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Setting the Parameters of Syllable Structure in Early Child Dutch

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1. Introduction

The emergence of Optimality Theory (OT) (McCarthy & Prince 1993, Prince & Smolensky 1993) has brought a new approach to phonological acquisition. In OT, the child's task is to rank a set of universal constraints on the basis of the input data. As shown by many recent works (e.g. Bernhardt & Stemberger 1998; Levelt, Schiller & Levelt 2000; Rose 2000; Dinnsen & O'Connor 2001), OT is now the dominant approach to phonological acquisition. In this paper, contary to the current OT trend, we adopt a *parametric* approach, and investigate the early stages of syllable acquisition in Dutch children. The data are drawn from the longitudinal corpora of spontaneous speech for 12 children acquiring Dutch as their first language (Fikkert 1994, Levelt 1994, MacWhinney 2000). Our aim in this paper is not to compare the two approaches directly (for a detailed comparison of the OT and parametric approaches to syllable acquisition and typology, see Pan and Snyder, in preparation), but rather to show that the parametric approach can provide an especially simple and elegant analysis of the developmental data. Here we restrict our attention to the earliest stages of syllable acquisition, before any branching constituents (branching onsets or branching rhymes) have appeared. We ignore vowel length in these early stages because, following Fikkert (1994), we take vowel length initially not to be distinctive. This leaves us with CV, CVC, V and VC as the earliest four syllable types.

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* The evidence provided in this paper has also been discussed in (Pan & Snyder, in press), but the present paper provides much greater detail about the acquisitional methods, findings, and implications. We thank Martin Ball, Diane Lillo-Martin, John Oller, Yael Sharvit, and Harry van der Hulst for reading and commenting on earlier versions of this paper. Snyder's contributions were supported by NIH grant DCD-00183.

2. Previous studies of Dutch

2.1 A parametric account

Fikkert (1994) provided an extensive and detailed discussion of syllable acquisition by Dutch children within the Principles-and-Parameters model (Chomsky 1981, 1986). She treated the acquisition of onsets and the acquisition of rhymes as two separate processes. For onsets, she found that children at first produced obligatory simplex onsets, then onsets became optional, and finally complex onsets appeared. For rhymes, she found that initially the rhyme only contained vowels, and then it branched into a nucleus and a coda. Lastly, final consonant clusters appeared. In Fikkert's analysis, the earliest four syllable types – CV, CVC, V and VC – involve the following two parameters:

(1) *Onset Parameter*
   a. Number of onsets is equal to 1: On = 1
   b. Number of onsets is equal to or smaller than 1: On ≤ 1
   c. Number of onsets is equal to or smaller than 2: On ≤ 2
   Where c → b → a

(Fikkert 1994:124)

(2) *Branching Rhyme Parameter*
   Rhymes can branch into a nucleus and a coda [No/Yes]

(Fikkert 1994:180)

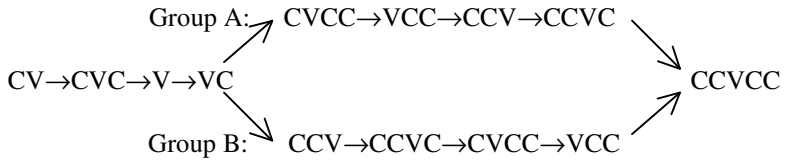
The Onset Parameter has three values. The most marked value (1c) implies the less marked values (1a) and (1b). The marked value (1b) implies the unmarked value (1a). In the Branching Rhyme Parameter, the underlined value is the default value. According to this analysis, CV and CVC syllables are possible when the Onset Parameter is still in the unmarked (or default) setting (1a), whereas V and VC syllables mean that the Onset Parameter is set to the value (1b). Likewise, CV and V syllables are possible under the unmarked setting of the Branching Rhyme Parameter, while CVC and VC syllables require the marked setting.

Yet, Fikkert's analysis leaves open how the syllable as a whole develops, and how the two parameters interact with one another. Moreover, the three-valued Onset Parameter proposed by Fikkert captures the Dutch acquisition data, but fails to account for crosslinguistic variation. According to Fikkert (1994:108), the most marked value (1c) of the Onset Parameter implies the less marked values (1b) and (1a). It thus predicts that no language should allow branching onsets without also allowing both simplex and empty onsets. This prediction is falsified by Arabela, Sedang, and Totonac (Blevins 1995, Levelt & van de Vijver 1998), languages with branching onsets but no empty onsets.

2.2 An OT account

Using the same data as Fikkert (1994), but working within an OT framework, Levelt, Schiller, and Levelt (2000) explored how the syllable as a whole develops. They aligned the children's data on a Guttman scale, and deduced the order of appearance of different syllable types as in (3), where an arrow means "appeared before."

(3)



Levelt, Schiller and Levelt (2000:242)

Levelt et al. interpreted this ordering as an *acquisitional* sequence. The earliest four syllable types were claimed to be acquired in the order in (3), one after the other. The acquisitional order was then analyzed as the result of an initial ranking, and subsequent re-rankings, of nine proposed constraints (Levelt et al. 2000:257).

Given that the data were aligned quite nicely, we agree with the order of appearance obtained from the Guttman scaling procedure. But the question is whether this ordering reflects the sequence of acquisition. Are there factors other than acquisitional stages that could account for the ordering?

Suppose a child utters some CVC syllables before her first recording session. Furthermore, suppose that CVC syllables have a lower frequency than CV syllables in this child's speech, with the result that the researchers record only CV syllables in their first few sessions. When the researchers first encounter a CVC syllable, in a later recording session, they may incorrectly conclude that CVC syllables were *acquired* later than CV syllables. Thus, the order of appearance of syllable types could simply reflect the relative frequency of use, rather than the order of acquisition. The Guttman scale tells us only the order of first appearance in the sample, not the underlying cause of this order.

So the question here is whether every step deduced from the Guttman scale is a genuine acquisitional stage. A genuine stage begins and ends with a substantial change in at least one fundamental property of the grammar. In contrast, an ordered appearance of surface forms, if it is due simply to their frequency of use in the child's speech, does not require any grammatical explanation. Levelt et al. interpreted every step obtained from the Guttman procedure as a genuine acquisitional stage, and tried to explain it grammatically. The danger in such an approach is that the grammatical theory will become unnecessarily complicated. (For further discussion, see Pan and Snyder, in preparation).

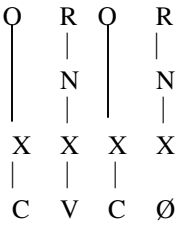
3. New findings from the Dutch data

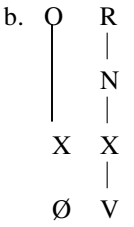
To test our concerns about the acquisitional stages claimed by Levelt et al., we re-examined the Dutch data used by Levelt's group. The corpora for their 12 subjects are available in the Levelt-Fikkert section of CHILDES (Fikkert 1994, Levelt 1994, MacWhinney 2000). In contrast to Levelt et al.'s findings in (3), our reanalysis indicates that the last three types, CVC, V and VC, are in fact acquired together. Their order of appearance is attributable simply to their relative frequency in the child's speech.

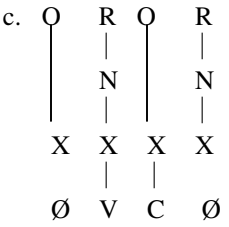
Of the 12 children, three (Jarmo, Noortje, Tom) have corpora in which only CV syllables are initially present. To assess whether order of appearance reflects ordered acquisition or simply relative frequency, we performed modified sign tests based on frequency of the syllable-types in a slightly later transcript. For example, Jarmo's corpus contains 41 CV syllables before his first CVC syllable. In a later sample of Jarmo's speech (containing 67 spontaneous utterances), Jarmo produced 40 CV syllables, and 9 CVC syllables. Under the null hypothesis that CV and CVC syllables were both available to Jarmo at the beginning of the corpus, and had the same relative frequency found in the later transcript, the likelihood of sampling 41 or more CV syllables simply by chance, before the first occurrence of CVC, is $p=(40/49)^{41}<.001$. We conclude that Jarmo indeed acquired CVC later than CV. Yet, Jarmo's acquisition of CVC/V/VC syllables showed no significant ordering ($p>.05$ for CVC vs. V, and for V vs. VC).

The corresponding analysis for Noortje revealed that CV was again significantly earlier than CVC ($p=(21/31)^{18}=.001$), but the remaining syllable-types (CVC vs. V, V vs. VC) were not significantly different ($p>.05$). Finally, Tom's corpus showed no significant ordering among the four syllable-types. Thus, our fine-grained analysis of the Dutch data indicates that CV can be acquired genuinely earlier than CVC/V/VC; but that the latter three syllable-types are actually acquired as a group, at least by the three Fikkert-Levelt children for whom relevant data are available.

A question that arises is why the syllable types CVC, V and VC would be acquired as a group. That is, what single property, common to all three syllable types, were Jarmo and Noortje eventually discovering? In (Pan & Snyder, in press), we have shown that this problem can be solved rather straightforwardly within a parametric model of phonology, namely Government Phonology (GP) (e.g. Kaye, Lowenstamm, & Vergnaud 1990; Kaye 1990, 1993). Within the GP framework, CVC, V and VC syllables can be represented as follows:

(4) a. 

b. 

c. 

In the above representation, CVC, V and VC syllables all contain empty categories, either an empty onset, an empty nucleus, or both. Therefore, the property of containing an empty category could be the characteristic shared by all three syllable types. An initial proposal we made is that the availability of empty C/V elements is determined by a single phonological parameter:

(5) *Empty Category Parameter*
Empty categories are allowed. [No/Yes]

The underlined value is the default value of this parameter. The child starts with the default setting [- empty category], and only produces CV syllables. When the child discovers that Dutch is [+empty category], the CVC, V, and VC syllables all become available. Any ordering among CVC, V, and VC simply reflects their relative frequency of use.

The proposed Empty Category Parameter can also shed light on the phenomenon of final-consonant deletion, a very common error for both normal and language-disordered children, which as yet lacks any satisfactory explanation. The common understanding is that children delete the final consonant because they "want to avoid" the final consonant. Yet, this is simply a restatement of the question. Another possibility is that deleting final consonants "simplifies" pronunciation (cf. Grunwell 1997), but this likewise offers little insight.[1] In particular, the notion of simplification fails to explain why children sometimes add an extra vowel, instead of deleting the final consonant.

In contrast, the proposed Empty Category Parameter provides a reasonable explanation. When a child cannot produce the final consonant in a CVC syllable, the reason is that her grammar does not yet allow the (marked) option of an onset followed by an empty nucleus. The following data from disordered and normal children support this hypothesis.

(6) Disordered speech: Jamie (7:2)
a. [kæː] 'cab' [dɔː] 'dog' [dʌ] 'duck'
b. [kæːbi] 'cabby' [dɔgi] 'doggie' [dʌki] 'duckie'
(Dinnsen, Elbert and Weismer, 1981)

1. We thank Dr. Martin Ball for this point.

The utterances in (6b), from a speech-disordered English-learning child named Jamie, show that he did not have any problem producing the consonants [b], [g] or [k]; he simply could not produce these consonants when they were followed by an empty vowel, as in (6a). Thus, in Jamie's grammar, the Empty Category Parameter was still in its unmarked setting.

(7) Normal speech: Mollie (18 months)

a. [bɛ] 'bed' [gu] 'good'

b. [buki] 'book' [bɪbi] 'bib' [waki] 'walk'

(Holmes 1927, cited by Goad, 1998)

In (7) we see utterances from a normally-developing English-learning child named Mollie, who had difficulty producing CVC syllables. She sometimes completely deleted the onset-rhyme pair that contained an empty rhyme, as in (7a); and sometimes repaired the problematic onset-rhyme pair by inserting a vowel, as in (7b). This pair of strategies clearly points to a problem in producing an onset followed by an empty nucleus.

A case of initial-vowel deletion, seen in a normally-developing French-learning child studied by Rose (2000), can be explained along the same lines. The child in question, Clara, deleted vowels in word-initial position during a stage when she was producing only CV syllables. "[I]t is noteworthy that deletion of word-initial syllables only occurs in VCV target words.… CVCV words show preservation of both syllables" (Rose 2000:99). In light of the Empty Category Parameter, the phenomena of initial-vowel deletion and final-consonant deletion have the same explanation: The child does not yet allow any onset-rhyme pair containing empty categories. These two phenomena can be unified as a single operation, namely "onset-rhyme pair-deletion" as in (8), which deletes any pair containing an empty category.

(8) *Problematic onset-rhyme pair-deletion*

a. Initial-vowel deletion: ØVCV → ~~ØV~~CV

b. Final-consonant deletion: CVCØ → CV~~CØ~~

Bernhardt and Stemberger (1998:370) note that the total absence of onsets in a child's phonology has never been reported, but the total absence of codas is common. This is also seen in (6) and (7). Jamie and Mollie deleted final consonants, but they never deleted an initial consonant. Researchers often discuss the error of final-consonant deletion, but they pay little attention to the uniformly *correct* use of the onset. The proposed Empty Category Parameter directly relates the correct use of initial consonants and the mistaken deletion of final consonants. The child's grammar initially disallows an onset-rhyme pair with an empty position. Hence, the child avoids the "final" consonant, which is actually followed by an empty vowel. The child does not delete initial consonants, however, because they are allowed in her grammar.

We have seen that the proposed Empty Category Parameter can account for the data from child Dutch, and that it also provides an explanation for the common child error of final-consonant deletion, as well as the error of initial-vowel deletion. A problem arises, however, when we consider its predictions for cross-linguistic variation. Syllable structure presumably involves several parameters, and if all the parameters are in their unmarked settings, the language allows only CV syllables. If the earliest four syllable types involve the Empty Category Parameter, we expect that a language has either all of the three syllable types with empty categories (CVC, V and VC), or none of them. This prediction is false. Thargari has only CV and CVC syllables, and Cayuvava has only CV and V syllables (Levelt & van de Vijver 1998). To account for the typology of syllable-type inventories, we propose in (Pan & Snyder, in press) to split the Empty Category Parameter into two parameters, as in (9).

(9) a. *Empty Onset Parameter*
Empty onsets are allowed. [No/Yes]

b. *Empty Nucleus Parameter*
Empty nuclei are allowed. [No/Yes]

In both parameters, the underlined value is the default value. The marked value implies the unmarked value, but not vice versa. These two parameters can account for the following syllable-type inventories (data from Levelt & van de Vijver):

(10)	[-EO, -EN]: CV	(Hua)
	[-EO, +EN]: CV, CVC	(Thargari)
	[+EO, -EN]: CV, V	(Cayuvava)
	[+EO, +EN]: CV, CVC, V, VC	(Mokilese)

The two parameters in (9) also predict three possible sequences of acquisition:

(11)	a.	Stage I: [-EO, -EN]	–	CV
		Stage II: [+EO, +EN]	–	(CV), CVC, V, VC
	b.	Stage I: [-EO, -EN]	–	CV
		Stage II: [+EO, -EN]	–	(CV), V
		Stage III: [+EO, +EN]	–	(CV), (V), CVC, VC
	c.	Stage I: [-EO, -EN]	–	CV
		Stage II: [-EO, +EN]	–	(CV), CVC
		Stage III: [+EO, +EN]	–	(CV), (CVC), V, VC

The children examined in this study (Jarmo, Noortje, Tom) provide support for the possibility in (11a) – Jarmo and Noortje acquired CV significantly earlier

than the other syllable types, but none of the children showed a significant gap within the CVC/V/VC cluster. A prediction is that (11b) and (11c) will be the only additional patterns attested, when more children's corpora are examined.

The predicted learning path (11b) is precisely borne out by the early three periods of French syllable acquisition reported in (Rose 2000): During Period 1, only CV syllables are allowed. During Period 2, both V and CV syllables are allowed. In Period 3, "the children allow for (a) CV syllables and (b) onsets of empty-headed syllables" (Rose 2000:161). For the two children Rose studied, Period 1 is seen only in Clara's data. The other child, Théo, does not display an obligatory CV period, and vowel-initial words are found in his early speech. Note that this is not counterevidence to the Stage I predicted in (11b). Théo may already have been in Stage II in his initial recording. Indeed, as indicated by Rose (2000:102), Théo is a few months older than Clara at the onset of data collection.

This prediction is also consistent with the implicational patterns reported in Harris (1994: 162-163), who notes "the existence of final VC] sequences in a language implies the existence of V] but not vice versa; ... and in languages permitting both V] and VC] the former is acquired before the latter."

In conclusion, the two proposed empty-category parameters – the Empty Onset Parameter and the Empty Nucleus Parameter – not only account for crosslinguistic variation but also make accurate predictions about syllable-acquisition sequences. Note that the two parameters still account for the Fikkert-Levelt data, account for final-consonant deletion, and account for initial-vowel deletion. The Fikkert-Levelt data include acquisitional sequences (for Jarmo and Noortje) in which the Empty Onset Parameter and the Empty Nucleus Parameter are set to their marked values at approximately the same time. Final-consonant deletion results from the unmarked setting of the Empty Nucleus Parameter, while initial-vowel deletion is caused by the unmarked setting of the Empty Onset Parameter.

4. Residuals and implications

In the Dutch data that we examined, the three syllable types – CVC, V, and VC – were acquired together. Yet, this finding is based on only three of the 12 children - Jarmo, Noortje and Tom. The 12 Fikkert-Levelt children are not ideal subjects in whom to study the earliest stages of syllable acquisition, because most of the children are already past those stages at the beginning of their corpora. The lack of significant ordering effects between CVC, V, and VC may well be counterexemplified by other Dutch children. Our prediction is that (11b) and (11c) will be the only additional patterns encountered, but this remains to be tested.

In agreement with Fikkert (1994) and Rose (2000), we contend that the initial stage of a child's grammar contains only CV syllables. The obligatory CV stage can be explained by the child having the unmarked settings for both the Empty Onset Parameter and the Empty Nucleus Parameter. Yet, the claim of an

initial stage with obligatory CV has been questioned recently, for example in (Bernhardt & Stemberger 1998), (Costa & Freitas 1998), and (Grijzenhout & Joppen-Hellwig, to appear). These researchers report that initial syllables are not always CV, but rather can also be V or VC.

We do not believe these researchers' findings are necessarily in conflict with our own. The difficulty is that the term "initial stage" is not explicitly defined. Sometimes the onset of data collection is regarded by researchers as the "initial stage," but the child's age at the initial observation varies considerably. Hence, even if a child produces V syllables in the initial recording, we should not conclude that this was necessarily among the first syllable-types that the child acquired. It is crucial to distinguish between the initial state of the child's grammar (say, at birth), and the state of the child's grammar when data collection begins (typically much later). Indeed, this same point is made by Rose, who suggests that the absence of an obligatory-CV stage in one of his subjects (Théo) might be due to the fact that he "actually went through a period where onsets were obligatory which ended before we started recording his outputs" (Rose 2000:102). The crucial prediction for our parametric analysis is that children who produce vowel-initial syllables in the initial recording will never go through an obligatory-CV stage *later*, because the marked setting implies the unmarked setting, and a later stage implies that the earlier stage has passed.

Our hypothesis that children syllabify the final consonant as an onset followed by an empty nucleus is supported by other work on child language, such as (Goad 1998) and (Rose 2000). The difference is that Goad and Rose claim that children initially syllabify final consonants as onsets of empty-headed syllables, but later they syllabify final consonants as codas. In our analysis, the final consonant can only be syllabified as an onset followed an empty nucleus; no resyllabification occurs.

Our parametric analysis predicts that some highly plausible learning paths will never be observed. In particular, acquisitional sequences in which VC is acquired significantly earlier than CVC, or in which VC is acquired significantly earlier than V, should be impossible.

Our analysis also suggests that certain older children may make the error of final-consonant deletion because their grammar does not yet allow empty nuclei. This has a direct implication for the appropriate phonological intervention. The intervention should help the child realize that a skeletal position is not always filled. A possible plan is to present the child with all the syllable types with empty categories (CVC, V, VC), and to teach the child to produce them (Pan 2002). The idea is that teaching the three syllable types with empty categories will be more efficient in helping the child make the generalization that empty categories are allowed. The conventional treatment for final-consonant deletion is only to teach the child to produce CVC syllables (e.g. Stoel-Gammon, Stone-Goldman, & Glaspey 2002:11). Our hypothesis is that an "empty-category intervention program" could be more efficacious, because it targets the root cause of final-consonant deletion, rather than a single manifestation.

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