)	mɛʔtʰ	bɛt'eʰ (m)	bɛʷɪ(i)
60wp:	bəʔt'	m̩mɛt		

4.3.6 Discussion

Ella reaches the 25wp early at 1;4.09. Up to the 60^{+}wp at 1;6.20, the number of prosodic structures, word types, and variants increase moderately. While the number of open syllables decreases from .42 to .19, the number of selected words increases from .32 to .51. This indicates that Ella's words become more accurate between the 25wp and the 60^{+}wp.

As can be seen from the analysis, Ella produces a range of different consonants regarding place and manner of articulation. Therefore, no extensive use of consonant harmony except if it matches the target can be found in the data. Voicing, however, especially final voicing at the 25wp, is a challenge for her. Ella's increase in closed syllables at the 60^{+}wp demonstrates the attempt of challenging structures despite or even because of this restriction. While she has a strong disyllabic template that ends in a fricative or glottal stop (<CVCV[fric/ʔ]), her <CVC> pattern includes a larger variety of consonants in final position in both sessions. At the 60^{+}wp, the advance of final consonants and some improvement of final voicing are clearly visible, as table 30 demonstrates.

Table 30 Examples from Ella's <CVC> template at 60^{+}wp demonstrating the range of consonants in final position

gloss	*s/a*	*variants*		
bag	a	ndaːks	m̩mɛt	
bag	s	bag(kx)	baːgx	bəʔt'
chips	s	ʃiːːps		
clothes	a	ləʊs		
flowers	(a)	glaʊʷɪz	glaʉʷɪz	
in there	a	n̩nɛʔ		
key	s	kix (i)	tʃiz (m)	
key	a	kəːiç	kəːiʃ (i)	keɪːɪç
lock	a	l̩lɑk'	n̩nɔk	
lock	s	lɔk'		
Michelle	a	ʃəʊŋ	ʃəʊʔ (*2)	ʃəʊʔp
more	a	mɑŋ	maɦ	
next	s	nɛʔtʃs		

Nevertheless, Ella's phonemic progression is minimal compared to her progression of word shapes and number of attempted targets. This is partially due to the fact that she already produces a wide range of consonants including fricatives at the 25wp. Within her vocal abilities, Ella slowly develops higher accuracy making use of stable structures with closed syllables. Only occasionally, difficult—and probably newly attempted—words are more strongly adapted in the later session although some of her attempts of TV characters are surprisingly advanced, e.g. [mʷɛkɪbɛnkiç] for *Makka Pakka*.

4.4 Ivy

From Ivy's 25wp at 1;5.19, all 35 target words that she attempts are included in the analysis. With 46 included target words out of 50, her last recorded session is thought to be around the 50wp. 10 of the target words are attempted in both sessions.

4.4.1 Prosodic structures

In the 25-word-session Ivy produces a large variety of structures, among which the disyllables <CVCV> and <CVCVC> are the most frequent structures without grouping together any patterns at this point (table 31). 45 structures and 80 types were identified. Only 18 from the overall 93 variants were classified as selected (.19), resulting in over 80% of the words being adapted to a target lexeme.

Table 31 Prosodic structures at 25wp

prosodic structure	*types*	*selected*	*adapted*	*variants*
CVCV	6	7	3	10
CVCVC	6	0	9	9
total: 45	80	18 (.19)	75 (.81)	93

More than a third of Ivy's word types (.38) and variants (.34) begin with a vowel. This is a considerably high number seeing that none of her target words begins with a vowel. Moreover, she produces more open (.59 types) than closed syllables (.41 types).

At the 50wp, the number of adapted words sinks to .57. Among the 51 different prosodic structures, <CVCVC> , <CVCV> , and <CVC> are the most commonly produced ones (table 32). Despite an increase in target words, both the number of types (79) and the number of variants (91) are almost identical with those of the earlier session.

Table 32 Prosodic structures at 50wp

prosodic structure	*types*	*selected*	*adapted*	*variants*
CVCVC	7	0	8	8
CVC	5	3	4	7
CVCV	5	4	3	7
total: 51	79	39 (.43)	52 (.57)	91

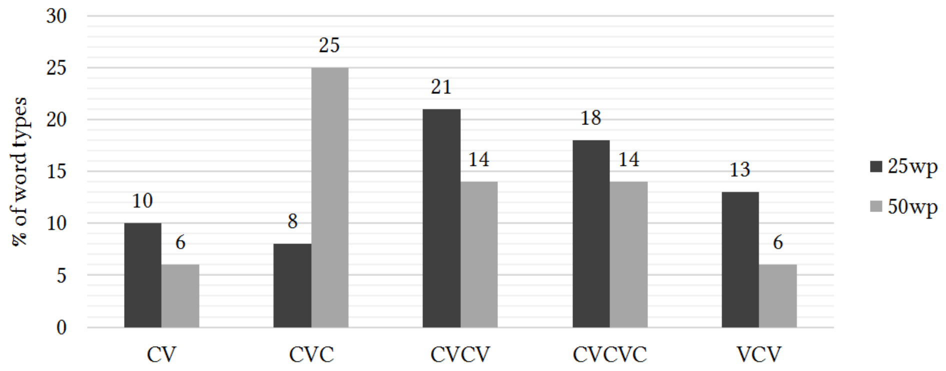
The number of types and variants beginning with a vowel remain high (.3 and .32). In this session, however, Ivy produces fewer open syllables (.43 types) than in the last.

4.4.2 *Patterns*

Corresponding with the two most common individual structures, Ivy's two most common patterns at the 25wp are based on the disyllables <CVCV> (.21 types) and <CVCVC> (.18 types). Three monosyllables also show some frequency: <CV> accounts for .1 types, <CVC> for .08 types, and <VCV> for .13 types. Overall these five patterns enclose .7 of all prosodic structures.

This distribution of structures and patterns changes at the 50wp. In the final recording, most of Ivy's word forms are based on a <CVC> pattern (.25 types). Apart from this major change, disyllables remain more frequently produced patterns than the monosyllables <CV> and <VCV> as figure 6 illustrates.

Figure 6 Ivy's most frequent patterns at 25wp and 50wp in comparison



4.4.3 *Templates*

Ivy's CVC pattern has a strong tendency for the last consonant to be a fricative or nasal. Due to the high increase of the <CVC> pattern and its further specification as <CV[F/N]> with only three exceptions at the 50wp, this pattern appears to be a strong developing template. As table 33 illustrates most of the final fricatives are not part of the phonological target system.

No other pattern reaches the .25 word type criterion. However, words with the <CVCVC> structure mostly end in fricatives and glottals and few nasals at the 25wp. Only 3 out of 11 types do not end in a fricative or nasal at the 50wp. This means the word ending of the closed monosyllable applies to the closed disyllable. Since it is difficult to differentiate between restrictions in production and template adaptation, it is not clear whether <CVC> and <CVCVC> are two distinct templates, one single template, or whether the restriction of final consonants rather reflects production difficulties.

When looking more closely at Ivy's <CVCV> pattern, which almost reaches the .25 mark at the 25wp, two templatic structures can be identified: Ivy either makes use of consonant harmony (<C_1VC_1V>) or inserts a medial /j/ for the second consonant (<CV[j]V>) (table 34).

Table 33 CV[F/N] template at 50wp (exceptions in grey)

structure	*target*	*s/a*	*variants*			
CVC	*cake*	a	dʊk̚			
CVC	*one*	a/s	ɹʊːn	wʰʊn	wʌn	ʔwʊn (i)
CVC	*again (i)*	a	dɛn	deɪnʔ		
CVC	*tower (i)*	a	gam			
CVC	*clock (i)*	s	ʃɔk̚			
CCCVVC	*name (i)*	a	n̩njeɪm			
CCVC	*book (i)*	s	m̩buɸ			
CCVC	*name (i)*	a	n̩jam			
CCVVC	*no*	(a)	ŋnəʊːɸ			
CVCC	*wolf*	(a)	ɹʊfɸ			
CVCC	*bang*	s	vaʔŋ			
CVCC(C)	*boats*	s	buʔts	mbəʊɬ (m)		
CVCCC	*dog*	s	dɑgkx			
CVCCCC	*bird*	s	bɛʔdtç			
CVVC	*line (i)*	s	jaɪːn			
CVVVC	*story (i)*	a	dəʊʷiç			
CVVVC(C)	*house*	a	haʊʷʊts			

Table 34 Ivy's variants with open disyllables at 25wp and their underlying templatic strategies

structure	*target*	*s/a*	*word forms*			*template*
CVCV	*baby*	s	bɛbiː (*3)	biβiⁿ	dabiːː (i)	c-harmony
CVCV	*mummy*	s	mɛmi (*2)	mæmiⁿ		c-harmony
CVCV	*zebra*	(a)	wɛbəʰ			c-harmony
CVCCV	*daddy*	s	dætdiⁿ			c-harmony
CVCCV	*Jessica*	a	ʃisʃæʰ			c-harmony
CVCCVV	*row row*	(a)	waːʔwəʊː			c-harmony
CVVCCV	*tractor*	a	daɪʔtɛʰ			c-harmony
CVVCV	*row row*	a	waːəroːː (i)			c-harmony
CVCVV	*jumpy*	a	ʊvɔɪⁿ			(c-harmony)
CVCV	*door*	a	d'ijɔːː			medial /j/
CVCV	*snake*	a	ʃi;jæʰ			medial /j/
CVCV	*yeah*	s	hijɛʰ	hijəːʰ		medial /j/
CVCVV	*miaow*	s	hijaʊːː (*2)			medial /j/
CVCVV	*yeah*	s	hijəːʌ(i)			medial /j/
CVVCV	*snake*	a	ʃeɪːjɛʰ			medial /j/
CVCVV	*yay!*	s	jəʔaɪː			initial /j/
CVCCV	*lion*	a	jɑʔwi (*2)			initial /j/

The effective <CV[j]V> pattern from the 25wp also appears at the 50wp and the palatal pattern is even extended to other word structures. Ivy's medial /j/ feature appears in a variety of structures (appendix). At the 25wp, 28 out of 93 variants (.3) contain a word-mid /j/ of which 22 are adapted. In the final session, 27 out of 91 variants (.29) feature a medial /j/ with 19 variants being adapted. Almost all adapted forms and part of the selected words are disyllabic or longer. This suggests that the attempt of longer words, which is more difficult, is supported by palatalization of the medial consonant. In fact, the word shape itself seems to play a minor role for this child while specific sound positions, like the final fricatives and nasals, provide some assistance with difficult targets.

4.4.4 Phonology

Ivy produces seven consonants frequently in both sessions ($x \geq 10$ instances). These are the same consonants for the 25wp and the 50wp. In addition to these, /ʃ/ is highly frequent in the earlier session, and /n/ in the latter (table 35).

Table 35 Ivy's consonant inventory at 25wp and 50wp

p	**b**					t	**d**				k	g	ʔ
	m						**(n)**					ŋ	
							r						
		f	v	θ	ð	s	z	(ʃ)	ʒ				**h**
								tʃ	dʒ				
w										**j**			
							l						

bold: frequently produced consonants

While voicing does not seem to be a major production problem in itself, word initial and final consonants are largely restricted in both sessions. Except for one word ending in a dark [ɫ], Ivy produces only fricatives, glottals, and nasals in word final position at the 25wp. This accumulates to 10 distinct consonants in 37 variants. Table 36 gives one example for each final consonant.

Ivy's range of final consonants as well as her consonant inventory in general does not develop significantly, i.e. more than one month after the 25wp both phonemic inventory and distribution across the target phonemes remain largely the same. However, she attempts three new consonants (/k/; /g/; /f/) in a small number of variants and overall increases her production range of plosives and nasals. Moreover, the range of initial consonants extends.

4.4.5 Variability

Ivy's word production at the 25wp is largely inaccurate and unstable. In many cases one target is attempted with several different prosodic shapes (e.g. *jumpy*). Some also vary significantly in their phonemic material (e.g. *What's that?*, table 37).

Table 36 Examples of closed syllables at the 25wp

manner/place of final consonant	*gloss*	*word form*	*total number*
fricatives	*monkey*	mm̩iç	21
	woof	w^{h}əʔɸ(i)	
	jumpy	ʃɔpʃɪʃ(i)	
	elephant	ijuːʂ	
glottal fricative	*door*	dəʊʔoɦ	3
glottal stop	*What's that?*	wʊtsjɪhaʔ	5
nasals	*bee*	biːːjuːm̩ːːːː	7
	mummy	mɑmin	
	miaow	ijaʊːːŋ	
lateral	*camel*	hibɑbʊɫ	1

Table 37 Examples for adapted word forms at 25wp

'jumpy'

structure	*word form*
CVCCVC	ʃɔpʃɪʃ (i)
CVCCVVCVCV	ʃɑʔʃaːɪʃijə (i)
CVCVC	ʃɑpiç (i)
CVCVV	ʒʊvɔɪ^{n}

'What's that?'

structure	*word form*
CVCC(C)VCVC	wʊtsjɪhaʔ
CVCCVC	hizjæʔ (i)
CVCVCCVC	wʊʃiç raːːʔ (m)
CVVCCVC	hɔɪʔzæʔ
VCCVCCV	ɒʔwʊʃjæ^{h} (m)

Although the overall number of adapted words sinks to .57 at the 50wp, many words are strongly adapted. Ivy attempts difficult words and word combinations and produces many word forms for them, e.g. *What's that* and *Little Red Riding Hood.*

While most of the word forms such as Ivy's variants for *teddy* become more accurate or remain comparatively stable across the 25wp and 50wp, the high-frequency infant word *mummy* is strongly adapted in the latter session (table 38).

4.4.6 Discussion

Ivy's increase in attempted words within one month between the analysed sessions is relatively small. Likewise, the number of structures, types, and variants also see very little change. The number of open and closed syllables is evenly distributed in both sessions.

Table 38 Variants for ‘teddy’ and ‘mummy’ at 25wp and 50wp

‘teddy’

25wp	*50wp*
hɪdiç	dɛʔdi
dɛdiç	dɛʔdi
	dɛdi (dɔ)
	dɛdi (dɔ)

‘mummy’

25wp	*50wp*
mɛmi	nɛniç
mæmi^{n}	hʊβavi
mɑmin	
mamiç	
mɛmin	

Despite this surprising invariance, Ivy’s production patterns change remarkably. At the 25wp, over 80% of Ivy’s words are adapted, resulting in a largely inaccurate output lexicon. Moreover, a considerable number of word forms is unstable, i.e. variants for the same target differ strongly. Variants not only vary within the same session, but also in comparison to one another. However, the number of adapted words decreases in the later session to .57.

This increase of accuracy correlates with slight advances in phoneme production. Although Ivy’s favoured consonants remain the same, her production range of initial and final consonants improves. Two strategies help Ivy to attempt difficult words despite restrictions in onset and word ending. First, a third of her word forms in both sessions begins with a vowel. This can be regarded as an ‘avoidance’ strategy, as she can produce vowels more easily in initial word position than many consonants. Secondly, she selects and adapts words to two patterns with a closed syllable that feature her preferred final consonants: <CV[F/N]> and <CVCV[F/N/ʔ]> . However, these patterns and her consonant restriction may be mutually influenced.

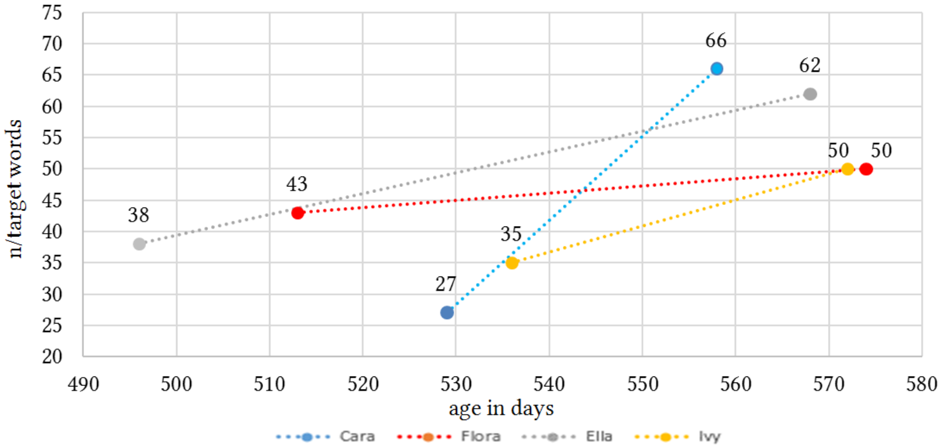
Another interesting production strategy is Ivy’s palatal pattern. In both sessions almost a third of her variants include /j/ in word medial position. It seems likely that Ivy’s <CV[j]V> template developed in cases where the target word did not feature harmonic or similar consonants. The palatalization strategy was then extended to more complex word shapes, which makes it one of Ivy’s most powerful and systematic adaptation strategies.

In summary, all of Ivy’s strategies include a systematic feature. After mastering the most basic word structures, word shapes play a minor role, whereas the production of favoured sounds in a specific word position supports her attempt of more complex words.

4.5 *Comparison of findings*

The four preselected children all reach the 25wp before 1;6 and their final session is recorded between the ages of 1;6.10 and 1;6.26. This facilitates the comparison between the children. While the classification may seem relatively homogeneous, the increase of attempted and identified target words differs between the children. Figure 7 shows the increase of total target words including onomatopoeia in relation to age.

Figure 7 Number of total target words in relation to age across all four children



The most remarkable development is Cara's increase from attempting the fewest targets to attempting the most in the shortest time (cf. blue points). Flora displays the opposite: at the 25wp she attempts most targets compared to the other children, but together with Ivy the least in the final session (cf. red points). Therefore, the figure illustrates the variability of word increase between different children. The dashed lines between the two sessions of each child only serve as a visual aid and are not intended to indicate a linear development.

Cara's high number of attempted words in the final session correlates with her high numbers of different structures, types, and variants. Table 39 summarizes the children's production numbers in comparison and clearly shows Cara's advance.

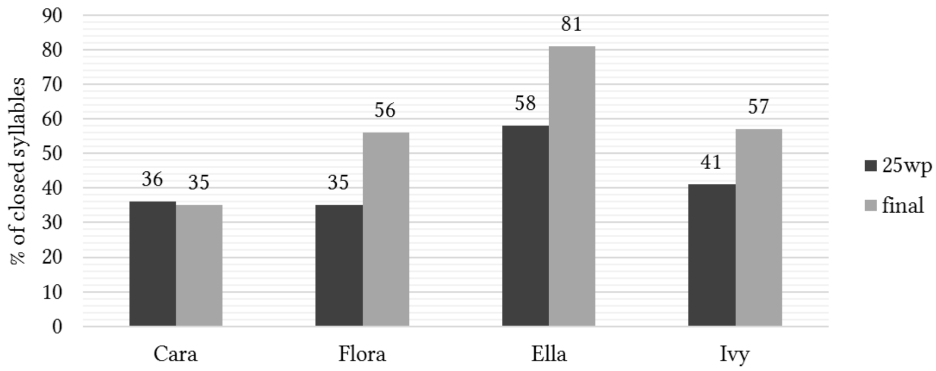
Table 39 Word production of the final session compared. Highest numbers are highlighted in **bold face**. Lowest numbers are underlined.

child	*wp*	*structures*	*types*	*selected*	*adapted*	*variants*
Cara	60^+	**67**	**141**	130 (.55)	100 (.45)	**230**
Flora	50	35	91	142 **(.68)**	67 (.32)	207
Ella	60^+	61	115	75 (.51)	72 (.49)	147
Ivy	50	51	79	39 (.43)	52 **(.57)**	91

Flora surprisingly produces a high number of variants despite producing the lowest number of distinct structures and attempting the fewest targets together with Ivy. Furthermore, Flora includes the most selected words, which results in the best match of child word forms to targets. Ivy however, who also only attempts 50 words in the final session, has the highest proportion of adapted words.

One development has been found across all children except for Cara. As figure 8 shows, the relative percentage of variants with closed syllables increases in the final session of Flora, Ella, and Ivy. Cara, in contrast, has an exceptionally low number of closed syllables at her 60^{+}wp.

Figure 8 Percentage of closed syllables at 25wp and in the final session



The low number of closed syllables correlates with Cara's favourite pattern <CVCV> , whereas all other children show high numbers of closed syllables in their final recorded session.

The patterns and templates that were found also differ for each child. Table **??** displays favoured patterns or features and proposed templates for Cara, Flora, Ella, and Ivy. As explained before, overuse or exploitation of a structure is an important criterion for the identification of templates. If 25% of the word types in one session belong to one single pattern, the respective pattern is classified as a stable template in this study. Therefore, patterns with .25 or more word types are highlighted in bold face in table 40.

As the table shows, two prosodic structures are particularly favoured: closed monosyllables and open disyllables. While the open disyllables have a strong tendency to include harmonizing consonants (cf. especially Cara and Flora, but also Ivy to some extent), <CVC> is less likely to be harmonic. Instead, the final consonant in closed syllables often seems to include strong features such as specific consonant groups or cluster combinations in word final position, e.g. Cara's <CVʔ$_{o}$P$_{o}$N>

Despite not reaching the .25 criterion, longer structures such as the closed disyllable play a role already at the 25wp of all children (including Cara and Ivy although not indicated here). The closed disyllable may also include harmony of the first two consonants as in Flora's case or specific final consonants despite a greater production range for shorter words with final consonants as it is the case for Ella.

Table 40 Favoured patterns and templates in comparison; structures accounting for .25 or more of all word types are highlighted with **bold face**.

Child	*Basic structure*	*Further specification*	*Proportion of types*	
			25wp	*final*
Cara	**CVCV**	Consonant harmony at 25wp	**0.31**	**0.35**
	CVC	CVʔ$_o$P$_o$N	**0.28**	0.16
	varying	(initial and final clusters)		
Flora	**CVCV**	Consonant harmony	**0.28**	0.12
	CVC		0.13	**0.29**
	CVCVC	Consonant harmony	0.1	0.19
Ella	**CVC**		**0.25**	**0.25**
	CVCVC	Final C: F or ʔ	0.13	0.23
Ivy	**CVC**	Final C: F or N	0.08	**0.25**
	CVCV	C$_1$VC$_1$V / CV[j]V	0.21	0.14
	varying	**palatal pattern**	**0.3**	**0.29**

Overall we find a tendency for words to become longer from the first words to the more advanced stages displayed in this analysis.

The onset and increase/decrease of templates differs between the children. Two children show a stable, frequently used template across both sessions: Cara, who reaches the 25wp comparatively late, but the 60$^+$wp early, makes strong use of her <CVCV> template in both sessions, which seems to be very successful. Ella, who is equally successful in her advances also uses a strong <CVC> template across both sessions. In addition to <CVC> , Ella develops a second pattern, <CVCV[F/ʔ], which almost reaches the .25 criterion in her final recorded session.

Like Cara, Flora makes use of <CVCV> at the 25wp. This number decreases in her final session, whereas <CVC> increases from only .13 types at the 25wp to .29 at the 50wp. Ivy's <CV[F/N]> template also develops over the time, reaching the .25 criterion at the 50wp. In addition, her words with <CVCV> shape show template typical forms with some being harmonic and others including a palatalized medial consonant. However, the number of word types with these patterns is comparatively low.

Overall two structures stand out: First, <CVC> is the most often used prosodic structure in the final recorded session of three children (Flora, Ella, and Ivy). Their final sessions lie closely together between 1;6.20 and 1;6.26 and include 50 to 62 attempted targets. In contrast to this, <CVC> is already a strong pattern at Cara's 25wp, but then decreases. This might be due to her preference for open (di)syllables. The second most remarkable pattern is the harmonic <C$_1$VC$_1$V> template that all children show at least to some degree and in at least one of the two sessions (though Ella by far the least).

When comparing the children's phonemes of both sessions a few generalizing conclusions can be drawn. Plosives (including /ʔ/) – the first consonants familiar from babble – seem to be the most stable phoneme group for all children except Ivy, who produces only /b/ and /d/ in a larger number. The voiced velar plosive is the least attempted of all plosives for all children at the 25wp, but not in the final session. In addition, nasals and the consonants /h/, /w/, and /j/ are established to some extent among all children at least in the final recorded session.

Slight advances of the phonological systems can be observed in all children. One of the strongest developments is the increase of fricatives. Each child, however, favours different target fricatives, and often fricatives that are not part of the target consonant system are produced. Ella stands out from the other children because she produces a high number of fricatives already at the 25wp. In general, Ella's phonological system is more advanced than the other children's. As a consequence, her system develops the least from the 25wp to the 60^{+}wp.

Generally, Ella and Cara differ from the other children in that phoneme position is a smaller problem for them than for Flora and Ivy. In their final sessions, Flora's production range for final consonants and Ivy's production of initial consonants increase. Ella, in contrast, who already produces fricatives frequently in final position at the 25wp, improves her production of voiced consonants instead.

5 Interpretation in the context of previous studies

Despite only including a small sample of children with two sessions each, the analysis shows various different production patterns. Overall it can be concluded that two of the children, Cara and Ella, are more advanced in the later session than Flora and Ivy. Not only do they attempt more targets than Flora and Ivy, but they also have prosodic abilities that lead to a rapid lexical increase. First of all, Cara and Ella have strong templates already at their 25wp and a well-established <CVC> pattern. In addition to this, Cara's most common template structure in both sessions is the partially harmonic $<C_1VC_1V>$. This suggests what has been presumed previously, namely that template formation accelerates lexical learning. However, Flora also makes extensive use of the open disyllable at the 25wp despite being less advanced in her production range and number of targets.

In the final session, Flora's <CVCV> production drops and words with <CVC> structure—a high-frequency structure in English (Vihman fc.:ch. 2)—increase instead. Ivy also reaches the .25 word type mark with <CVC> in the final session, even developing more specific templatic features within this structure. The preference of all children for closed over open monosyllables in the final recorded session is mimicked by the preference of closed syllables overall, except for Cara who masters <CVC> earlier than the other children. In her analysis of American children at their 25wp, Vihman notices that <CV> is favoured by five out of seven children aged 1;3 – 1;5. Two children, however, favour closed monosyllables. Vihman concludes that '[t]he key difference between the first and later words of these American children is the expansion of closed monosyllabic variants' (fc.:ch. 2). The English children Cara, Flora, Ella, and Ivy also expand their production of closed monosyllables and closed syllables in general over the two sessions that were analysed. In conclusion, <CVC> can be regarded as a more advanced structure than open monosyllables and mastery of this structure is likely to be related to the child's developmental stage overall.

In the data, open disyllables have been found to include harmonizing consonants much more frequently than closed monosyllables. Consonant harmony is a process well known in phonological acquisition and has been reported by different researchers. Lise Menn believes harmony to be an assimilation strategy across syllables and as such to be different from contact assimilation in adult phonology (1983:180–81). Vihman also reports consonant harmony for at least two of the American children that she analysed. In the data of English children, consonant harmony was found among the words of Cara and Flora as well as Ivy to some extent. Ella, in contrast, who has the most developed phoneme inventory at the 25wp, chooses other strategies over consonant harmony. This leaves the question open as to why harmony is less frequent in closed monosyllables.

Although we find consonant harmony among all children, Cara's <CVCV> pattern seems to develop further. Cara appears to extend her vocal production abilities through the well-practiced open disyllable. In her final recorded session, most words with this structure do not feature consonant harmony anymore. This suggests developmental advance, supporting the assumption that Cara and Ella are the furthest developed children.

Likewise, Ivy does not only produce harmonic disyllables. Some of her open disyllables are adapted to a palatal pattern <CV[j]V> . This strategy has also been reported by Vihman for an American child named Alice. At the age of 1;6, Alice attempts 35 different targets, the same number of targets that Ivy produces at the age of 1;5.19. Alice also adapts words to a disyllabic template with medial /j/. While Alice's palatal pattern extends to monosyllables, Ivy produces a large variety of disyllables with medial /j/ which exceed the .25 mark already at the 25wp.

The children's acquisition strategies differ in more ways than simply preferred structures. It was found that some children have a much closer match of word forms and targets, which was referred to as selection. This is particularly the case for Flora, who is comparatively less advanced. Flora seems to pick her structures and targets very carefully, which at the same time results in her slower lexical advance. However, we cannot formulate any conclusions since Ivy, who is at an equal stage as Flora in the final session, adapts the largest number of words out of all the children. No conclusive explanation currently exists as to why some children adapt more words than others. Menn stresses that there is no evidence that the variability of adaptation relates to the child's personality (1983:177–71). Nevertheless, adaptation is often related to template formation and thus can serve as a strong aid in extending the child's lexical and vocal production range.

Some phonetic strategies can also support lexical expansion. In particular these include avoidance, i.e. not attempting words containing a difficult sound, exploitation, i.e. overuse of a familiar and well-establish sound, dropping a sound, or replacing it by another sound (Menn 1983:178–9). In the analysed data, exploitation is the most frequently applied strategy. Ivy and the American child Alice exploit the palatal /j/, for example, which provides them with an effective adaptation method.

This type of exploitation of sounds in specific word positions may be regarded as a ‘perceptual focus’[7] as it provides the child with a production aid similar to a template. However, it may also mean that it enables the child to focus on other parts of a word with the word ending serving as a template within the word itself.

Restriction of the final word position with an influence on prosodic structures and template formation can be identified for at least three of the four English children: Cara, Ella, and Ivy each have a template structure that includes specific final consonants or consonant clusters. Furthermore, Flora has a tendency for final fricatives. Despite her strong selection method, she often adds a fricative to the end of words, even to open syllables. Since Flora is able to produce a high number of open syllables already at the 25wp (.65 of all variants), it is unlikely that she adds fricatives to the end of words because of motoric reasons or production difficulties. It is more likely to be an overuse of a well-working strategy. Ella also makes use of this strategy and attaches fricatives to the end of many words including open syllables.

6 Conclusion

The analysis suggests that the development of the earliest words up to the 25wp does not determine the speed of lexical development after this point. Moreover, the approach of this paper demonstrates that for the analysis of infants of such a young age the distinction between diphthongs and monophthongs is often not crucial. The same can be said for consonant clusters which are normally not being used extensively at this stage. Therefore, patterns can include more than one exact structure (Vihman fc.:ch. 2) and minor differences of variants are less relevant for the analysis of child data. As such, the findings support a whole-word approach to phonological analysis. In conclusion, syllable structures, visualized through a radical prosodic approach, provide a good basis for the classification of word types, but may be grouped together into common patterns and extended by specific features.

Based on the analysis and interpretation, two well-supported general assumptions about the interrelation between prosodic templates and phonological selection can be made:

1. The production range of consonants seems to be extended at least partially through well-practiced structures, i.e. with the help of familiar templates.
2. The data suggests that some templates feature specific phonemes that the child favours and overuses. This may include individual prominent sounds or longer phonotactic sequences.

The analysis also indicates that preferred patterns and even templates may change between the 25wp and later recordings. While some templates remain stable across both sessions, others decrease in the final session or only emerge then. Furthermore, templates, patterns, and individual features such as the palatal pattern, are not

[7] Term used by Vihman fc.:ch. 2

always clearly distinguishable. What they have in common, however, is that they all belong to a wider systematization of the child's output lexicon as an adaptation to the filtered input lexicon.

Overall, the findings of the analysis emphasize that systematicity emerges already around the 25wp, although templates may change over time as the child makes progress. Systematic selection and adaptation strategies as well as templates could be identified for all four children at their 25wp and even more so in the later session. However, some children show a strict systematic adaptation early on while others develop this more towards the 50 or 60wp. All strategies seem to be fairly common compared to the literature, yet no child makes use of all strategies. Only tentative hypotheses about the reasons for these differences could be made within this paper and it cannot be emphasized enough how important detailed analyses are to strengthen or disprove what has been researched thus far.

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