SYLLABLE GEOMETRY

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1. INTRODUCTION[1]

Of all syllable types, CV is often taken to be the least marked type[2]. In order to know what the statement "CV is the unmarked syllable type" actually means, we have to consider the history of the term "markedness".

As is well known, the notion of markedness is based on the use Trubetzkoy made of the notion of mark[3] in privative oppositions. It was, among other things, the direction of neutralization that brought Trubetzkoy to the idea that, e.g., a voiced stop is distinguished from a homorganic voiceless stop by the fact that it bears an additional mark. If there is neutralization between the two types of stops, the voiced member of the pair looses its mark "voiced" and hence becomes voiceless.

Typologists like Greenberg (1966) have used this idea of marking in order to make general cross-linguistic comparisons. In most cases, this extension of the notion of markedness has proved satisfactory. For instance in the case of the opposition voiced/unvoiced in stops, it was found that in many languages there is a neutralization between a voiced and a voiceless stop in certain positions, the resulting segment being unvoiced. No languages are known in which a general neutralization in the opposite direction can be found. The cross-linguistic distribution of the different types of stops also seems to confirm the correctness of this extension of the notion of "markedness". Taking again the example of the opposition between voiced and voiceless stops, it has been noted that there are many languages which have voiceless stops, but not voiced ones, in their phoneme inventory, while there are no languages which have voiced stops but not voiceless ones[4].

However, as far as I know, little attention has been paid to the logical possibility that in one language or in one group of languages the marked

value of an opposition or correlation is the reverse of that found in other languages. As we will see below, this it is precisely the situation that we seem to encounter with regard to syllable structure.

Concerning syllable structure, processes of neutralization seem to favor a CV syllable structure, at the expense of other types of structure. Schane (1972: 207) mentions a type of rule which he terms "the preferred syllable structure rule". For instance, the well-known truncation (or, from a different point of view, liaison) phenomena in French involve a rule which deletes the *t* of *petit* in *petit garçon* [pətigarsɔ̃] 'little boy', but which does not affect it in *petit ami*, [pətitami] 'little friend'. According to Schane, such a rule –a rule deleting a consonant before another consonant– is a natural rule because it creates a CV syllable structure, which he claims to be the preferred structure. Schane then goes on to say that "in French the whole complex interplay of elision and liaison is intended to guarantee the CVCV pattern" (p. 208). Because of this type of phenomena, CV can be taken to be the unmarked syllable in French. Cross-linguistic comparison seems to confirm the idea that CV is the unmarked syllable type (see, e.g., the survey by Bell 1971): phonological processes which change the structure of the syllable often seem to aim at creating a CV structure.

In certain other languages, however, a CV syllable (i.e., an open syllable with a short vowel), can be regarded as marked. Trubetzkoy (1969: 178) mentions that in German, Dutch, and English, a syllable with a long vowel must be considered unmarked. This is because in a stressed final open syllable, the opposition long/short is neutralized in the direction of long vowels.

It seems that, in such a case, we are faced with a conflict between the original meaning of "markedness" (relating to privativity) and the typological meaning of the term. I will show here that this conflict can be resolved by a deeper study of syllabification, i.e. the process of assignment of syllable structure.

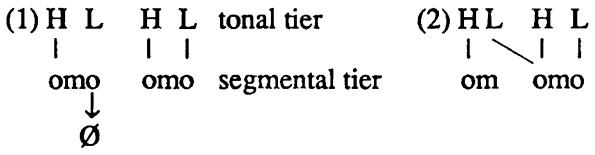
2. AUTOSEGMENTAL PHONOLOGY AND SYLLABIFICATION

Unlike other theories of syllabification, my syllabification model exploits all the basic principles of autosegmental phonology, as developed by Williams (1971 [1976]) and Goldsmith (1976). Therefore it is useful to give a short outline of these principles (for a more extensive overview, see van der Hulst and Smith 1982, 1985).

2.1. SOME BASIC CONCEPTS OF AUTOSEGMENTAL PHONOLOGY

Crucial to autosegmental phonology (and to nonlinear phonology in general) is the idea of a *multilayered* representation. In their general

overview, van der Hulst and Smith (1985: 14) mention three arguments for separating a tonal and a segmental tier. The first is that it is observed that if an element (a so-called *tone bearing unit* (TBU)) bearing a tone is deleted, the tone remains and is connected to another TBU. Consider the form in (1) (from van der Hulst and Smith 1985: 14):



Initially, the hypothetical form *omo omo* contains an alternating high-low tone pattern, starting with a high tone. However, as shown in (1), the second vowel is deleted, but not the low tone which is linked to it. As a result, this tone is now "floating". In this type of situation it is frequently noted that the floating tone is then linked to another TBU, even if this unit already bears another tone. In our case the result will be as in (2), where a low tone followed by a high tone is linked to what is now the second syllable of the form. The resulting sequence of a low tone followed by a high tone linked to the same TBU is realized as a *rising* tone. The process of linking unlinked tones to TBU's that are already linked to other tones is called *dumping* (cf. below for a summary enumeration of the basic principles of autosegmental phonology).

The second argument is the fact that in many tone languages there are certain morphemes that consist exclusively of a tone, or morphemes that, although they have a TBU, do not have a tone themselves.

The third argument concerns the fact that words consisting of different numbers of syllables may display a behavior that strongly suggest that they have the same tonal melody. For instance, in Etung (cf. Edmunson and Bendor-Samuel 1966) we find the following melodies on mono-, bi- and trisyllabic words (taken from van der Hulst and Smith 1985: 14):

(3)	1 syllable	2 syllables	3 syllables
(a)	L	L L	L L L
(b)	H	H H	H H H
(c)	L͡H	L H	L H H
(d)	H͡L	H L	H L L
(e)	-	L H͡L	L H L
(f)	-	H L͡H	H L H
(g)	-	L L͡H	L L H
(h)	-	H H͡L	H H L

The notations L͡H and H͡L indicate a rising and falling tone respectively. We see here that we have the same tone patterns. If there are not enough syllables to allow for a one-to-one relationship between syllables and tones, the tones are realized as rising or falling tones (so-called *contour* tones).

This has led Goldsmith (1976) to posit the following *Association Conventions*:

(4) **Association Conventions:**

(a) **Mapping:** Insert association lines between *one* tone and *one* TBU – going from left-to-right/right-to-left – starting with the left/rightmost tone and TBU.

(b) **Dumping:** Left over tones are associated to the nearest TBU to their right/left.

(c) **Spreading:** Left over TBU's are associated to the nearest tone to their left/right.

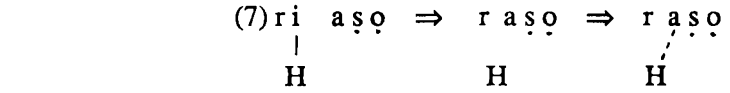
Let us now see step by step how these principles apply in the Etung case. In Etung, mapping takes place from left to right. (3a) and (3b) are forms that have only one tone. The low tone in (3a) and the high tone in (3b) are linked to the leftmost syllable by the principle of mapping, after which spreading has to take place to the following syllable in the bisyllabic forms and to the following two syllables in the trisyllabic forms. In (3c) and (3d) there are two tones. In the case of the monosyllabic forms the first tone is linked to the syllable by mapping. The second tone is then dumped on this same syllable. In the case of the bisyllabic forms, mapping takes place from right to left, and after this process neither unlinked tones nor unlinked TBU's are left. Hence no spreading or dumping needs to take place. In (3e-h), there are three tones. In the case of the bisyllabic forms the first two tones are linked by left-to-right mapping. The third tone that is left over is then linked to the rightmost syllable by dumping. In the case of the trisyllabic forms, left-to-right association (mapping) between tones and syllables takes place, and all the nodes are satisfied: there are no empty nodes left over, neither syllables nor tones.

After Goldsmith had formulated these principles, Halle and Vergnaud (1982) rejected the idea of universal spreading, by showing that prelinked tones (i.e., tones which are linked to a TBU in the lexicon) do not spread. Subsequently it was shown by Pulleyblank (1983: 117ff.) that at least for some languages spreading simply does not apply at all, or does not apply to certain word classes. If it does not take place, a *default value* (usually a low or a mid tone) is assigned to the relevant empty tone-bearing unit. (Although Pulleyblank claims that spreading takes place by a rule, it is still a general mechanism. Whether it takes place or not is a parametrized choice.)

A comparison of the Yoruba forms in (5) and (6), taken from Pulleyblank (1983: 123-125), shows how default assignment works (" ´ ", " ` ", "-" stand for a high, a low and a mid tone respectively):

(5) ṣē ọ̀rẹ́ → ṣọ̀rẹ́ 'to be friends'
(6) rí āṣọ̄ → ráṣọ̄ 'see a cloth'

We see that a process of vowel deletion is operative here, deleting the leftmost vowel in a sequence of two vowels. In (5), the mid tone which belonged to the deleted vowel has disappeared as well, but in (6), the second vowel has become high, i.e. it has adopted the tone of the first vowel. This is explained as follows: some vowels in Yoruba bear a tone of their own, others are toneless, i.e. they have no tone of their own. If these end up having no tone, eventually a default tone value, here a mid tone, is assigned to them. In (5), the deleted vowel is toneless (in cases where it is not deleted it eventually receives a (default) mid tone). In (6) however we are faced with the following situation:

(7)


Here the first vowel is deleted, but not the tone which belonged to it. The now floating H is mapped to the next vowel, the *a*, which was toneless (in other cases this vowel shows up with the default mid tone). Since spreading is not operative, the following *o* remains toneless and receives a mid tone by default tone assignment.

We thus have four major principles in autosegmental phonology which, as we will see below, all play a major role in syllabic phonology also: *mapping*, *dumping*, *spreading*, *default value assignment*. These four principles reflect the tendency of both tones and TBU's to avoid remaining unlinked. Mapping is either driven by the tones, or by the TBU's or both; spreading and default value assignment are driven by unlinked TBU's; dumping is driven by unlinked tones. We will see below (2.4) that in similar cases where two kinds of reduplicative elements are to be linked, it is not always the elements on both layers that trigger the linking processes.

2.2. SYLLABIC STRUCTURE AND EMPTY NODES

Having outlined the principles of autosegmental phonology, we now come to the structure of the syllable. A classic way of looking at the syllable is in terms of a division between *onset* and *rhyme*, where the onset contains all the material before the syllabic sonority peak, and the rhyme the

remainder in the syllable. The division is given in (8); thus, a syllable *ta* has the structure given in (9):

(8) 

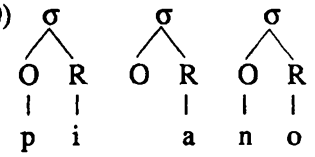
σ = syllable
O = onset
R = rhyme

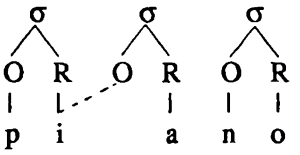
(9) 

The bipartition between onset and rhyme has been advocated by, among others, Pike and Pike (1947) and Fudge (1969). One reason that is usually mentioned is that these constituents are relatively independent of each other with respect to syllable weight and phonotactic restrictions: while it is observed that relatively few restrictions hold between onset and rhyme, there are many restrictions applying within the domains of the onset and of the rhyme themselves.

Because syllable structure is normally predictable, it is usually taken to be assigned by rule or algorithm rather than to be underlyingly present in the lexicon[5]. The process of assignment of syllable structure –syllabification– can be thought of as assigning a specific structure like (8) to a string of segments. According to this conception, the basic subsyllabic nodes like onset and rhyme are always present if there is material in the string that requires to be syllabified. For instance, if a syllable starts with a vowel (which has to be linked to a rhyme), the onset will be present but empty.

The fact that the onset is present in such cases can be demontrated by a very common type of process, the filling of empty onsets. As first example, let us consider the optional pronunciation of the word *piano* in French: [pijano][6]. We assume a possible initial syllabification as in (10):

(10) 

(11) 

The process we are faced with here is one of spreading of the high unrounded front vowel to the empty onset of the second syllable. The behavior of *i* in (11) is parallel to that of tones and the role of the onset to that of a TBU. Because of the fact that *i* spreads to the onset, which is not the peak of the syllable, it is realized as a homorganic glide, i.e. a non syllabic high vowel.

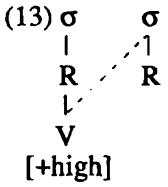
We thus see that the notion of spreading can be used to explain a phenomenon for which otherwise a rule would have to be formulated. In the SPE-framework, such a rule would be formulated as in (12):

(12) **Glide insertion**

$$\emptyset \rightarrow \begin{bmatrix} \text{- syll} \\ \text{- cons} \\ \text{+ high} \\ \alpha \text{ round} \\ \beta \text{ back} \end{bmatrix} / \begin{bmatrix} \text{+ syll} \\ \text{+ high} \\ \alpha \text{ round} \\ \beta \text{ back} \end{bmatrix} \text{ —— } V$$

This rule, of course, explains nothing. It explains neither why the glide inserted after the high vowel is homorganic to that vowel, nor why the glide insertion takes place precisely before a vowel and not before a consonant. Other syllabification theories which do not employ the notion of empty nodes have the disadvantage of having to state specific linking rules. In such a framework (see, e.g. Hayes 1989[7]), a rule like the following one has to be formulated:

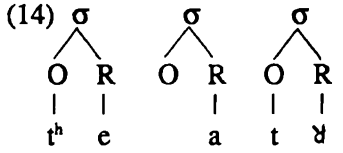
(13)



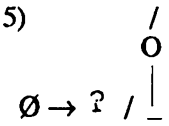
Although here we are faced with a far more general and elegant rule than the SPE type rule in (12), it still does not explain why the process of linking the high vowel to the second syllable takes place precisely if and only if this syllable starts with a vowel.

Another example of an autosegmental process is provided by a process of onset filling in German. In German and indeed many other languages, a vowel which is underlyingly in word-initial position or is word-internally preceded by a nonhigh vowel[8], automatically gets a glottal stop in front of it. Hence a word like *Theater* is pronounced as [tʰe ʔ at̪ɐ̯]. We can thus say that the syllable structure assigned by syllabification is as in (14):

(14)



It can be assumed that a neutral, or *default* consonant fills the onset by an automatic process. This default consonant is usually a glottal stop, but it can also be, e.g., a *t* as in Axininca Campa (described by Payne 1981: 107ff.). The process of onset-filling in German can be schematized as in (15):

(15)


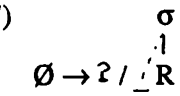
(15) says that an empty onset is filled with a glottal stop. It should be noted that (15) is not really a rule that needs to be stated. One only needs to state in the grammar that an onset cannot be empty in German, and that the glottal stop is the neutral (or: default) consonant; language independent principles will take care of the rest. We are thus faced here with default value assignment, which as we have seen in section 2.1, is an autosegmental principle, along with spreading.

If this process were accounted for in a linear framework, then we would have to write the following rule:

(16) SPE-type glottal stop insertion

$$\emptyset \rightarrow ? / \left\{ \begin{matrix} V \\ \# \end{matrix} \right\}\_ \; V$$

Again we see that a consonant is inserted before a vowel and not before another consonant, something a linear framework cannot explain. If we try to formulate a rule in a hierarchical syllabic framework, but without empty subsyllabic nodes, we get a rule like the following:

(17)


Although, like rule (13), this rule is more elegant than its linear counterpart, it does not explain why a glottal stop is inserted before a rhyme and not before a consonant.

The type of phenomena discussed here suggest that syllabification can generate empty syllabic nodes that trigger syllabic adjustment processes. The nature of the processes that occur is completely governed by the principles of autosegmental phonology. Here we have seen two cases of onset filling. Onset filling takes place either, as in the French case, by spreading of the high vowel to the empty onset position, or, as in the German case, by insertion of the neutral (or default) consonant glottal stop. Indeed, it seems that if there is a string which has to be syllabified, a complete syllabic structure consisting of onset and rhyme is superimposed onto the string of segments, and processes which fill the empty nodes can occur (although this will not necessarily happen in all languages).

2.3. REDUPLICATION PHENOMENA

Up to now, we have considered syllabic structures with only two basic nodes, onset and rhyme. I will claim below that this syllable structure is not universal, and that other syllabic structures contain empty nodes in certain cases. Assuming that empty nodes trigger readjustment processes like those exemplified in the preceding section, I shall now study reduplication phenomena, which have recently attracted the attention of a fairly large number of linguists.

McCarthy and Prince (1986) convincingly show that in many languages, reduplication can be seen as the assignment of an extra syllable of a specific shape to a copy of the string of the root. Consider the following data from Mokilese taken from Harrison (1976: 60-61) by McCarthy and Prince (1986: 21):

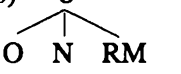
(18) **Mokilese Reduplication**

	Verb stem	Progressive	
(a)	pɔdok	pɔd-pɔdok	'plant'
(b)	wadek	wad-wadek	'pick'
(c)	kookɔ	koo-kookɔ	'grind coconut'
(d)	caak	caa-caak	'bend'
(e)	pa	paa-pa	'weave'
(f)	wi.a	wii-wi.a	'do'

In (18f) "." indicates a syllable boundary. We see here that the reduplicative prefix is always a long syllable, which either has the form CVC (18a,b) or CVV (18c-f). In (18a-d) the reduplicative prefix is simply a copy of the first three elements of the stem. This is not the case in (18e,f). Here, the reduplicative prefix cannot simply be a copy of the first three segments of the stem, since the stem itself consists of just two segments. In these latter forms, the vowel of the stem has apparently been copied into the reduplicative prefix and subsequently lengthened. As mentioned by McCarthy and Prince, this can adequately be accounted for by assuming that the reduplicative prefix is a heavy syllable. They state that the reduplicative prefix simply has the form given in (19), where "μ" stands for "mora":

(19) σμμ

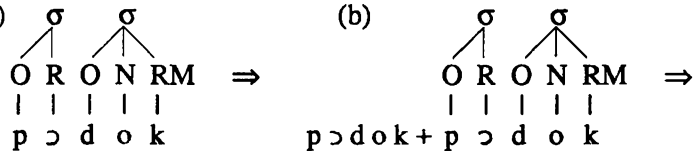
(20)

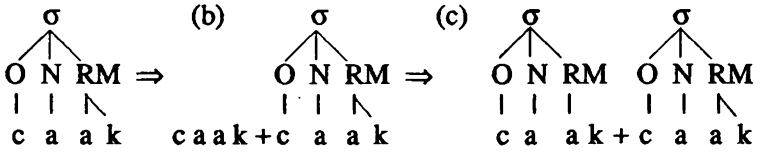


N = nucleus
RM = right margin

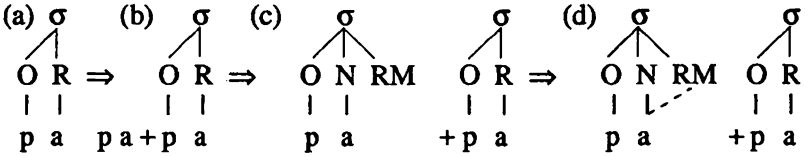
By (19) they mean a heavy syllable, which contains two morae. As is well known, the mora is the weight unit used by the Prague school and in the literature on poetic metre. McCarthy and Prince assume that a syllable does

not consist of nodes like "rhyme", but contains one or two (in exceptional cases three) morae. Translating their assumption into my framework, I shall assume that such a bimoraic syllable has the form given in (20). The process of reduplication in Mokilese can then be assumed to take place as follows: on the melodic (or segmental) tier, a copy of the stem is prefixed to the stem itself. The reduplicative syllable is then superimposed onto this form and one-to-one association (mapping) takes place from left to right. Examples of this process are given in (21) and (22), which correspond to (18a) and (18d) respectively:

(21) (a) 

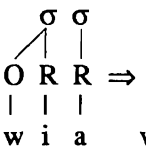
(22) (a) 

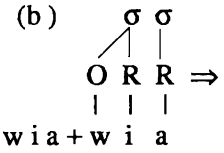
(The reader may wonder why in the reduplicated form in (22) the final *k* of the copy of the stem is not linked to the right margin of the reduplicative syllable. I will show below that this is because reduplication, unlike regular syllabification, is a morphological operation.) Now consider what is going on in (18e). Here the mapping of elements on the melodic tier to subsyllabic nodes will fail to fill the third subsyllabic node, cf. (23c):

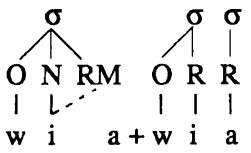
(23) (a) 

Then, as in tonal processes, spreading will take place, producing the outcome *paa* (23d).

That reduplication in Mokilese really involves assignment of a heavy syllable and not copying of the first three segments of the stem is confirmed by the data in (18f). If only copying were involved the outcome would be *wia-wia*, instead of the observed *wii-wia*. Assignment of a heavy syllable explains why we do not find *wia-wia*. A reduplicate of the form *wia-* would not consist of one (heavy) syllable, but of two syllables. Instead the first two segments of the melodic tier are incorporated into the reduplicative affix and subsequently spreading takes place[9]:

(24) (a) 

⇒ (b) 

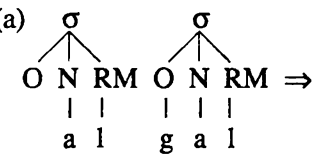
⇒ (c) 

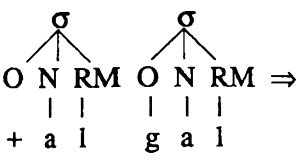
Apart from examples involving filling of the third position of the syllable in reduplication, we also find examples of onset filling in reduplication phenomena; cf. the following examples from Oyangand, again quoted from McCarthy and Prince (1986: 15), whose source is Sommer (1981: 237):

(25) **Oyangand Reduplication**

(a) /ẹḍẹṛ/	'rain'	ẹḍẹḍẹṛ	'heavy rain'
(b) /algal/	'straight'	algalgal	'straight as a ram rod'
(c) /igu-/	'go, walk'	igigun	'keeps going'

We see here that the reduplicate consists sometimes of two, sometimes of three segments. This can be explained in the following way: the reduplicative syllable is a heavy one; the initial syllable of the stem contains an empty onset. Cf. (26), which refers to (25b):

(26) (a) 

⇒ (b) 

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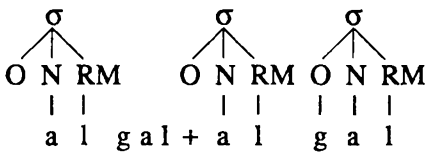
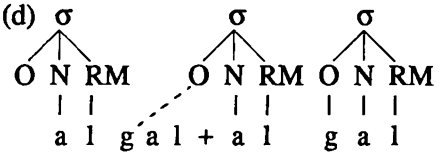
(c) 

Apparently, the mapping of the elements of the reduplicative copy on the segmental tier onto the tier containing the subsyllabic nodes (also called segment bearing units, cf. section 2.4) does not stop at the end of the syllable inserted by the process of reduplication. There is another empty node, the onset of the stem syllable, that is open for linking. Because of the process of reduplication, which involves the insertion of a copy of the melodic elements of the stem, the onset can now be filled[10]:

(26) (d)



After having seen the application of the autosegmental principles of spreading (French) and default value assignment (German) to basically syllabic processes, we are faced here with the application of a third autosegmental principle, the most fundamental of all, viz. mapping. Below, in section 2.4 where I define more precisely my concept of syllabification, I will show that the fourth fundamental principle of autosegmental phonology, viz. dumping, also has a role to play in syllabic phonology.

2.4.SYLLABIFICATION

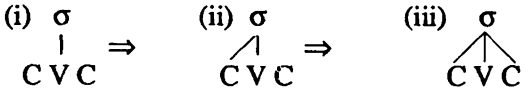
Up to now, two types of syllabification theory have generally been proposed. The first one is the *rule approach*, advocated in different versions by, among others, Kahn (1976), Steriade (1982), Levin (1985). In essence, it says the following:

(27) **Rule approach to syllabification**

(i) one syllable is associated with each [+syll] segment of the string;
(ii) a maximum number of consonants is associated with the syllable containing the [+syll] segment following them. The consonants must form a permissible syllable-initial cluster;
(iii) the remaining consonants are associated with the syllable containing the [+syll] segment preceding them. These consonants must form a permissible syllable-final cluster.

An example is given in (28):

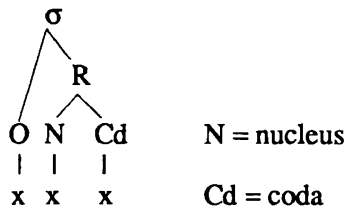
(28) (string to be syllabified: CVC)



As Itô (1986: 4-7) points out, this approach has to stipulate syllabification rules, while other models of syllabification can derive the desired result by invoking independently needed principles.

The second type of syllabification theory is known as the *template matching approach.* General mapping procedures map the string of segments to a *syllable template*, which functions as a set of well-formedness conditions. Such an approach is taken by, among others, Halle and Vergnaud (1978), Selkirk (1982), Noske (1982, 1988a), Itô (1986, 1988). The form of a template varies according to the authors, but it often has a structure like in (29)[11]:

(29)



Additional conditions can be applicable to the template. For an example, see the template and conditions proposed for French in Noske (1982: 259-261, 1988a: 46-48). These conditions have to state, e.g., which constituents are obligatory and which are optional. For example, it can be assumed that the peak of the syllable must always be present. Sometimes the onset is also obligatorily present. In addition, it must be stipulated how many segments may be linked to a specific node, and what their cooccurence restrictions are.

It must be realized, however, that if the template were only a set of well-formedness conditions, the template would not itself *trigger* phonological processes. It would only *block* derivations in two types of cases: (i) in the case in which a node must be present and phonetically realized, while there is no segment which can be linked to this node, and (ii) in the case where the string cannot be parsed into subsyllabic nodes, because it contains segments that cannot cooccur. This latter situation would arise, e.g., if the string contained a sequence of three consonants, and the syllable template allowed only for a single consonant in both the onset and the coda.

In contrast to the concept of the template as a set of pure well-formedness conditions, it has often been proposed that template mapping actually involves the creation of empty nodes which are present in the template but to which no segments correspond, as a result of the mapping process. Subsequently, either default segments are inserted into these empty nodes, or a linking of the nodes to segments that are already linked to other

nodes takes place. Here above we have seen that such processes occur in German and French for empty onsets. Insertion of a default vowel can take place in empty nuclei (see ter Mors (1985) for Klamath, Noske (1985) for Yawelmani, Itô (1986, 1988) for Axininca Campa, Icelandic, Arabic, Temiar). Linking of empty nuclei to vowel segments already linked to other nuclei takes place in e.g. many Bantu languages, whose maximal syllable is CV, when they adjust loan words of a more complex syllable structure to their own syllable structure requirements.

We thus see that in the literature cited, the template is not exclusively used as a set of well-formedness conditions, but as the superimposition of a certain hierarchical structure. I think that there has been a general failure to realize that a theory in which the template approach triggers syllable repair mechanisms like onset and nucleus filling crucially involves this imposition of a certain hierarchical structure. It thus seems that in such a theory, the template is of a complex and hybrid character: it is the expression of a set of well-formedness conditions as well as the assignment of a certain structure.

It is clear that this double role of the template shows that the theory is not well developed on this point. In the last decade, generative linguistics has developed, in both syntax and phonology, into a framework in which the interaction of very simple submodules accounts for the complex processes which are observed in languages. Therefore, it is better to separate the two roles of the template. As mentioned above, not all conditions are expressible within a template. In our view, then, syllabification is only the assignment of syllable structure, while conditions, which now can take a more simple form, are expressed separately. Most of these conditions will be applicable to one of the domains defined by the nodes *onset*, *nucleus*, and *right margin*.

The syllabification theory I propose derives from the assumptions of autosegmental phonology. It makes use of the same association conventions. These conventions apply between the tier containing segments and the one containing subsyllabic nodes, just the way they apply between the tier containing tones and the one containing TBU's. Because of this parallelism, I will refer to the subsyllabic nodes as *segment bearing units* (SBU's). I assume, then, that syllabification takes place as follows:

(30) **Syllable assignment theory**: The string of segments is scanned for nonsyllabified segments in a directional way (RL or LR). If an nonsyllabified segment is encountered, a syllable of the canonical shape is superimposed onto the string of segments. Then, optimal linking between the segments and segment bearing units takes place, according to the general conventions of autosegmental phonology. Then the scanning process begins again, etc.

The directionality of syllabification has been proposed by many linguists, e.g. Steriade (1984), ter Mors (1985), Noske (1985, 1987, 1988b), Dell and Elmedlaoui (1985), Itô (1986, 1988). According to the general autosegmental phonology conventions, the linking simply involves association in a one-to-one fashion (mapping) of the segments to the SBU's. It is triggered by the SBU's that were inserted when the first unsyllabified segment was encountered by the syllabification mechanism. Then, provided it is allowed by the wellformedness conditions, dumping takes place. It is in this way that an onset can be filled with more than one element. If an SBU has not been linked to any segment by one-to-one association or by dumping, then either the SBU will be filled with a default segment, or a segment already linked to another SBU will spread to it. Thus, we apply all four major autosegmental principles concerning the linking of elements to their bearing units.

By assuming the syllable assignment in (30), we have considerably narrowed the gap between normal syllabification and the processes of reduplication in e.g. Mokilese and Oyangand, as outlined in section 2.3. Recall that in these languages reduplication is the imposition of a specific syllabic structure to a copy of the verb root. Afterwards, association takes place. There remains only one major difference. The assignment of a syllabic structure to a verb root copy is a morphological operation, and is thus driven by the SBU's of the specified syllable, inserted by reduplication (this applies especially to reduplication in Mokilese), while in regular syllabification it is the result of the phonological requirement that all normal elements (i.e. not forming part of a reduplicate copy) have to be syllabified. Hence, with reduplication, the only requirement is that SBU's have to be filled. Therefore, one-to-one association (mapping) will take place, as well as spreading, but not dumping. It is for this reason that the reduplicated form in (18d) is *caacaak* and not **caakcaak* (cf. (22)). This also explains that, in general, in reduplication, if the root contains a complex onset, the onset of the reduplicate usually contains only the first element of that of the original.

3. THE NATURE OF THE ASSIGNED SYLLABLE

The reader will have noticed that the reduplicate syllables discussed in section 2.3. contain three basic nodes. This is in contradistinction with the usual onset-rhyme bipartition, which is usually taken as universal. We have also seen some spreading effects to the third position (e.g. in (23d)). This brings us back to our initial misgivings about the universally unmarked status of CV syllables. In the following, I will show that, in certain languages, similar spreading effects take place during regular syllable assignment.

3.1. DUTCH

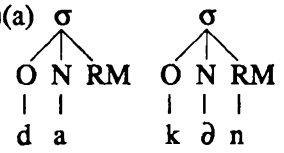
In Early Middle Dutch, there is a process of vowel lengthening in open stressed syllables (Schönfeld 1970: 30, van Bree 1977: 281-282)[12]. Although the process is no longer productive[13], the functioning of the process can still be seen in present-day forms:

(31)	orthographic form	phonetic form	underlying form	
(a)	dak	[dɑk]	/dak/	'roof'
(b)	daken	[da:kən]	/dak+ən/	(plur.)
(c)	god	[xɔt]	/xod/	'god'
(d)	goden	[xo:dən]	/xod+ən/	(plur.)
(e)	weg	[wɛx]	/wex/	'road'
(f)	wegen	[we:xən]	/wex+ən/	(plur.)

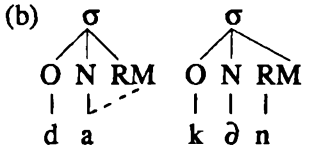
The singular form in (31c) also shows the working of the well-known process of final devoicing. It can be assumed that the syllabification of the plural forms involved the superimposition of a syllable of the form (32). After one-to-one association but before spreading we arrive at the structure in (33a). We then get spreading (33b):

(32)

(33)(a)



(b)

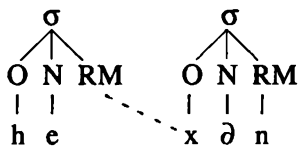


As mentioned above, this process is no longer productive. A plural of the form in (34), is not pronounced with a long vowel:

(34)	orthographic form	phonetic form	underlying form	
	heg	[hɛx]	/hex/	'hedge'
	heggen	[hɛxən]	/hex+ən/	(plur.)

According to van der Hulst (1984: 103) these forms contain an ambisyllabic consonant, which is short on the surface. In a recent article, Smith et al. (1989) reminded phonologists that phonetic measurements have revealed that this shortening does not take place fully. Indeed Nooteboom (1972: 33, 39-40) has found that consonants following short vowels in Dutch are statistically significantly longer than those following long vowels. This can be explained elegantly by assuming that in the course of history of Dutch the direction of spreading has simply been reversed. Instead of spreading from the left, spreading from the right takes place, hence the following consonant is linked to the empty third syllable position:

(35)

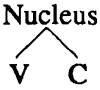


Thus the difference between Early Middle Dutch and Modern Dutch in this respect can be explained by the change in the setting of a single parameter. The fact that there are still plurals in Dutch behaving like the ones in (31) must be due to diacritical marking in the lexicon. The diacritic will indicate that the direction of spreading is reversed for these forms. Children learning Dutch frequently overregularize and pronounce the form in (31b) as [dɑk͡ən]. In any case, it must be concluded that the syllable assigned during syllabification contains three places and not two, in Modern Dutch as well as in Early Middle Dutch.

3.2. GERMAN

The situation in German is not very different from the one in Dutch. Writing in a somewhat different framework from ours (i.e. that of CV Phonology, based on Clements and Keyser (1983)), Wiese (1988: 87) stresses that the mimimal syllable nucleus in German must contain two elements, in his framework:

(36) Nucleus



Wiese (1988: 67) mentions that:

> A long tense vowel can be realized as a short lax one in colloquial language [...]. In these cases however, the following consonant will become associated with the end of the first syllable, i.e. it becomes ambisyllabic, in cases where there is only one consonant available. A syllable ending in a shortened vowel is impossible.

After having mentioned that this phenomenon of vowel shortening typically but not exclusively takes place in non-native words, especially if the vowel does not carry the main stress, Wiese gives the following examples of this type of alternation (1988: 68) (a dash over the consonant means that it is ambisyllabic):

(37) (a) *Afrika* [a:-fri:-ka:] vs. [af-rI͡ka:] 'Africa'
(b) *Metall* [me:-tal] vs. [mɛ͡tal] 'metal'
(c) *zumal* [tsU:-ma:l] vs. [tsU͡ma:l] 'even more so because"
(d) *Philosophie* [fi:-lo:-zo:-fi:] vs. [fI͡lo:-zɔ͡fi:] 'philosophy'
(e) *Kalender* [ka:-lɛn-dɐ̯] vs. [ka͡lɛn-dɐ̯] 'calender'
(f) *Kuli* [ku:li] vs. [kU͡li] "coolie"

We can conclude that in German, when a vowel is shortened, the position it occupied in the third SBU of the syllable in question becomes empty and then undergoes spreading from the following consonant[14]. This, combined with the fact that a syllable ending in a short vowel is excluded, demonstrates that the syllable is tripositional in German.

3.3. WIYOT

Wiyot is an Algonquian language spoken in North Western California. The main source is Teeter (1964). In Wiyot, the syllable is nearly always heavy. Teeter writes (1964: 16-17):

> Wiyot syllables always begin with a consonant or cluster followed by a vowel. Where the vowel is short they must also phonetically end in a consonant, the same as that of the beginning of the next syllable, except at the end of a word.

It is clear that the situation in Wiyot is quite similar to that in Modern Dutch. There are apparently three positions in the syllable, and spreading takes place from right to left. Thus the third position of the syllable is filled by the following consonant. At the end of a word, where there are no following segments from which spreading can take place, nothing happens, and this is thus the only position where we find light syllables. Apparently there is no filling of SBU's by default segments in this language.

3.4. NAVAHO

In their monograph on the phonology and morphology of Navaho, Sapir and Hoijer (1967: 3-4) report that when "an initial or medial CV [sc. syllable, R.N.] precedes another syllable that begins with a consonant, the consonant of the second syllable is mechanically lengthened". Sapir and Hoijer give the following examples:

(38) (a)	dišaah	→	diš.šaah	'I start to go'
(b)	tą́žii	→	txą̀ž.žiih	'turkey'
(c)	niyol	→	niy.yol	'wind'

If we assume that a syllable contains three positions, it is quite clear that this "mechanical" lengthening can be understood as the result of a spreading process, just as in the case of Wiyot and the Germanic languages. There is more evidence for a canonical three place syllable in Navaho, for Sapir and Hoijer continue:

> CV syllables that occur independently in final position in the word are invariably closed with an h. Strictly speaking, then, CV does not occur independently or in final position,

> the h which closes a CV syllable is phonemically identical with the final h of a CVh syllable.

As examples Sapir and Hoijer give:

(39) (a) to → txwoh 'water'
(b) to.n̥.li̥ → txwo.n̥.li̥h 'river'

This can be explained by the assignment of a default consonant, *h*, to the final (third) SBU in the syllable. It may be no accident that *h*, like the glottal stop we encountered in the German case, is a glottal consonant. These segments are probably the most neutral consonants of all, because they have no supraglottal articulation: they can be considered as a minimal gesture towards the production of a consonant. Finally, Sapir and Hoijer note:

> Followed by n̥, n̥C, or VV, (V and the other syllabic consonants do not follow CV), the boundary of the CV syllable is marked by a fall of sonority between its vowel and the n or V which follows.

This is the case in e.g. (39b) (in the first syllable), as well as in the following forms cited by Sapir and Hoijer (the drop in sonority is not indicated):

(40) (a) n̥.di.nɬ.ti̥ 'you have found him'
(b) n̥.lo.ee 'Hail Chant'

We think that this "drop in sonority" must be interpreted as the same kind of default assignment as the *h*-insertion at the end of a word: *h* in fact also constitutes a drop in sonority, more specifically a drop in voicing. If it is assumed that this is one and the same process, and that the introduction of the drop in sonority equals the insertion of a segment, the picture becomes quite clear. V's and syllabic nasals cannot spread to preceding right margin positions, because they are syllabic by nature: there is no evidence of gliding in Navaho, so it must be assumed that an element cannot spread from a nuclear position to a nonnuclear position, i.e. that syllabic elements are subcategorized for exclusively nuclear positions. Hence, only the principle of default value assignment remains in order to fill the empty SBU. It can be concluded, then, that Navaho also has a basically tripositional syllable.

4. CONCLUSION

In this article it was my aim to challenge the generally received idea that a short CV syllable is the unmarked syllable. In order to do this, I have constructed the following argument.

First, it was demonstrated that very general insertion processes like glide insertion (in hiatus position) or glottal stop insertion (in hiatus position as well as in the initial position of a word starting with a vowel) can best be seen as the filling of empty positions. By assuming this, these processes can be seen as the result of the general application of principles of autosegmental phonology, in this case spreading and default value assignment. These principles have found their motivation elsewhere in phonology. If one does not assume empty nodes, one has to posit specific rules, which of course means that generalizations have been missed.

Second, I have showed that reduplication in certain languages involves the superimposition of a specific syllable type (containing three positions or Segment Bearing Units) to a copy of the stem. In addition, we saw that in the case of Oyangand, spreading takes place from the copy of the stem to the empty onset position of the syllable to which the stem itself is linked.

Third, I have formulated a syllabification theory in which, just like in reduplication, a specific syllable is superimposed on the segments. The only difference being that this superimposition is segment driven (or skeleton driven) and not triggered by morphology, as in the case of reduplication.

Fourth, I have adduced evidence from two Germanic languages (Dutch and German) as well as from Amerindian languages (Wiyot and Navaho) that the syllable superimposed by syllabification contains three positions and not two, just like the syllable superimposed by Mokilese reduplication. This was done by showing how spreading applies in all these languages, as well as default assignment in the case of Navaho.

We can thus conclude that the observed discrepancy between the West Germanic languages, or languages like Wiyot and Navaho on the one hand, and many other languages on the other, is the result of a difference in the nature of the syllable assigned by syllabification[15].

NOTES

(1) I would like to thank Norval Smith, Linda Shockey, David Michaels and Michel Kefer for their comments on earlier versions of this paper. Remaining errors are mine. The ideas advanced in this paper are treated more extensively in Noske (in preparation).

(2) An example of such claims can be found in Vennemann (1988: 69, fn.3).

(3) Trubetzkoy (1969: 10) indicates that the notion "mark" (Merkmal) stems from Karl Bühler.

(4) Moravcsik and Wirth (1983: 11), referring to Aguas (1968), mention the Australian language Gudandji as a possible exception. The voiced stops in this languages are, however, only "lightly voiced".

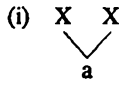
(5) Barra Gaelic (see Borgstrøm 1937, 1940) is sometimes quoted as an exception.

(6) Other possible pronunciations of *piano* in French are [piano] and [pjano]. For an explanation of this variation, see Noske (1982: 290-292; 1988: 75-77). In these articles, I was not really concerned with explaining the possible pronunciation type [pijano]. The glide in [pijano] is referred to as being the result of an "epenthesis process" (1982: 309, fn.36; 1988: 88, fn.29). As shown here, it can be seen as the result of spreading, a very general principle.

(7) Hayes (1989) does not use the concept of rhyme, but uses morae instead. For reasons of exposition, I have maintained the rhyme node in (10).

(8) In the case of high vowels, spreading takes places as in the French case. Hence *Hiat*, 'hiatus' is pronounced as [hija:t].

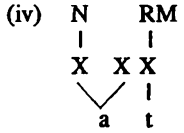
(9) Unlike (24), the right margin node in (22) does link to an *a*. This vowel however is preceded by another *a*. The two subsequent *a*'s in (22) must in fact be seen as a simplified representation for two adjacent slots on the CV or X-tier linked to the same segment:



The configuration in (i) represents an underlyingly long vowel. In a language where long vowels are permitted, but diphthongs like *ia* are disallowed, only slots on the CV or X-tier that are the second member of an underlying long vowel can be incorporated into the right margin node. We thus see that there are two possible representations for vowels that are long on the surface, that given in (ii) and that given in (iii):

The structure in (ii) represents an underlyingly long vowel which is syllabified into two subsyllabic nodes, and hence is also long on the surface. The structure in (iii) represents a vowel that is not long underlyingly but which has acquired surface length by the process of spreading: the single X-slot has been linked to two subsyllabic nodes. This lengthening process takes place only in a language where the process of spreading such as in (24c) is operative. A vowel can also be underlyingly long but short on the surface. This type of case can be found when the syllable structure does not permit the second X slot of the long vowel in (i) to be connected to the right margin. This may happen if

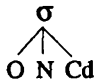
the right margin is already filled with a segment. Such a case is displayed in (iv), where the syllable is closed by a *t*:

(iv)


An example of such a shortening process can be found in Yawelmani (cf. Noske 1985: 348ff.).

(10) The reason why we do not get spreading in the reduplicated forms in (25a,c) (e.g. **eḍḍeḍeṛ* and **iggigun*) is not known, but there are two possible explanations. The first possibility is that spreading does not take place in this language, but only association. The second is that although spreading is available in the language, there is a general constraint against geminates. In both cases, the intervocalic consonant will be transferred from the right margin position of the first syllable to the onset position of the second syllable, since the third position of the reduplicative syllabe must be originally filled with a consonant followed by a syllable with an empty onset.

(11) The structure in (29) is a hierarchical one, in the sense that there is branching at a level below the syllable node. Davis (1982, 1985) has argued that the arguments for such a hierarchical structure are at least questionable, by showing among other things that many distributional restrictions do not apply between constituents in the rhyme, but, e.g., between the coda and the onset. He instead assumes a flat structure:



which I have assumed tacitly here. In addition, as I show in this article, syllable structure is sometimes bipositional and sometimes tripositional. I refer to the second node in a bipositional structure as "rhyme", while in a tripositional structure I refer to it as "nucleus". This is done here only to avoid the introduction of new and confusing terminology. However, I do introduce the term "right margin" replacing "coda" for the third position in a tripositional syllable structure, because in my theory a right margin can contain not only consonants, but also the second part of a long vowel or diphthong, whereas the usual conception of the coda does not allow for this.

(12) In Middle English, essentially the same process took place. See e.g., Strang (1970: 249), Steponavičius (1987: 167-168) and Dobson (1962).

(13) The lengthening as displayed in (31) is sometimes reproduced in modern loan words. Hamans (1988: 140) reports that the plural of the name of the Kanak tribe in New Caledonia was quoted on the radio and in certain newspapers as [ka:na:kɔ̀n] (orthographically *Kanaken*), while another newspaper used the form [ka:nɑ̀.kɔ̀n] (orthographically *Kanakken*).

(14) Hamans and Noske (1988) show that the schwa/zero alternations in German can be explained as a direct consequence of syllabification. The analysis presented there crucially involves directional syllable assignment (exactly as in the proposal in (30)), with the direction set from left to right, and a tripositional syllable. Unfortunately it would take us too far afield to present the details of this analysis here, but I refer the interested reader to the paper in question, which demonstrates the need for a tripositional syllable in German independently of the phenomena mentioned by Wiese.

(15) In Noske (1985, 1987) it is shown that for Yawelmani and Tonkawa respectively we need to posit a basic tripositional syllable as well. In these languages, syncope processes like "two sided open syllable deletion" (C → Ø / VC_CV) are clearly syllabically conditioned. Michaels (1989: 4-5) shows that the same is true for stressed syllables in English. This seems to disprove Vennemann's claim (1988: 2) that no syllabically conditioned process can go in the direction of a more complex syllable than CV.

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