Syllable types in cross-linguistic and developmental grammars[*]

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1. INTRODUCTION

In this paper we consider syllable types in acquisition, language typology, and also in a third dimension, namely production frequency in the language surrounding the language learner.

In Optimality Theory (Prince & Smolensky 1993) both language acquisition and language typology can be accommodated. The basic assumption is that constraints are universal, but that the rankings of these constraints are language particular. For language typology the idea is that different rankings reflect different (possible) languages. For acquisition the idea is that the learner needs to acquire the language-specific ranking of his mother tongue. The assumption here, like in most other work on acquisition to date (cf. Gnanadesikan 1995, Tesar & Smolensky 1996), is that structural constraints initially outrank faithfulness constraints. The grammar in this state prefers structurally unmarked outputs over faithful ones. By promoting faithfulness in the ranking, or by demoting structural constraints, the outputs can become more marked and more faithful to their inputs.[1]

What is the expected relation between language typology and language acquisition? Concentrating here on syllable types, languages can be structurally marked or unmarked with respect to the structural constraints that refer to syllable type: ONSET, NO-CODA, *COMPLEX-ONSET and *COMPLEX-CODA. A language is structurally unmarked with respect to a structural constraint when such a constraint dominates

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[1] The input is assumed to be similar, minus some perceptual loss, to the adult output.

faithfulness, and it is marked when such a constraint is dominated by faithfulness. For language acquisition the assumption is that the child's output is initially structurally totally unmarked. All the structural constraints dominate faithfulness. If this initial state of the grammar is equal to the final state grammar of the language to be learned, no further developmental steps need to take place. However, if the language to be learned is marked in one or more ways, the learner needs to acquire the appropriate grammar. The assumption is that this is done by promoting faithfulness to a position that outranks a specific structural constraint. This will lead to outputs that can be marked with respect to the outranked structural constraint. When the language to be learned is marked in several respects, it can be hypothesized that the learner acquires these marked aspects of the grammar gradually. That is, there could be a learning path where the learner, in going from the initial state of the grammar, $G_{initial}$, to the final state of the grammar, G_{final}, passes through several intermediate grammars. To combine language acquisition with language typology, the expectation is that the intermediate grammars of the language learner are also final state grammars of languages of the world. Vice versa, it is expected that since languages can be marked in different respects, there are different possible learning paths the learner of a very marked language can take to reach the final state. In its strongest form the hypothesis is thus that there is a 1:1 relation between grammars of languages in the world, and intermediate grammars in language acquisition.

In order to check these assumptions, we have combined data on cross-linguistic variation in syllable types (Blevins 1995) with data on the acquisition of syllable types (Levelt, Schiller & Levelt 1997). In the remainder of this paper we will first present the grammars of languages of the world, to which we refer, slightly off the mark, as "cross-linguistic grammars", that were deduced from data in Blevins. Then we will proceed to the developmental grammars discussed in Levelt, Schiller & Levelt, and the two sets of grammars will be lined up. The similarities and differences will be discussed, and finally, a solution for the particular nature of the learning path for Dutch children is presented in terms of syllable type frequencies in the input.

2. Cross-linguistic grammars for syllable type

From data in Blevins (1995) twelve different syllable type inventories could be deduced. These are listed in (1):

(1) Syllable Type Inventories

Language example	Type(s)				
Hua	CV				
Thargari	CV	CVC			
Cayuvava	CV	V			
Arabela	CV	CCV			
Sedang	CV	CVC	CCV(C)		
Mazateco	CV	V	CCV		
Klamath	CV	CVC	CVCC		
Mokilese	CV	CVC	V(C)		
Totonac	CV	CVC	CVCC	CCV(C)(C)	
Finnish	CV	CVC	V(C)	(C)VCC	
Spanish	CV	CVC	V(C)	CCV(C)	
Dutch	CV	CVC	V(C)	CCV(C)	(C)(C)VCC

As can be seen in (1), languages allow syllable types with different degrees of complexity. The language Hua has only syllable type, namely CV, while Dutch, like English, on the other end, allows a whole set of more complex syllable types. The one syllable type that all languages have in common is CV, and this type is regarded to be totally unmarked. In terms of markedness it can thus be said that Hua is structurally the most unmarked language with respect to syllable type, while Dutch is the most marked one.

In Optimality Theory there are two main types of constraints. On the one hand there are structural constraints that demand outputs to be structurally unmarked, while on the other hand there are Faithfulness constraints that demand outputs to be faithful to their inputs whether these are structurally marked or not. The ranking of structural constraints vis-à-vis Faithfulness in a grammar determines the structural markedness allowed in a language. When all structural constraints outrank Faithfulness the language is structurally totally unmarked, and when Faithfulness outranks all

structural constraints the language allows outputs that are structurally marked in any possible way. When Faithfulness is ranked somewhere in between structural constraints, the language allows some complexity in output forms.

The structural constraints that are relevant here are in (2):

(2) Structural constraints

ONSET	A syllable should have an onset
NO-CODA	A syllable should not have a coda
*COMPLEX-ONSET	A syllable should not have a complex onset
*COMPLEX-CODA	A syllable should not have a complex coda

The constraints ONSET and NO-CODA are well-known from the literature. The more general constraint *COMPLEX is split up into one constraint referring to onsets and one referring to codas. This is necessary to differentiate between languages that allow complex onsets but no complex codas and vice versa, and also to differentiate language learners that acquire complex onsets first from those who acquire complex codas first.

In (3), then, are the different rankings of the structural constraints from (2) vis-à-vis a general faithfulness constraint FAITH that characterize the typologically different languages in (1). This is called a factorial typology. The rankings of the structural constraints among each other are not relevant here.

(3) Factorial Typology

(a) Unmarked

Hua	ONSET	NO-CODA	*COMPLEX-O	*COMPLEX-C	>>**FAITH**

(b) Marked I

Cayuvava	NO-CODA	*COMPLEX-O	*COMPLEX-C	>>**FAITH>>**	ONSET
Thargari	ONSET	*COMPLEX-O	*COMPLEX-C	>>**FAITH>>**	NO-CODA
Arabela	ONSET	NO-CODA	*COMPLEX-C	>>**FAITH>>**	*COMPLEX-O

(c) Marked II

Sedang	ONSET	*COMPLEX-C	>>**FAITH>>**	NO-CODA	*COMPLEX-O
Mazateco	NO-CODA	*COMPLEX-C	>>**FAITH>>**	ONSET	*COMPLEX-O
Mokilese	*COMPLEX-O	*COMPLEX-C	>>**FAITH>>**	ONSET	NO-CODA
Klamath	ONSET	*COMPLEX-O	>>**FAITH>>**	NO-CODA	*COMPLEX-C

(d) Marked III

Totonac	ONSET	>>**FAITH>>**	NO-CODA	*COMPLEX-C	*COMPLEX-O
Spanish	*COMPLEX-C	>>**FAITH>>**	ONSET	NO-CODA	*COMPLEX-O
Finnish	*COMPLEX-O	>>**FAITH>>**	ONSET	NO-CODA	*COMPLEX-C

(e) Marked IV

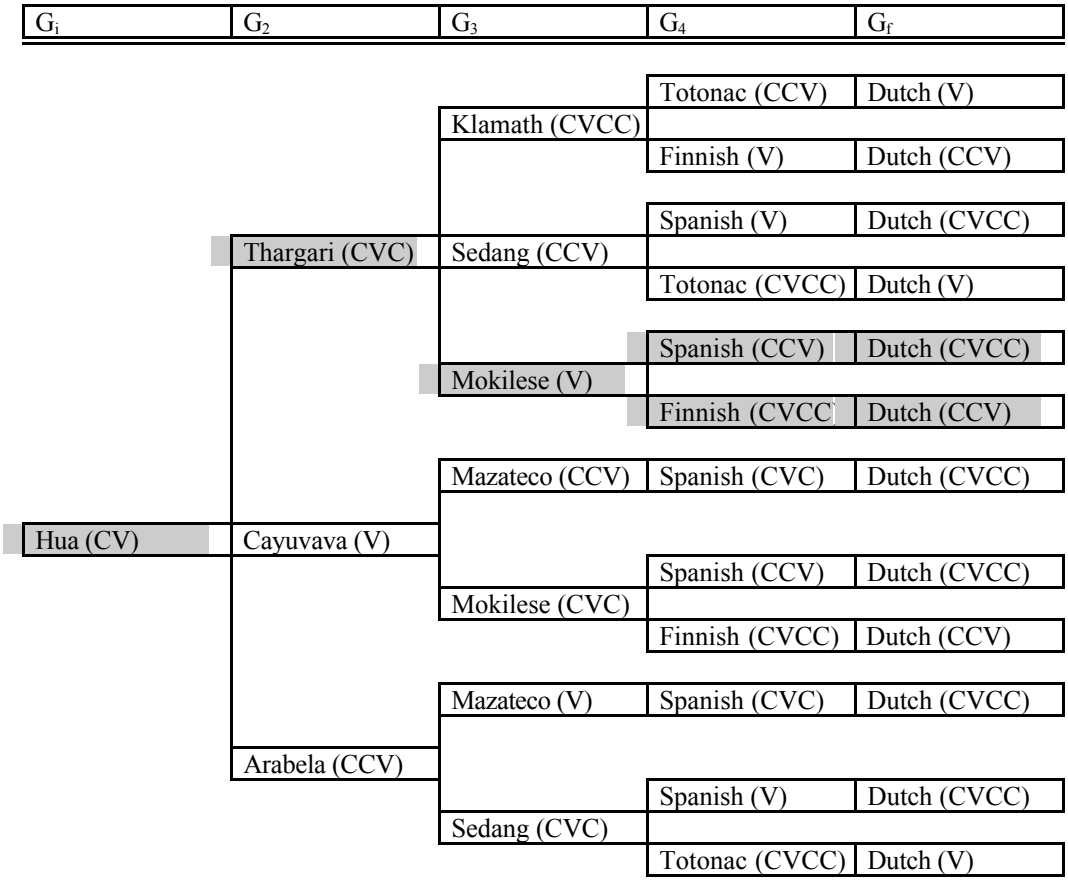
Dutch	**FAITH>>**	ONSET	NO-CODA	*COMPLEX-O	*COMPLEX-C

Because the constraints NO-CODA and *COMPLEX-C are interwoven to a certain extent, only two logically possible rankings are in fact impossible in practice, namely (i) NO-CODA >> **FAITH** >> *COMPLEX-C, *COMPLEX-O, NO-CODA, ONSET and (ii) NO-CODA, *COMPLEX-O, ONSET >> FAITH >> *COMPLEX-C. In both cases the ranking of *COMPLEX-C below NO-CODA is vacuous. All other possible rankings are thus attested in the world's languages, as given in Blevins (1995), and there are apparently no other languages that require different constraints and/or rankings in order to characterize their syllable type inventories. The rankings are grouped according to the degree of complexity that is allowed in outputs. In (a) is the *Unmarked* ranking for Hua, in (b) are *Marked I* rankings, that lead to syllable outputs that can be structurally marked in maximally one way, in (c) are *Marked II* rankings that allow well-formed syllables to be marked in two different ways, in (d) are *Marked III* rankings that allow well-formed syllables to be marked in three different ways, and in (e) are *Marked IV* rankings that allow well-formed syllables to be marked in four different ways.

3. FACTORIAL TYPOLOGY AND LEARNING PATHS

Assuming that the initial grammar in acquisition, G_i, leads to language output that is structurally maximally unmarked, and assuming that the final-state grammar, G_f, is either equal to G_i or a grammar that allows structurally more marked outputs, the learning path from G_i to the final-state grammar G_f is expected to link grammars that allow increasingly marked outputs. From the factorial typology in (3) above we can deduce twelve different paths that link the grammar from *Unmarked* languages, through those of *Marked I*, *Marked II* and *Marked III* languages respectively, to the grammar of the most marked *Marked IV* languages. These are depicted in (4). In all of these linkings, FAITH gradually moves up in the constraint ranking from the lowest position in the ranking to the highest position by promoting over one Structural constraint at a time. The linkings of the grammars from *Unmarked* to *Marked IV* languages are hypothesized to be the learning paths that a language learner could take, going from unmarked G_i to a most marked G_f. For ease of exposition, in (4) languages and a typical example of the added syllable types are mentioned instead of grammars.

(4) Learning paths deduced from the Factorial Typology



The shaded boxes in (4) indicate the learning paths from an unmarked initial stage to a final marked stage deduced from the data of Dutch children. In the next section we will discuss how these stages have been established. In section 5, the relation between cross-linguistic grammars and acquisition stages will be discussed, and in section 6 the specific learning paths taken by Dutch children will be explained through an interaction of the adult grammar and frequency.

4. LANGUAGE ACQUISITION

Levelt, Schiller & Levelt (1997) established the development of syllable types in longitudinal data of twelve children acquiring Dutch as their first language. For a period of one year these children were recorded every other week. The children's ages ranged between 0;11 and 1;11 at the start of the data-collecting period Approximately 20.000 spontaneous utterances formed the input to a syllabification algorithm developed by Schiller (Schiller, Meyer, Baayen & Levelt 1996). The resulting syllable type data from primary stressed positions were then submitted to a Guttman scale, at four different points in time, namely, first recording, first three recordings, first six recordings and all recordings. With a Guttman scale, a shared order - of development in this case - can be established, and it can be seen to what extent a particular order is followed by individual subjects. It turned out that there was a shared developmental order, with two variants. This order is shown in (5):[2]

(5) Developmental order for syllable type

A: > (5) CVCC, VCC> (6) CCV, CCVC

(1) CV > (2) CVC > (3) V > (4) VC > (7) CCVCC

B: > (5) CCV, CCVC > (6) CVCC, VCC

The structures CV, CVC, V and VC were acquired in this order by all the children. One group of children (A) then went on to acquire CVCC, VCC and CCV, CCVC, while another group (B) acquired the same structures in a different order, namely CCV, CCVC and CVCC, VCC. The last syllable type for both groups to be acquired was CCVCC.

[2] Compared to the order given in the manuscript by Levelt, Schiller & Levelt, some developmental steps have been collapsed here for ease of exposition

From these data a learning path through grammatical stages was deduced, from a G_i allowing only a structurally most unmarked output, via intermediate grammars, to a G_f similar to the grammar of Dutch. In these grammars, the structural constraints from (2) above featured, next to a general faithfulness constraint FAITH. We will come back to the exact nature of these developmental grammars below.

5. CROSS-LINGUISTIC GRAMMARS VERSUS DEVELOPMENTAL GRAMMARS

Given the linked cross-linguistic grammars in (4) and the developmental stages in (5), it is shown in (6) how these line up:

(6) Comparison between cross-linguistic grammars and developmental stages

Acquisition	Corresponding Language	Non-corresponding G_n alternative
G_i	Hua	
G_2	Thargari	Cayuvava, Arabela
G_3	?	
G_4	Mokilese	Sedang, Klamath
G_{5A}	Finnish	Spanish
G_{5B}	Spanish	Finnish
G_6	?	
G_f	Dutch	

As can be seen in (6), the hypothesis formulated above, namely that there is a 1:1 relation between developmental grammars and cross-linguistic grammars, appears to be too strong in two ways.

First, the process of the acquisition of syllable types appears to require more grammars than the established cross-linguistic grammars: apparently no cross-linguistic grammar exists that corresponds to the developmental grammars G_3 and G_6.

The developmental grammar G_3 allows CV, CVC and V syllables, but no syllables of the type VC, and no syllables with complex onsets or codas. The problem here is how specifically VC syllables can be disallowed. Since both CVC and V are allowed, both the structural constraints ONSET and NO-CODA must be dominated by FAITH. However, such a grammar would also allow VC syllables.

A similar problem arises for G_6. This developmental grammar allows, apart from CV, CVC, V and VC syllables, syllables with complex onsets and syllables with complex codas. However, syllables with both complex onsets and complex codas, CCVCC, are not allowed. In order for CCVC and CVCC to be allowed, FAITH must dominate both *COMPLEX-ONSET and *COMPLEX-CODA. This grammar, however, would also allow CCVCC syllables.

Both situations can be captured grammar-wise, by invoking Local Conjunction (Smolensky 1993, Kirchner 1996). Here two (or more) constraints are conjoined to form a derived constraint, which is violated just in case all the conjoined constraints are violated by an output candidate. This was done in Levelt, Schiller & Levelt. In order to capture the situation in the third developmental stage, in the grammar a conjoined constraint ONSET&NO-CODA dominated FAITH, while FAITH dominated both ONSET and NO-CODA. Output candidates of the type VC would violate this conjoined constraint, unlike V and CVC. For the situation in the sixth developmental stage a conjoined constraint *COMPLEX-ONSET&*COMPLEX-CODA was invoked, which dominated FAITH while FAITH in turn dominated both *COMPLEX-ONSET and *COMPLEX-CODA. This grammar disallowed CCVCC syllables, while allowing both CVCC and CCVC.

Several questions concerning this solution remain to be answered. First of all, do we need to take every developmental stage deduced from the Guttman scale seriously, i.e. as reflecting a specific developmental grammar? If we do, then the second question is

whether cross-linguistically a grammar exists which unexpectedly makes use of either of the proposed conjoined constraints. Although the conjoined constraints in the developmental grammars could also reflect something acquisition-specific, like transient processing problems, we will offer some speculations about the potential special status of both VC and CCVCC syllables in languages of the world.

A VC syllable in Dutch is heavy because it is closed. Since it is heavy it must be a foot, and perhaps feet, at a certain stage of acquisition, are required to begin with a consonant. Languages in which feet must begin with consonants are attested (Goedemans 1996, Gahl 1997, Downing 1998). This idea implies that, just like in child language, somewhere in the world a grammar could exist which allows for CV, CVC and V syllables but excludes VC exactly because it would be a foot without a beginning consonant. Further research should settle the matter.

Concerning syllables of the type CCVCC, it is worthwhile to observe that these are subject to a number of restrictions which are hardly discussed in the literature (but see Cairns 1988, Fudge 1968, 1987). Both clusters may not be each other's exact mirror image, for example. While Dutch has *lel* ``hit, earlobe´´ and in addition the words *klem* ``clasp´´ and *melk* ``milk´´, where it can be seen that *kl* is a well-formed onset and *lk* is a well-formed coda, a word like *klelk* sounds distinctly odd. This shows that even in Dutch, syllables with complex margins at both sides are extremely marked. So again we would not be surprised to encounter a grammar which not merely restricts but simply excludes syllables with both complex onsets and complex codas.

In (7), then, the sequence of developmental grammars, from G_i to G_f, is presented. Like in (3) above, we are only concerned with the dominance relations of structural constraints versus faithfulness, not with the rankings of structural constraints among each other. No ranking is indicated here. The conjoined constraints in (7) are **COMPLO&C* for *COMPLEX-ONSET & *COMPLEX-CODA, and *ONS&NC* for ONSET & NO-CODA.

(7) Developmental grammars for syllable type

G_i	*ComplO&C	*COMPLEX-C	*COMPLEX-O	ONS&NC	ONSET	NO-CODA	**>>FAITH**
G_2	*ComplO&C	*COMPLEX-C	*COMPLEX-O	ONS&NC	ONSET	**>>FAITH>>**	NO-CODA
G_3	*COMPLO&C	*COMPLEX-C	*COMPLEX-O	ONS&NC	**>>FAITH>>**	ONSET	NO-CODA
G_4	*COMPLO&C	*COMPLEX-C	*COMPLEX-O	**>>FAITH>>**	ONS&NC	ONSET	NO-CODA
G_{5A}	*COMPLO&C	*COMPLEX-O	**>>FAITH>>**	*COMPLEX-C	ONS&NC	ONSET	NO-CODA
G_{5B}	*COMPLO&C	*COMPLEX-C	**>>FAITH>>**	*COMPLEX-O	ONS&NC	ONSET	NO-CODA
G_6	*COMPLO&C	**>>FAITH>>**	*COMPLEX-C	*COMPLEX-O	ONS&NC	ONSET	NO-CODA
G_f	**FAITH>>**	*COMPLO&C	*COMPLEX-C	*COMPLEX-O	ONS&NC	ONSET	NO-CODA

Let us now turn to the second problem for the hypothesis that there is a 1:1 relation between developmental grammars and cross-linguistic grammars: there is less variation in development than expected. If we neglect G_3 and G_6 for a moment, of the twelve possible learning paths that link G_i to G_f only two are taken by the Dutch language learners (the shaded boxes in (4)). The developmental grammar G_2, for example, corresponds to the grammar of Thargari, not to the grammars of either Cayuvava or Arabela, which are equally possible; In going from G_i to G_2, FAITH could have promoted over *COMPLEX-ONSET, resulting in the grammar for Arabela, or over ONSET, resulting in the grammar for Cayuvava. The learners of Dutch, however, promote FAITH over NO-CODA. The only variation is for G_5. The learners of Group A acquire complex codas before they acquire complex onsets, and their grammar at that point is equal to the grammar for Finnish, which allows complex codas but not complex onsets. The learners of Group B acquire complex onsets first, and their grammar at this point corresponds to the grammar for Spanish, which allows complex onsets, but not complex codas.

One explanation for the lack of variation is that we do not have enough acquisition data yet. Awaiting a larger study, an alternative explanation is explored below.

6. GUIDES THROUGH THE LEARNING PATHS

It is thought that the structure of a grammar, combined with the assumptions that (i) in the initial state of the grammar structural constraints dominate faithfulness and (ii) that development consists of promotions of faithfulness in the hierarchy, determines which developmental steps can be taken. The twelve learning paths relating G_i to G_f are determined in this way. However, the idea is that when the grammar provides the learner with a choice, other factors will push the learner in a certain direction.

We will follow the learning path of Dutch learners in (4),[3] and see what could force the choice for specific learning path over other possible learning paths.

(i) G_i to G_2: Hua to Thargari.

In this developmental step, FAITH can be promoted over NO-CODA (Thargari), ONSET (Cayuvava) or *COMPLEX-ONSET (Arabela). In addition to CV, Thargari would allow CVC, Cayuvava would allow V and Arabela would allow CCV.

The question here is why the learners at this stage prefer CVC syllables over both V and CCV syllables. For CCV the answer could simply lie in the fact that the sounds needed for the production of complex onsets, especially liquids, are not acquired at this point (Fikkert 1994). The CCV option is therefore not a very likely one.

The learner's choice for CVC syllables instead of V syllables could be due to the special role of codas in Dutch. Lax vowels in Dutch can only appear in closed syllables (cf. Van der Hulst 1984, Kager 1989, Fikkert 1994, Van Oostendorp 1995 and Booij 1995, to give an non-exhaustive list). This generalization is based on three observations. First, words cannot end in lax vowels (/tɑksi/, but not /tɑksɪ/). Second, lax vowels cannot appear in hiatus (/piano/ but not /pɪano/). Finally, lax vowels can be

[3] For now we disregard the developmental stages that require reference to conjoined constraints. G3

followed by at most two non-coronal consonants (/rɑmp/), while tense vowels can be followed by at most one non-coronal consonant (/ram/ but not /ramp/). These observations can be explained if it is assumed that lax vowels only appear in closed syllables and that syllables can have at most one extra non-coronal consonant following the coda. In other words, syllables with lax vowels are *obligatorily* closed. In contrast to this, there is no process in Dutch which requires syllable to be *onsetless*. The picture that emerges is that CVC syllables are more salient than onsetless syllables and acquiring CVC before V would be a natural step.

The problem with this phonological explanation is that the distinction between lax and tense vowels is acquired relatively late in the acquisition process (Fikkert 1994). As a consequence, the distinction between tense and lax vowels is not yet acquired at the stage in which the children master the closed syllable. It is not clear, then, whether children at this stage would recognize the significance of codas, and therefore of CVC syllables, in Dutch.

However, the significance is reflected in the frequency of these syllables in speech input.

The corpus of syllable types in speech that was used here (J.C. Van de Weijer, p.c.) contained 120064 syllables. The significance of the differences between the frequencies of different syllable types was tested with Fisher's exact tests.

The syllable type CVC has a frequency of 30.1 in the speech corpus, and is the most frequent syllable by far after CV (42.1). Moreover, it is significantly more frequent than both V (3.6) and CCV (2.0), and the choice for a G_2 that would allow for CVC syllables could thus very well be based on frequency information.

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and G4 from (6) are thus collapsed, as are G6 and Gf.

(ii) G_2 to G_3: Thargari to Mokilese

FAITH can now be promoted over ONSET (Mokilese), *COMPLEX-CODA (Klamath) or *COMPLEX-ONSET (Sedang). In addition to CV and CVC, Mokilese would allow V and VC, Klamath CVCC, Sedang CCV and CCVC.

The choice here for onsetless syllables instead of a syllable with a complex margin could have the phonological explanation offered before: the sounds needed to produce clusters of consonants are still problematic. For this explanation to be tested, the data on the acquisition of certain sounds and the data on the acquisition of syllable types need to be compared.

Another explanation is again provided by frequency information. Frequencies: V + VC = 14.9, CVCC = 3.6, CCV + CCVC = 4.9. The onsetless syllables V and VC, with a frequency of 14.9, are significantly more frequent than either the type CVCC (3.6) or the types with complex onsets CCV and CCVC (4.9). In order to allow these most frequent onsetless syllables FAITH is promoted over ONSET.

(iii) G_3 to G_4: Mokilese to Finnish (Group A) Mokilese to Spanish (Group B)

FAITH can now be promoted over either *COMPLEX-ONSET (Spanish) or *COMPLEX-CODA (Finnish). In addition to CV, CVC, V and VC, Spanish would allow CCV and CCVC, Finnish would allow CVCC and VCC.

At this point variation is found. Some learners take the direction of Spanish, while others take the direction of Finnish. In terms of phonology, the ambiguity is expected, since complex codas and complex onsets are often mirror images of each other. The frequency guide fails too in this case. The frequency of the syllable types that would be added to the inventory by promoting FAITH over *COMPLEX-O, CCV and CCVC, is 4.9, while the frequency of the types CVCC and VCC, that would be allowed by promoting FAITH over *COMPLEX-C, is 4.0. The difference is not significant in this case, and therefore probably not salient enough to force a choice: some learners

promote FAITH above *COMPLEX-ONSET, others promote FAITH above *COMPLEX-CODA.

The relation between frequency data and the learning path is summarized in (8)

(8) Speech Input Frequency and the Learning Path

a. G_i: *COMPLEX-C, *COMPLEX-O, ONSET, NO-CODA >> FAITH

G_2 options	**result**	**Input frequency**
1: >>FAITH >> NO-CODA	Thargari. Adds CVC	CVC: 30.1
2: >>FAITH >> ONSET	Cayuvava. Adds V	V: 3.6
3: >>FAITH >> *COMPLEX-O	Arabela. Adds CCV	CCV: 2.0

CVC is significantly most frequent, option 1 is taken.

b. G_2: *COMPLEX-C, *COMPLEX-O, ONSET >> FAITH >> NO-CODA

G_3 options	**result**	**Input frequency**
1: >> FAITH >> ONSET, ...	Mokilese. Adds V and VC	V + VC: 14.9
2: >> FAITH >> *COMPLEX-O,	Sedang. Adds CCV and CCVC	CCV + CCVC: 4.9
…		
3: >> FAITH >> *COMPLEX-C,	Klamath. Adds CVCC	CVCC: 3.6
…		

V is significantly most frequent, option 1 is taken.

c. G_3: *COMPLEX-C, *COMPLEX-O >> FAITH >> ONSET, NO-CODA

G_4 options	**result**	**Input frequency**
1: >> FAITH >>*COMPLEX-O,	Spanish. Adds CCV and CCVC	CCV + CCVC: 4.9
…		
2: >>FAITH >> *COMPLEX-C,	Finnish. Adds CVCC and VCC	CVCC + VCC: 4.0
…		

No significant difference between input frequencies. Some learners take option 1, other learners take option 2

On the whole, then, the frequency of syllable types in Dutch speech appears to be a good candidate for a learner's guide through the learning paths. In the case of Dutch it could exactly predict the choice for some specific grammar, when there were several possibilities. It is likely though, that the frequencies of syllable types in speech, in turn reflect the nature of the grammar of the language in question.

7. Conclusion

Syllable types have been considered from three different angles in this paper: Acquisition, typology and production frequency. In line with the OT literature on language acquisition, it is assumed that acquisition is a process in which faithfulness dominates more and more markedness constraints. Second, the syllable types of a number of languages have been considered and, in line with one of the central claims of Optimality Theory, it was concluded that differences between languages can be represented as a differences in the ranking of constraints. This served as the basis for the hypothesis that every stage in the acquisition of a language should correspond to a cross-linguistic grammar.

This correspondence has been found for all but two stages in the acquisition of Dutch syllable types. It could be that the relevant non-corresponding stages, requiring reference to conjoined constraints, are acquisition-specific. If this is true it should be explained why re-ranking of constraints in acquisition is different from re-ranking constraints in cross-linguistic grammars. Furthermore, it would cast doubt on the idea that constraints are innate and universal. As far as we can see, however, there is no principled reason why these stages should not correspond to cross-linguistic grammars.

The other part of our hypothesis implied that every cross-linguistically determined grammar could form an intermediate developmental grammar in the learning path from

unmarked Gi to the Gf of a very marked language. It turned out, however, that the learners of Dutch followed a specific learning path, from numerous possible paths.

This lack of variation is attributed to factors that guide the learner through the possibilities. Production frequency, often grounded in the grammar of the target language, appears to determine which learning path is followed. If the child has a choice between various paths, the path of the significantly most frequent syllable type is chosen. If there is no significant difference between the syllable types that correspond to different possible paths, variation is expected and attested.

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