COMPENSATORY LENGTHENING AND THE THEORY OF SYLLABIFICATION

by

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Abstract

In this thesis, a theory of Parametric Phonology, as developed for example by Kaye and Lowenstamm (1984), Lowenstamm and Kaye (1985) and Piggott and Singh (1985), is assumed. A particular setting for three different parameters is proposed in languages which have a process of compensatory lengthening in their grammar. The setting of the first parameter defines a language as being quantity sensitive; the setting of the second parameter determines a branching nucleus as a heavy syllable. As for the last parameter setting, it is characterized by the presence of a constraint on syllable structures which syllabifies a sonorant into a nucleus, if possible. It is argued that only segments which are found in the nucleus can trigger compensatory lengthening following their deletion. In the course of this thesis, it is argued that a principled and restricted theory of syllabification is needed to differentiate other "lengthening" processes from the process of compensatory lengthening under study in this thesis. Furthermore, within this framework, compensatory lengthening can be seen to follow from properties of representation and principles and parameters of Universal Grammar.

Résumé

Dans ce mémoire, une théorie de la phonologie paramétrique, telle que développée entre autres par Kaye et Lowenstamm (1984), Lowenstamm et Kaye (1985) et Piggott et Singh (1985), est présumée. Une mise en position particulière pour trois paramètres différents est proposée pour les langues qui possède un processus d'allongement compensatoire. La position du premier paramètre définie une langue comme étant sensible a la quantité de la syllable; la position du deuxième paramètre détermine qu'un noyau branchant est considéré comme étant lourd. Quant à la position du dernier paramètre, elle est caractérisée par la présence d'une contrainte de la structure syllabique qui syllabifie une sonorante dans le noyau d'une syllable, si la structure se prête à une telle syllabification. Il est argumenté dans ce mémoire que ~~seuls~~ les éléments se trouvant dans le noyau peuvent déclencher l'allongement compensatoire à la suite de leur effacement. Dans l'ensemble de ce mémoire il est argumenté qu'une théorie restrictive et basée sur des principes universels est nécessaire pour pouvoir différencier entre certains processus d' "allongement" et le processus d'allongement compensatoire à l'étude dans ce mémoire. De plus, à l'intérieur de ce cadre paramétrique, l'allongement compensatoire peut être considéré comme découlant de propriétés de représentation et de principes et paramètres de la Grammaire Universelle.

Acknowledgements

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I am also indebted to Zofia for the encouragement she gave me and for reading and making editorial comments on an early draft of my thesis.

Finally, I would like to thank my thesis advisor, Professor G.L. Piggott, whose criticisms and suggestions have been invaluable in shaping the thrust of this thesis. Naturally, any remaining omissions, inconsistencies, ambiguity and innacuracies are my own.

The main work for this thesis was written two years ago. Its submission, however, was delayed for reasons beyond my control. Although this study does not reflect the more recent works in phonology, I believe that nothing that has been recently published contradicts in any way the main assumptions underlying the proposals put forward in this thesis.

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CHAPTER III - APPARENT COUNTEREXAMPLES

0. Preface

Certain phonological processes are found in language after language. To describe them simply in terms of language-specific rules would entail that very important generalizations are being missed. An alternative means of describing those processes __without resorting to phonological rules__ would be to appeal to the principles and parameters of Universal Grammar. Such an approach is advocated by Chomsky (1981). Singh (1980) takes a similar position, arguing that some phonological processes can be characterized as repair strategies invoked to fix up violations of well-formedness conditions on such prosodic domains as the syllable, the foot and the word. Singh claims that each of these strategies (e.g. resyllabification, assimilation, epenthesis, etc.) would be the result of the setting of some parameter, an option available, in principle, to every grammar. The setting of one parameter may also be prompted by the prior setting of another parameter (i.e. the setting of the first parameter may force the setting of the second parameter in a certain way). Furthermore, the presence or use of a particular strategy may be linked to the parameter settings found in a particular grammar.

In this thesis, I claim, following Hayes (1981), that there is a parameter of Universal Grammar, the setting of which defines languages as being either quantity sensitive or quantity insensitive. Sensitivity to quantity means that rules of the language may be influenced by the branching or non-branching of certain nodes of syllable structure, i.e. by the weight of the syllable. For example, a language may have a rule which can only apply to syllables having a branching nucleus, or it may have a rule which is sensitive only to branching rimes. That particular language must be able to look below the level of the rime to find the appropriate environment for the application of those rules. In a quantity insensitive language, on the other hand, no rule will be conditioned by the branching or non-branching of the rime or of its constituents. In those languages which are quantity sensitive, a further parameter determines which branching structures define a heavy syllable (i.e. branching rime, branching nucleus or both).

I also claim that some processes can be found only in quantity sensitive languages. Furthermore, of those processes that are found in quantity sensitive languages, some will only be found in languages where a branching rime is considered the defining characteristic of a heavy syllable, whereas others will only be found in languages where a branching nucleus is considered heavy. Compensatory lengthening and gemination are two such processes, compensatory lengthening being found in languages where branching nuclei define heavy syllables and gemination in languages where a branching rime is considered to mark a heavy syllable. I further claim that this distribution of the two processes is linked to a strategy to keep syllables heavy. Thus, gemination will fill an empty position in the coda of a branching rime, while compensatory lengthening will fill an empty position in a branching nucleus.

In Chapter 1, I will provide an overview of compensatory lengthening under three different frameworks. First, I will look at the linear framework and show how this framework was ill-equipped to deal with a process such as compensatory lengthening. Then, I will look at two different frameworks within non-linear phonology: the autosegmental approach and the metrical approach. I will discuss analyses of compensatory lengthening done within both those frameworks. Finally, I will describe the particular theory of phonology I assume in this thesis.

In Chapter 2, I will define the process of compensatory lengthening under study in this thesis. I will, then, present analyses of 'lengthening' in four different languages: Kwakiutl, Lithuanian, Luganda and Ancient Greek. I will show that, of those four languages, only Lithuanian and Ancient Greek demonstrate the presence of a process of compensatory lengthening in their grammar, even though analyses of compensatory lengthening have been proposed in Luganda.

I will argue throughout this thesis for the need for a very restricted and principled theory of syllabification, such as the one I assume, to differentiate between compensatory lengthening and other 'lengthening' processes.

In Chapter 3, I will deal with what seem to be counterexamples to my claims and will show that, in fact, those apparent counterexamples fall within the scope of my analysis.

Chapter 1

The Background

1.1 Linear Phonology

In a phonological model of the type outlined in Chomsky and Halle (1968) (hereafter SPE), a process such as compensatory lengthening poses certain problems in terms of how it is to be represented by mean of rules. Compensatory lengthening is a process which entails the lengthening of a vowel following the deletion of the segment (usually a sonorant or a glide) to its right. In an SPE framework, phonological representations are seen as linear sequences of segments and boundaries, and a process like deletion would normally be represented by a rule of the form of (1):

1. A ---> Ø/ X____Y

This type of rule is of greater interest, however, when the deletion of the segment involves the concomitant lengthening of an adjacent vowel. For example, in a language such as Klamath, one finds a process whereby the sequence V? is realized as a long vowel in the environment before a consonant or word boundary.<1> This is represented by what can be called the two-step approach.

2a. $V \dashrightarrow V \; / \; \_\_\_\_ ? \left\{ \begin{matrix} C \\ \# \end{matrix} \right\}$

b. $? \dashrightarrow \emptyset \; / \; V\_\_\_\_ \left\{ \begin{matrix} C \\ \# \end{matrix} \right\}$

As was pointed out by Kenstowicz and Kisseberth (1979), there are at least two reasons for objecting to this analysis. First, rule (2a) does not represent the sort of phonological process that can be motivated on independent grounds. Vowels do not typically lengthen before the sequence ʔC and ?#. Second, the environment in (2b) obviously repeats part of the environment of (2a). To order the deletion rule first without reference to the preceding vowel, although a more plausible rule than (2b), would not allow one to account for the lengthening of the vowel. Once the glottal stop has been lost, there simply is a vowel standing next to a consonant or word boundary.

This problem of description led some linguists to argue for a more powerful type of rule (the so-called 'transformational rule'). A rule written in the transformational format consists of two parts, just like any other phonological rule: a structural description and a structural change. This type of rule, as reflected in (3), seems particularly appropriate for the process of compensatory lengthening.

3.
$$\begin{array}{llll} \text{SD} & V & ? & \left\{\begin{matrix} C \\ \# \end{matrix}\right\} \\ \text{SI} & 1 & 2 & 3 \quad \text{---->} \\ \text{SC} & 1 & 2 & 3 \\ & [+\text{long}] & [\emptyset] & \end{array}$$

The type of rule illustrated in (3) raises the issue of how to represent long vowels. In both traditional and generative descriptions long vowels and long consonants have been represented in one of two different ways: as a single segment specified [+long] or as a sequence of two identical segments. A clear example consistent with the latter, the geminate representation, is found in Lithuanian (Kenstowicz 1972). In this language, there is a rule which deletes the final half of a diphthong with falling tone in word-final position. As well long vowels with a falling tone become short in that position (e.g. /langúo/ ---> [langu], /kalbá:/ --> [kalba]). If long vowels are represented as geminates the shortening of a long vowel can be accounted for by the same rule which deletes the final half of a diphthong. However, Lithuanian also has a rule of deletion involving compensatory lengthening. If we allow for a transformational rule like the one in (3), the length of the vowel would have to be described by the feature [+long]. Thus, both representations of vowel length would appear to be required in a single language, the choice between the two depending on the particular phenomenon to be accounted for.

The problems discussed above are minor flaws, however, when compared to a fundamental one which is that, although the process of compensatory lengthening is found in numerous languages, there does not seem to be any way of describing it without resorting to language-specific rules. Although the environment for compensatory lengthening does seem to be always the same (a deleted segment, usually a sonorant, a glide or [s], followed by a consonant or a boundary), and although compensatory lengthening seems to occur in languages in which an independently-motivated length contrast exists (deChene and Anderson 1979), the linear framework fails to embody any explanation for those features that are not language-specific.

DeChene and Anderson (1979) manage to circumvent the problem of how to formulate the rule of compensatory lengthening by arguing that there is no such distinct phonetic process. Consequently, no unified phonetic explanation needs be sought. They argue that such cases which involve the loss of a postvocalic consonant plus the appearance of length in an immediately adjacent vowel can be understood as the transition of the consonant, through loss or reduction of its occlusion, to an eventual glide G. It is the monophthongization of the resulting sequence VG which gives rise to a syllable nucleus that is interpreted as distinctively long. As an example, they point to certain Old English dialects which show syllable-final loss of g after front vowels with concomitant lengthening of those vowels. For the West Saxon examples given below, both forms with g and forms without are attested in texts. Proto-Germanic reconstructions are shown on the left:

4. *frignjan	'to ask'	frignan -->	fri:nan
*thegnaz	'young man, thane'	- egn -->	e:n
*magadin-	'young person (dim.)	m gden -->	m :den

Dechene and Anderson contend that, given the evidence of other Germanic languages, the sound which is written g (actually) in OE texts clearly developed from a velar stop. By the OE period, g represented a spirant in most contexts, and in the vicinity of a front vowel, it represented a palatal spirant which merged with y. They further point out that, in fact, some dialects had instances of i for g, as in the spelling meiden from the Kentish Glosses to Proverbs. Thus, for the examples in (4) there is evidence for a diphthongal stage through which the vowel nuclei passed before they were reanalyzed as long monophthongs. Moreover, deChene and Anderson argue that the existence of an independently motivated length contrast in the language is a necessary condition for compensatory lengthening. Since there are cases of consonant loss which do not lead to compensatory lengthening, deChene and Anderson argue that it is monophthongization of a VG sequence, regardless of the G, which invariably leads to vowel length in a language with an independently motivated length contrast.

Although deChene and Anderson give quite convincing evidence of cases of glides developed from stops, their arguments are weaker for proposed cases of glides developed from spirants. In Greek, for example, evidence can be found that [s] weakened to [h] word-initially before a vowel, while it became lost word internally, e.g. khe:lioi < kheslioi 'one thousand'; sela:na < selasna 'moon'. In Latin, however, there is no phonetic evidence that the dental spirant [z] went through an intermediate stage before being lost before coronal stops (where [z] is the reconstructed allophone of [s] before a voiced segment), e.g. ni:des < nisdo 'nest', si:do: < sisdo: 'I sit down' and siscerno: 'I part, separate', distuli: 'I dispense' vs. di:duco: 'I split, separate'. Nevertheless, deChene and Anderson must posit an intermediate development involving the loss of occlusion in (preconsonantal) [z], leading to the voiced glottal spirant [ɦ].

With regard to glides developed from sonorants, one of the cases discussed by deChene and Anderson is that of Komi Izma, a Permian (Uralic) language. For which data are presented by Harms (1967). In this language, the loss of syllable-final /l/ when followed by a consonant-initial suffix is always associated with compensatory lengthening of the preceding vowel. According to deChene and Anderson, presumptive evidence for gliding as an intermediate step in this process is provided by a concomitant quality alternation where the reflex of /ɨlC/ is [ɨ:C], while the reflex of /alC/ is not [a:C] but [o:C]. They argue that this can be accounted if the development of syllable-final /l/ to a back rounded semi-vowel /w/ is postulated. The change from /aw/ to [o:] through monophthongization would be the expected result.

As is pointed out by the authors themselves, cases in which a nasal consonant is involved in a change leading to compensatory lengthening, although very common, are the most problematic for their analysis. The only cases which do not seem to contradict their proposal are those in which syllable-final consonants are apparently replaced by semi-vowels in alternation.<2> For example, in Polish, a nasalized labial glide appears as a regular alternant of <u>n</u> following a mid vowel and before a fricative. Thus, we have <u>wstęga</u> [fstɛŋga] /fstɛng+a/ 'ribbon', but diminutive <u>wstążka</u> [fstɔ̃w̃žka] /fstɛng+ɛk+a/. A nasalized palatal glide appears in words like <u>fiński</u> [fĩỹsci] 'Finnish' (cf. <u>fin</u> [fin] 'Finn') and <u>szatański</u> [šatãỹsci] 'Satanic' (cf. <u>Szatan</u> [šatan] 'Satan'). Polish does not show any lengthening coincident with the loss of a nasal, but, according to deChene and Anderson, it establishes the general point that glide formation from a nasal consonant is possible.

1.2 Multi-Dimentional Phonology

Because of some unsolvable problems within the linear framework, most particularly with respect to the description of 'suprasegmental phenomena' such as tone and stress, two different lines of research evolved into the theories known as Autosegmental Phonology and Metrical Phonology. Although they developed in response to different problems (tone for the autosegmental model and stress for the metrical model), the two theories have expanded in such a way as to overlap in some domains. I will first give an overview of the autosegmental framework and show how compensatory lengthening can be handled within it. Then, I will give an overview of the metrical framework. Two different analyses of compensatory lengthening will illustrate the evolution of the theory since it was first proposed. Finally, I will describe the particular approach to phonology that I have adopted: the theory of parametric phonology as developed for example by Kaye and Lowenstamm (1984), Lowenstamm and Kaye (1985) and Piggott and Singh (1985).

1.2.1 The Autosegmental Approach

In the theory of autosegmental phonology, it is proposed that phonological representations be split up into several tiers, each constituting an autonomous linear sequence of segments. Elements on one tier may be linked to those on another tier by association lines that indicate how they are to be co-articulated. Leben (1976) was the first to introduce the concept of multi-tiered representations where 'suprasegmental' features like tone are seen as different from and not part of the representation of consonants and vowels. This proposal was taken up by Williams (1976) who argues that tonal features appearing on segments should be represented separately from the segments themselves. Thus, tones should be described as 'suprasegments' which are mapped onto segments in accordance with a particular rule. (This mapping rule applies from left to right, according to Williams.)

Both Leben (1973) and Williams (1971) propose models in which phonological representations are multi-tiered before mapping and one-tiered after it. However, in such a model, if tones are merged with segments one cannot account for short vowels that have a contour tone, because this merging is done on a one-to-one basis, i.e. one tone per segment. In representing tones the current assumption is that a tonal contour such as a rising tone is, in fact, composed of the sequence of a low tone followed by a high tone; a falling tone is composed of a high tone and a low tone. How, then, can we account for the merging of two tones onto one segment, a short vowel?

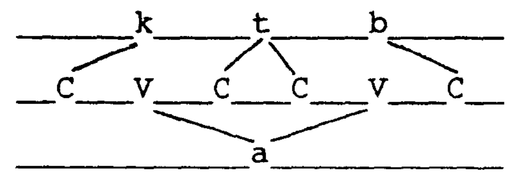
This problem led Goldsmith (1976) to propose a different interpretation of the mapping relation and to elaborate another approach: Autosegmental Phonology. Goldsmith proposed that phonological representations be seen as consisting of separate and autonomous autosegmental tiers. Goldsmith uses the word 'autosegmental' rather than 'suprasegmental' to show that each tier is independent, and that the relation of segments on one tier to the segments on another tier with which they are associated is merely one of simultaneity in time. This co-articulation is represented by mean of association lines. Thus, a contour tone on a short vowel is represented with two tones on the tonal tier being linked to one vowel on the segmental tier.

McCarthy (1979a, 1981) extended the autosegmental framework in some very interesting ways by showing that this new approach to phonological representations could help solve certain outstanding problems in Semitic phonology and morphology. McCarthy's main contribution was to demonstrate that by splitting the segmental tier into three separate and autonomous tiers, the vowel tier, the consonantal (or root) tier, and the prosodic tier (i.e. Halle and Vergnaud's 1980 CV-skeleton), the basic structure of the paradigm of Semitic verbal stems could be accounted for in a simple and natural fashion. Thus, the second binyan of the root ktb 'to write', [kattab], is represented as in (5):

5. Consonantal tier (root)

CV tier (prosodic template)

Vocalic tier



Another contribution of McCarthy's was the proposal of three universal conventions for the association of autosegments to the CV-skeleton. These conventions are made explicit in McCarthy (1981).

6.i. If there are several unassociated melodic elements and several unassociated melody-bearing elements, the former are associated one-to-one from left to right with the latter.

ii. If, after application of the first convention, there remains an unassociated melodic element and one or more unassociated melody-bearing elements, the former is associated with all of the latter.

iii. If all melodic elements are associated and there are one or more unassociated melody-bearing elements, all of the latter are assigned the melody associated with the melody-bearing element on their immediate left if possible.

In contrast with earlier versions of the autosegmental theory, no provision is made for the automatic association of an unassociated melodic element with a melody-bearing element that has already been associated. The other addition to the theory made by McCarthy is a revised version of Leben's (1973)

Obligatory Contour Principle (henceforth OCP). This principle prevents any two identical elements from appearing next to each other on the same autosegmental tier. However, McCarthy argues for a weaker version of the OCP in that it would operate as part of an evaluation metric rather than as an absolute universal principle.

As shown by McCarthy's analysis of the Semitic verbal system, autosegmental phonology can be extended in a number of fruitful ways to problems other than those related to tonal phenomena. Reduplication processes are ideal candidates for this kind of treatment (Marantz 1982, Odden and Odden 1985). Another benefit offered by the autosegmental model is a way of handling compensatory lengthening. One such analysis is provided by Clements (1981, 1985).

In Luganda, the following generalizations hold with regard to vowel length (Clements 1981):

7. G1 Luganda has no surface vowel sequence. The initial nonhigh vowel of an underlying vowel sequence is deleted, with concomitant lengthening of the last vowel of the sequence. /ka-ezi/ keezi 'small moon'.

G2 Glide formation induces length on the following vowel. The initial high vowel of an underlying vowel sequence is replaced by a glide, with concomitant lengthening of the following vowel. /mu-ezi/ mweeze 'moon'.

G3 Nasal Clusters induce length on the preceding vowel. This statement holds both within and across morphemes and word boundaries. /mu-ntu/ muuntu 'person', /ba-N-gob-a/ baangoba 'they chased me'.

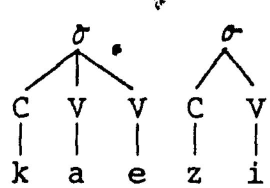
G4 Lengthening is not cumulative. All syllables are either short or long: there are only two degrees of vowel length. /li-anda/ lyaanda 'charcoal', /ba-a-N-gob-a/ baangoba 'they chased me'.

G5 Vowels are short before geminate consonants. This generalization takes precedence over those cited above. /mu-luadde/ mulwadde 'patient', /ba-a-e-ggal-a/ beggala 'they shut themselves in'.

G6 Words are organized into moras according to the following principles: (a) a short vowel counts as one; (b) a long vowel counts as two; (c) a phrase initial nasal cluster counts as one; (d) geminate consonant counts as one.

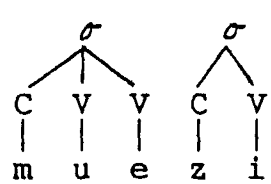
For his analysis of the Luganda data, Clements postulates three autonomous tiers: a syllable tier consisting of strings of syllabic nodes, a CV tier consisting of strings of the elements C and V,<3> and a melodic tier consisting of strings of segments. He assumes that Luganda syllables have structures of the sort reflected in the following representations:

8a.

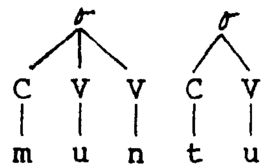


'small moon'

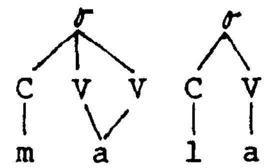
b.



'moon'

c. 

'person'

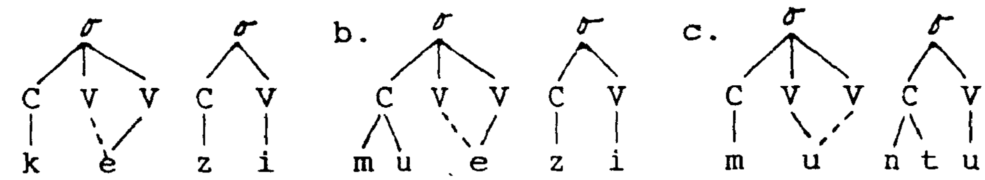
d. 

'smear'

Clements argues that Luganda syllables are of the form CV*, where C is a single C-element and V* is a sequence of V-elements. He also argues that, by a special statement of Luganda grammar, preconsonantal nasals are dominated by V-elements. To account for (7G1), Clements postulates a rule of vowel deletion which deletes a nonhigh vowel before another vowel. This rule applies to (8a) and deletes the first vowel. The unattached V is then linked to the only segment left attached to another V position, as shown below in (9a). (7G2) is accounted for by a rule of Glide Formation which reaffiliates a high vowel to the preceding C-element if it precedes another vowel. So in (8b), the back glide, represented here as [u], is relinked to the preceding C-element, leaving a V-element unattached. This is shown in (9b). (7G3) requires a rule of prenasalized stop formation resulting from the reassociation of a post-vocalic nasal to the following C-element. Thus, similarly to what happens in (8b), the nasal in (8c) is moved to another position, the following C-element, and leaves an empty position behind. The vacant V-positions left by the application of those three rules are filled by the general spreading conventions of autosegmental phonology as indicated by the broken lines in

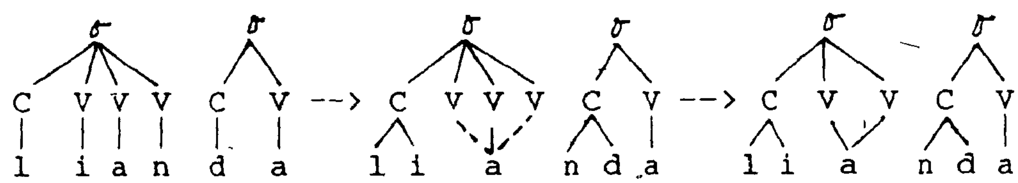
(9a,b,c):

9a. b. c.



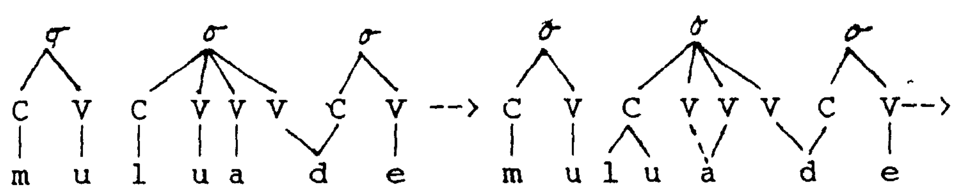
Finally, Clements has to postulate a rule of V-trimming of the form V---> Ø /____VV, which applies to the CV tier alone, in order to account for (7G4). Application of this rule is shown below.

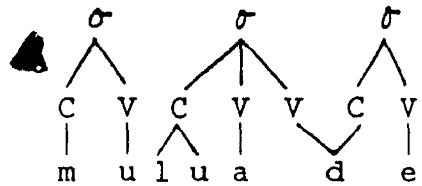
10.



As for geminate consonants, Clements proposes that they are multi-attached segments dominated by the sequence VC on the CV tier. This hypothesis allows him to account for (7G5) in a similar way as for (7G4): through the rule of V-trimming, discussed above, which requires a long (i.e. multi-attached) vowel to become short (singly attached) before a following V-element (no sequences of three V-elements being allowed). This vowel shortening is exemplified in (11).

11.





As is shown by this analysis of compensatory lengthening in Luganda, autosegmental phonology gives a coherent and elegant explanation of the process. Compensatory lengthening can be seen as the linking up of an already linked segment to a position on the CV tier left unattached by a process of deletion or movement on the segmental tier. This is quite similar to the phenomenon of 'tone stability' discussed by Goldsmith (1976), in which a tone left over by the deletion of a vowel becomes attached to the nearest following vowel.

There are some problems, however, with the conception of syllable structure illustrated above. The main problem being that the theory of syllable structure assumed by Clements is too powerful. There does not seem to be any principle to restrict in any way, the number of possible syllable structures. In other words, there is no principled theory of which types of linking between the CV tier and the segmental tier are universally allowed and which are not. For example, Clements simply stipulates that in Luganda preconsonantal nasals are dominated by V-elements. Nothing in his theory disallows, or for that matter forces, this move. The linking is assumed because the structure of Luganda seems to require it. Thus, his theory of syllabification is not easily falsifiable. Furthermore, since there are no explicit assumptions about which elements can be found under V or under C, and which ones cannot, there is no way to explain why only certain segments (i.e. [+sonorant] segments and [s]) seem to trigger compensatory lengthening, when they leave a syllable final position.

Another problem is Clements' rule of V-trimming. Because the theory does not limit the number of V slots attached to a syllabic node Clements can represent the underlying structure of certain words in Luganda with three consecutive V-elements, one of which must in any case be trimmed at the end of the derivation. These problems will be discussed in more details in chapter 2, and another analysis of the data will be given within quite a different framework.

1.2.2 The Metrical Approach

In the metrical framework, the emphasis is not on autosegmental tiers, i.e. on parallel sequences of segments linked together by association lines, but rather on the hierarchical organization of units. The theory of metrical phonology was originaly proposed to handle problems of stress, but, as with the autosegmental approach, it was extended to other phenomena, in particular to those exhibiting features linked to syllable and 'foot' structures. Liberman and Prince (1977) were the first to use the term 'metrical' to refer to a particular theory developed to handle stress, where stress is assigned in terms of structural rather than segmental properties.

Developing the ideas first presented in Liberman (1975), Liberman and Prince (1977) proposed that stress be represented as a matter of <u>relative</u> prominence of constituent structures rather than of absolute properties of vowels. In their analysis of English stress, Liberman and Prince express relative prominence by using binary branching tree structures in which each pair of sister nodes is labeled s(trong)/w(eak) or w/s, depending on which node is the stronger. First, the English stress rule assigns [+stress] to certain vowels working from right to left.

12. $V \rightarrow [+\text{stress}] \;/\; \underline{\quad\quad} C_0((\breve{V}(C)\breve{V}\ C_0)\left\{\begin{matrix}\#\\ [+\text{stress}]\end{matrix}\right\}$
(applies iteratively)

With each iteration of the rule, metrical structure is created over the syllable that has just been stressed, as well as the syllables that have been skipped over, following the constraint that [-stress] syllables may not be dominated by s. This means that every sequence of a [+stress] syllable followed by a maximal sequence of [-stress] syllables is associated in a left-branching tree labelled s/w (i.e. left node s, right node w). This is shown in (13).

```
13a. bandanna        b.  banana
     +  +  -             -  +  -
        s  w             w  s  w
         \/               \  \/
                           \  s
                            \/
```

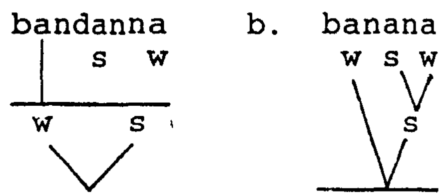
Since [-stress] syllables cannot be dominated by s, the first syllable in (13b) is adjoined to the tree as a weak sister ~~node.~~

With regard to words with more than one stressed syllable, as in (13a), the prominence distinctions among those syllables are determined by incorporating them into a higher level structure in which only right nodes may branch. The nodes of this structure are labeled w/s if the right node branches, otherwise they are labeled s/w. The resulting structures are shown in (14).

```
14a. bandanna        b.  banana
     +  +  -             -  +  -
     w  s  w             w  s  w
      \  \/               \  \/
       \  s                \  s
        \/                  \/
```

Liberman and Prince's proposal offers a better representation of the phenomenon of stress than the segmental analyses exemplified in SPE, where stress is seen as a (distinctive) feature of individual vowels. It appropriately reflects the fact that stress is a relationship of relative prominence between syllables. Two problems, however, were left over from the SPE framework: the need for a feature [+stress] and an iterative stress assignment rule. In an early unpublished paper by Prince (1976) and in Selkirk (1980), a proposal is developed which eliminates the need for a stress assignment rule. This proposal assumes that the 'metrical feet' created by each iteration of the stress rule in (12) can be given an independent status in the theory. Thus, using the notion of foot, the representation of (14) is ~~as~~ follows (The horizontal lines indicate the position of the feet.):

15a. b.



The stresses can thus be read as relative prominence within feet and relative prominence between feet, with a stronger prominence difference within a foot than between feet. This eliminates the need for a feature [+stress].

Another advance for the theory is in the way feet are created. Instead of using the iterative stress assignment rule, a theory of foot construction in conjunction with a theory of syllable internal-structure is developed which restricts the type of syllables that the nodes of a well-formed tree may dominate. For example, Selkirk (1980) disallows the occurrence of tense vowels in the w position of a foot. The stress rule of English could thus be stated roughly as follows (Hayes' (1981) formulation of Selkirk's rule):

16. <u>English Stress Rule</u>

At the right edge of a word, construct the largest possible foot, subject to the following conditions:

i. The foot is left branching, with sister nodes labelled s/w.

ii. The foot may not contain more than three syllables.

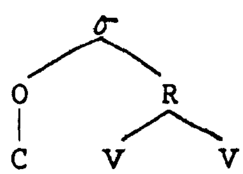
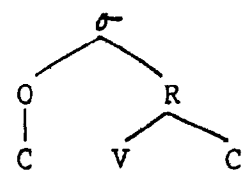
iii. The rightmost weak syllable of the foot must not contain a tense vowel.

iv. The remaining weak syllable, if there is one, must be light; i.e. of the form C V, where V is lax.

What is interesting to note in this theory is that the syllable plays a crucial role in determining stress placement. In fact, many stress rules draw a distinction between light syllables of the type CV, and heavy syllables which have the form CVV or CVC. This distinction between light and heavy syllables must be made quite often in the formulation of phonological rules<4> and has usually posed a problem of representation for the linear framework. In such a framework the equivalent to the notion of heavy syllable has to be expressed as a disjunction, as shown in (17):

17. $$C \left\{ \begin{matrix} VV \\ VC \end{matrix} \right\} \begin{matrix} C \\ \# \end{matrix}$$

This problem was addressed by McCarthy (1979a, b) and Vergnaud and Halle (1979) by proposing an internal structure for the syllable. The idea that the syllable has internal structure had been proposed before (e.g. Pike and Pike 1947, Fudge 1969) but its potential was more readily apparent within a theory that recognizes hierarchical structures. McCarthy and Vergnaud and Halle argue for a syllable which is divided into an <u>onset</u>, consisting of the segments preceding the syllabic peak of the syllable (if any), and a <u>rime</u>, consisting of everything else. As is noted by these authors, the structure of the rime node offers a simple way of distinguishing between light and heavy syllables. If long vowels are represented as two identical segments the disjunction shown in (17) can be represented as a branching rime.

18.  and 

Furthermore, since stress assignment in quantity sensitive languages is sensitive to the distinction between light and heavy syllables and not at all sensitive to what is in the onset, one can say that stress rules apply only to the rime projection.

Developing this idea of stress assignment being sensitive to the branching or non-branching of the rime, Hayes (1981) proposes a universal theory of natural stress rules which distinguishes languages as being quantity sensitive or quantity insensitive. Hayes argues that a small number of parameters determine the structure of all the stress systems of the world. If, in a particular language, a foot formation rule is dependent on the branching or non-branching of a projection (either the rime or the syllabic projection<5>), then, it constructs quantity sensitive feet. In a quantity insensitive language, the weight of syllables is of no consequence for the application of rules (i.e. the branching or non-branching of any projection is not taken into account). Of the kind of feet that can be constructed, only two possibilities are considered: bounded or unbounded feet. Bounded means that there is a limit to the number of syllables that may be grouped into a foot. In fact, Hayes claims that, among bounded feet, there are universally only disyllabic feet, called binary feet, and monosyllabic feet, called degenerate feet.

The structures constructed by the stess rules can thus be universally divided into four categories: binary, quantity sensitive, e.g. Eastern Cheremis (Kiparsky 1973, Itkonen 1955); binary, quantity insensitive, e.g. Maranungku (Tryon 1970); unbounded, quantity sensitive, e.g. Aklan (Hayes 1979); unbounded, quantity insensitive, e.g. Angula (Kirton 1977).

Another parameter that further subdivides the four categories is whether the trees constructed by the stress rules are right dominant or left dominant, i.e. whether the trees are left branching and always s w or right branching and always w s.

The metrical framework, like the autosegmental framework, can be and has been extended to deal with other phenomena. Compensatory lengthening is one such process which has been reanalyzed within the metrical framework. For the purpose of this thesis, I describe as metrical all the analyses which use internal branching below the syllabic node, whether or not those internal structures are explicitly described as coda, nucleus, onset and rime. On the other hand, all the analyses which do not explicitly use internal structures within the syllable, i.e. the only branching available is that of the syllabic node, I will classify as autosegmental.

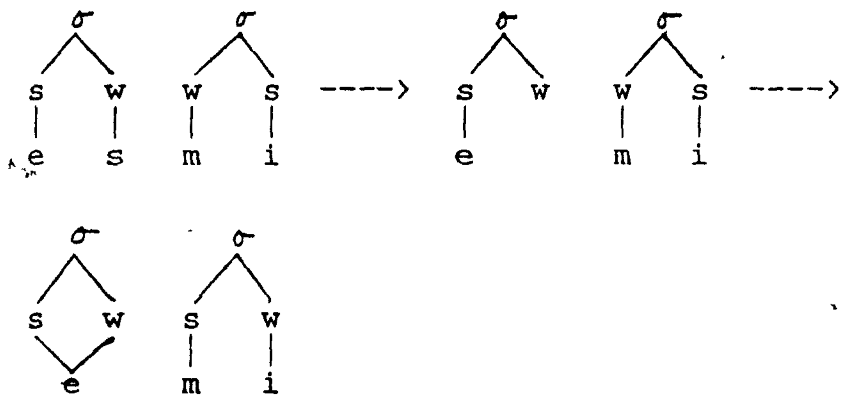
One good example of an analysis within the metrical framework is Ingria's (1980) study of compensatory lengthening in Ancient Greek. In this language, when a sonorant, a glide or [s] is deleted, there is lengthening of the preceding vowel even when the vowel is not adjacent to the deleted segment. This is shown in (19a), where [s], the deleted segment, is not adjacent to the vowel, and in (19b) where it is.

19a.	ekrinsa 'judge'	---->	ekri:na	a:ŋgelsa 'announce'	---->	a:ŋge:la
b.	esmi 'I am'	---->	e:mi	selasna: 'moon'	---->	sela:na:

With regard to the examples where the deleted segment is not adjacent to the lengthened vowel, Ingria postulates a rule of metathesis which would make that segment adjacent to the vowel.<6> In his analysis, Ingria assumes a syllable structure similar to those shown in (18). The main difference is that, instead of nodes labelled O, N and C, the s/w labels attributed by Ingria to McCarthy (1976) are used.

Ingria argues that compensatory lengthening is triggered in Ancient Greek when a [-syllabic] segment is deleted at the end of a syllable. The node left empty after deletion is then associated with the segment attached to the preceding node (i.e. the nucleus).

20.

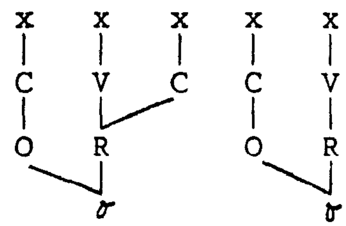


Ingria proposes the Empty Node Condition to capture the process which is illustrated in (20).

21. <u>The Empty Node Condition</u>

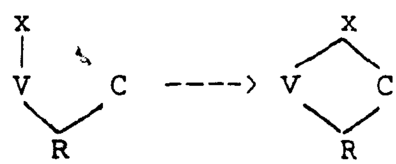
Empty w nodes which are part of a syllabic coda are to be associated with the terminal element dominated by the immediately preceding syllabic nucleus. All other empty nodes are to be pruned.

In her own analysis of compensatory lengthening in Ancient Greek, Steriade (1982) assumes a somewhat different representation for syllable structures in that she incorporates a CV skeleton between the syllable structure itself and the segments. Thus, we might have a phonological representation like the one shown in (22).

22. 

Steriade reformulates Ingria's Empty Node Condition to encode the notational differences between her representation of the syllable and Ingria's.

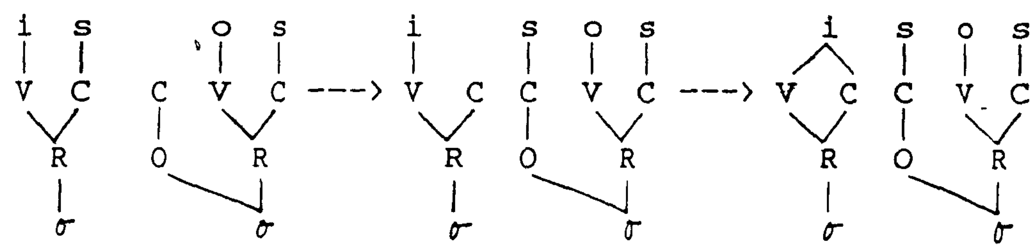
23. An empty slot in the rime is associated with the segment in nuclear position. Formally,



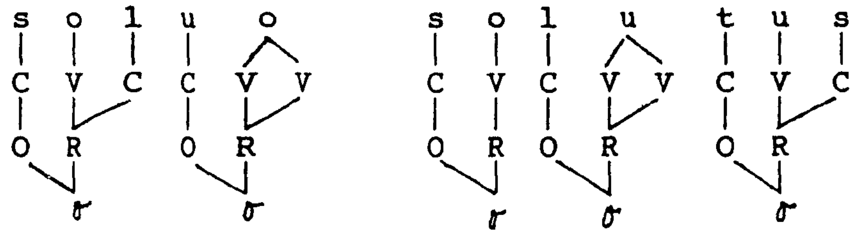
Steriade argues for the validity of (23) in Ancient Greek and believes that there are some reason to consider it a universal convention.

In her analysis, Steriade discusses the loss of <u>w</u> in the onset of a syllable. In Ingria's paper, the deletion of <u>w</u> is also discussed, but in his analysis, <u>w</u> is metathesized with a preceding consonant before deletion. Thus, according to Ingria, the segment is actually in the coda when deletion occurs. For example, /ksenwos/ 'stranger' would become [ksewnos] before the deletion rule applies. Steriade, on the other hand, argues against any rule of metathesis in Ancient Greek and postulates rather a rule of onset <u>w</u> deletion.

She further argues that compensatory lengthening results in some cases from the resyllabification of a segment from a syllable final position to the initial position of an 'onsetless' syllable, i.e. a syllable whose onset is not linked to any element on the segmental tier. For example, consider the output of onset *w* deletion in a form like *isos*:<7>

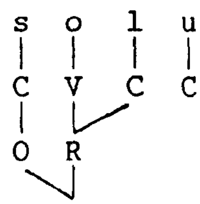
24. 

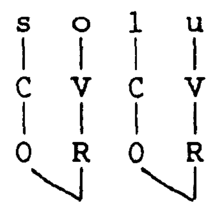
In (24), the empty onset of the second syllable has been vacated by the deleted *w*. Resyllabification associates the final consonant of the preceding syllable to the empty onset, leaving an empty coda. The ENC, then, associates the empty slot with the segment in the nucleus position. Any consonantal segment lost in postnuclear position without subsequent compensatory lengthening effects must, according to Steriade, have vacated a C slot that did not belong to the rime. However, as Steriade herself points out, resyllabification rules do not in general lead to compensatory lengthening, as is shown by alternations like those between Latin *soluo:* and *solu:tus.*

25. 

Both alternations derive from the root /solu/ 'to release'.

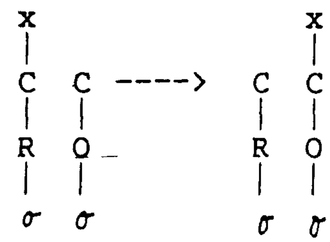
Steriade's position is that rules of syllabification require that structures such as the one in (26a), where the final glide is extrametrical, be resyllabified as in (26b) before a consonant initial suffix like the participial <u>-to-</u> in <u>solu:tus</u>. However, this instance of resyllabification does not trigger compensatory lengthening.

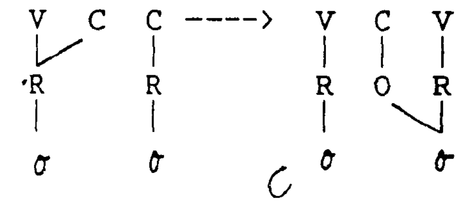
26a. 

b. 

Steriade assumes, thus, two kinds of reyllabification "rules". The first kind of resyllabification has as input the juxtaposition of a closed syllable and an onsetless syllable. The latter includes all morphemes or words that begin with a vowel. The second kind of resyllabification, as exemplified in (27), has as input a syllable beginning with an empty C slot and occurs only in the immediate output of segmental deletion rules like the onset <u>w</u> deletion rule postulated for Ancient Greek. The most frequent structure is shown in (28).

27. Resyllabification 1 28. Resyllabification 2





Thus, because in (28), unlike (27), the movement affects a skeletal position rather than a segment, no empty C slot is left behind.

Like the autosegmental model, the metrical framework gives a principled account of the process of compensatory lengthening. However, as with Clements' analysis of the phenomenon in Luganda, there is no explanation of why compensatory lengthening only occurs in certain languages (i.e. those languages where vowel length is phonologically relevant). Moreover, there is no explanation of why it should be [+sonorant] segments and [s] that trigger compensatory lengthening when they are deleted or moved at the end of a syllable.

In fact, particularly with Steriade's analysis, the generalisation is lost. By proposing an onset w deletion rule, she allows stops to trigger compensatory lengthening. For example, if in /odwos/ w is deleted in the onset, we have to say that the movement of a stop to the empty slot of the onset triggers the association of the vowel with the stop's former position, giving the resulting [o:dos].

The analyses by Ingria and Steriade, as well as that of Clements, express the observation that the process of compensatory lengthening occurs only when a particular structure is found, namely a branching rime with a slot (or branch) left unattached after the application of some rule. This is captured by conventions such as the ones in (21) and (23). These conventions should hold for any representation meeting the conditions described above. However, there are some languages in which similar structures do not trigger compensatory lengthening. Instead the right branch of the structure is pruned.

Ancient Greek, in fact, has a rule which deletes stops at the end of a word and before another stop.

29a.	/melit/	'honey'	[meli]
	/so:mat/	'body'	[so:ma]
	/damart/	'spouce'	[damar]
	/anakt/	'lord'	[ana]
b.	/CV-komid-k-a/	'I have provided'	[kekomika]
	/CV-anut-k-a/	'I have persuaded'	[e:nuka]

Note that, although the stop is deleted in a structure which meets the conditions of the convention stated in (21) and (23), no compensatory lengthening takes place. Obviously, the Empty Node Convention of Steriade's and Ingria's misses some important generalization about the process of compensatory lengthening. This generalization, I claim, is related to the fact that the process preserves a heavy syllable from becoming light and that only [+son] segments and s/z trigger it. Furthermore, in Clements' handling of the process in the autosegmental framework there is no way to differentiate between the structures which trigger compensatory lengthening and those which do not.

1.3 Parametric Phonology

The development of the autosegmental and the metrical frameworks, along with the new 'principles and parameters' approach to syntax, have led some linguists to argue that any analysis of phonological processes which are found in language after language should attempt to describe those processes in terms of a "parametric" grammar. In other words, those universal processes must be viewed, if not as parameters, at least as being linked to the presence of some parameter in the languages under study.

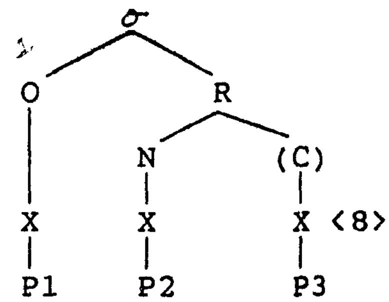
In this thesis, I will assume a theory of Parametric Phonology as developed for example by Kaye and Lowenstamm (1984), Lowenstamm and Kaye (1985) and Piggott and Singh (1985). In this framework, it is assumed that phonological representations of the syllable consist of at least three autonomous tiers, as illustrated in (30):

30.

1. prosodic tier

2. skeletal tier

3. segmental tier



Assuming the theory of syllable structure developed in the works of Lowenstamm and Kaye (1985) and Piggott and Singh (1985), I argue for a syllable which consists minimally of an onset and a rime. In addition, the rime has an obligatory constituent, the nucleus, and it may also contain a second (optional) constituent, the coda. The terminal nodes of syllable trees are not segments themselves, but a set of skeletal slots or points (i.e. the skeletal tier) to which segments are linked. All the nodes on the syllabic tier may branch, allowing for more complexity than is reflected in (30).

According to this theory, there are likely to be universal and language-specific constraints on what segment may be associated with the terminal elements of the onset, nucleus or coda. There are also likely to be constraints on the complexity of structures with branching onsets, nuclei and codas. For example, the nucleus may be allowed to dominate only two slots on the skeletal tier. There may also be parameterized conditions on syllables which limit the number of elements that can be linked to certain nodes. One such condition is the OCP which prevents two identical elements from being next to each other on any autosegmental tier. Another condition is that of Prosodic Government as proposed by Kaye and Lowenstamm (1984). This condition on syllable structures defines a relation between the head of the syllable (i.e. the most sonorant element in the nucleus) and the constituents of the rime.

31. <u>Prosodic Government</u>

The head of the syllable must govern
the other constituents of the rime.

With regard to syllabification, I will assume that there are universal principles such as the ones proposed by Piggott and Singh (1985) in their analysis of the process of epenthesis.

Piggott and Singh (1985) argue that their analysis of epenthesis depends crucially on their conception of syllabification, i.e. the set of strategies by which all the segments and slots in a string are (exhaustively) assigned to well-formed syllables. First, there is a principle which applies relatively freely, constructing an initial set of syllable structures. This Initial Syllabification Principle (ISP) which is stated informally in (32) is mediated by a set of principles and conditions which include those cited in (33).

32. <u>The Initial Syllabification Principle</u>

Every skeletal slot is assigned to a position in a syllable, maximizing onsets.

33. <u>Syllabification Conditions</u>

a. Every node of syllable structure must dominate at least one skeletal slot.

b. A segment which is specified [+vocalic] must be associated with at least one nucleus slot.

c. A slot which is linked to a segment unspecified for the feature [vocalic] must be associated with a nucleus unless it precedes a slot linked to a [+vocalic] segment, in which case the former is assigned to the onset.

d. A [-vocalic] segment is not associated with the nucleus.

According to Piggott and Singh (1985), sonorant consonants and the 'sonorant fricative' [s] (i.e. [+sonorant, +consonantal] segments) may appear under the nucleus in some languages, among them being English. They may also appear as the second (i.e. the right-most) constituent of the nucleus. Furthermore, the onset is the only node which may be allowed to be empty or to be linked to a null element after ISP and all the other principles and conditions on syllabification have applied.

Resyllabification is viewed as a set of strategies by which segments are reassigned to different positions if ISP creates structures that violate some substantive constraint in a particular language. The syllabification conditions, however, can never create structures that violate universal principles. According to Piggott and Singh, the conditions on syllabification presented in (32) and (33) do not initially permit sonorants into the nucleus. Sonorants are assigned to the nucleus through one of two devices. A given language may include among its set of resyllabification strategies a condition on syllabification like the one stated here as (34), to which I will tentatively give the name Sonorant Reassignment. The presence or absence of this condition is a parameter of Universal Grammar.

34. <u>Sonorant Reassignment</u>

A [-vocalic] segment is associated with the nucleus iff it is also [+sonorant].

Alternatively, a language may have a rule which moves a sonorant into the nucleus. Crucially, application of the rule which moves a sonorant follows resyllabification, and it leaves an empty slot behind. As will be argued in Chapter 2, the condition in (34) plays a crucial role with regard to the occurrence of compensatory lengthening.

Notes to Chapter 1

<1> The example is from Kenstowicz and Kisseberth (1979). See Barker (1963) for more detailed data on Klamath.

<2> In their paper deChene and Anderson discuss Middle French which has a very clear case of nasal deletion triggering compensatory lengthening. They are not, however, primarily concerned with arguing for a glide stage (between the nasal stage and the long vowel stage), but rather focus on the means by which distinctive vowel length came to be introduced in the language, thus allowing compensatory lengthening to appear in French. I suspect, though, that to argue for a glide stage in Middle French would be a problem for deChene and Anderson.

<3> The theory of CV phonology views C's and V's as 'timing units' without intrinsic feature content.

<4> The notation used in linear phonological rules which correspond to that of a light 'open' syllable is shown in (a). In (b), the representation is that of a heavy 'closed' syllable.

a. $\ldots\ldots / \underline{\qquad} \begin{Bmatrix} CV \\ \# \end{Bmatrix}$

b. $\ldots\ldots / \underline{\qquad} C \begin{Bmatrix} C \\ \# \end{Bmatrix}$

<5> Hayes suggests that when a language stresses only long vowels and diphthongs, only [+syllabic] segments are projected for the purpose of stress assignment.

<6> This rule of metathesis has also been proposed by Kiparsky (1967).

<7> In the framework I assume, I do not consider the example discussed in (24) to be a case of resyllabification. Resyllabification does not leave empty slots behind. The process at work in (24) should rather be seen as that of movement which usually leaves an empty slot.

<8> Henceforth, points will be used instead of X's to indicate skeletal slots.

Chapter 2

Compensatory Lengthening: Case Studies

2.1 A Proposal

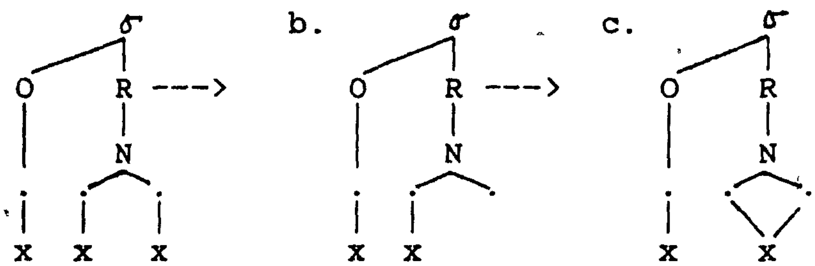
In this chapter, I propose an analysis of compensatory lengthening in which this phonological process can be seen as being dependent on the particular settings of certain parameters. In other words, if those parameters are not set in the way specified, compensatory lengthening cannot occur.

Recall that deChene and Anderson (1979) point out that compensatory lengthening is found only in languages where vowel length is phonologically relevant. Using Hayes' categorization, I will argue that compensatory lengthening can only be found in languages which are quantity sensitive. Of those languages which are quantity sensitive, only the ones in which branching nuclei define a heavy syllable will allow compensatory lengthening. I also claim that compensatory lengthening, along with some other processes, is a surface manifestation of a principle of structure preservation (i.e. in the case of compensatory lengthening, the preservation by the language of two points in the nucleus). Furthermore, for those languages in which the deletion or movement of a sonorant triggers compensatory lengthening, I will argue that

Sonorant Reassignment must be part of their grammar.

Moreover, compensatory lengthening will only be triggered if the branching of the nucleus is endangered by some process of movement or deletion as shown in (1b).

1a.



This proposal underlines my claim that only segments which can appear in the nucleus trigger compensatory lengthening following their deletion or movement.

In this chapter, I will be looking first at two quantity sensitive languages, Kwakiutl and Lithuanian, in which only the branching nucleus is considered a heavy syllable, as revealed by processes of stress assignment or tone placement. I will argue that those languages demonstrate the existence of Sonorant Reassignment, and I will show, at least with respect to Lithuanian, that the process of compensatory lengthening is part of its grammar and follows from the setting of the parameters discussed above (i.e. quantity sensitive vs. quantity insensitive; branching nucleus and/or branching rime as heavy; absence or presence of Sonorant Reassignment in the grammar). More importantly, in these two sections I will be arguing for the need for a very restricted and principled theory of syllabification to differentiate between compensatory lengthening and other processes which are used to preserve the points of a branching structure in a quantity sensitive language.

In the second part of Chapter 2 , I will argue for an analysis of Luganda and of Ancient Greek quite different from the ones presented by Clements (1981, 1985) and Steriade (1982) respectively. The main difference will come not only from our somewhat different proposals with regard to syllable structures (although the particular syllable structure I adopt is based on principles of syllabification which are of great importance to my analysis) but also from the theoretical assumptions underlying the analyses themselves. The claims I make in this chapter regarding compensatory lengthening will then be extended to other languages and most particularly to some apparent counterexamples to my claims.

2.2 The Case of Kwakiutl

One of the problems in dealing whith compensatory lengthening is how to differentiate this process from other processes with similar surface manifestations. In this section, my aim will be to refine a part of the theory of syllabification I assume, most particularly the status of Sonorant Reassignment. I will also show how the process of compensatory lengthening under study in this thesis differs from other processes which are used to preserve existing structures, but not necessarily a branching nucleus.

I will examine certain facts about the phonology of Kwakiutl, a language spoken on the coasts of Queen Charlotte Sound in British Columbia, which argue for the existence of Sonorant Reassignment. I will show that this condition on syllabification plays a major rôle in Kwakiutl's phonology.

One of the most interesting facts about Kwakiutl is that a sequence of a short vowel followed by a tautosyllabic sonorant behaves like a long vowel. In the onset position, sonorants are true consonants (i.e. they act as any other consonant would in that position). In stems of the type CVS and CVSC (where S stands for sonorant), their function is quite different, however. Boas (1947) notes that the sequence VS has to be considered a long vowel with regard to many phonological processes, the only exceptions being those cases in which the stem CVS is followed by a suffix with an initial vowel that does not induce any modification of the stem (i.e. in those cases where the sonorant is initially syllabified into the onset of a syllable).

The stress rule provides a good illustration of the way long vowels pattern with short vowels plus tautosyllabic sonorants. Kwakiutl is a language in which the stress placement is linked to the quantity of the syllables. The stress rule can be stated informally as follows (Bach 1975):

2 . Stress first syllable with long vowel or vowel plus tautosyllabic sonorant or if none, stress last syllable.

This is exemplified in (3).<1>

3.	nəpá	'to throw a round thing'
	cəmá	'to point'
	cətxá	'to squirt'
	cí:kwa	'bird'
	gá:sa	'to walk'
	mə́nza	'to make kindling wood'
	də́lxa	'damp'

Other processes in the language also show long vowels patterning with sequences of vowel plus tautosyllabic sonorant. For example, there is a process of reduplication which is used to mark functions such as plurality, repetition and distribution. When a stem of the type CV:(C) is reduplicated, it takes the form CV:CV(C). That is, the second (reduplicated) syllable of the stem has its vowel shortened, as shown in (4a). In corresponding reduplications of stems of the form CVS and CVSC the shortening is brought about by dropping the sonorant (S) so that the reduplicated forms surface as CVSCV and CVSCVC. This is illustrated in (4b).

4a. stem xwa:l- xwá:xwalmut 'remains of fish cutting'

gá:nul	'night'	pl. gá:ganul
bá:gwəm	'boy'	pl. bá:bagwəm

b.	stem	səl-	sə́lsəmut	'what is left after drilling'
	stem	məl-	mə́lməzo	'white on flat surface'

Another process in which short vowels plus tautosyllabic sonorants act like long vowels involves lengthening of the stem vowel brought about by the addition of certain suffixes. When these suffixes are added, lengthening is obligatory. However, vowels plus tautosyllabic sonorants pattern like long vowels in being impervious to further lengthening. This is exemplified in (5), where the lengthening suffix is <u>-ap</u> 'each other, one another'.

5.	stem	wəl-	wá:lapˀ	'to question one another'
	stem	qwəd-	qwá:dapˀ	'to leave one another'
	stem	kwe:l-	kwé:lapˀ	'to feast one another'
	stem	hanl-	hánlapˀ	'to shoot each other'
	stem	gəlq-	gə́lqapˀ	'to grasp each other'

All these processes cited so far argue for an analysis where short vowels with tautosyllabic sonorants have a structure similar to that of long vowels. This is made possible in a framework which assumes the existence of Sonorant Reassignment (described in Chapter 1), or its equivalent, and which also assumes that the presence or absence of this condition in a particular language depends on the setting of a parameter of UG. In the case of Kwakiutl, the parameter is set so that Sonorant Reassignment is one of the resyllabification strategies of the language (following Piggott and Singh 1985). Thus, a long vowel and a sequence vowel plus sonorant would both be represented as a branching nucleus.

Let us look ~~again~~ at the three processes: stress, shortening and lengthening, and see how an analysis of Kwakiutl which incorporates the assumption that Sonorant Reassignment is part of the grammar can give a principled explanation of those processes within a parametric framework. First, let us look at the stress rule given in (2), which is repeated here as (6).

6. Stress first syllable with long vowel or vowel plus tautosyllabic sonorant or if none, stress last syllable.

Assuming the presence of Sonorant Reassignment, this rule can be translated into (7):

7. Stress the first syllable with a branching nucleus or if none, stress the last syllable.

Alternatively, adopting Hayes' (1981:51) metrically based formulation of the stress rule in the Eastern Permijak dialect of Komi, which is similar to that of Kwakiult, we may come up with the rule given in (8).

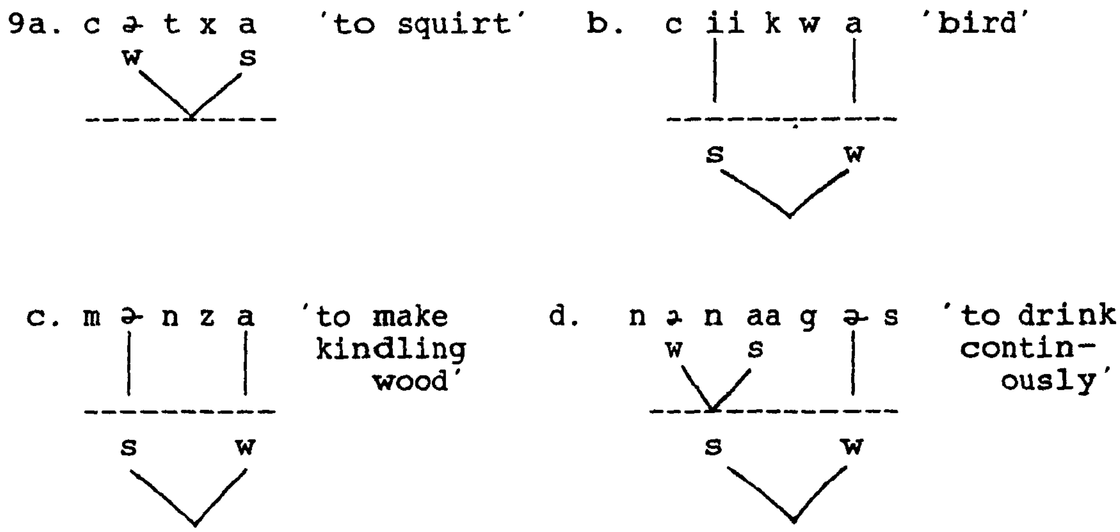
8. <u>Kwakiutl Stress Rule</u>

a. On the nucleus projection, form a right dominant, unbounded foot at the right edge of a word.

__recessive nodes cannot branch__

b. Form a left dominant word tree.

Some examples of the application of the rule are shown below:



Obviously, Kwakiutl can be classified as a quantity sensitive language which considers only the branching nucleus as a heavy syllable. Furthermore, sonorants are found in the right-most position of the nucleus through the presence of Sonorant Reassignment in the grammar. Nevertheless, the examples of 'shortening' and 'lengthening' given in (4) and (5), which also seem to reflect the presence of Sonorant Reassignment and, in the case of (5), seem to show at least surface similarities with compensatory lengthening, should be examined carefully. I will show that by using a very restricted theory of syllabification, we can differentiate between real instances of compensatory lengthening and processes which show surface similarities with those of compensatory lengthening. I will demonstrate that the examples in (5) have nothing to do with the process of compensatory lengthening under study here. I will also show that the cases of reduplication (shortening) argue for the presence of Sonorant Reassignment, although in an unexpected way. Some new assumptions will also have to be considered.

Let us look first at the theory of syllabification I assume. Piggott and Singh (1985) have proposed an initial syllabification principle (ISP) which is mediated by an additional set of syllabification principles. Those principles assign segments and slots to well-formed syllables. They are shown again in (10).

10. <u>Syllabification Conditions</u>

a. Every node of syllable structure must dominate at least one skeletal slot.

b. A segment which is specified [+vocalic] must be associated with at least one nucleus slot.

c. A slot which is linked to a segment unspecified for the feature [vocalic] must be associated with a nucleus unless it precedes a slot linked to a [+vocalic] segment, in which case the former is assigned to the onset.

d. A [-vocalic] segment is not associated with the nucleus.

A set of resyllabification principles reassigns segments to different positions if the initial syllabification creates a structure which violates any language-specific constraint. I claim that the order in which segments are assigned to syllables is of crucial importance to a restricted and principled theory of syllabification. The order I propose is given in (11). The importance of this order of syllabification will be made clear in the following sections of this chapter.

11a. A nucleus is erected over each slot (or two slots) linked to a [+vocalic] segment.<2>

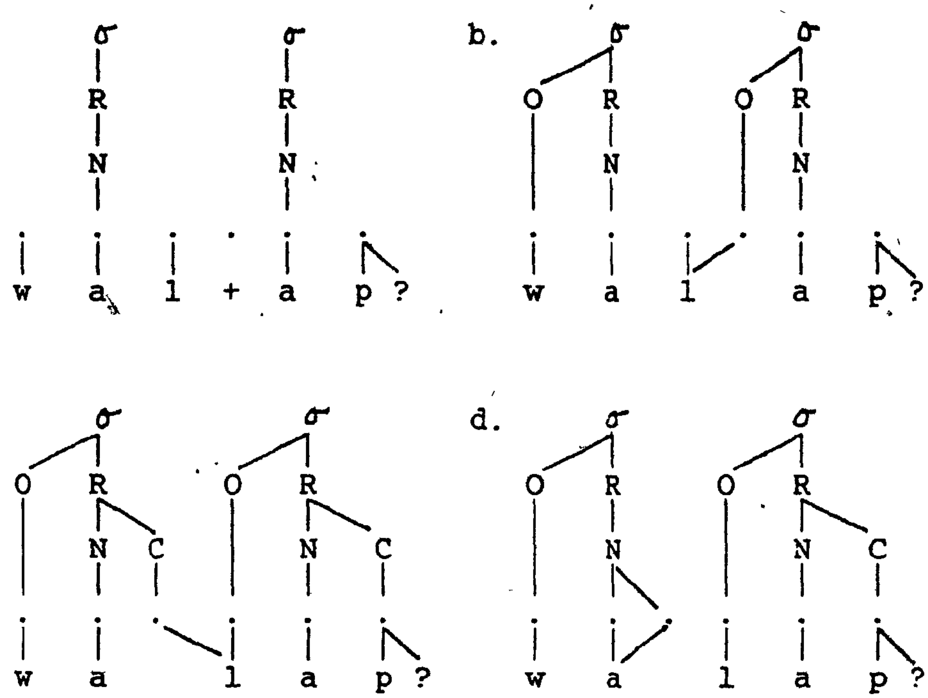
b. An onset is erected over the slots preceding the nucleus, unless the slot is linked to a segment unspecified for [vocalic].

c. A segment which is unspecified for [vocalic] is linked to the nucleus unless it precedes a slot linked to a [+vocalic] segment, in which case the former is assigned to the onset.

d. Any unattached [-vocalic] segment is linked to the coda.

One of the claims I have made about the process of compensatory lengthening is that only [+son] segments can trigger this process. Therefore, no stop should trigger compensatory lengthening. Note, however, that, in the examples in (5), there is at least one case which seems to show compensatory lengthening triggered by a stop: /qwəd-/. Using the order of syllabification given in (11), I will show that the 'lengthening' process illustrated in (5) has, in fact, nothing to do with compensatory lengthening. Syllabification of some of the data is exemplified in (12) and (13). The suffix -apʔ is assumed to contain three slots in the lexicon.

12a.

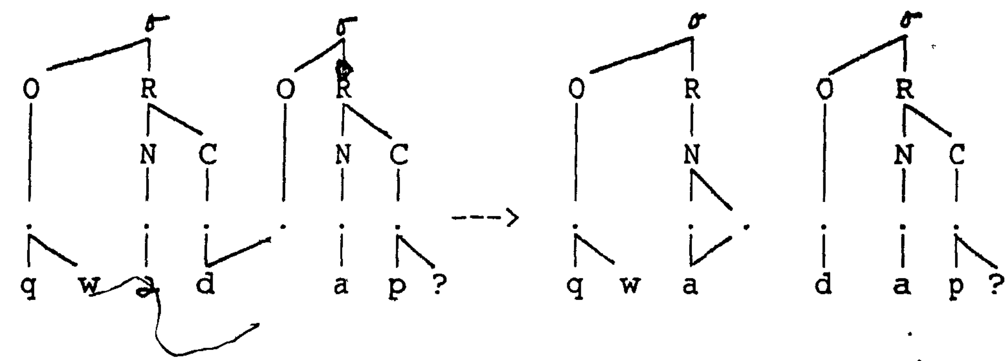


In (12a), nuclei are erected over the two vowels. In (12b), onsets are erected over the slots preceding the nuclei, with the sonorant [l] spreading to the unlinked slot of the second onset. Note that the glide, which is not specified for [voc], is linked to an onset since it precedes a [+voc] element. The unattached [-voc] segments are then linked to the coda of their respective syllable, as shown in (12c). The result of the initial syllabification, however, violates a language-specific constraint which does not allow geminates in any position. The points linked to the geminate are resyllabified and the first point is reassigned to the nucleus. The vowel, then, spreads to the new slot of the nucleus, as shown in (12d).

If as I argue, compensatory lengthening is a strategy to preserve the two points of a nucleus, the process at work in (12) cannot be construed as compensatory lengthening, the preserved point having been syllabified first in a coda. The fact that the geminate is a [+son] is of no particular importance in this instance.

In fact, in (13), where the stem ends in a stop, lengthening occurs exactly as in (12).

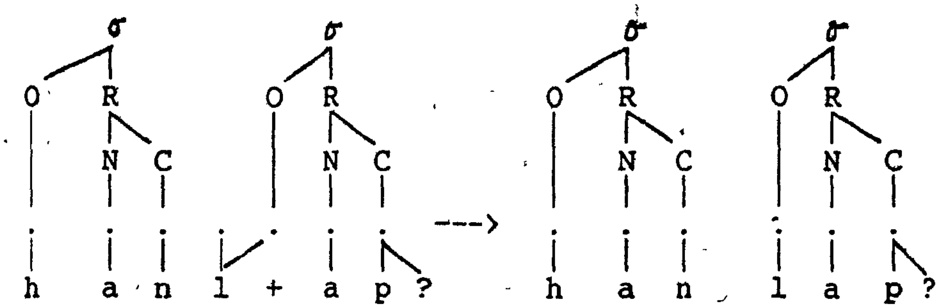
13.



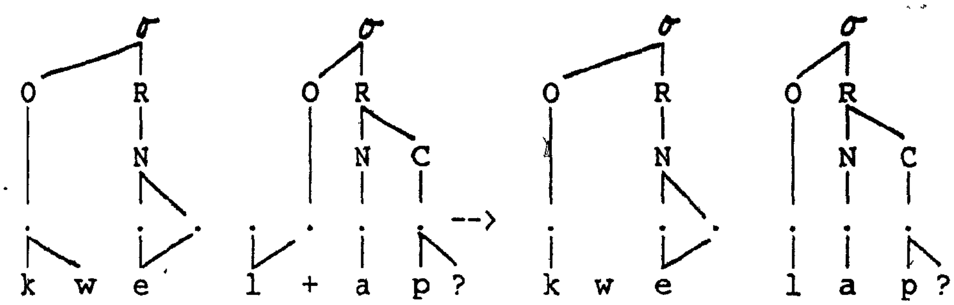
The process of 'lengthening' shown in (12) and (13) is simply a consequence of the relinking of an unlinked slot to the nearest node. Although this process of lengthening can be construed as some form of "compensatory lengthening" triggered by the requirements of syllabification, it is not an instance of the process of compensatory lengthening under study here, which is triggered by the deletion or movement of an element already part of the nucleus. There may also be some other kinds of 'lengthening', each triggered by other processes of syllabification. These I will group as 'Non-compensatory lengthening' and will not discuss them in more details here.

In (14), cases where no lengthening occurs are shown.

14a.



b.



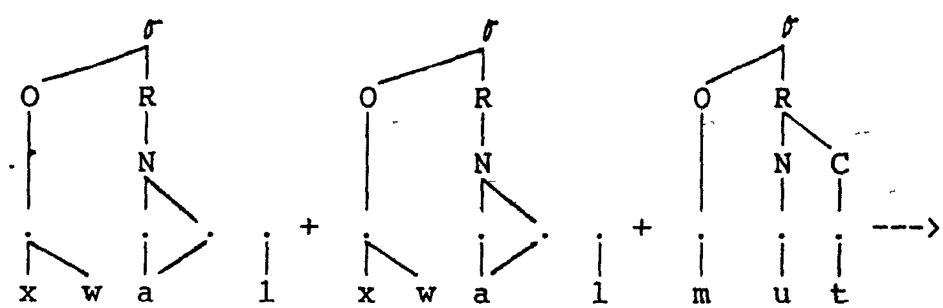
In (14a), as was the case in (12), the first point of the geminate sonorant [l] cannot be syllabified in the onset, this being an ill-formed syllable universally. However, in contrast with (12), to syllabify it in the preceding coda would create a structure whose complexity is not allowed in Kwakiutl.<3> Thus, the unlinked slot is simply erased. Sonorant Reassignment subsequently moves the nasal into the nucleus of the first syllable. In (14b), the first slot of the geminate is also erased, this time because codas are not allowed in rimes which already have a branching nucleus.

Let us now look at the cases of reduplication presented in (4). Following Schlindwein (1985), I will assume that the process of reduplication consists of two distinct subparts: the morphological affixation of some incompletely specified prosodic element, and the phonological copying of lower-level material (Odden and Odden 1985).

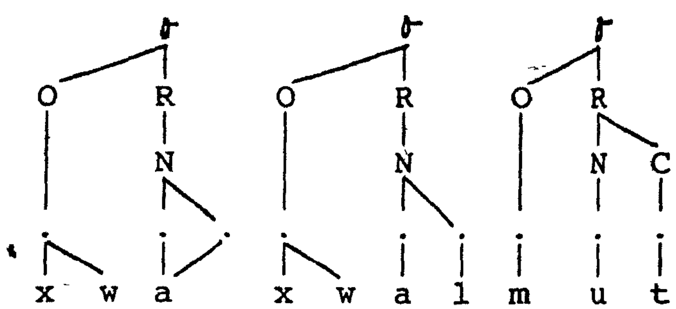
In (15) and (16), the forms [xwa:lmut] and [selmut] have their stems reduplicated, resulting in [xwa:xwalmut] and [selsemut] respectively.

In (15), a reduplicative suffix is first adjoined to the stem. This suffix reduplicates the whole stem, and the melody of the stem is then copied onto the skeletal tier of the suffix. To this reduplicated form is added the suffix /-mut/.

15a.



b.



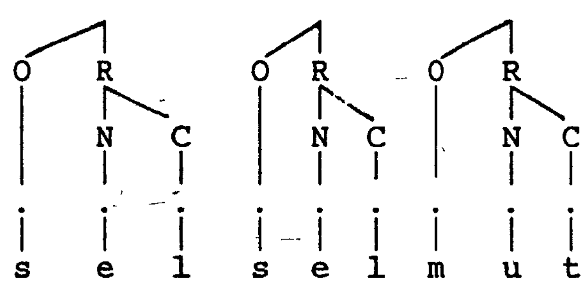
The whole form is, then, syllabified. In the first syllable, the sonorant [l] is lost because it cannot be syllabified into the nucleus or the following onset. Furthermore, it cannot be linked to a coda, presumably because of the presence of a branching nucleus in the syllable.

In the second syllable, however, the branching nucleus is shortened allowing the sonorant [l] to be kept. This shortening could be attributed to a constraint on metrical structure which would state that this penultimate syllable, which must be in a weak metrical position, cannot be heavy. The shortening permits the sonorant to be kept by allowing it to be syllabified into a coda. Note, however, that Sonorant Reassignment will move the sonorant into the nucleus, making it branching again. One has to argue, then, that this process of shortening applies only following syllabification.

Let us look, now, at the form /sel-/, as shown in (16). What is interesting to note is the difference in syllabification of the [+son] segment in the two examples. In (15), the stem /kwa:l-/ has a long vowel, while in (16), the stem /sel-/ has a short vowel.

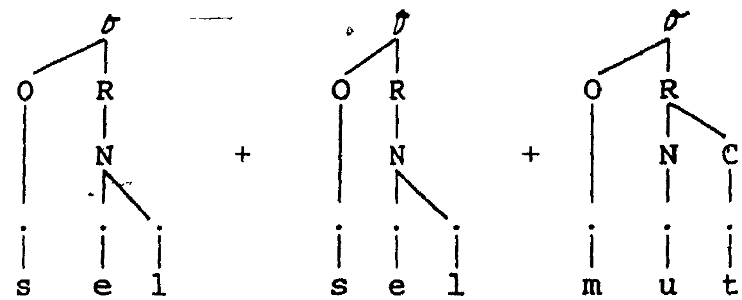
If Sonorant Reassignment is part of the set of resyllabification mechanisms, the derivation of /sel-/ should be similar to that of /xwa:l-/ in (15). The resulting structure, before Sonorant Reassignment applies, is not the correct representation, however. This is shown in (16a).

16a.*



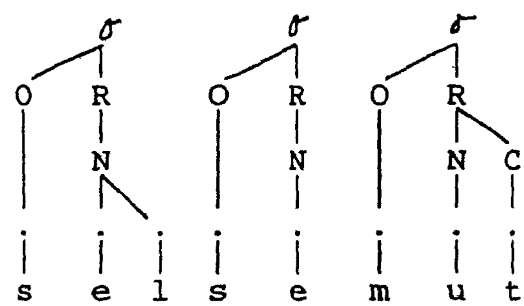
If, as I argue above, shortening only applies following syllabification, this process cannot apply to the form in (16a). To arrive at the desired result, the sonorant must be syllabified into the preceding nucleus before the whole stem is reduplicated, as shown in (16b).

16b.



The branching nucleus of the reduplicated stem can then be shortened, giving the result shown in (16c).

16c.

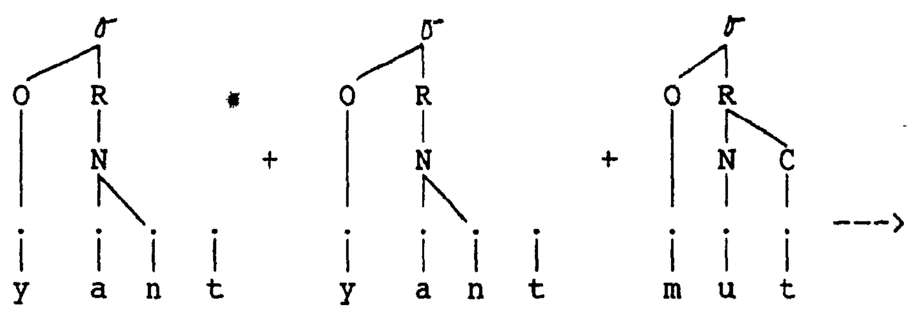


Obviously, Sonorant Reassignment cannot be part of the set of resyllabification mechanisms since the sonorant must be part of the nucleus before the reduplication of the stem, i.e. before the suffixes have been added. Otherwise, if the sonorant is first syllabified into a coda, it should be possible to reassign it to the nucleus of the reduplication suffix without having it shortened, since shortening applies only following syllabification and Sonorant Reassignment is part of the resyllabification conditions.

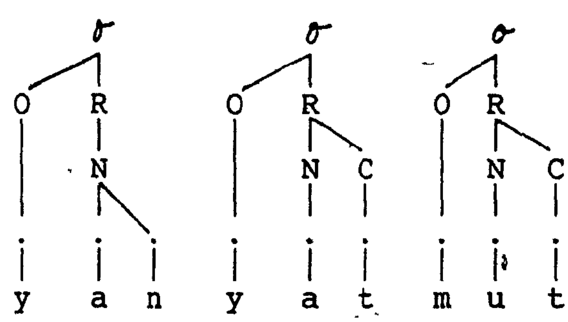
On the other hand, if Sonorant Reassignment is part of the syllabification conditions, the shortening of only the long vowel in the first case and of the sequence vowel + sonorant in the second case can be explained by the fact that they are both found in branching nuclei following syllabification where shortening occurs.

As for stems of the form CVSC, they are syllabified as in (17). Note that the stop [t] in the second syllable is allowed to be syllabified into a coda because of the shortening of the branching nucleus, while it has to be deleted in the first syllable.

17a.



b.



Stems of the type CV[-son](C) do not reduplicate at all, as shown in (18). In Kwakiutl, the large majority of stems of the type CVCC have a sonorant as their medial consonant.

18.	tsəx-	tsəxmut	'hair singed off'
	təp-	təpmut	'broken pieces'
	tsətx-	tsətxəmut	'left after squirting'
	kwəsx-	kwəsxəmut	'left after splashing'

Henceforth, I will claim that the parameter which allows the syllabification of sonorants into the nucleus is, in fact, part of the syllabification conditions which mediate ISP. This is not in any way an undesirable move. In syntax, parameter settings determine initial representation. If a particular parameter (e.g. pro-drop) is present in the grammar, it is present on each and every level of derivation, an intrinsic part of the language. Why, then, should it not be the case in phonology that parameter settings determine initial representations? It is logical to maintain that parameters are part of the mechanisms which mediate ISP.

I will therefore assume that Sonorant Reassignment as presented by Piggott and Singh (1985) is, in fact, a parameter of U.G. which is found in the set of syllabification principles and conditions which mediate ISP. This parameter I will rename the Nucleus Maximization Condition (henceforth NMC) to clarify its new status in the grammar. Any process which resyllabifies a sonorant into a nucleus after some rule or condition has applied (e.g. shortening) would simply be a manifestation of the presence in the language of that particular parameter of U.G.

In conclusion, Kwakiutl can be argued to be quantity sensitive. Furthermore, it is sensitive only to branching nuclei, as demonstrated by the stress rule. Kwakiutl shows the presence of sonorants into the right-most position of the nucleus. It also offers evidence for the presence of the NMC in the set of syllabification mechanisms which mediates ISP, and of the existence of at least two stages in the derivation of a form: that of syllabification and of resyllabification. I propose, that principles and parameters apply on all stages of a derivation but that somes processes, such as shortening, can be found only at some particular stage of a derivation. As for the presence of compensatory lengthening in the language, I have shown that the process at work in Kwakiutl, although a structure-preserving strategy, is not a strategy to preserve a heavy syllable. Thus, it must be differentiated from the process of compensatory lengthening under study in this thesis.

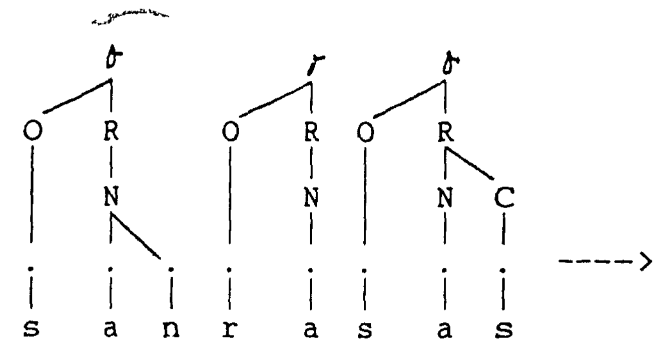
Consequently, I will now turn to another language, Lithuanian, which not only will give support for the assumptions discussed above, but which also has clear cases of compensatory lengthening.

2.3 The case of Lithuanian

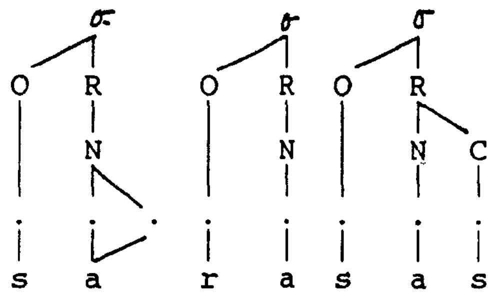
Compensatory lengthening is a well-known process of Lithuanian. The language has many instances of deletion of a sonorant with concomitant lengthening of the preceding vowel. For example there is a rule which deletes n when the segment is followed by a [+continuant] consonant or by a sonorant. The deletion process triggers the lengthening of the preceding vowel. This can be shown most clearly by forms containing the prefix san-.<4>

19a.	sámbu:ris	'assembly'	cf.	bu:rĩ:s	'crowd'
	sámpil	'stock, store'		pìlnas	'full'
	sántaka	'confluence'		teké:ti	'to flow'
b.	sá:junga	'union'		jũngas	'yoke'
	sá:slavos	'sweeping'		slúoti	'sweep'
	sá:rasas	'list, register'		rasí:ti	'to write'
	sá:nari:s	'joint'		narĩ:s	'link'<5>

20a.



b.



There is considerable evidence that sonorants are syllabified in the nucleus in Lithuanian. What is most interesting in this language is the fact that vowel+sonorant sequences have always been considered to pattern with diphthongs and long vowels. In fact, sequences of vowel+sonorant have been called 'mixed diphthongs' in the literature (Kenstowicz 1972). In our framework, those three different kinds of sequences of segments can simply be represented by a branching nucleus in Lithuanian.

I will first demonstrate that the Nucleus Maximization Condition must be part of the grammar of Lithuanian. To do so, let us look at some verbs which are part of the first subclass of what has been called the ablauting pattern. All of them contain an underlying short vowel followed by one or more obstruents.

21.

infin.	3rd pres.	3rd past	
tŭ:pti	tùpia	tȗ:pe:	'perch'
pŭ:sti	pùcia	pȗ:te:	'puff'
drĕ́:bti	drĕbia	drȇ:be:	'splash'
drĕ́:ksti	drĕskia	drȇ:ske:	'tear'
vȏ:gti	văgia	vŏ́:ge:	'steal'
blŏ́:ksti	blăskia	blȏ:ske:	'fling'

The second subclass of the ablauting pattern, on the other hand, is formed from stems with an underlying long vowel followed by a liquid or a nasal.

22.

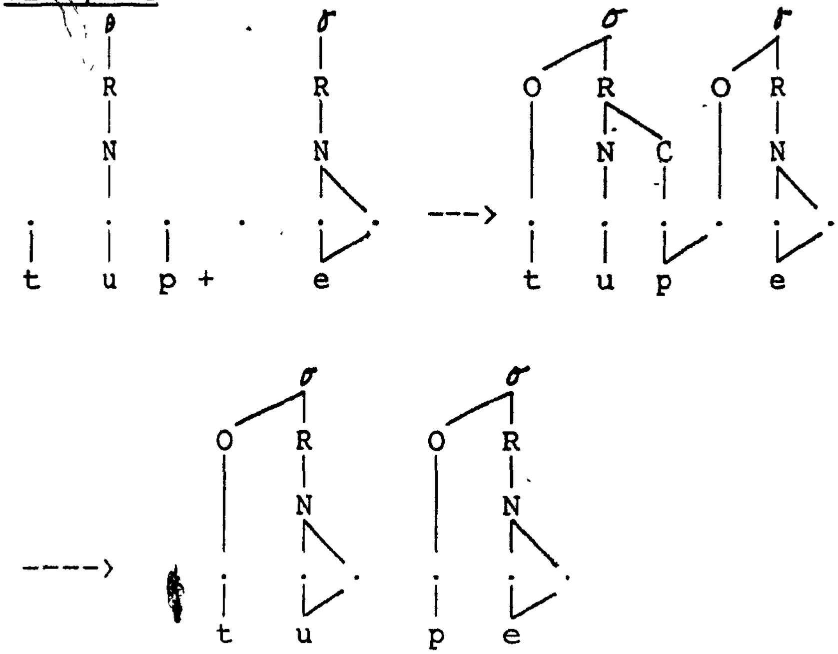
infin.	3rd pres.	3rd past	
gélti	gε̑lia	gé:le:	'sting'
lémti	lĕmia	lé:me:	'doom'
kárti	kăria	kɔ́:re:	'hang'
gírti	gìria	gí:re:	'praise'
mínti	mìna	mí:ne:	'trample'
kúlti	kùlia	kú:le:	'tresh'

All the roots in the ablauting pattern are described as undergoing lengthening of the root vowel in the non-present. In the second subclass, however, the root vowel is short when the root is followed by a suffix starting with a consonant.

This lengthening can be best explained by postulating that each of the non-present affixes has three slots as part of its representation in the lexicon.

The formation of the 3rd past of the first subclass of the ablauting pattern can be illustrated as in (23), while the second subclass can be exemplified as in (24).

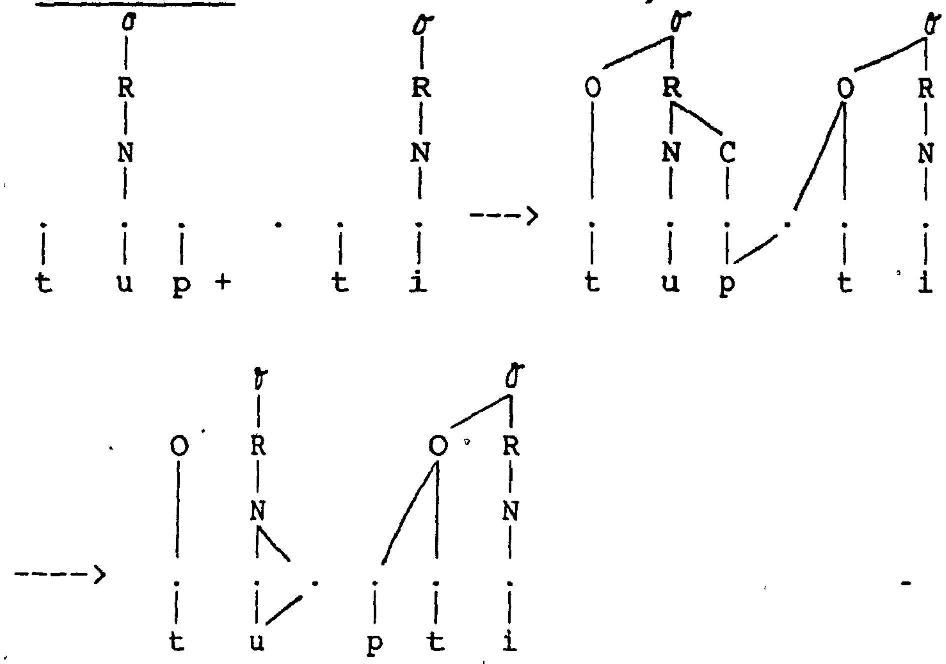
23a. 3rd past



In (23a), nuclei are initially erected over the [+voc] elements. Onsets are then erected over the slots preceding the nucleus. As for the first slot attached to the stop [p], it is syllabified into a coda. The resulting geminate, however, is not allowed in Lithuanian. Therefore, the links of the first slot are erased, and the slot is relinked to the nearest available node, the nucleus. The vowel linked to that nucleus, then, spreads to the new nuclear slot.

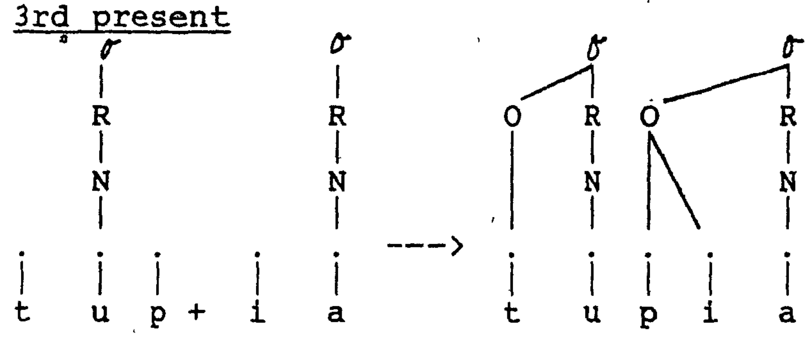
In (23b), we are faced with a similar situation as the one found in (23a). By spreading to the unlinked slot of the suffix, the stop [p] has become a geminate. The first slot linked to the stop [p] has then to be resyllabified into the preceding nucleus, while the second slot is resyllabified into a coda.

23b. <u>infinitive</u>



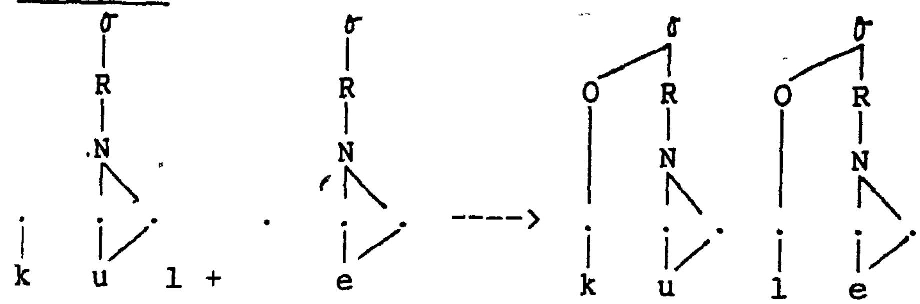
In (23c), on the other hand, the third present suffix is represented as having only two slots. After the erection of a nucleus over each vowel, an onset is simply erected over the preceding slots.

23c. <u>3rd present</u>



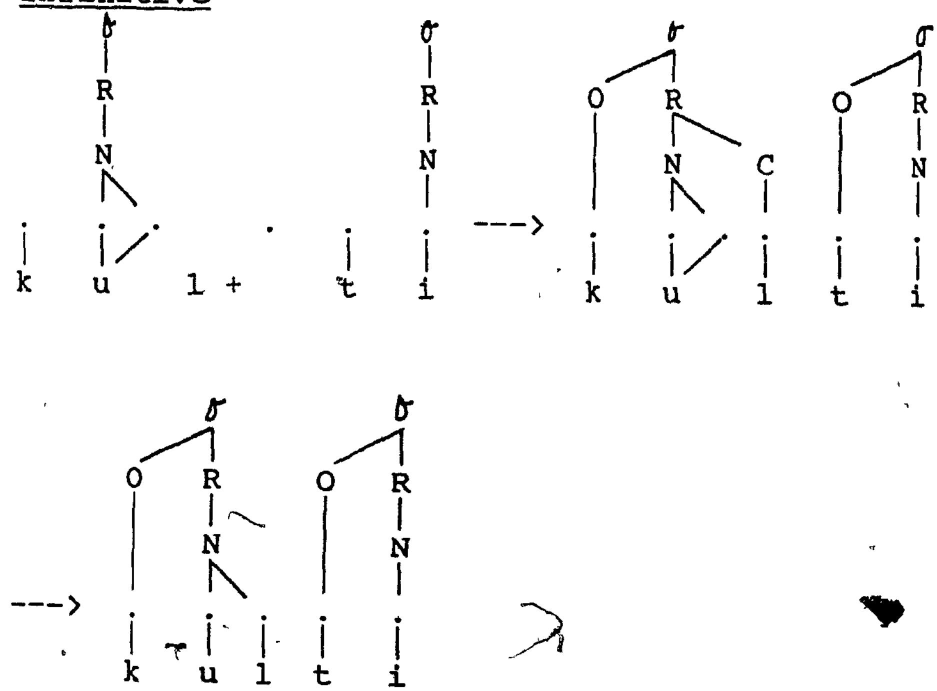
Let us now look at some verbs from the second subclass of the ablauting pattern and see how their structure differs from that of the first subclass.

24a. <u>3rd past</u>



The stems of the second subclass are represented as having a long vowel rather than a short one. Furthermore, their [+son] element is without a point in the lexicon. Thus, in (24a), the sonorant is simply linked to the unattached slot of the suffix.

24b. <u>infinitive</u>



In (24b), the sonorant is also linked to the floating slot of the suffix. This slot, however, cannot be linked to the onset since the sequence which would be created is not allowed in Lithuanian.<6> The slot has to be assigned to another node. Since the nucleus has already two slots, the sonorant is syllabified into a coda. This initial syllabification of a branching nucleus whithin a branching rime is then reduced to a simple branching nucleus by a process of shortening. This shortening process could be seen as some manifestation of the presence of Prosodic Government in the grammar. Recall that Prosodic Government only allows syllables in which the head governs the other constituents of the rime. The shortening will be discussed in more details below.

A very strong argument in favor of the presence of the NMC in Kwakiutl was based on the stress pattern of the language. In Lithuanian, except for very secondary rules, stress is lexically given.<7> The tone patterns of the language are, however, a very different matter. An important feature of Lithuanian is that tones are sensitive to elements below the syllabic node. In fact, Lithuanian tones can be shown to be sensitive to which sequences of segments are found in a branching nucleus. This analysis of tone in Lithuanian will argue for the need to postulate the NMC as being part of the initial syllabification mechanisms rather than as being part of the set of resyllabification conditions, as proposed by Piggott and Singh (1985).

As indicated above, Lithuanian is a language where stress is for the most part lexically given. However, the type of tone which accompanies the stress seems to be dependent on the kind of segments it is linked to. When the stress is on an underlying long vowel, i.e. a single element linked to a branching nucleus, a high tone, indicated by an acute accent, is assigned.<8> When the stress is on a diphthong or a short vowel followed by a sonorant, i.e. two elements linked to a branching nucleus, a low tone, indicated by a circumflex accent, is assigned. The grave accent on short vowels indicates only the stress position since no tone is ever found linked to a non-branching nucleus.

This sensitivity of tones to the composition of a branching nucleus can be best illustrated through the shortening process to which I alluded above. This process shortens a long vowel when followed by a glide in a closed syllable.<9> Since the underlying length contrast between long vowels followed by a glide and short vowels also followed by a glide in a closed syllable is neutralized by this process, the only way to recover the contrast is by the different tones which fall on those syllables. This is shown in (25). In the middle column, we can see that the difference in tone is dependent on the length of the accented vowel, thus, the contrasting result.

```
25a.   x                    H
      ka:imas ---->  ka:imas ---->  káimas
       x                  L
      vaikas  ---->  vaikas  ---->  vãikas


  b.   x                  H
      ka:uti ---->  ka:uti ---->  káuti
       x                  H
      ka:ue: ---->  ka:ue: ---->  ká:we: ---->  kó:we:
```

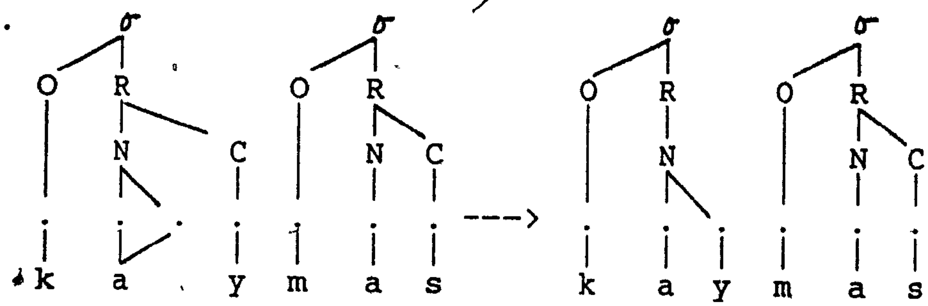
In (25b), the second example shows a long vowel followed by a glide in what is not a closed syllable. Shortening does not apply in that case.

The same process of shortening applies also to long vowels followed by sonorants when found in closed syllables. This is shown in (26):

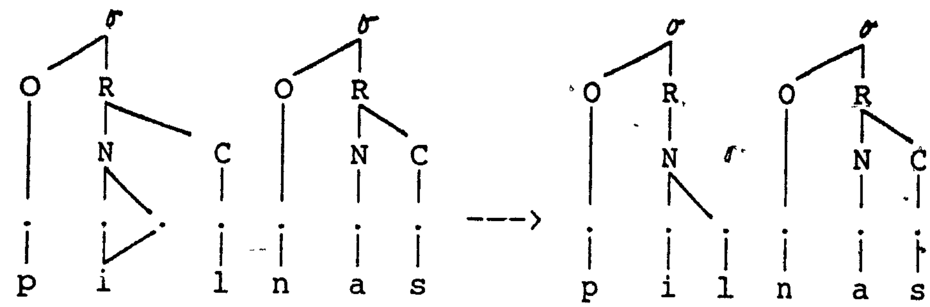
```
26.    x                  H
     pi:lnas ---->  pi:lnas ---->  pílnas
       x                  L
     vilkas  ---->  vilkas  ---->  vĩlkas
       x                  H
     va:rnas ---->  va:rnas ---->  várnas
       x                  L
     rankas  ---->  rankas  ---->  rãnkas
```

This process of shortening can be illustrated as in (27a,b). In (27c), there is no shortening because the glide is in the following syllable.

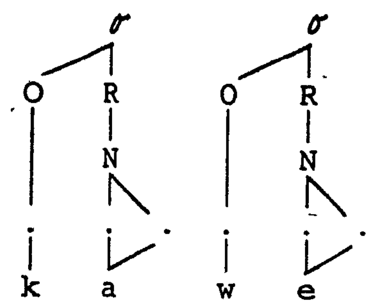
27a.



b.

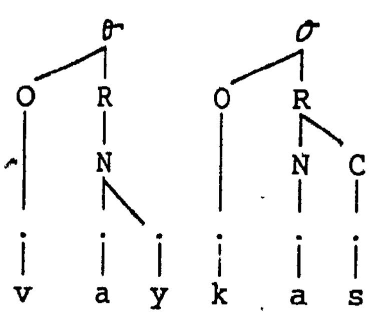


c.

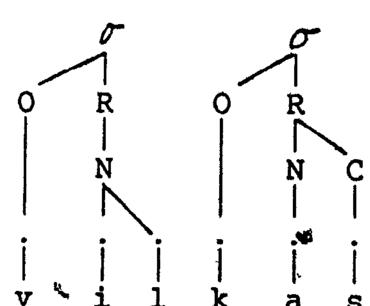


The examples in (28), on the other hand, show the structures of stems with a short vowel underlyingly.

28a.



b.



Assuming that tones are assigned before shortening applies, I propose that, in the structures in (27), the first syllable of the stems receives a high tone because the two nucleus slots are linked to a single element on the segmental tier. In (28), on the other hand, the syllable receives a low tone since the two nucleus slots are each linked to a different element on the segmental tier.

29. <u>Tone Assignment of Stressed Syllables</u>

a. On the nucleus projection, assign a high tone to a segment linked to two nucleus slots.

If two segments are linked to the two nucleus slots, assign a low tone.

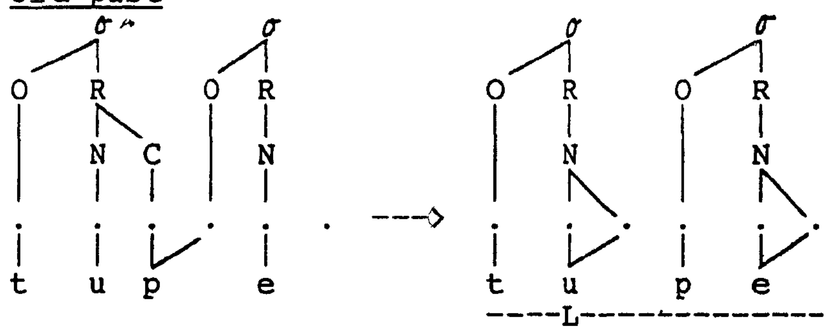
b. no tones are assigned to non-branching nuclei.

What is important to note is that, to obtain the results in (27) and and in (28), it is necessary for sonorants to be syllabified into the nucleus before tones are assigned. The shortening process would be assumed to apply following resyllabification. Note that the sonorant is found in the nucleus following this shortening. This is consistent with the assumption that parameters which are part of the syllabification mechanisms are, in fact, present throughout the derivation.

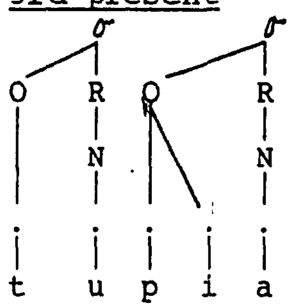
As expected, the shortening rule does not affect tones. Although the right-most slot of the nucleus has been erased, the nucleus itself has been kept intact through the resyllabification of the coda into a nucleus slot. The fact that the nucleus slots are now attached to two different elements on the segmental tier does not trigger a reassignment of tones. The evidence given above, thus, indicates that Lithuanian is sensitive to the number of elements on the segmental tier which are linked to a branching nucleus.

Let us now look again at some of the examples in (23) and (24) and see how Tone Assignment would apply to those forms. First, let us examine how tone assignment applies to the first subclass of the ablauting pattern.

30a. <u>3rd past</u>



b. <u>3rd present</u>



In (30a), the vowel of the stem is underlyingly short, and stays the same after syllabification. If, as I argue, tones are assigned at this particular stage of the derivation no tone can be assigned, since the nucleus does not branch.

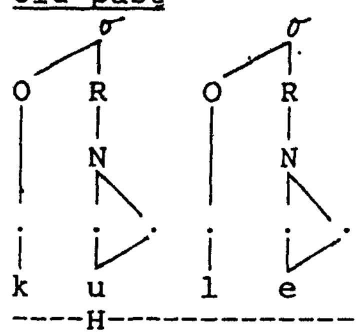
After resyllabification, however, the nucleus does branch. I propose that, if at some point in the derivation a non-branching nucleus becomes branching, a low tone is assigned to that branching structure which would otherwise be without a tone. In (30b), on the other hand, no tone will be assigned since the nucleus stays non-branching.

31. <u>Secondary Tone Assignment</u>

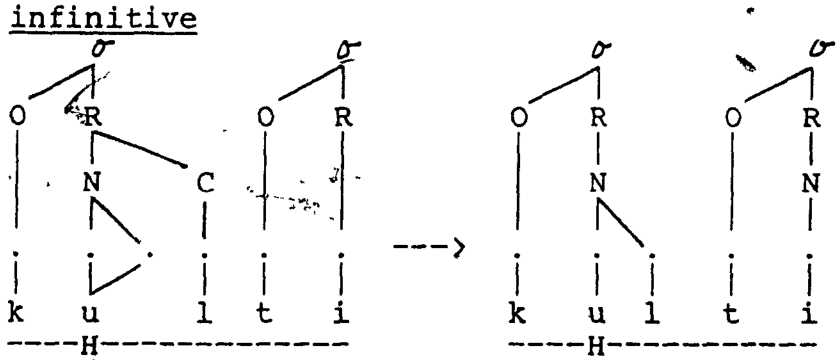
A stressed non-branching nucleus is assigned a low tone iff it become branching at a latter stage.

In the case of the second ablauting pattern, the resulting tone assignment is as shown in (32).

32a. <u>3rd past</u>



b. <u>infinitive</u>



In both (32a) and (32b), the stem vowel is linked to two slots in the lexicon. After syllabification, which creates a branching nucleus over the two slots, a high tone is assigned. In (32b), the shortening process, produces a branching nucleus linked to two different elements on the segmental tier. Tone assignment applying only following the initial syllabification, the high tone is kept throughout.

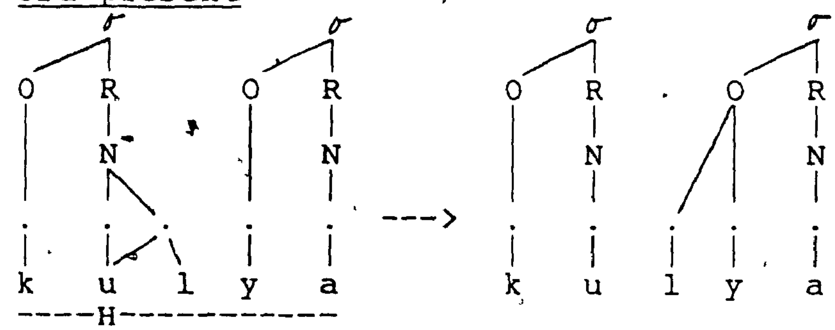
If we compare the present tense of the two subclasses, however, we can see that both sets are represented by a short vowel in an open syllable, even those of the second subclass which have a long vowel underlyingly.

To help resolve this problem, let us consider a third subclass which is traditionnaly regarded as ablauting and where the underlying long vowel is followed by a glide in the same syllable. Note that, in (33), the present tense is not characterized by a non-branching nucleus, i.e. the tone has not been erased.

33.	infinitive	3rd present	3rd past	
	káuti	káuja/káuna	kó:ve:	'beat'
	ráuti	ráuja/ráuna	ró:ve:	'tear'
	bliáuti	bliáuja/bliáura	blió:ve:	'bleat'
	griáuti	griáuja/griáuna	grió:ve:	'thunder'

I argue that this difference in tone assignment between (22) and (33) can be easily explained if the NMC is part of the set of syllabification mechanisms. Recall that, in (24), the sonorant is linked initially to the preceding onset. In that particular case, however, there was an available unlinked slot to which the sonorant could anchor. This is not the case in (34) where the present tense of the second subclass is illustrated.

34a. <u>3rd present</u>

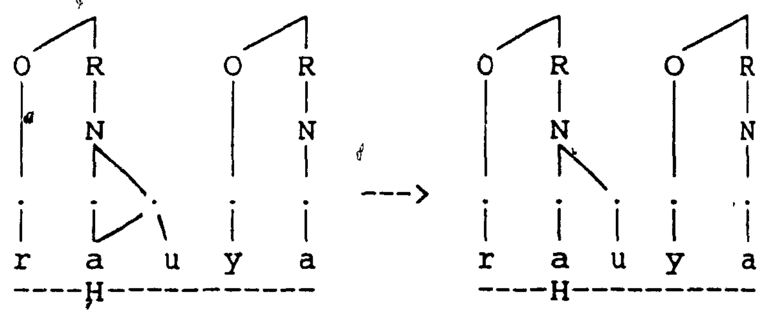


In (34a), the nuclei are erected over the [+voc] elements. Onsets are then erected before each nucleus. As noted above, there is no unlinked slot to which the sonorant can be attached. Because of the presence of the NMC, I propose that the sonorant is initially linked to the right-most point of the nucleus, rather than linked to the point in the onset.

In Lithuanian, however, this three-part linking of two segments to two slots in the nucleus violates a language specific constraint which requires that the two elements in that particular structure share the same specification for [cons]. All the links of the non-permissible structure are erased, triggering the loss of the tone which was anchored to the nucleus. The vowel is then assigned to the nucleus while the sonorant is resyllabified into the following onset, taking with it the right-most point of the nucleus.

Let us now look at the third subclass of the ablauting pattern and see how it differ from the second subclass.

34b. <u>3rd present</u>



In (34b), syllabification follows the same pattern as in (34a). The resulting structure is allowed, however, since the two elements linked to the nucleus points are similarly specified [-cons]. Note that the [+high] vowel [u] is linked to the second slot of the nucleus not because of the presence of the NMC, but because of the universal constraint which does not allow two glides in the same coda. The shortening process, then, reduces the structure to a short vowel plus a glide (i.e. a simple diphthong).

Clearly, Lithuanian can be regarded as a quantity sensitive language in which a branching nucleus defines a heavy syllable. Furthermore, the analysis of tone placement in Lithuanian gives additional evidence for my claim about the status of the NMC as a parameter found with the set of syllabification mechanisms which mediate ISP.

Let us now look at the process of compensatory lengthening in Lithuanian. At the beginning of this section

I gave an example of compensatory lengthening triggered by the deletion of [n] before a [+continuant] consonant or a sonorant. Another example of the deletion rule with concomitant lengthening of the preceding vowel is found in some derived intransitives. These verbs are of two kinds. There are those which add the suffix /-st/ to the present tense stem, and there are those which infix a nasal instead. What is interesting to note about those verbs is the distribution of the suffix compared to that of the nasal infix. If the root contains a long vowel or a diphthong, either of the form VS or VG, the suffix /-st/ is added.

35.

<u>infin.</u>	<u>3rd pres.</u>	<u>3rd past</u>	
dí:gti	dí:gsta	dí:go	'sprout'
álkti	álksta	álko	'hunger'
gãisti	gaĩsta	gaĩso	'tarry'

If the root vowel is underlyingly short and the following consonant is a stop, the dental nasal n is infixed.

36.

<u>infin.</u>	<u>3rd pres.</u>	<u>3rd past</u>	
àkti	ã̆nka	ã̆ko	'become blind'
slàpti	slã̆mpa	slã̆po	'get wet'
gèsti	gẽ̆nda	gẽ̆do	'spoil'

However, if the root vowel is underlyingly short and the second consonant is a fricative, then, the root vowel appears as lengthened bearing a low tone and the suffix is added.

37. <u>infin.</u>   <u>3rd pres.</u>   <u>3rd past</u>

infin.	3rd pres.	3rd past	
sàsti	sã̆:sta	sâso	'grow scabby'
grìsti	grĩ̆:sta	grĭso	'be tired of'
glèzti	glẽ:zta	glĕzo	'weaken'

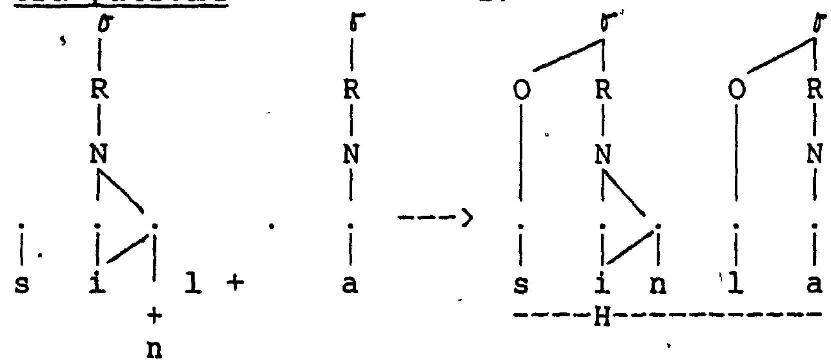
Finally, if the root vowel is long and the final consonant is a sonorant, there are two possibilities. If the consonant is a nasal, the form is suffixed, but if the consonant is a liquid, then, either suffixing takes place, or the root vowel is lengthened.

38.

infin.	3rd pres.	3rd past	
pazínti	pazí:sta	pazìno	'get acquainted'
kímti	kímsta	kìmo	'get hoarse'
bálti	bã̆:la/bálsta	bã̆lo	'whiten'
sílti	sĭ:la/sílsta	sìlo	'grow warm'

Let us then look at the case of compensatory lengthening illustrated in (38). In (39a), nuclei are erected over the [+voc] elements of the stem and of the suffix. The infix, being without a point, is linked to the right-most point of the nucleus. Note that, in contrast with (34a), the sonorant [l] is linked to the onset because of the availability of an unlinked slot. This is similar to the derivation in (24), where the sonorant is later attached to the unlinked slot. This is shown in (39b).

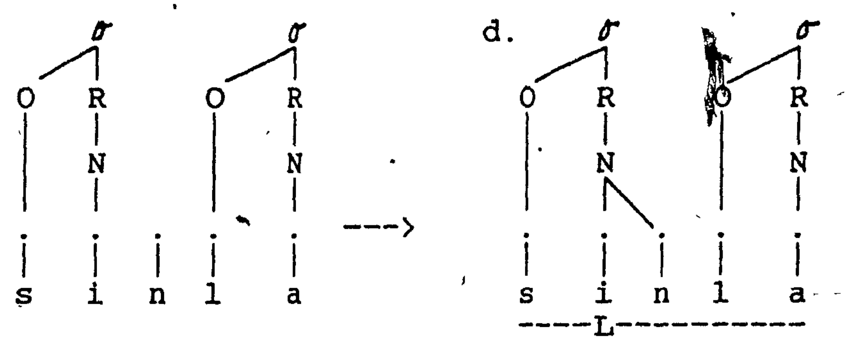
39a. <u>3rd present</u> b.



As was argued for the form in (34a), the nuclear structure is not allowed. The nasal cannot be resyllabified into the onset, however, because it would create a consonant cluster which is not allowed in Lithuanian. Thus, it can only be resyllabified back into the nucleus, as shown in (39d).

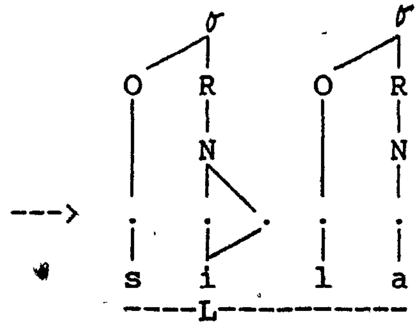
I again assume that, when all the links of a non-permissible nucleus are erased, the tone linked to that nucleus is also lost. After resyllabification, the new branching nucleus is assigned a low tone by the later rule.

39c. d.



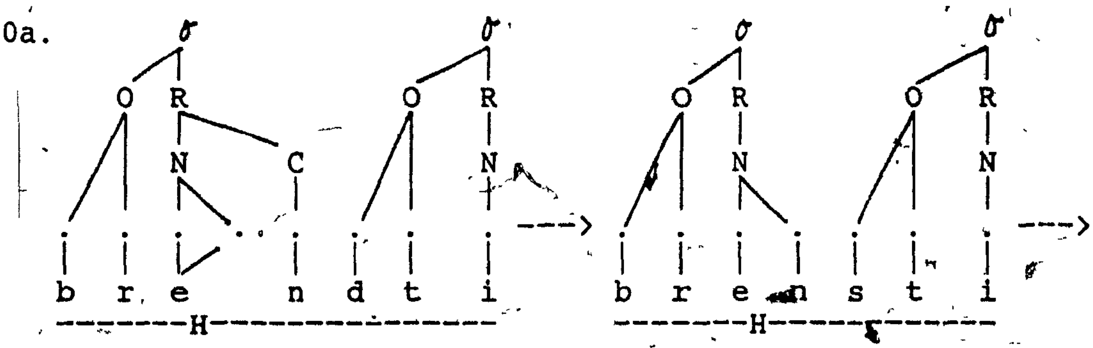
Recall, that in Lithuanian, there is a rule which deletes nasals before [+cont] consonants and sonorants. The environment for the deletion rule is also found in (39d), giving the result in (39e).

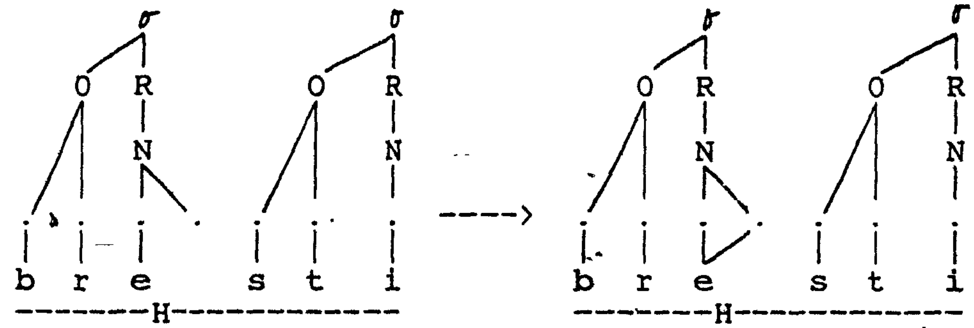
39e.



Another example below illustrates the fact that processes such as compensatory lengthening or shortening do not have any influence on the assignment of tones. The verbs <u>bréndo</u> 3rd past 'ripen' and <u>brẽnto</u> 3rd past 'rot' are derived from the underlying stems /bre:nd-/ and /brend-/ respectively. The corresponding infinitive forms for those stems are bre:sti and bre:sti where the stem-final dental stops have been assimilated to [s], according to Kenstowicz's (1972) analysis of the forms. The result of this assimilation rule triggers the deletion of [n].

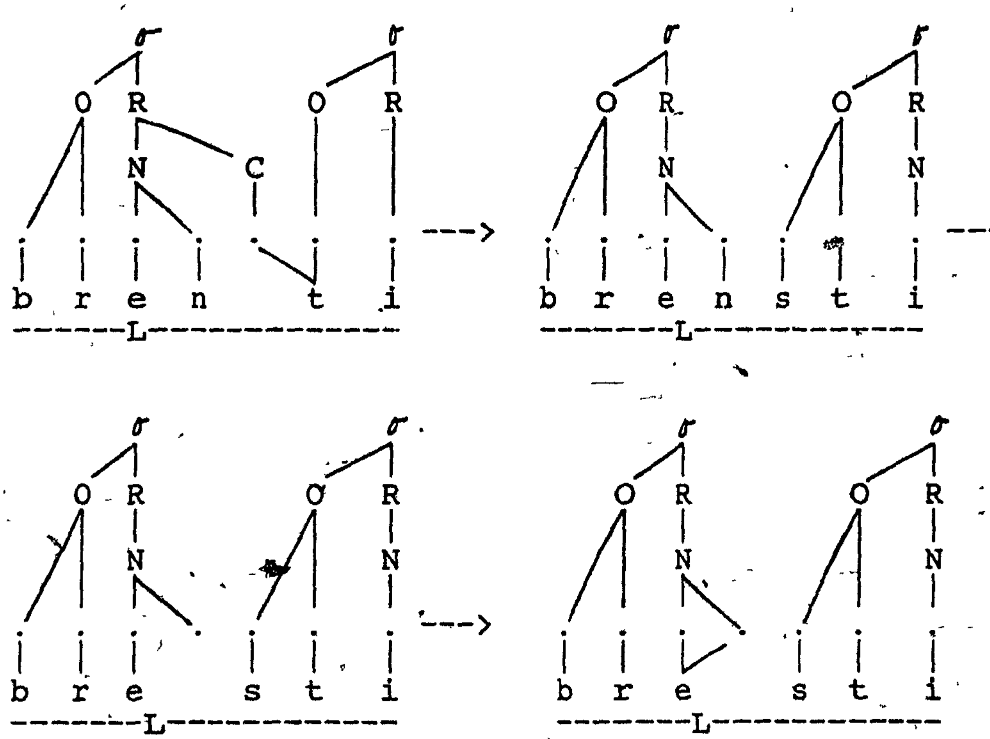
40a.





In (40a), a high tone is assigned to the long vowel before shortening applies. Later on in the derivation, the assimilation of the stop [d] to [s] triggers the deletion of the sonorant. Compensatory lengthening, then, applies to preserve the structure.

40b.



In (40b), the NMC syllabifies the sonorant directly into the nucleus, and a low tone is assigned. The stop [t] is also assimilated to [s]. Note that the assimilation rule triggers a resyllabification of the segment into the following onset. The segment [n] is then deleted in the right-most position of the nucleus, triggering compensatory lengthening.

The fact that the branching nucleus is kept throughout the derivation allows the tone, whether high or low, to stay on the stressed syllable, no tone being allowed on light syllables.

In this section, I have shown that Lithuanian has the Nucleus Maximization Condition as part of its set of syllabification strategies. I have also shown that, although stress is mostly fixed in Lithuanian, tone is sensitive to the branching or non-branching of the nucleus. Furthermore, the assignment of the two different types of tones is sensitive to the number of elements on the segmental tier linked to the slots of the nucleus. Therefore, Lithuanian can be classified as a quantity sensitive language where a branching nucleus defines a heavy syllable. Furthermore, I have shown that the process of compensatory lengthening is part of the grammar of Lithuanian, and that it is triggered by the deletion of a nasal in the right-most position of the nucleus.

In the following section, I will go over the facts of Luganda and Ancient Greek and give an analysis of those two languages within a parametric framework.

2.4 Luganda and Ancient Greek Revisited

2.4.1 Luganda: Compensatory Lengthening?

In Chapter 1, we looked at Clements' analysis of compensatory lengthening in Luganda within an autosegmental framework. In this section, I will give an analysis of the process within the parametric framework I have adopted. Let us look again at the Luganda facts as presented in Clements (1981).

41. G1 Luganda has no surface vowel sequence. The initial nonhigh vowel of an underlying vowel sequence is deleted, with concomitant lengthening of the last vowel of the sequence. /ka-ezi/ keezi 'small moon'.

    G2 Glide formation induces length on the following vowel. The initial high vowel of an underlying vowel sequence is replaced by a glide, with concomitant lengthening of the following vowel. /mu-ezi/ mweeze 'moon'.

    G3 Nasal Clusters induce length on the preceding vowel. This statement holds both within and across morpheme and word boundaries. /mu-ntu/ muuntu 'person', /ba-n-gob-a/ baangoba 'they chased me'.

G4 Lengthening is not cumulative. All syllables are either short or long: there are only two degrees of vowel length. /li-anda/ lyaanda 'charcoal', /ba-a-N-gob-a/ baangoba 'they chased me'.

G5 Vowels are short before geminate consonants. This generalization takes precedence over those cited above. /mu-luadde/ mulwadde 'patient', /ba-a-e-ggal-a/ beggala 'they shut themselves in'.

G6 Words are organized into moras according to the following principles: (a) a short vowel counts as one; (b) a long vowel counts as two; (c) a phrase-initial nasal cluster counts as one; (d) a geminate consonant counts as one.<10>

Clements (1981, 1985) argues that (41G2) and (41G3) are evidence for the presence of compensatory lengthening in Luganda. It has to be noted, however, that, as (41G2) and (41G3) indicates, every glide and every nasal which is placed in the nucleus through initial syllabification are later found linked to the onset of the preceding or of the following syllable respectively with concomitant lengthening of the adjacent vowel. Thus, no glides or nasals in medial position will ever be part of a branching nucleus in surface structure.

If we were to postulate that Luganda has the NMC as part of its syllabification mecanisms, we would be faced with a paradox: a language which selects the setting of a parameter in such a way as to initially syllabify sonorants (and glides) into the nucleus only to remove them from that position in all cases at a later stage of the derivation. Recall that in all the other cases of compensatory lengthening we have looked at in this chapter and in Chapter 1, the sonorants which trigger the process of compensatory lengthening are deleted only in certain environments and are found in the nucleus elsewhere.

This paradox is clearly undesirable within a principled and coherent theory of syllabification. Therefore, I propose an analysis of the Luganda data which will assume that compensatory lengthening is not part of the grammar of the language. Reconsidering the Luganda facts, I propose the following assumptions: sonorants and glides cannot be assigned to the nucleus; there are prenasalized consonants in Luganda; Luganda permits only CV syllables, unless the element in the coda is also linked to the preceding onset (i.e. a geminate consonant); empty nuclei are allowed.<11>

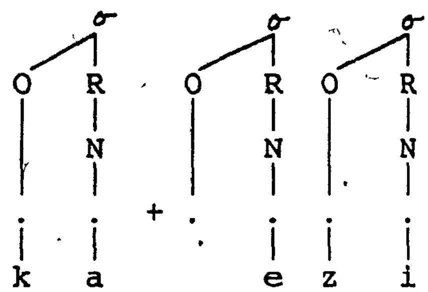
With regard to the first assumption, I propose that sonorants and glides are not allowed in the nucleus in Luganda because of the presence of a constraint on syllabification in the grammar. This syllabification condition can be stated as in (42).

42. <u>The Proper Linking Condition</u>

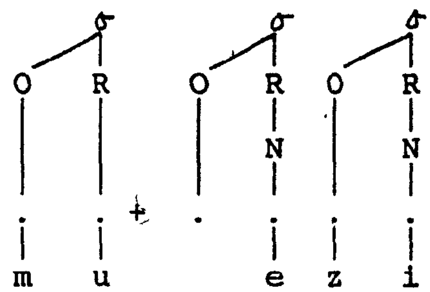
Two elements on the segmental tier
cannot be linked to the same nucleus.

Let us, then, look at the initial syllabification of the forms /ma-ezi/, /mu-ezi, /mu-ntú/ and /maala/, keeping in mind the assumptions proposed above. In (43a), a nucleus is erected over each of the three [+voc] segments. Then, an onset is created before each nucleus. Note that the medial onsets do not have an element available for linking on the segemental tier.

43a.

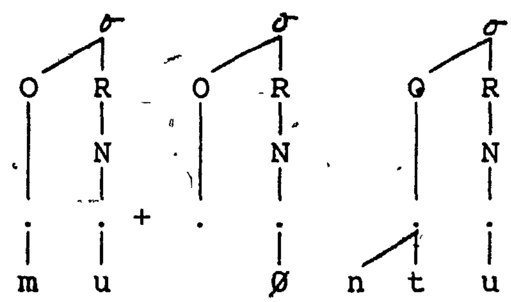


b.

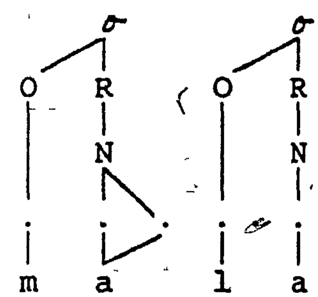


In (43b), nuclei are also erected over each [+voc] element. Note that the glide /u/, although not specified for [voc], is also found in a nucleus. This can be explained by the fact that, in the form /mu-/, it is the only element available for that position. Onsets are then erected before those nuclei. Again, the medial onset is found unlinked.

43c.



d.

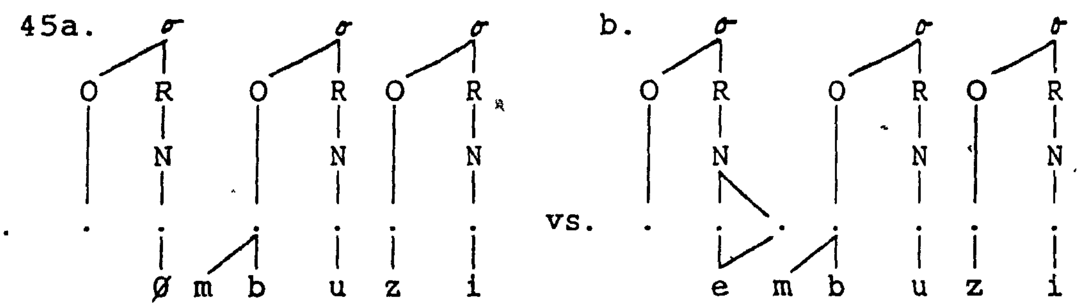


In (43c), there is not only an empty onset but also an empty nucleus in the medial syllable. I propose that, in Luganda, a form such as /-ntu/ must be preceded by an (empty) nucleus. That is, there is a constraint in Luganda which disallows prenasalized consonants from being in the onset of the first syllable of any morpheme.

44. <u>Prenasalization Condition</u>

> Any prenasalized consonant found at the beginning of a morpheme must be preceded by an empty nucleus.

The application of this constraint on syllabification can be illustrated with the forms <u>m̀búzì</u> vs. <u>è:mbúzì</u> 'goat'.



In (45a), the empty nucleus is non-branching. In (45b), however, the nucleus of the first syllable is branching. As was proposed above, I assume that both forms of the word 'goat' have three syllables. The different surface structures are brought about by the lengthening of the nucleus in the first syllable of the form in (45b) which triggers the insertion of an epenthetic vowel. This insertion of an epenthetic vowel can be explained by the presence of a universal constraint which disallows empty segments in branching structures.

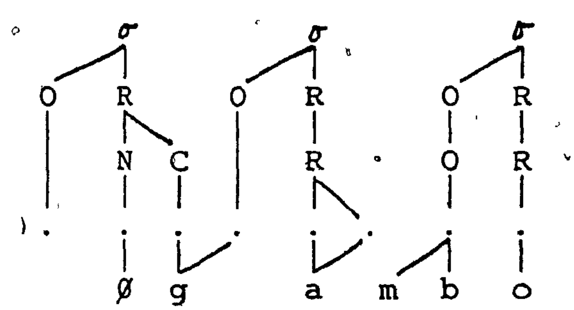
Note also that the nasal bears a tone in <u>m̀búzì</u> as do the vowels in both forms. In fact, in Luganda, not only the nasal segments in a sequence of nasal plus consonant but also the first half of a geminate consonant bears a tone.<12> Tone placement in Luganda is illustrated in (46). (A high tone is represented by an acute accent and a low tone by a grave accent.)

46. kìtábó	'book'	báálàbá	'they saw'	
yògérá	'Speak!'	kíndábá	'it sees me'	[kííndábá]
ǹdábà	'I see'	gêndá	'Go!'	[géèndá]
ǹgúlá	'I buy'	káàbá	'Cry!'	
m̀málè	'mud-fish'	twálàbá	'we saw'	[twáálàbá]
d̀díbà	'skin, hide'	kwâtá	'Seize!'	[kwáàtá]

More forms with geminate consonants are shown in (47). I propose the syllable structure shown in (48) for the form [ggambo].

47a. kúlíǹná	'to climb'	b. s̀sângá	'tusk'
kùcóp̀pá	'to become a pauper'	t̀táká	'soil'
kúb́bìká	'to dip'	g̀gámbó	'news'

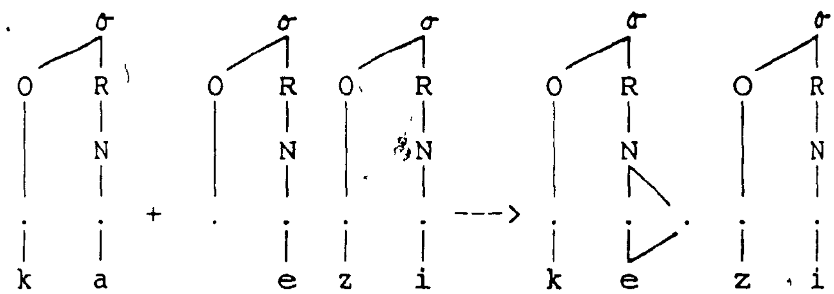
48.



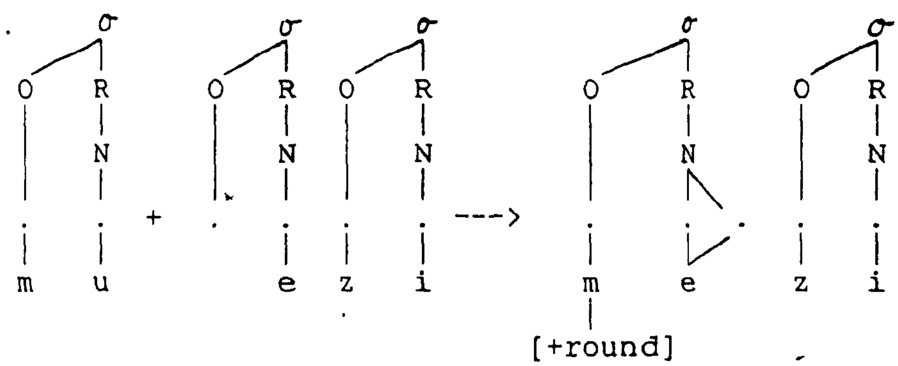
Luganda has a rule which assigns a tone to each slot in the rime, as shown in (46) above. Since, in structures where the nucleus slot is linked to a null element, there is no phonetic feature to which the tone can attach, it surfaces on the nearest element, i.e the nasal feature in a prenasalized consonant or the first half of a geminate. Since, in Luganda, tones are sensitive to the number of points found in a rime, I argue that Luganda should be considered a quantity sensitive language where both branching rimes and branching nuclei define a heavy syllable.

Let us now look at how the non-permissible structures in (43) are to be resyllabified.

49a.



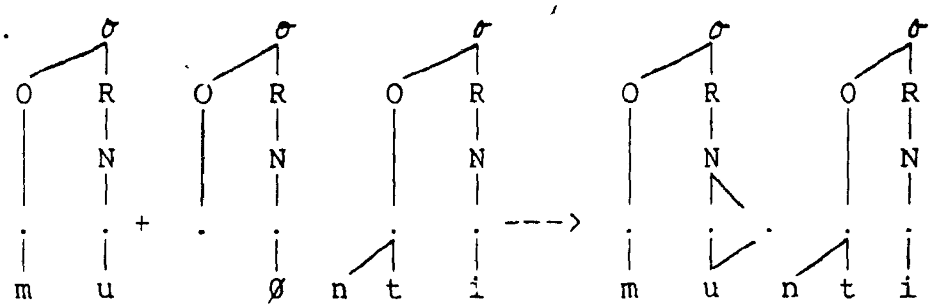
b.



In (49a, b), the structures after syllabification are that of vowels in hiatus. In Luganda, however, this is not allowed. Note that the medial onset in both structures is empty and not simply linked to a null element on the segmental tier. This means that the two vowels can be said to be adjacent on the segmental tier. These structures, thus, violate the OCP which does not allow adjacent identical segments on the same tier. In (49a), the violation is repaired by deleting the first vowel. The second vowel, then, spreads to the slot left unlinked, and the medial onset is erased. The same kind of restructuring occurs in (49b) with the addition of labialization of the preceding consonant. Following de Freitas (1986), I will argue that after the deletion of the glide, the labial feature [+ round], which is found on an independant tier, is linked to the preceding consonant.

According to Archangeli (1985), the fact that the feature [round] is not deleted along with the vowel can be explained by her proposal of a distinction between planes and tiers. For example, the vowel plane is argued to incorporate two tiers, a [round/back] tier and a [high] tier. Archangeli refers to this representation of vowel segments as coplanar with vowel features found on separate tiers but part of a single plane.

49c.

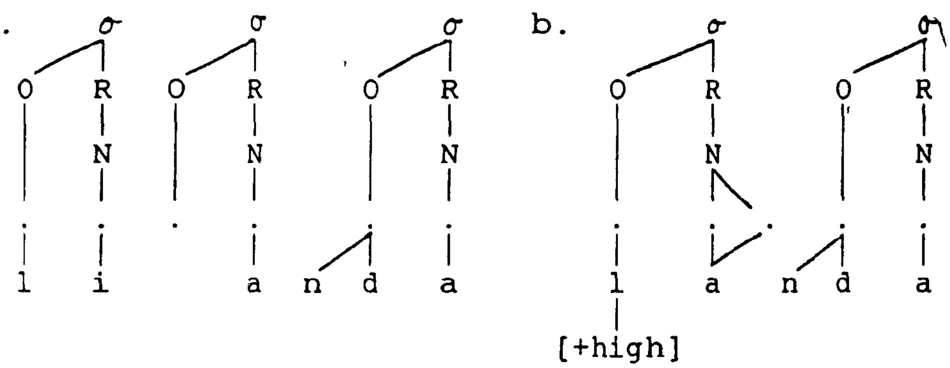


In (49c), I assume that the null element of the second nucleus still has some of the characteristics of a [+voc] element, being found on the vocalic tier. Therefore, the structure also violates the OCP. The null element is erased and the first vowel spreads to the slot left unlinked.

In Clements' analysis, there was a need for a V-trimming rule, because of the application of two different processes to certain forms, both resulting in an increase in the length of the vowel. For example, according to Clements' analysis, in the derivation of a word like /li-anda/, both the glide and the nasal are moved, each triggering compensatory lengthening.

Let us, then, look at the form /li-anda/, keeping in mind the assumptions I have proposed above.

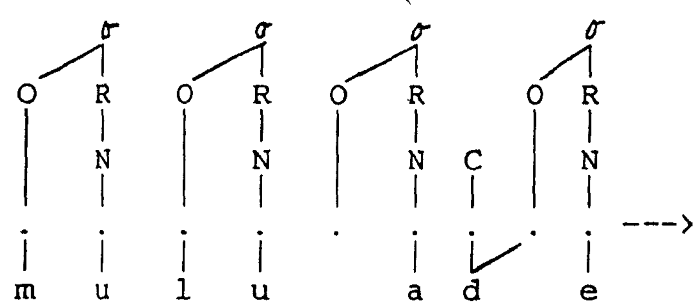
50a.



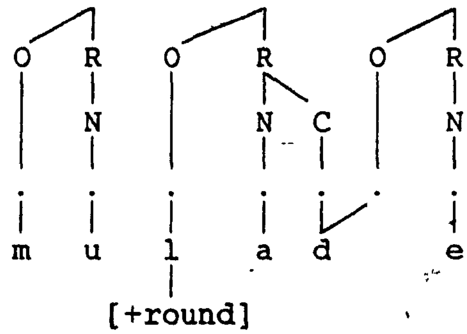
Note that, in contrast with the form /mu-ntu/ in (43c) and (49c), the structure in (50a) does not contain an empty nucleus before the prenasalized stop. Recall, however, that the constraint which makes the presence of an empty nucleus necessary has to do with prenasalized consonants at the beginning of a morpheme. This is not the case in (50). Thus, an OCP violation is only found in the first two syllables. To repair the violation, the first vowel is erased as was the case in (49b) with the form /mu-ezi/. The palatal feature [+high] is then linked to the preceding onset. In my analysis, there is no need for Clements' V-trimming rule since there is only one OCP violation occuring in the structure.

That same rule of V-trimming was used by Clements when one of the processes identified in (41G1-3) applied before a geminate consonant. According to Clements, for example, in the derivation of /mu-luadde/, the glide [u] in the medial syllable was moved to the preceding onset, triggering lengthening of the vowel following it. This long vowel had to be shortened subsequently through the V-trimming rule since no long vowels are allowed before a geminate consonant in Luganda. This instance of the V-trimming rule can also be eliminated in my analysis. The derivation of /mu-luadde/ would be as in (51).

51a.



51b.



As can be seen in (51b), there is no nucleus slot left unlinked after the deletion of the vowel [u] in the second syllable. This can be explained by postulating the presence of Prosodic Government in the grammar of Luganda. Prosodic Government disallows the presence of a branching nucleus within a branching rime. There is therefore no need for Clements' V-trimming rule in this structure, since Prosodic Government shortens any long vowel followed by a coda. So, using simply a small number of syllabification principles and parameters, we can eliminate completely the rule of V-trimming postulated for Luganda by Clements.

In this analysis of lengthening in Luganda, I have shown that there is in the language no process of compensatory lengthening triggered by the movement of a sonorant out of the nucleus. Rather, the lengthening manifestations in Luganda are the result of a repair strategy brought about by OCP violations. I have also argued for the presence of a constraint on syllabification in Luganda, the Proper Linking Condition, which disallows sonorants and glides from being assigned to the nucleus.

Now let us look at a language which has compensatory lengthening in it's grammar, Ancient Greek, and see how my analysis of the process differs from the ones presented by Ingria (1980) and Steriade (1982).

2.4.2. Ancient Greek: Compensatory Lengthening vs. Gemination

We looked earlier at Ingria's (1980) and Steriade's (1982) analysis of Ancient Greek. The syllable structures assumed by each are somewhat different from the syllable structure I adopt. For example, unlike Ingria and Steriad, I argue for the presence of an obligatory onset. Although this node may be empty (i.e. its slot may be linked to an empty element on the segmental tier, or, alternatively, its slot may be left unattached), I assume that it must be present in any given syllable.

Let us, then, examine compensatory lengthening in Ancient Greek within the framework I assume. The most striking fact concerning compensatory lengthening in this language is the divergence between two Aeolic dialects (Lesbian and Thessalian) and all the other Greek dialects. In general when a segment is deleted, the vowel preceding that segment is lengthened, even when the segment is not underlyingly adjacent to that vowel. In Lesbian and Thessalian, however, the result is a lengthened adjacent consonant, whether this consonant precedes or follows the deleted segment in underlying representation. The following examples may be taken as illustrative. Lesbian and Thessalian are here represented as L/T.

In (52a), the deleted segment [s] is not adjacent to the vowel while in (52b), it is. In each case, however, gemination applies in Lesbian and Thessalian, and compensatory lengthening applies in the other dialects.

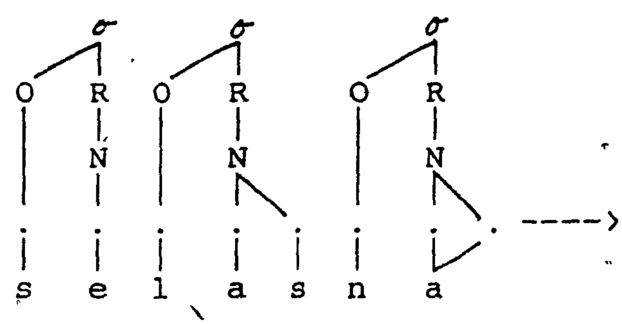
52a.	/ekrinsa/	'judge'	L/T	ekrinna
			Elsewhere	ekri:na
	/a:ŋgelsa/	'announce'	L/T	a:ŋgella
			Elsewhere	a:ŋge:la
	/bolsa:/	'council'	L/T	bolla:
			Elsewhere	bo:la:
b.	/esmi/	'I am'	L/T	emmi
			Elsewhere	e:mi
	/selasna:/	'moon'	L/T	selanna:
			Elsewhere	sela:na:

Ancient Greek is well-known to be a quantity sensitive language. The metrical patterns have been shown to be based on the quantity of syllables, a fact which was fully discussed by the Greek grammarians (e.g. Dionysius Thrax). If a syllable contains a long vowel, it is always heavy. If the syllable ends in a short vowel, it is light. However, if the short vowel is followed by a tautosyllabic consonant, the syllable is considered heavy. That is, both branching nucleus and branching rime define a heavy syllable.

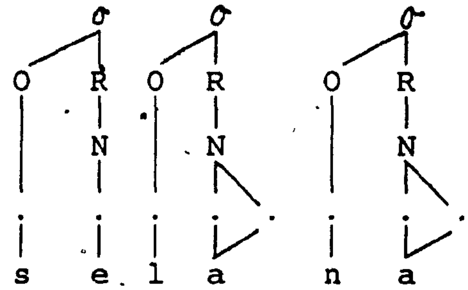
As one would expect, the element which triggers compensatory lengthening in most dialects (e.g. in Attic, Cretan and Ionian) can be found in the nucleus (the [+sonorant] fricative [s])<13> when the Nucleus Maximization Condition is part of the grammar. I propose that the reason for the absence of compensatory lengthening in Lesbian and Thessalian is that the NMC is not part of their grammar. The segment [s] in the L/T examples in (52) above is always found in the coda when deletion occurs. The dialects without compensatory lengthening still need a strategy to keep intact the two slots found in their branching rime after the deletion rule applies (i.e. to preserve a heavy syllable). Gemination fills this need. This can be illustrated through the derivation of /selasna:/ 'moon'. In Lesbian and Thessalian, gemination applies to the structure, as shown in (54), while in the other dialects compensatory lengthening applies to the structure, as shown in (53).

53. <u>Other Dialects</u>

a.

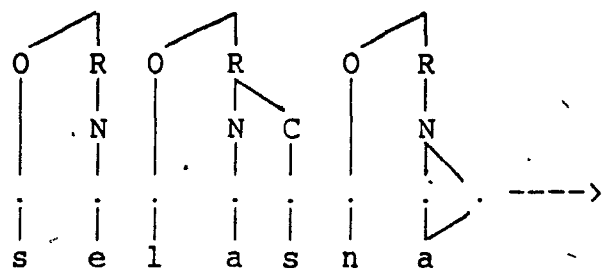


b.

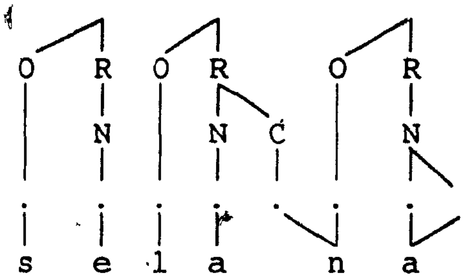


54. Lesbian and Thessalian

a.



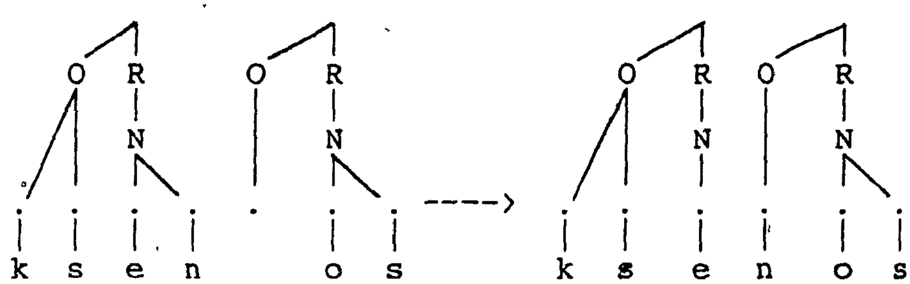
b.



Thus, the choice between compensatory lengthening and gemination is dependent on the position of the deleted segment within the syllable.<14> It must be noted, however, that neither of these processes is used when there are still two slots left in the rime after deletion has applied. For example, consider the rule which metathesizes y and w with a preceding sonorant after a vowel, and the rule which deletes w before a sonorant when preceded by a [-back] vowel. The derivation of the underlying form /ksenwos/, for example, would give the expected result [kse:nos] in most dialects. What is more interesting, however, is what happens in Attic, Lesbian and Thessalian which do not have the metathesis rule as part of their grammar.

In Attic, Lesbian and Thessalian, unlike the other dialects, [w] is in the onset of the second syllable when deletion occurs in the environment of a [-back] vowel. The glide and the nasal have not interchanged their positions. In Attic, the Nucleus Maximization Condition is part of the grammar, which means that the nasal is assigned to the nucleus by initial syllabification, as shown in (55).

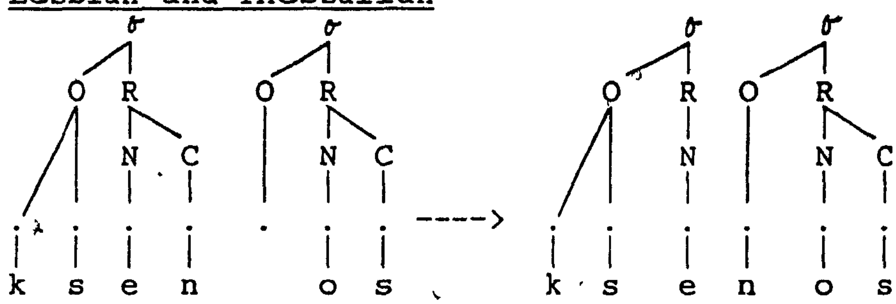
55a. <u>Attic</u> b.



However, because of the absence of the metathesis rule in that particular dialect, the deleted glide [w] is in the onset of the following syllable. That is, the deleted segment is not linked to a slot within the rime. Recall that the slot of a deleted segment is kept through compensatory lengthening only when there is a need to preserve a branching nucleus or a branching rime in a quantity sensitive language. This deletion of a segment in the onset, however, gives as a result an ill-formed structure. The nasal in the coda must then be resyllabified into the onset. Recall that resyllabification does not leave a point behind. The result is shown in (55b).

In Lesbian and Thessalian, the Nucleus Maximization Condition is not part of the grammar. The nasal is therefore found in the coda, rather than in the nucleus as is the case with the other dialects. Similarly to Attic, however, Lesbian and Thessalian do not have the metathesis rule. Thus, as with Attic, the glide is in the onset of the following syllable when deletion occurs. Resyllabification follows, giving the same surface result as in (55).

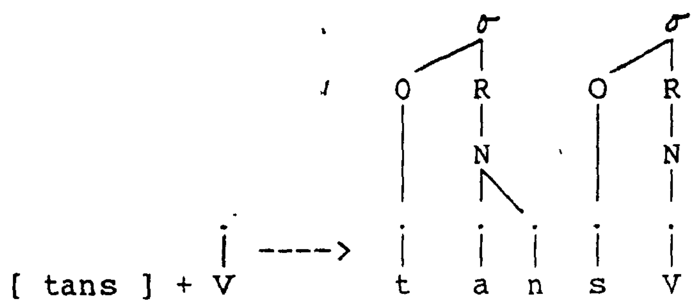
56. <u>Lesbian and Thessalian</u>



Those two examples show again that the position of the deleted segment is of crucial importance for the application of compensatory lengthening and gemination. If compensatory lengthening and gemination are surface manifestations of a need to preserve the number of slots within branching nuclei and rimes, deletion in the onset will never present a structure which would require either of these two processes to apply. It is only the number of slots in the rime which differentiates between heavy and light syllables.

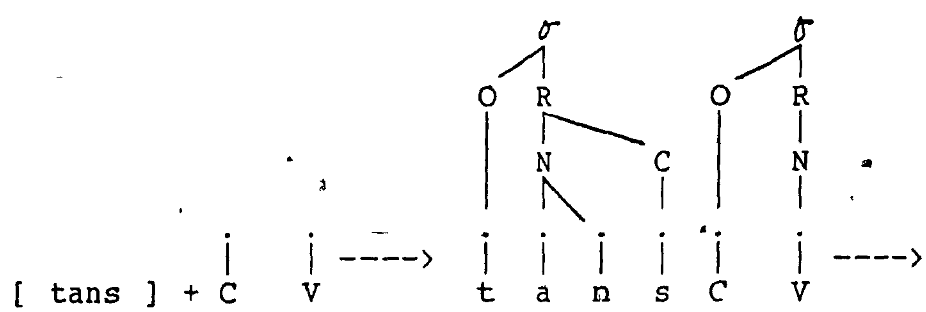
Another interesting situation is found in Cretan. For a stem such as /tans/ which ends with ns, two phonetic forms may be found: [tas] when followed by a consonant and [tans] when followed by a vowel. The derivation of the two structures is shown in (57) and (58).

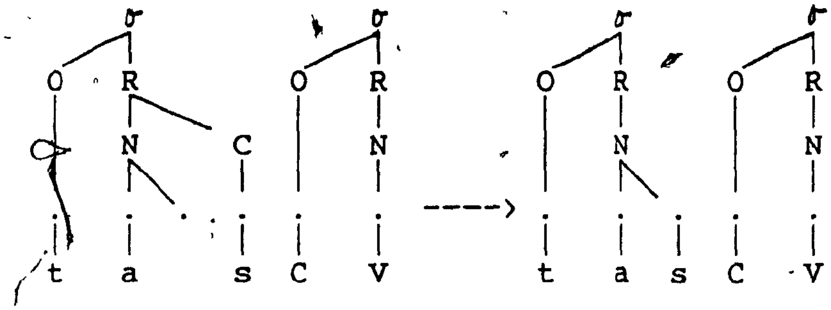
57.



In (57), the situation is quite straightforward. [s] is syllabified into the onset of the second syllable, while [n] is syllabified into the nucleus of the first syllable, because of the presence of the Nucleus Maximization Condition in the grammar.

58.





In (58), however, the situation is more complex. In Cretan, there is a rule which deletes [n] before [s] when the two segments are tautosyllabic. This rule does not apply in (57) because the conditions are not met. Since [n] and [s] are tautosyllabic in (58), the deletion rule applies. The end result is not compensatory lengthening, however, since there is no need to preserve a third slot. The resulting branching rime is then reanalyzed as a branching nucleus given the presence of the Nucleus Maximization Condition in the grammar.

Notes to Chapter 2

<1> In the representation of consonants and vowels, I follow Bach's system rather than Boas'.

<2> The proposal in (12a) is also put forward by Levin (1985).

<3> This, in fact, could be seen as another parameter of the set of syllabification conditions which mediate ISP. Kaye and Lowenstamm (1982) have proposed an implicational universal which would constrain in a very severe fashion the inventory of syllable types of each language. They have found that, if a language allows onsets and rimes of a certain complexity, it also allows all the onsets and rimes of lesser complexity. Moreover, they have found that, for a given language, the most complex onset may not exceed the complexity of the most complex rime.

<4> The dental nasal [n] assimilates in point of articulation to a following stop or affricate.

<5> The acute accent on the long vowel of the first word indicates a high tone. The circumflex accent on the second word indicates a low tone.

<6> This sequence may in fact be disallowed universally.

<7> For some analyses of stress rules in Lithuanian, see Kiparsky and Halle (1977) and Halle and Vergnaud (1987).

<8> There are some examples of long vowels bearing a low tone which can be divided into two groups. First, there are the long vowels which are desinences of verb endings, i.e. which are found at the end of a word. Since a high tone is not allowed on the last syllable of a word, this can be easily explained by a rule like the following: H ---> L/ ___#. As for the second group, Kenstowicz (1972) argues that those long vowels with low tone are the manifestation of nasal deletion with its concomitant lengthening. This will be discussed later.

<9> This shortening process is known as Osthoff's Law in the literature (Kenstowicz 1972).

<10> Clements' claims about the distribution of tones in Luganda is based on studies by Tucker (1962) and Stevick (1969).

<11> See Kaye, Lowenstamm and Vergnaud (1987) for arguments in favor of a theory which allows all obligatory nodes (i.e. the onset and the nucleus) to be linked to empty segments in some structures.

<12> As was pointed out to me by Christine Tellier, this seems also to be the case in Japanese.

<13> According to Piggott and Singh (1985), characterizing [s] as a [+son] fricative can explain various aspects of the behaviour of that segment (and its voiced counterpart) in many languages. See also Selkirk (1984) for other reasons to put [s] in the same natural class as the nasals and the liquids.

<14> This choice is only possible in a language where both branching nucleus and branching rime define a heavy syllable. However, apart from the Greek data, I have found no languages which, being sensitive only to branching rimes, have also a process of gemination in their grammar.

Chapter 3

Apparent Counterexamples

In this chapter, I will consider languages which appear to be counterexamples to some of my claims about the process of compensatory lengthening. I will show that these apparent counterexamples are, in fact, consistent with my proposals.

3.1 Old and Middle French

One of the best known examples of the process of compensatory lengthening is found in Middle French. During that period in the history of French, the deletion of nasals and of [s] in preconsonantal position resulted in compensatory lengthening. What is interesting to note is that, in most analyses of the process, it is argued that, prior to the appearance of compensatory lengthening in the language, length was phonologically irrelevant. It is argued, in fact, that the length distinction arose as a consequence of such processes as compensatory lengthening in Old and Middle French.<1>

This kind of analysis is in contradiction with the main claim of my proposal. I have argued in this thesis that compensatory lengthening can be seen as a strategy to preserve heavy syllables. In other words, it can be seen as the manifestation of a principle which preserves the two points of a branching nucleus in quantity-sensitive languages. There should be no reason for a language without any length distinction to have a process such as compensatory lengthening in its grammar. Only languages which are sensitive to branching nuclei would have a need to preserve two points in this particular structure.

In this section, I will show that a coherent and plausible analysis of the facts of Old and Middle French can be given, assuming that Old French was sensitive to quantity prior to the appearance of compensatory lengthening in the grammar. I will be looking at the stress rules of French and of Latin; I will also be looking at the history of French vowels from Late Latin to Old French. From this analysis of the French vowel history, I will argue that the French stress rule is consistent with an analysis of the language as being quantity sensitive.

In Modern French, stress placement is determined by the following familiar rule, shown here in the linear framework.

1. $V \dashrightarrow [+\text{stress}] / \_\_\_ \; C_0([-\text{tense}]\; C_0)\#$

The rule stresses the last syllable unless it contains schwa (the only [-tense] vowel in the language), in which case the penultimate syllable is stressed. A stress rule similar to the one given in (1) is assumed to apply in Old and Middle French. This is exemplified in (2a), where the last syllable does not contain schwa, and in (2b), where the last syllable contains schwa. The words are from Middle French.

2a.	amí	'friend'	b.	pɔ́rtəs	'carry'
	portǽr	'carry'		čántəθ	'sing'
	icí	'here'		aprɛ́ndrə	'take/learn'
	vójc	'voice'		amíə	'friend f.'
	aparánt	'visible'		fústəs	'were'
	fjærəmɛ́nt	'fiercely'		trɛ́cə	'braid'

There is, however, a set of words in Middle French which are considered to be exceptions to the stress rule. Some of them are given in (3).

3.	ánjələ	'angel'
	imájənə	'image'
	órdənə	'order'
	órfənə	'orphan'
	vírjənə	'virgin'

Note that in these examples, where the stress is on the antepenultimate syllable, both post-stress syllables contain schwa.

Let us now look at one particular analysis of Old French which does not postulate a length distinction during that period of the history of the language. In his analysis of Old French morphophonology, Walker (1981) argues for an underlying representation of Old French vowels which comprises only short vowels. Since diphthongs and at least one long vowel [æ] are also part of the inventory of Old French, Walker must posit a rule which diphthongizes the mid-vowels [ɛ], [e], [ɔ] and [o], and a fronting rule which fronts and lengthens the only low vowel in the language, [a]. The interesting point is that both rules apply only to stressed vowels. It could, then, be said that diphthongs and the fronted long vowel [æ] are found in stressed syllables; their short counterparts elsewhere. This statement must be amended, however. Although diphthongs and the fronted vowel only occur in stressed syllables, short vowels are not found only in unstressed syllables. They can also be found in stressed syllables when those syllables are closed, e.g. evéskə 'bishop', fɛ́stə 'feast', pɔ́rtəs 'doors', pártə 'to leave', 3rd pl. pres. Therefore, it would be more accurate to state that diphthongs and the fronted vowel [ǣ] only occur in stressed open syllables, and their short couterparts elsewhere. This is exemplified in (4).<2>

4a.	arons	erent	'plough'
	lavons	levent	'wash'
	clamont	claiment	'cry out'
b.	achevont	achievent	'terminate'
	abregions	abriegent	'shorten'
	depecions	depiecent	'cut up'
c.	covront	cuevrent	'cover'
	morons	muerent	'die'
	poons	pueent	'be able'
d.	abevons	abeivent	'give a drink'
	bevons	beivent	'drink'
	creons	creient	'believe'

e. aorons cosons laborons | aourent cousent labourent | 'adore' 'sew' 'work'

e. aorons	aourent	'adore'
cosons	cousent	'sew'
laborons	labourent	'work'

According to Walker's analysis, in the first column of (4b,c,d,e) the short mid-vowels are seen to occur in open syllables. The last syllable of each word, which is closed, is stressed. In the second column, the underlyingly short vowels have been stressed. They are then diphthongized. In (4a), however, it is the fronting rule which is operating. The low vowel [a] becomes the long vowel [æ] when stressed in the second column.

Walker (1981) argues for simple vowels as the underlying representations in all cases, resulting in the need for the rules of diphthongization and of fronting. The table of vowels shown here in (5a) is held to indicate the underlying representations. I provide the table in (5b), which represents the stressed vowels.

5a. Underlyingly b. Stressed Vowels (in open syll.)

5a. Underlyingly			b. Stressed Vowels (in open syll.)		
i	u	u	i	u	u
e		(o)	ej		ow
ɛ		ɔ	je		we
æ:	a	<3>	æ:		

This representation of the Old French vowel system gives a good idea of the kind of analysis usually posited for the language. The assumptions I make in this thesis with regard to compensatory lengthening force me, however, to regard the phonological system of Old French in a different light. I will argue that the diphthongs are, in fact, the underlying representations of the mid-vowels in Old French; I will also argue that high and low vowels are underlyingly long. The shortened vowels and diphthongs will be found in unstressed or closed syllables. This is illustrated in (6).

6a. <u>Underlyingly</u>	b. <u>Unstressed vowels</u> (or stressed in closed syll.)
i: u: u:	i u u
ej ow	e (o)
je we	ɛ ɔ
æ:	a

Although the vowel system shown here in (6a) is highly marked, it is not a priori indefensible. In fact, I will argue that this system evolved from a reanalysis of the Latin vowel system brought about by the changes which occurred as a result of the shortening and lengthening of vowels in certain positions during the Gallo-Roman period.

Furthermore, if we consider the diphthongs to be the underlying representations, the fact that they are shortened in closed syllables could be attributed to the presence in Old French of Prosodic Government, discussed briefly in Chapter 1. This condition on syllabification, given again in (7), was first proposed by Kaye and Lowenstamm (1985) to account for the automatic shortening of long vowels whithin a branching rime in certain languages. They also claim that Prosodic

Government is a principle of Universal Grammar. I, on the other hand, am assuming that it is a parameter of Universal Grammar which may or may not be present in any language.

7. Prosodic Government

> The head of the syllable must govern
> the other constituents of the rime.

Kaye and Lowenstamm (1985) argue that the nucleus can be considered the head of a syllable. In a branching nucleus the left-most point is usually considered the head. In languages in which Prosodic Government is present, the head of the syllable must be able to govern all the other constituents of the rime. The coda, however, can only be governed if the head is not part of a branching nucleus as this would block government out of the nucleus node. This explains why long vowels and diphthongs cannot be found in closed syllables in the languages in which Prosodic Government holds.

Thus, in Old French, the diphthongs would have to be shortened in both stressed and unstressed closed syllables, making their branching nucleus non-branching to allow the element in the nucleus (the head) to govern its sister constituent of the rime. The appropriate language-specific rule for Old French would not, then, be one of diphthongization of stressed mid-vowels in open syllables, but rather one of vowel shortening in unstressed open syllables. In closed syllables, shortening is due to the presence of Prosodic Government in the grammar.

We have thus far proposed the diphthongs as underlying representations for the mid-vowels. In these cases, stress falls either on a diphthong, (i.e. a branching nucleus), or on a short mid-vowel in a closed syllable (i.e. a branching rime). What about the case of the low fronted vowel [æ:]? Other linguists (e.g. Pope 1934, Schwan and Behren 1964, Einhorn 1974) have represented this vowel differently, Pope as [ē] and Einhorn as [e:]. In fact, Walker himself argues that the distinctive feature of length introduced by [æ:] is one reason for putting the vowel in the vocalic system of Old French. Recall that diphthongs are not part of this system, according to Walker. (See (5a).) Therefore, I claim that [ǣ] is the underlying representation of the shortened vowel [a].

With regard to [i], [ü] and [u], my claim that they are phonologically long in underlying representation is supported by Pope (1934). According to Pope, the influence of position began to affect the length of vowels at the end of the Late Latin period. In Early Gallo-Roman, all the short stressed vowels which were in open syllables had been lengthened, and all the long vowels which were in closed syllables had been shortened. In monosyllabic words ending in a single consonant the vowel was also lengthened. The latter circumstance can be explained if we assume that the last consonant in any word is not part of the rime, but rather is assigned to an appendix at the right edge of the word.<4> Thus, the vowel is, for all purposes, found in an open syllable which happens to be followed by an appendix.

Also starting in Late Latin, all unstressed long vowels were shortened; thus, all quantity differences were obscured in unstressed syllables. By the Early Old French period the lengthened stressed mid-vowels [ɛ], [ɔ], [e] and [o] had already diphthongized in open syllables and before a single consonant in a monosyllabic word. This gives us a system in which all stressed vowels in open syllables are long or diphthongized. In closed syllables, on the other hand, all the vowels are short as are all the unstressed vowels in open syllables. Vowels in monosyllabic words are either long or diphthongized.

Let us now examine the stress rules of both Latin and French, and see how the stress configuration changed in the transition from Latin to Old French. In Latin, the tonic syllable (i.e. the one with the main stress) of a word of more than two syllables is always the penultimate, if that syllable is heavy. If the penultimate syllable is light, the accent falls on the antepenultimate syllable. The main stress rule of Latin can be stated informally as in (8).

8. <u>Latin Stress Rule</u>

a. Stress the penult if it is heavy, and in disyllables.

b. Otherwise stress the antepenult.

In Gallo-Roman, final short and long [e], [i], [o], [u] paroxytones<5> (i.e. words which have their main stress on the penult) and intertonic short and long [e], [i], [o], [u] and [aw] were reduced to [ə] and dropped before the ninth century, unless required to block impermissible sequences of consonants. Final [a] was simply reduced to schwa. These processes are illustrated in (9).

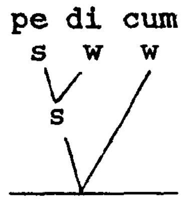
9.	rḗgem	> reis	mū́rōs	>	murs	firmi̥tā́tem	>	ferté
	dḗbet	> deit	mínus	>	mēins	mandū́kare	>	mandžíer
	mū́ri	> mür	áudit	>	ot	pistúrire	>	pestrír

Among proparoxytones (i.e. words which have their main stress on the antepenult) a final vowel was retained in all words, except those made paroxytone in Late Latin and Early Gallo-Roman by the deletion of the unstressed penultimate vowel. In those paroxytone words, the final vowel was reduced to schwa.

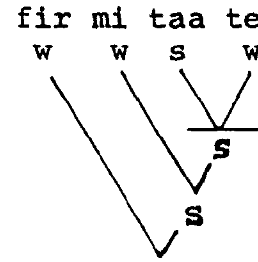
10.	áznə	<	ásinum	píedzə	<	pédicum
	béivrə	<	bíbere	pɔ́ltsə	<	póllikem
	kúntə	<	kómitem	pórtsə	<	pórtikum
	dízmə	<	dɛ́kimum	dútə	<	dúbito

Considering these facts, we can say that Late Latin vowels, whether short or long, were reduced and then deleted in Gallo-Roman (except [a] which was simply reduced to [ə]), when in the weakest unstressed position of a metrical tree. According to the Latin Stress Rule, as reformulated in (11), paroxytone words have their most recessive (or embedded w) point in their final syllable, while proparoxytone ones have their most recessive (w) point in their penultimate syllable. This is exemplified in (11).

11a. <u>Paroxytone</u>



b. <u>Proparoxytone</u>



Furthermore, since in proparoxytones the final vowel is also weak, its syllable is reduced, but not deleted. The Latin stress rule is given in (12) within the metrical framework.

12. <u>Latin Stress Rule</u>

a. Make the last rime extrametrical

b. On the rime projection, form a left dominant binary foot at the right edge of the word.

__Dominant nodes must branch__

c. Form a right dominant word tree.

Keeping in mind the examples in (9) and (10), let us look at the stress rule in French. The wholesale reduction or elimination of atonic vowels made Old French a language in which all words were either oxytone (i.e. main stress on the last syllable) or paroxytone, and if paroxytone, then always ending in a syllable containing [ə]. As has been noted by many authors, it is a fundamental fact of the French language that in all 'traditional' words (i.e. derived directly from Latin), the syllable that bore the tonic word-accent in Late Latin continues to bear it in French. In Early Gallo-Roman all short stressed vowels had become long, and mid-vowels had diphthongized. All long vowels in closed syllables were being shortened (the weight of the syllable was kept, however, since branching rimes are also considered heavy in Late Latin). Also, all unstressed vowels had been deleted or reduced to schwa.<6>

I claim that by that point in the history of the language (i.e. Early Old French) the vowel system had been reanalyzed in such a way as to consider only long vowels and diphthongs as underlying segments. All the short vowels in similar positions had been deleted or reduced to schwa (the only underlying short vowel left in the system) during the Gallo-Roman period. The presence of short vowels (other than schwa) in closed syllables can be readily explained by the presence of Prosodic Government in the grammar of French.

Based on this particular reanalysis of the vowel system, we can say that Old French is a language in which the only syllables having no branching rime or nucleus in underlying representation are those containing schwa. Recall that final [-son] consonants are appendices and are not linked to a branching rime. The stress rule can thus be formulated as follows:

13. French Stress Rule

a. Make the appendix extrametrical

b. On the rime projection, form a left dominant, binary foot at the right edge of a word.

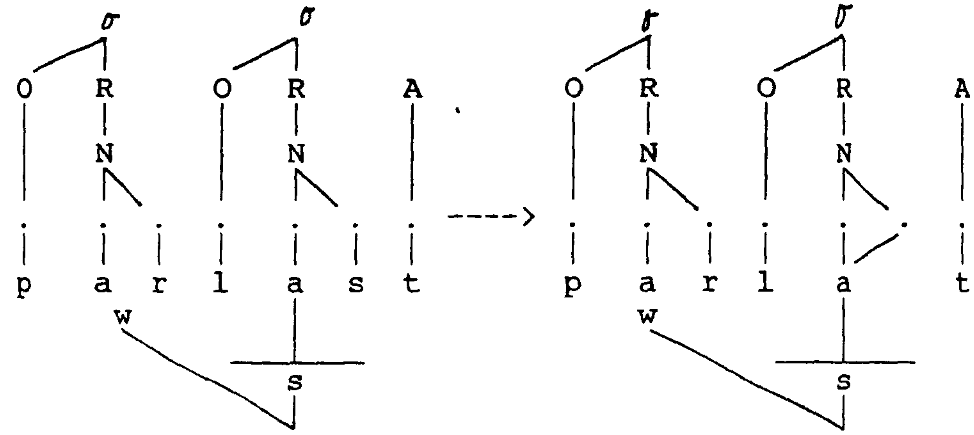
__Dominant nodes must branch__

c. Form a right dominant word tree.

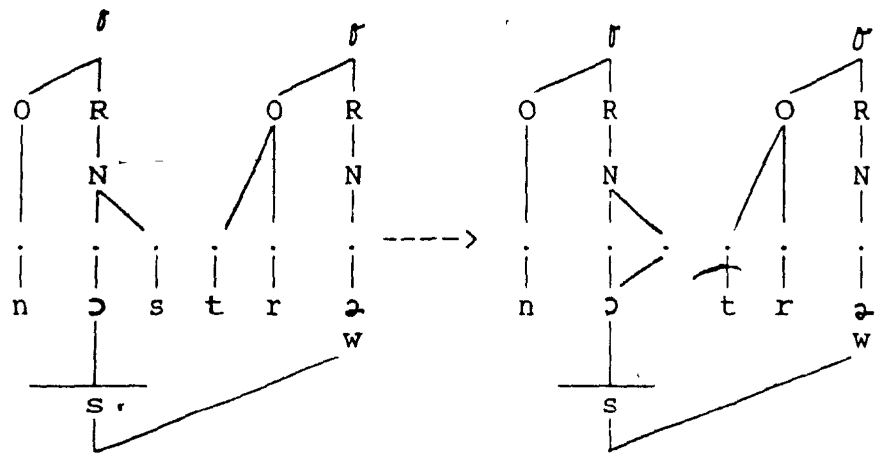
Note that the French Stress Rule is similar to the Latin Stress Rule. One difference lies with the extrametrical element: the final rime in Latin and the appendix in Old French. Another difference between the two languages is the fact that the only underlyingly short vowel in Old French is [ə] whereas in Late Latin every long vowel has its short counterpart.

Now that we have argued for a grammar of Old French in which the Latin quantity sensitivity was preserved, let us look at the process of compensatory lengthening which arose in the language during the Late Old French period. The best known case of compensatory lengthening in French is the one triggered by the deletion of [s] and [z] in preconsonantal position. Other consonants which triggered lengthening when deleted preconsonantally were [n], [m] and [l], i.e. sonorant consonants.<7> The following example illustrates one type of compensatory lengthening.

14a.



b.



I have shown in this section that Old French can be analyzed as a quantity sensitive language where both branching rime and branching nucleus define a heavy syllable, prior to the appearance of any process of compensatory lengthening into the grammar. I will not concern myself here with the vowel changes which occurred in Middle French since length distinction has already claimed to be phonologically relevant during that time period by a number of linguists (e.g. DeChene and Anderson 1979).

3.2 Semitic Languages

In this section I will look at two Semitic languages, Tiberian Hebrew and Maltese Arabic. The syllabification of Semitic languages differs from that of the languages presented in the preceding sections of this chapter and Chapter 2. Regardless of those differences in syllabification, I will demonstrate that the presence of compensatory lengthening in Maltese Arabic can be linked to the same settings of the parameters discussed throughout this thesis. I will also examine Lowenstamm and Kaye's (1985) analysis of compensatory lengthening in Tiberian Hebrew, and I will argue that this process does not occur at a similar stage in the derivation as does the process of compensatory lengthening found in Maltese Arabic.

In Semitic languages syllable trees are not erected over strings of segments in the manner described in Chapter 2. Rather, a template is associated wiht each morphological process within the lexicon. Those templates are then linked to a consonantal root and a melodic tier at the initial syllabification stage. If this initial linking of the elements on the melodic tiers to the template creates a structure which violates a language-specific constraint, resyllabification processes apply to modify the template. In this analysis of compensatory lengthening in a Semitic language, I will be using Lowenstamm and Kaye's (1985) reformulation of the template representation introduced by McCarthy (1979, 1981).

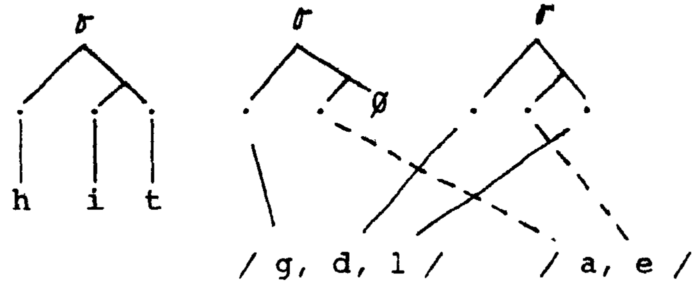
I will first look at Lowenstamm and Kaye's (1985) analysis of compensatory lengthening in Tiberian Hebrew and show how this particular analysis seems to contradict some of my claims about the process. Then, I will look at the process of compensatory lengthening in another Semitic language, Maltese Arabic. I will show that the cases of compensatory lengthening found in Tiberian Hebrew do not in any way argue against my analysis and that, in fact, those cases of compensatory lengthening fall under different conditions of syllabification from that of the process of compensatory lengthening under study in this thesis.

In their paper on Tiberian Hebrew, Lowenstamm and Kaye (1985) argue that compensatory lengthening and gemination arise when there is a discrepancy between the number of Level 2 positions (i.e. the number of slots available for mapping onto by the melodic tier) and the number of terminal nodes on Level 1 prosodic trees in some morphological classes. This is shown in (15) where the right-most branch of the medial syllable does not dominate a position at Level 2. According to Lowenstamm and Kaye this sort of configuration indicates the presence of Ø, a null element.

15. Level 1

Level 2

Level 3

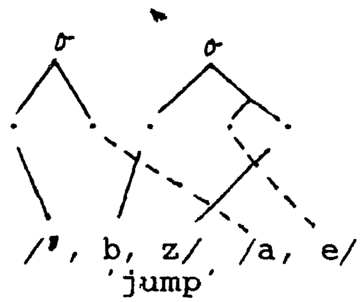


In (15), the ∅ position has been skipped since it cannot serve to anchor any of the segments on the melodic tiers. This null element has to be filled, however, to obtain a permissible structure. The point may be interpreted in two ways: either as a C or as a V, generating either hitgaddeel or the ill-formed *hitgaadeel. Since the former must be derived, what is necessary is for the right branch of the rime of the unlabeled medial syllable to be appropriate for the linking of a C not a V. That is, the node dominating the branching structure should be identified as a rime not a nucleus. According to Lowenstamm and Kaye (1985), such a result is derived from their principle (10) which restricts the distribution of null elements to non-branching constituents.<8> If the branching structure dominating ∅ is a nucleus, the null element would be found in the right-most branch of a branching constituent (N). If the branching structure is a rime, on the other hand, the null element would be in the coda: a non-branching structure in this case.

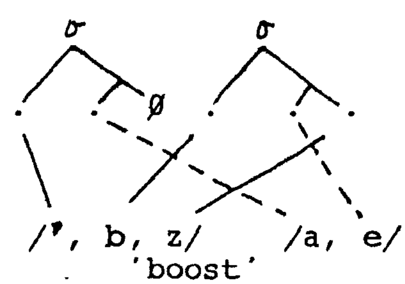
In fact, in Tiberian Hebrew, gemination is the usual case. Compensatory lengthening appears only when, in a configuration like (15), the medial consonant cannot geminate (i.e in Tiberian Hebrew, the resonants /?, ʕ, ḥ, r, h/ which never geminate in any context). From this analysis of the facts in Tiberian Hebrew, Kaye and Lowenstamm conclude that gemination is the unmarked or 'default' way of syllabifying the null element, and that one should expect that a language in which every consonant can geminate will never display compensatory lengthening. Specifically, their solution embodies the assertion that gemination takes precedence over compensatory lengthening.

Gemination also occurs in Maltese Arabic under circumstances similar to those of Tiberian Hebrew. There is in Maltese Arabic a class of verbs which are derived from triconsonantal root verbs by adding a position linked to a null element to the first syllable of their template. For example, the verb 'to boost' is derived from the root /ʕ,b,z/ 'to jump' in the way illustrated in (16).

16a,



b.



The structure linked to the null element is reanalyzed as a rime so that the medial consonant /b/, can spread to the empty slot, giving the result ['abbez]. In fact, in Maltese Arabic, whenever this situation arises, gemination always takes place.

The conclusions drawn from the analyses of compensatory lengthening and gemination illustrated in (15) and (16) do seem different from the ones drawn in my own analysis of the process. I have argued that compensatory lengthening occurs only to preserve a branching nucleus, and gemination to preserve a branching rime. In Tiberian Hebrew, however, it seems that a branching rime can still be preserved when gemination cannot apply by reanalysing the structure as a branching nucleus, thus allowing compensatory lengthening to apply. One could assume that this is the way compensatory lengthening manifests itself in non-concatenative languages. However, there are cases of compensatory lengthening in Maltese Arabic which behave exactly as I have been predicting throughout this thesis.

In Maltese Arabic, the singular form of verbs in the present tense is represented by the template CV+$C_i C_j VC_k$, while the plural form is represented by the template CV+$C_i C_j C_k$+u. (The subscripts indicate the triconsonantal root.)

17.

Singular		Plural	
ní+msaḥ	'I wipe'	ní+msḥ+u	'we wipe'
tí+msaḥ	'you wipe'	tí+msḥ+u	'you wipe'
ní+kteb	'I write'	ní+ktb+u	'we write'
tí+kteb	'you write'	tí+ktb+u	'you write'

However, there are exceptions to these patterns. Some examples are listed in (18).

18a. <u>Singular</u> | <u>Plural</u>

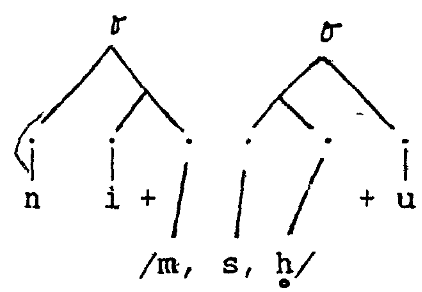
ní+tlef	'I lose'	ni+tílf+u	'we lose'
tí+tlef	'you lose'	ti+tílf+u	'you lose'
ná+ḥrab	'I flee'	na+ḥárb+u	'we flee'
tá+ḥrab	'you flee'	ta+ḥárb+u	'you flee'

b.

ní+sool	'I cough'	ni+sóol+u	'we cough'
tí+sool	'you cough'	ti+sóol+u	'you cough'
ní+laab	'I play'	ni+láab+u	'we play'
tí+laab	'you play'	ti+láab+u	'you play'

As can be seen above, the plural forms of the examples in (18a) are of the shape $CV+C_i VC_j C_k+u$, whereas the regular template is $CV+C_i C_j C_k+u$, as in (17). Note that in (18a) the irregular morphological template is found only in forms which have a sonorant as the medial segment of the consonantal root. (The examples in (18b) will be discussed later.) The template for plural of the consonantal root /m, s, h̥/ can be represented as in (19) (Lowenstamm and Kaye 1985).

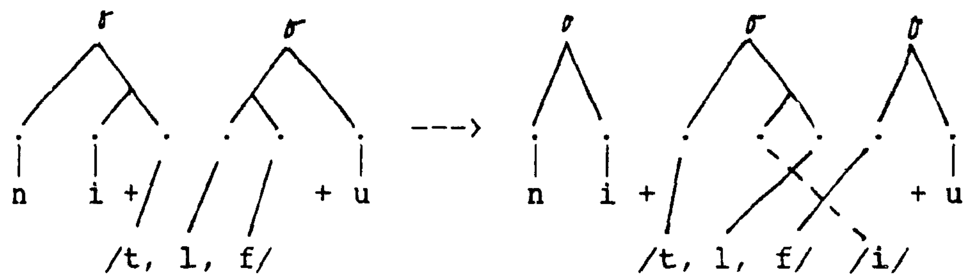
19.



To the template is affixed the prefix /ni-/ and the suffix /-u/. The elements on the consonantal tier then spread to the points left in the structure.

With regard to the forms in (18a), the usual template is resyllabified in such a way as to break up the cluster formed by the sonorant and the consonant in the onset of the second syllable. This is illustrated in (20). Although non-concatenative languages differ from the other languages with regard to the initial syllabification (i.e. templates are associated wiht morphological processes in the lexicon), impermissible structures are resyllabified following the set of resyllabification principles discussed in Chapter 1.

20.



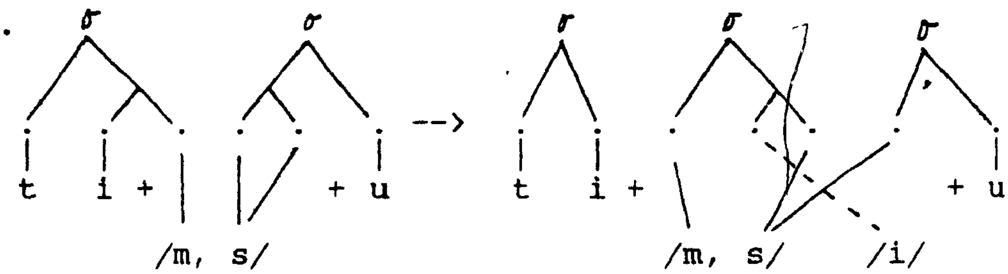
Compared with the forms in (17) and (18a), the forms in (18b) seem to be derived from a two consonant root, with the addition of length to the stem vowel.

Let us, then, look at some biconsonantal roots, shown here in (21).

21a.

<u>Singular</u>		<u>Plural</u>	
t+ḥóbb	'you love'	t+ḥóbb+u	'you love'
t+bíšš	'you sprinkle'	t+bíšš+u	'you sprinkle'
t+míss	'you touch'	t+míss+u	'you touch'

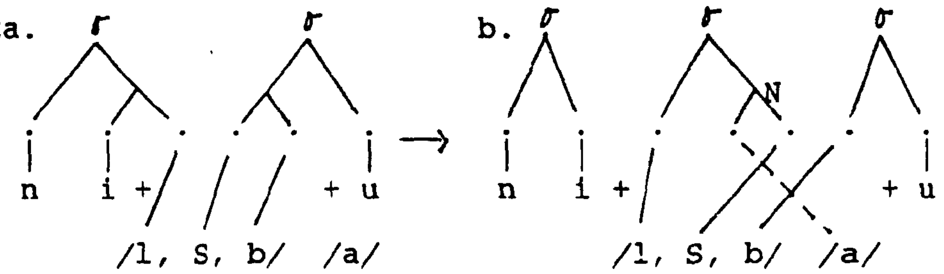
b.



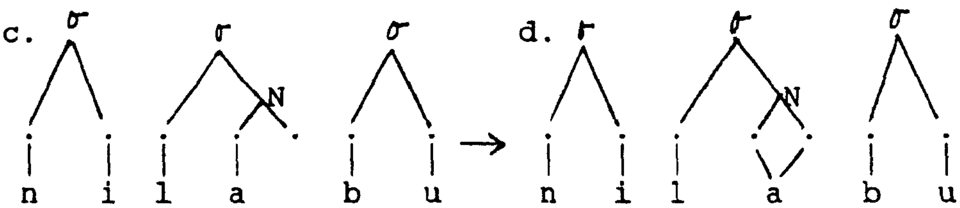
Assuming that the forms in (18b) and the forms in (21) are syllabified in the same way (as shown in (21b)), it would be difficult to explain why there is no geminate consonant in (18b), while there is a geminate in a form like /t+ḥóbb+u/ in (21). Note also that biconsonantal roots are characterized by the deletion of the prefix vowel.

In his analysis of Maltese Arabic, Brame (1972) accounts for the differences by proposing that long vowels found in forms like those in (18b) are the result of a process of compensatory lengthening. Still according to Brame, the process is triggered by the deletion of a sonorant.<9> In my analysis, the nature of the sonorant in question will not be discussed. I will simply use a diacritic segment S to indicate the presence of the proposed sonorant. Thus, the initial syllabification of the consonantal root /l, S, b/ can be shown as in (22a).

22a.



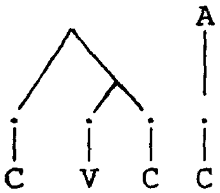
c.

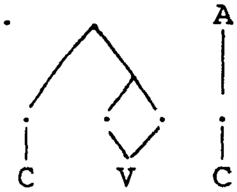


In (22a), the unacceptable sonorant cluster found in the onset of the second syllable of the initial structure is resyllabified as in (22b). In (22c), all the conditions on resyllabification have applied. The sonorant is subsequently deleted in the nucleus, leaving an empty slot, which triggers compensatory lengthening, as shown in (22d).

The above analysis assumes that the NMC holds in Maltese Arabic. I have also argued that compensatory lengthening can only be present in languages which are sensitive to branching nuclei. This sensitivity to the quantity of syllables is illustrated by the stress rule in Maltese Arabic.

Following McCarthy (1979a), as reanalyzed by Hayes (1981), the syllable structure for superheavy syllables in Semitic languages is assumed to be as in (23).

23a. 

b. 

With the exception of superheavy syllables which only occur at the end of words and must be syllabified as in (23), the stress rule in Maltese Arabic is similar to the Latin Stress Rule. Keeping in mind that the appendix of a superheavy syllable is itself considered a constituent, the stress rule of Maltese Arabic is as follows:

24. <u>Maltese Arabic Stress Rule</u>

a. Make the last immediate node of the final syllable extrametrical.

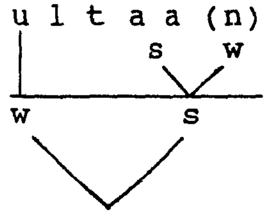
b. Form a binary, left dominant foot at the right edge of a word.

__Dominant nodes must branch__

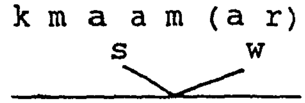
c. Form a right dominant word tree.

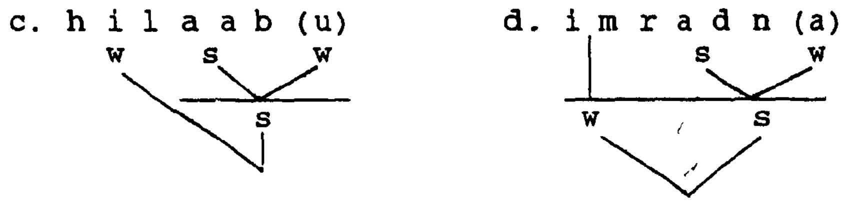
This is exemplified in (25). The extrametrical constituent is adjoined as a weak member to the preceding foot.

25a. s u l t a a (n)



b. k m a a m (a r)





Since quantity sensitivity is a prerequisite to the presence of compensatory lengthening or gemination in any language, let us now look at the stress rule for Tiberian Hebrew. Main stress assignment, as described by McCarthy (1979a), can be stated as follows:

26. <u>Main Stress Rule</u>

At the earliest level of representation,
main stress is assigned to the final syllable
if it is closed, otherwise to the penult.

This statement, according to Hayes (1981), can be expressed by the construction of binary, left dominant feet at the right edge of the word. The rule must apply on the rime projection only, i.e. only the branching rime is considered heavy, not the branching nucleus. According to Hayes, Tiberian Hebrew also needs a Deforestation rule which deletes every metrical structure to the left of the main stress.

27. <u>Deforestation</u>

Delete all metrical nodes that are commanded by
an s at their right.

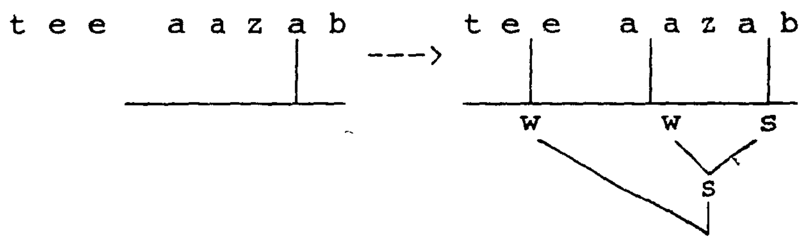
Once Deforestation has applied the rest of the metrical structure can be erected using the following rules.

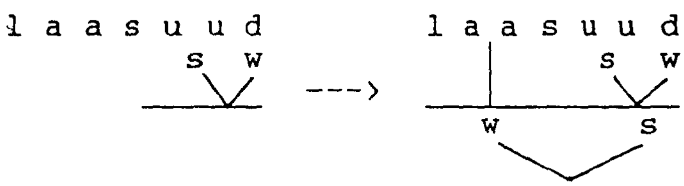
28. <u>Secondary Stress Rule</u>

a. On the nucleus projection, form unbounded left dominant feet in which dominant nodes must branch.

b. Form a right dominant word tree.

This is shown in (29).

29a. 

b. 

Although the foot bearing the main stress is erected only on the rime projection, the rest of the metrical structure is erected on the nucleus projection, showing the language to be sensitive to both branching rime and branching nucleus. Thus, the presence of compensatory lengthening and gemination in the language would not be inconsistent with my hypothesis, even if compensatory lengthening is present as a marked option, as Kaye and Lowenstamm assume. In Tiberian Hebrew, as in Maltese Arabic, the process of gemination occurs at a stage where the skeletal positions are being linked to the consonantal root and the vocalic melody. At this stage, compensatory lengthening is used only when gemination is not allowed by the constraints of the language. That is, when the only consonant available for linking cannot geminate, the branching rime is reanalyzed as a branching nucleus so as to allow for the linking of some other element. Note that this reanalysis is brought about by a language specific constraint on possible sequences of segments.

I have shown, however, that in Maltese Arabic there is a process of compensatory lengthening which does not come from the reanalysis of a branching rime into a branching nucleus. Rather, compensatory lengthening occurs to preserve a point left empty by the deletion of a segment in the nucleus. The two strategies, whatever their level of derivation, can still be seen as the surface manifestation of a need to preserve the two points of a branching nucleus.

Therefore, these analyses of compensatory lengthening and gemination in Maltese Arabic and Tiberian Hebrew show that the Semitic languages are not counterexamples to my main proposals concerning these processes. In fact, I have shown that the instance of compensatory lengthening in Maltese Arabic can be incorporated into my analysis of the process.

3.3 Conclusion

In this thesis, I have proposed an analysis of compensatory lengthening within a parametric framework. I have shown that the presence of compensatory lengthening in a language can be linked to the particular setting of certain parameters of Universal Grammar.

Starting with the assumption that the process of compensatory lengthening is a surface manifestation of the need to keep a heavy syllable branching, I have claimed that this process can only be found in quantity-sensitive languages where a branching nucleus is considered heavy. Furthermore, only segments which can be found in the nucleus will trigger compensatory lengthening when deleted. I have also argued for the presence of the Nucleus Maximization Condition in those languages where the deletion of a sonorant triggers compensatory lengthening.

In the course of this thesis, I have argued for the need for a very restricted and principled theory of syllabification. I have shown how a universal order of syllabification can be used to differentiate between various processes with similar surface manifestations. I have also argued that Piggott and Singh (1985)'s Sonorant Reassignment can be best seen as a parameter of U.G. which is part of the set of syllabification principles which mediate ISP. This parameter I have renamed the Nucleus Maximization Condition.

To conclude, in this framework, compensatory lengthening is no longer considered a language-specific rule in a particular grammar. Instead, compensatory lengthening can be seen to follow from properties of representations and principles and parameters of Universal Grammar.

Notes to Chapter 3

<1> The reduction of vowels in hiatus is another such process.

<2> The phonological interpretation of these forms is, for the most part straightforward, except for the segment which is claimed to be the fronted vowel [æ] by Walker. It is represented orthographically as *e* (*ai* before nasals).

<3> Although Walker uses [ǣ] as the reflex of Vulgar Latin [a] in stressed position (i.e. as an allophone of /a/), he still argues that [ǣ] is a phoneme in the Old French vowel system, which accounts for its presence in both tables.

<4> This dces not seem to be a controversial move, since Bouchard (1981) has argued for an appendix at the end of each syllable in Modern French (word-internal appendices), following the claim that there can only be one consonant in the coda of French syllables. Furthermore, by making the appendix extrametrical, one can explain why last syllables containing schwa are

skipped over by the stress rule even when those syllables end in a consonant.

<5> Except for final unstressed [i], [o] and [u] in hiatus with the tonic vowel in Late Latin or brought into hiatus by the deletion of an intervocalic consonant in Early Gallo-Roman. Those vowels became glides and combined with the preceding vowel to form a diphthong.

<6> Many linguists (e.g. Pope 1952:205) have argued that, in Old and Middle French, quantity was not distinctive. If, as I claim, all the underlying vowels were either long or diphthongized, with the exception of schwa, this seemingly non-distinctiveness can be readily explained. All the rimes are branching underlyingly, again with the exception of non-branching nuclei linked to schwa.

<7> [l] was deleted after [i]. After all other vowels, [l] vocalized to [u], which, then, combined to form diphthongs and triphthongs with the low and mid-vowels. After the rounded high vowels [ü] and [u], however, it merged with the preceding vowel, lengthening it.

<8> Principle (10): Null elements may not appear in branching constituents, where constituent refers to the prosodic constituent immediately dominating the null element (Lowenstamm and Kaye 1985:9).

<9> See Brame (1972) for a detailed account of his choice of ʕ as the abstract sonorant found in Maltese Arabic.

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