On the acquisition of rhyme structure in Dutch

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0. Introduction

In this paper I focus on developmental patterns in the acquisition of rhyme structure in Dutch.[1] Rhyme structure in Dutch has several characteristics that children have to learn. First, syllables can be closed. Second, Dutch has both long and short vowels. Third, the vowel length contrast only exists in closed syllables; in open syllables only long vowels occur. This is captured by the *minimal rhyme constraint* which states that Dutch rhymes are minimally bipositional (cf. Trommelen 1983, van der Hulst 1984, Kager & Zonneveld 1986, Kager 1989). In addition to this language-specific minimal rhyme constraint Dutch rhymes also obey the universal *maximal rhyme constraint*, which states that rhymes are maximally bipositional (Kaye & Lowenstamm 1981, Kager 1989). However, at the end of words an extra consonant is allowed, which I will refer to as the extrarhymal consonant.[2]

Section 1 gives a description of the four developmental stages that can be distinguished in the acquisition of rhymes. In section 2 I will give a formal account of the stages and explain the transitions from one stage to the next as the setting of a parameter. Section 3 summarises the main conclusions.

1. Developmental stages in the acquisition of rhyme structure: a description

The data used in this paper come from the Fikkert/Levelt corpus. It contains longitudinal data of 12 children acquiring Dutch as their first language. The children were recorded every other week and were followed for a period of one year. In this paper I only give data of one of the children, Jarmo, whose developmental patterns are representative for other children.

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[2] This extrarhymal consonant lies outside the rhyme, but within the scope of the syllable, because it can make a syllable heavy, as shown in Fikkert (1994).

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1.1. Stage 1: the core syllable CV

At the initial stage of acquisition Jarmo produces no forms with final consonants. Target words with final consonants are 'repaired', that is, final consonants are not realised, as shown in (1).

(1)	*Final consonant deletion*					
a	klaar	'ready'	/kla:r/	→	[kɑ], [ka:]	(1;4.18)
b	daar	'there'	/da:r/	→	[da:], [dɑ]	(1;5.2)
c	poes	'cat'	/pu:s/	→	[pu:]	(1;5.2)
d	dit	'this'	/dɩt/	→	[tɩ], [ti:]	(1;5.2)
e	tok	'cluck'	/tɔk/	→	[kɔ], [ka:]	(1;5.27)

Jarmo's data in (1) show that final consonants are deleted no matter what kind of vowel precedes them. Moreover, words like *klaar* 'ready' (1a) with long vowels in the adult target forms and words like *dit* 'this' (1d) with target short vowels, are produced with both long and short vowels. It is therefore clear that vowel length distinctions are not used systematically. I therefore assume that all vowels are represented by one V slot at this stage and that length is purely phonetic.

1.2. Stage 2: the appearance of final obstruents

At stage 2 the first closed syllables appear in Jarmo's production forms. However, they are invariably closed by obstruents. From 1;6.13 syllable-final fricatives appear in Jarmo's forms, as shown in (2a). At 1;7.15 final plosives appear in Jarmo's production forms, as shown in (2b):

(2) a	*Final fricatives*					
	deze	'these'	/ˈde:zə/	→	[tɛiʃ]	(1;6.13)
	deze	'these'	/ˈde:zə/	→	[de:s]	(1;6.27)
	poes	'cat'	/pu:s/	→	[pu:s]	(1;7.29)
	paard	'horse'	/pa:rt/	→	[pa:s]	(1;7.15)
	bal	'ball'	/bɑl/	→	[bɑΦ]	(1;8.12)
	boot	'boat'	/bo:t/	→	[pɑuf]	(1;8.26)
b	*Final plosives*					
	aap	'monkey'	/a:p/	→	[ɑp], [a:p]	(1;7.15)
	eend	'duck'	/e:nt/	→	[a:t]	(1;7.15)
	schaap	'sheep'	/sχa:p/	→	[ha:p], [hɑp]	(1;7.15)
	eend	'duck'	/e:nt/	→	[ɑt]	(1;7.29)

Sonorants are not yet produced in syllable-final position. They are most often not realised at all (3a); alternatively, they are replaced by fricatives (3b). Replacement is however far less frequent than deletion.

(3) a	*Deletion of final sonorants*						
	daar	'there'	/da:r/	→	[da:], [dɑ]	(1;6.27)
	klaar	'ready'	/kla:r/	→	[ka:]	(1;6.27)
	bal	'ball'	/bɑl/	→	[bɑ]	(1;7.15)
	boom	'tree'	/bo:m/	→	[bɑu]	(1;7.29)
b	*Substitution of final sonorants*					
	bal	'ball'	/bɑl/	→	[bɑΦ], [bɑf]	(1;8.12)
	boom	'tree'	/bo:m/	→	[bo:χ]	(1;8.12)
	oor	'ear'	/o:r/	→	[ɔχ]	(1;9.9)
	leeuw	'lion'	/le̩:w/	→	[he:uf]	(1;11.20)

Since vowel length distinctions only occur in closed syllables, I hypothesised that vowel length distinctions can only be learned when the child has closed syllables. At this stage closed syllables indeed occur. Does Jarmo also represent vowel length distinctions at this stage? If we look at the percentage of vowel length errors at this stage (from 1;6.13 until 1;9.23) in (4), we can observe that this percentage is very high.

(4) *Percentage of vowel length errors at stage 2*

Vowel length errors
39% (67/174)

Vowel length is more or less random, that is, vowel length distinctions have not yet been mastered. In (5a) examples are given of the shortening of target long vowels and in (5b) of the lengthening of target short vowels.

(5) a	*Shortening of target long vowels*					
	aap	'monkey'	/a:p/	→	[ɑp]	(1;7.15)
	schaap	'sheep'	/sχa:p/	→	[ɑp]	(1;7.15)
	oog	'eye'	/o:χ/	→	[ɔχ]	(1;9.9)
	poes	'cat'	/pu:s/	→	[pʉs]	(1;9.23)
b	*Lengthening of target short vowels*					
	vis	'fish'	/vɩs/	→	[hi:ʃ]	(1;8.12)
	bof	'wham'	/bɔf/	→	[bɑuf]	(1;8.26)
	vis	'fish'	/vɩs/	→	[i:ʃ]	(1;9.9)

1.3. Stage 3: the appearance of final sonorants and vowel length

At 1;7.29 nasals also appear in final position in Jarmo's production forms, as shown in (6), although nasals are still frequently subject to deletion:

(6)	*Final nasals*					
	boom	'tree'	/bo:m/	→	[bɔm]	(1;7.29)
	haan	'cock'	/ha:n/	→	[hɑm]	(1;7.29)
	bom	'boom'	/bɔm/	→	[pɔm]	(1;7.29)
	haan	'cock'	/ha:n/	→	[ɑn]	(1;8.12)

From 1;11.20 Jarmo sometimes produces a liquid in syllable-final position, as shown in (7a). However, liquids are more often deleted than realised. Sometimes they are not deleted, but substituted, as shown in (7b):

(7) a	*Final Liquids*					
	bal	'ball'	/bɑl/	→	[bɑl]	(1;11.20)
	bril	'glasses'	/brɩl/	→	[pʊɩl]	(2;3.9)
b	*Substitution of final liquids*					
	bal	'ball'	/bɑl/	→	[bɑΦ]	(1;8.12)
	uil	'owl'	/œyl/	→	[ɛn]	(1;7.29)

Although Jarmo's template is able to accommodate final consonants of the adult target in his own template, sonorants in final position are usually not realised as such at stage 2, and they are frequently deleted at stage 3 as well, contrary to final obstruents, as can be seen in (8). Moreover, (8) also shows that sonorants following long vowels are more frequently prone to deletion than sonorants following short vowels at stage 3, indicating that the vowel length distinction becomes relevant in the child's system. Deletion of final obstruents is not related to the length of the preceding vowel, as also shown in (8):

(8) *Jarmo's production of* $V(V)C_{son}$ *and* $V(V)C_{obst}$ *targets at stage 3*

target VVC_{son}		target VC_{son}		target VVC_{obst}		target VC_{obst}	
child's form		child's form		child's form		child's form	
VV	75% (47/63)	VV	42% (8/19)	VV	6% (5/77)	VV	5% (2/40)
VC	13% (8/63)	VC	47% (9/19)	VC	14% (11/77)	VC	70% (28/40)
V	3% (2/63)	V	5% (1/19)	V	1% (1/77)	V	5% (2/40)
VVC	9% (6/63)	VVC	5% (1/19)	VVC	78% (60/77)	VVC	20% (8/40)

The following picture can be deduced from (8):

(9)		*Adult target*	→	*Jarmo's production form*
	a	VVC_{son}	→	VC_{son} or VV
		VC_{son}	→	VC_{son} or VV
	b	VVC_{obst}	→	VC_{obst} or VVC_{obst}
		VC_{obst}	→	VC_{obst} or VVC_{obst}

Sonorants show a close relationship with the length of the preceding vowel. If we look at vowel length errors in the child's production of adult target words ending in a sonorant, we see that long vowels before sonorants are shortened if the final sonorant is produced (10a). However, short vowels are lengthened when final sonorants are *not* produced (10b). Stated differently, whether or not the final sonorant is produced is largely dependent on the length of the preceding vowel: if a long vowel is produced, sonorants are generally deleted (10b, c). If a short vowel is produced, sonorants are often produced, as shown in (10a, d):

(10) *Jarmo's production of targets ending in sonorant at stage 3*

a	*VVC_{son} → VC_{son}*					
	maan	'moon'	/ma:n/	→	[mɑm], [mɔm]	(1;10.9)
	uil	'owl'	/œyl/	→	[œʊ]	(1;10.9)
	haan	'cock'	/ha:n/	→	[hɑm]	(1;10.23)
	boom	'tree'	/bo:m/	→	[bɔm]	(2;0.4)
b	*VC_{son} → VV*					
	bal	'ball'	/bɑl/	→	[bo:]	(1;10.9)
	bal	'ball'	/bɑl/	→	[bɑu]	(1;10.9)
c	*VVC_{son} → VV*					
	trein	'train'	/trɛin/	→	[tɛi]	(1;10.9)
	stoel	'chair'	/stu:l/	→	[ty:]	(1;10.9)
	daar	'there'	/da:r/	→	[da:]	(1;10.9)
	boom	'tree'	/bo:m/	→	[bo:]	(1;10.9)
d	*VC_{son} → VC_{son}*					
	bal	'ball'	/bɑl/	→	[pɑʊ]	(1;10.23)
				→	[bɑl]	(1;11.20)
	bim	'ding'	/bɩm/	→	[mɩm]	(2;0.4)
	bam	'dong'	/bɑm/	→	[bɑm]	(2;0.4)
	ballon	'balloon'	/bɑ'lɔn/	→	[pɔm]	(2;0.28)

If we consider vowel length errors in the child's production forms of target words ending in obstruents we see that at stage 3 most of the vowel length errors occur when the final consonant is retained. That is, in the child's production forms long vowels are shortened and short vowels lengthened in closed syllables (11a,b). There seems to be no relationship between vowel length errors and final obstruent deletion.

(11) *Vowel length errors before obstruents at stage 3*

a	*Vowel lengthening*					
	pad	'toad'	/pɑt/	→	[ta:t]	(1;11.20)
				→	[pa:t]	(1;11.20)
	vis	'fish'	/vɩs/	→	[te:s]	(1;11.20)
	bad	'bath'	/bɑt/	→	[ta:t]	(2;0.4)
b	*Vowel shortening*					
	huis	'house'	/hœys/	→	[ɑʃ]	(1;10.9)
	kous	'stocking'	/kɑus/	→	[kɑs]	(1;10.9)
	poes	'cat'	/pu:s/	→	[pʉs]	(1;10.23)
	uit	'out'	/œyt/	→	[hɑt]	(1;11.6)
	boot	'boat'	/bo:t/	→	[tɔt]	(1;11.20)
	koek	'biscuit'	/ku:k/	→	[kɔk]	(2;0.4)
	kijk	'look'	/kɛik/	→	[kɑk]	(2;0.4)

Vowel length errors go in both directions and are independent of final consonant deletion. It seems, therefore, that vowel length is not completely mastered before obstruents.

1.4. Stage 4: mastering vowel length and extrarhymal consonants

At stage 4 an important change in Jarmo's system is that the percentage of deleted obstruents *increases* after long vowels, as in the examples in (12):

(12) *Deletion of obstruents after long vowels*

boek	'book'	/bu:k/	→	[tu:]	(2;2.6)
daag	'bye bye'	/da:χ/	→	[da:]	(2;2.6)
kijk	'look'	/kɛik/	→	[kɛi]	(2;3.9)
boot	'boat'	/bo:t/	→	[bo:]	(2;3.9)
vijf	'five'	/vɛif/	→	[fɛi]	(2;3.9)
buik	'belly'	/bœyk/	→	[bœy]	(2;4.1)
kijk	'look'	/kɛik/	→	[kɛi]	(2;4.1)
vijf	'five'	/vɛif/	→	[sɛi]	(2;4.1)
uit	'out'	/œyt/	→	[œy]	(2;4.1)

The percentages are given in (13):

(13) *The percentages (and raw scores) of deleted final consonants*

Target:	VC_{obst}	VVC_{obst}	VC_{son}	VVC_{son}
Stage 3	10% (4/40)	8% (6/77)	53% (10/19)	78% (49/63)
Stage 4	13% (7/54)	26% (6/24)[3]	25% (6/24)	73% (61/84)

However, if we look at the relationship between final consonant deletion/production and vowel length at stage 4, schematised in (14), additional observations can be made, certainly in comparison with (8).

(14) *Jarmo's production of $V(V)C_{son}$ and $V(V)C_{obst}$ targets at stage 4*

target VVC_{son}		**target VC_{son}**		**target VVC_{obst}**		**target VC_{obst}**	
child's form		child's form		child's form		child's form	
VV	70% (59/84)	VV	21% (5/24)	VV	25% (6/24)	VV	4% (2/54)
VC	6% (5/84)	VC	67% (16/24)	VC	38% (9/24)	VC	78%(42/54)
V	2% (2/84)	V	4% (1/24)	V	0% (0/24)	V	9% (5/54)
VVC	21% (18/84)	VVC	8% (2/24)	VVC	38% (9/24)	VVC	9% (5/54)

First, target forms ending in VVC_{obst} are more often produced as either VV or VC_{obst} than at stage 3. Examples of the latter possibility are given in (15):

(15) *Vowel shortening at stage 4*

kijk	'look'	/kɛik/	→	[kɑk]	(2;1.22)
uit	'out'	/œyt/	→	[ɑt]	(2;1.22)
niet	'not'	/ni:t/	→	[nɪχ]	(2;2.6)
vlieg	'fly'	/vli:χ/	→	[tɪχ]	(2;2.27)
kijk	'look'	/kɛik/	→	[kɛk]	(2;4.1)

Second, target forms ending in VC_{obst} are less prone to be produced as VVC_{obst} in comparison with stage 3. In other words, the following pattern is now found:

[3] Remarkably, the number of selected target words ending in VVC_{obst} has decreased substantially here.

(16) *Jarmo's production of target words ending in a final obstruent*
a $VVC_{obst} \rightarrow VC_{obst}$ or VV
b $VC_{obst} \rightarrow VC_{obst}$

These observations are very similar to those of final sonorants at stage 3 (see 9). This seems to indicate that the child allows two positions in the rhyme: either a long vowel or a short vowel plus a consonant.

However, three additional observations need to be explained. First, target forms ending in VVC_{son} are now more often produced correctly than at stage 3, as shown in (17):

(17) $VVC_{son} \rightarrow VVC_{son}$

haan	'cock'	/ha:n/	→	[ha:m]	(2;2.6)
kalkoen	'turkey'	/.kɑl'ku:n/	→	[ku:ŋ]	(2;2.6)
schuur	'shed'	/sχy:r/	→	[χu:ʀ]	(2;2.6)
tuin	'garden'	/tœyn/	→	[tœyn]	(2;2.27)
daar	'there'	/da:r/	→	[ta:ʁ]	(2;3.9)
banaan	'banana'	/ba:'na:n/	→	[na:n]	(2;3.9)

Second, the first final consonant clusters appear at this stage:

(18) *Final consonant clusters*

hand	'hand'	/hɑnt/	→	[hɑnt]	(2;3.9)
strand	'beach'	/strɑnt/	→	[tlɑnt]	(2;3.9)

Third, target forms ending in VVC_{obst} are still often produced correctly, although less frequently as at stage 3. These three observations seem to suggest that the child is beginning to allow an extra position after a bi-positional rhyme. Furthermore, at stage 4 vowel length errors are rare.

2. Discussion and formal account

2.1. Stage 1: no codas

At the initial stage in the acquisition process all parameters have the default value. The fact that at stage 1 no syllable is closed by a consonant gives evidence for the default setting [NO] of the branching rhyme parameter (19):

(19) *Branching rhyme parameter*:
Rhymes can branch into a nucleus and a coda [YES/<u>NO</u>]

The fact that vowel length is non-distinctive gives evidence for the default setting [NO] of the branching nucleus parameter, given in (20):

(20) *Branching nucleus parameter*:
The nucleus can be branching [YES/NO]

This results in the universal core syllable CV.

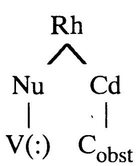
2.2. Stage 2: branching rhymes

At stage 2 the child's system allows closed syllables, which are invariably closed by an obstruent. The child has not yet mastered vowel length distinctions, and therefore represents all vowels as one V slot. That is, the branching nucleus parameter (20) still has the default value. Obstruents following target long and short vowels therefore are in the same position: they are mapped onto the child's VC rhyme template.

Once closed syllables are allowed, the repair strategy which deletes final consonants should cease to exist. Although this is largely true for obstruents, it does not hold for sonorants. Apparently, obstruents can be accommodated into the child's template, while sonorants cannot.

Since obstruents are universally never part of the nucleus, they *have* to be in the coda. I assume that the child is learning that rhymes can be branching into a nucleus and a coda. That is, the child is learning the marked value [YES] for the branching rhyme parameter (19). From the fact that sonorants are not realised at this stage, I conclude that they are not represented in the coda, although, in principle, they could be. The child seems to have, next to the core syllable template, a maximally bipositional rhyme template, in which the rhyme can branch into a nucleus and a coda, which is realised as an obstruent, as in (21):

(21) *Branching rhyme template*:



This template explains why sonorants are deleted at this stage: they cannot be mapped onto the template unless they are replaced by obstruents, as in (3b).

The transition from stage 1 to stage 2 thus involves the setting of a syllable parameter, the 'branching rhyme' parameter, from the default value

[NO] to the marked value [YES]. Furthermore, the child has determined that only obstruents can fill the coda position.

2.3. Stage 3: branching nuclei and the maximal rhyme constraint

At stage 3 sonorants appear in final position, although they are deleted more often than not. As we have seen, at this stage there are clear differences between obstruents and sonorants in syllable-final position in the child's production forms: (i) obstruents are generally produced, while sonorants are often deleted; (ii) whether sonorants are produced is largely dependent on the length of the preceding vowel. However, the fact that sonorants are sometimes realised indicates that they *can* now be accommodated into the child's template. Moreover, the fact that they behave differently from obstruents suggests that they are in a different position from obstruents. I therefore propose that they are not in the coda, but are part of the nucleus. Apparently, the child is setting the nucleus parameter (20) from the default value [NO] to the marked value [YES]. In other words, the child now has a template in which the nucleus can branch, as represented in (22), as well as the core syllable template and the template in (21).

(22) *Branching nucleus template*:

```
    Rh
    |
    Nu
   /  \
  V   [+son]
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where [+son] either is filled by a sonorant consonant or by the second part of a long vowel or diphthong

Target rhymes consisting of a short vowel and a sonorant can now be mapped onto the child's template. However, target rhymes consisting of a long vowel and a sonorant cannot; hence, the final sonorant is usually deleted. However, there are other possibilities available to the child: target VC_{son} rhymes can also be realised as long vowels, which fill both positions in the nucleus. Target rhymes consisting of a long vowel plus a sonorant can also be realised as a short vowel plus a sonorant. However, VC_{son} and VVC_{son} target rhymes are generally not produced as VVC_{son} or V. This suggests that the child's template is *minimally* and *maximally* bipositional. How both positions are filled is not dictated by the template; hence, we find much variation in realising a bipositional template.

However, the child produces both long and short vowels before obstruents. What needs to be explained is that the strong relationship between a sonorant and the preceding vowel is not observed between an obstruent and the preceding vowel. I will argue that the patterns can be described by assuming that

(i) vowel length is more or less mastered; (ii) sonorants are in the nucleus, obstruents in the coda; (iii) rhymes are maximally bipositional (having a branching rhyme and a branching nucleus in the same syllable violates the maximal rhyme constraint) and (iv) the earlier branching rhyme template (21) is preferred over the newly acquired branching nucleus template (22).

At stage 3 there is no relation between final obstruent deletion and vowel length errors. Although VVC_{obst} is sometimes produced as VC_{obst}, VC_{obst} is also frequently realised as VVC_{obst}. Final obstruent deletion, although rare, is equally likely to occur after long and short vowels. It therefore seems that the child realises a vowel and the coda consonant. However, if the coda consonant is realised the preceding vowel can only occupy one position in the nucleus, given a maximal bipositional rhyme. Thus, although vowel length distinctions may be mastered, they cannot be represented in all positions.

2.4. Stage 4: extrarhymal consonants

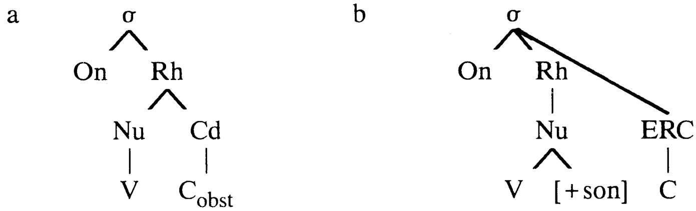
Stage 4 is characterised by the fact that obstruents and vowels show a similar behaviour at stage 4 (see 16) as sonorants and vowels at stage 3 (see 9). One logical possibility is not found, however: vowel lengthening under deletion of an obstruent, i.e. $VC_{obst} \rightarrow VV$, is not attested. Apparently, compensatory lengthening is restricted to nuclei, which provides evidence for the claim that obstruents and sonorants are in different syllabic positions. It is also an argument that nuclei are constituents.

A long vowel occupies two positions. A final obstruent following the long vowel therefore cannot be part of the rhyme, which is universally maximally binary. The consonant has to be in extrarhymal position, which apparently is not yet always present in the child's template. Hence, final obstruents following long vowels are often deleted when long vowels are represented as bipositional. However, as shown above, the existence of production forms ending in VVC_{son}, VVC_{obst} and $VC_{son}C_{obst}$ at this stage provide evidence for a bipositional rhyme plus an extra consonant. The child's template *can* now accommodate three positions. At stage 4 the extrarhymal parameter is being set from the default value [NO] (underlined) to the marked value [YES]:

(23) *Extrarhymal parameter*
A (final) bipositional rhyme can be followed by an extra consonant

This leads to the template in (24b). An extrarhymal consonant after an obstruent (24a) violates the Sonority Sequencing Principle and is disallowed.

(24) *Template at stage 4*



However, the newly acquired template in (25b) is often overruled by the child's previous templates of stage 3.

3. *Summary and conclusions*

In this paper I have discussed the setting of some of the syllable parameters. At stage 1 no syllable parameters are set. All parameters have the default value. At stage 2 the branching rhyme parameter has been set to the marked value [YES]. At stage 3 the branching nucleus parameter is set to the marked value [YES]. Finally, at stage 4 the extrarhymal parameter is set to the marked setting [YES].

The account presented here clearly supports the existence of the subsyllabic constituents rhyme, nucleus, and coda. They are needed to adequately describe the developmental stages in the acquisition of rhymes. They are furthermore related to different parameters, whose settings determine the child's template. In its turn, the template dictates the relationship between the adult input and the child's output forms.

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