TOPICS IN THE VOWEL PHONOLOGY OF KOREAN

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To God who loves All.

To all who love Linguistics.
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ABSTRACT

The aim of this study is broadly twofold: in the first part, I present recent theoretical developments dealing with the nature of phonological representations. Based on data from various languages, I propose a monovalent feature system, feature underspecification, a feature geometry model with a branching place node, and a moraic syllable structure. In the second part of the study I apply these to the vowel phonology of Korean. It is shown that with the single-valued feature system and syllable structure motivated in the first part, a comprehensive and consistent analysis can be offered to different aspects of Korean vowel phonology.

It is shown that the on-glide in Korean is an onset segment rather than a coda segment. Vowel harmony in Korean is analyzed as the spreading of the feature-size morpheme [RTR] under the condition of tongue position node adjacency and an attempt is made to relate the ideophone vowel harmony to the vowel harmony in verb suffixation. Moreover, the study clearly shows that umlaut in Korean can be explained by the spreading of [coronal] from the high front vowel to the target across consonants: the blocking effect that some of the intervening consonants display is dealt with consistently without abandoning feature geometry or underspecification theory. It is also argued that vowel merger and iii deletion in Korean can be explained by adopting weightless vowels, given the hierarchical representation of features and syllables.

The focus of the discussion in this dissertation is to see how the different modes of representation interact with one another in the phonological phenomena in Korean that involve vowels. More emphasis is laid on the modes of representation than on the interaction of rules and rule ordering. Thus it is shown that the problems and exceptions of previous analyses of Korean vowel phonology can be dealt with within the theoretical frameworks presented in the first part of the dissertation.
“Unfortunately or luckily, no language is tyrannically consistent. All grammars leak.”

-Edward Sapir in Language (1921: 39)-
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PART II A COMPREHENSIVE ANALYSIS OF THE VOWEL PHONOLOGY OF KOREAN

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Chapter 1

Introduction

There are two major components in phonological analysis: rules and representations. Rules operate on representations to produce utterance forms. The generative approach, as in Chomsky and Halle (1968) and other related works, can be characterized by linear representations and ordered rules. More emphasis, however, is placed on rules: their conditions and their interactions. However with the advent of non-linear approaches, initiated notably by Goldsmith (1976) and Kahn (1976), researchers have contended that the phonological representation is more than just a linear arrangement of feature bundles and that rules can be stated very generally without detailed conditions added to each and every rule. Thus the focus on phonological research has been shifted from the nature of rules to that of representations. This study is in line with a representation-oriented approach to phonological analysis.

The object of this study is to present a unified account for various aspects of Korean vowel phonology. There are several interesting aspects to the vowel phonology of Korean, a system that is generally considered difficult to describe systematically. Many phonologists
have attempted to explain different aspects of Korean vowel phonology, which include vowel harmony, vowel fronting, and vowel coalescence.

In the generative framework, C-W. Kim (1968) and B-G. Lee (1973) offer an extensive account for vowel phenomena. In the non-linear or multi-linear framework, many researchers have shown their interest in Korean vowel phonology. McCarthy (1983) discusses vowel harmony in ideophones, H-S. Sohn (1987b) and Y-S. Kim (1984, 1988) discuss two vowel harmony processes, vowel harmony in ideophones and in verbal suffixation. Hume (1990) and Y-S. Kang (1991) study vowel fronting, while H-S. Sohn (1987b) and Y.Y. Cho (1990b) deal with the vowel coalescence phenomena. Other researchers have also shown interest in these and other areas of Korean vowel phonology.

One of the most problematic aspects in the studies of Korean vowel phonology is that virtually every researcher presupposes a different feature specification and a different feature geometry model. Often the feature system proposed to explain one aspect fails to account for other aspects of the vowel phonology of Korean. For example, McCarthy (1983) and J-S. Lee (1992) propose [+high] to be specified in order to explain vowel harmony in ideophones, while H-S. Sohn (1987b) and Y. Y. Cho (1990b) argue that [+high] should not be specified for the most natural explanation of vowel coalescence.

Against this backdrop, the aim of the study will be broadly twofold: in the first part, I will present recent developments dealing with the nature of phonological representations and propose certain modifications of the generally accepted view of phonological representations. Specifically, based on data from a variety of languages, I will propose a monovalent feature system, a feature geometry with a branching Place Node, and a moraic syllable structure. The second part of this study involves the application of these representations to the vowel phonology of Korean. Specifically, I will examine the phonology of Korean glides including the controversial issue about the location of on-glides in Korean syllable structure. I will also examine vowel harmony in both ideophones and verbal suffixation, vowel fronting, and vowel
coalescence including cases involving vowel deletion. It will be shown that with the features and syllable structures motivated in the first part of this study, a comprehensive and consistent analysis can be offered to different aspects of Korean vowel phonology. Thus it will be seen that the problems and exceptions of previous analyses of Korean vowel phonology can be dealt with, if certain aspects of the representations developed in the first part of this study are adopted.

The basic assumption in this study is that, as McCarthy (1988: 84) points out, "if representations are right, rules will follow". Such a representation-based approach to the vowel phonology of Korean will be shown to be more consistent, complete, effective and explanatory than the previous rule-based approaches.

Part I deals with three different areas of representation: feature underspecification, feature geometry and syllable structure. In Chapter 2, I will discuss feature underspecification. I will propose a monovalent feature system and argue that it is a logical extension of Archangeli's (1984) radical underspecification and Archangeli and Pulleyblank's (1991) combinatorial specification. One immediate consequence of using a monovalent feature system is that we can eliminate almost all the redundancy rules. I will introduce the following specification for Korean vowels where [+] means the presence of the feature:

(1) Korean Vowel Specification

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>æ</th>
<th>o</th>
<th>a</th>
<th>i</th>
<th>u</th>
<th>o</th>
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<tbody>
<tr>
<td>open</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>front</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>round</td>
<td></td>
<td>+</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTR</td>
<td>+</td>
<td></td>
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</table>
It will be shown that features not specified in (1) are phonologically inactive and remain unspecified throughout the phonological derivation.

Chapter 3 deals with feature geometry. I will first review the recent proposals on feature geometry, adopt Lahiri and Evers' (1991) version of feature geometry and expand it by adding tongue root features under the Tongue Position Node as shown in (2):

(2) Feature Geometry

One of the characteristics of this feature geometry is that it has a branching Place Node. This branching Place Node dominates an Art Nodes and a TP Node. Given the basic principle in feature geometry, that is to group the features that function together under the same node, it will be argued that not only tongue height features such as [high] and [low] but also the tongue root
features [Advanced Tongue Root (=ATR)] and [Retracted Tongue Root (=RTR)] should be grouped together under the TP Node. I will show that the feature geometry given in (2) is supported by data from Korean as well as from other languages. I will also suggest that the feature geometry can vary from language to language with respect to certain parameters. Accordingly, I will briefly discuss the parameterization of feature geometry, too.

In Chapter 4, I will introduce moraic syllable structure. I will briefly explain the historical development of syllable theories and adopt McCarthy and Prince's (1986) style of syllable structure as illustrated with the English word "plane" in (3):

(3) Moraic Syllable Structure

Moraic theory has been proven to be very effective in explaining language particular syllable weight assignment for such phenomena as quantity-sensitive stress (Hyman (1984, 1985)), compensatory lengthening (Hayes (1989)) and templatic morphology (McCarthy and Prince (1986)).

Korean does not have a quantity-sensitive stress system, nor does it have conspicuous compensatory lengthening phenomena except in initial syllables. However, we find that the moraic structure presented in (3) is proven to be very important in explaining phonological changes conditioned by weighted segments such as umlaut in Korean as well as explaining "/li/ irregular verb" phonology.

Thus, in the first part of this work comprising the next three chapters, the basic representations in feature specification, feature geometry and syllable structure will be
discussed. In the second part, I will present a comprehensive analysis of the vowel phonology of Korean. In Chapter 5, I will deal with the controversial issue of the location of on-glides in Korean syllable structure and the compensatory lengthening effect due to glide formation. I will propose the Onset Hypothesis which argues that Korean on-glides should be located in the onset position of the syllable in spite of their graphemic representation as parts of vowels. Two sets of data will be considered. The first set of data that include vowel harmony in ideophones, optional glide deletion and the "Popuri" language game (a CV insertion language game), will show that only the Onset Hypothesis can explain them consistently without exceptions. The second sets of data are those which are usually quoted in the literature to support the Nucleus Hypothesis that Korean on-glides are part of the nucleus. These include phonotactic constraints, consonant cluster simplification and ideophone specific deletion phenomena. It will be shown that the Onset Hypothesis can account for all these data and that those data cannot be used to exclusively support the Nucleus Hypothesis.

I will also talk about glide formation in Chapter 5. Glide formation is optional and it usually results in compensatory lengthening in initial syllables. But it is also found that there are some exceptions to this generalization. For some vowels, glide formation is obligatory and it is not accompanied with resultant compensatory lengthening. I will argue that such effect is due to the fact that those vowels are not associated to moras in underlying representation.

In Chapter 6, vowel harmony (=VH) in ideophones and verbal suffixation will be dealt with. I will show that VH can be explained straightforwardly by adopting a feature geometry model that has a branching Place Node. VH will be analyzed as part of the morphological derivation in which a feature-size morpheme [RTR] is introduced to base forms, with subsequent linking and spreading. This accounts for the derivation of the traditional "light" ideophones. In my analysis I will strongly argue for the necessity of employing a branching Place Node in feature geometry.

I will also argue that the affixal VH found in verbal suffixation can be accounted for by
adding a special condition on the triggering vowel. By doing so, I will show that there are similarities and differences between these two vowel harmony processes in spite of the repeated assertion in the literature that the two harmony processes cannot be related.

In Chapter 7, vowel fronting, or umlaut, will be discussed. Umlaut in Korean may pose a serious challenge to the feature geometry and underspecification proposed in Part I, since [coronal] consonants, which are assumed to be underspecified, can block the umlaut process. However, with a careful reanalysis of the relevant data, I will show that the feature geometry can actually explain the [coronal] blocking effect. I will show that in spite of the complexity of the umlaut data in Korean, the framework laid out in Part I can explain the major observations in Korean umlaut.

Chapter 8 deals with vowel coalescence and vowel deletion. I will separate out two different aspects of Korean vowel coalescence: a post-lexical optional vowel coalescence with resultant vowel lengthening and a lexical obligatory vowel coalescence without a lengthening effect. The optional vowel coalescence can be explained by positing one general rule of vowel coalescence following de Hass (1988). However the obligatory vowel coalescence, or obligatory /i/ deletion, which does not trigger vowel lengthening defies an easy explanation. I will point out problems of previous rule-based approaches to /i/ deletion in Korean and propose that the obligatory /i/ deletion can be accounted for in a representation-based approach. To be more specific, I will argue that the obligatory nature of /i/ deletion comes from the fact that some vowels including /i/ are underlyingly represented without moras. This is the same approach, which I adopt for explaining the obligatory glide formation in Korean in Chapter 5.

Thus, in Part II, it will be shown that the comprehensive analysis of the vowel phonology of Korean is possible if the right representations are adopted. In general, this study will strongly argue that the representation-oriented approach to phonological analysis along with very general rules and universal principles is more explanatory than rule-based approaches
which resort to conditions on each rule and ordering between rules.
PART I

THEORETICAL ASSUMPTIONS
Chapter 2

Feature Specification

2.0. Introduction

The aim of this chapter is to provide an overall picture of the theoretical assumptions on feature specification necessary for the study of vowel phonology in Korean. Since Chomsky and Halle (1968; henceforth SPE), the study of phonology has shown considerable development in research methods and theory construction. One can view SPE-type phonology as having two dimensions: the representational dimension and the rule dimension. The emphasis in SPE and in early generative phonology was on the nature of rules and how they interact.

Recent phonological studies, however, have shown different trends. One trend is to put more emphasis on representation than on rules. McCarthy (1988: 84) points out that "if the representations are right, then the rules will follow". Such an approach can obviate the long standing argument on rule ordering and rule interactions or the obligatoriness or optionality of rule application.

Another trend noticeable in the recent development of phonology is the modular approach. What is meant by this is that phonological processes make reference to several independent components which are interacting with one another. The recent diversification of
studies in phonology dealing with lexical phonology, tonal phonology, syllable phonology, feature geometry, and underspecification theory, reflect such a modular approach.

In light of these recent developments in phonology, I will take up the issue of feature specification in this chapter. And in particular, I will consider underspecification theory. There are two main streams in underspecification theory: Contrastive Underspecification and Radical Underspecification. In this chapter I will examine each of these theories of underspecification. I will then develop and propose a monovalent feature system and argue that the monovalent feature system maintains the major observation captured by underspecification theory while avoiding some problems caused by the radical version of underspecification theory. Finally I will offer a monovalent feature system for the vowels in Korean, the language which is the focus of this dissertation.

2.1. Background

Jacobson and Waugh (1979) observed that the term stocheia was used for the basic units of sound description in the Greek philosophical literature. The stocheia were thought to be indivisible primes of sounds, which are equivalent to phonemes in contemporary phonology. This idea of taking a phoneme as the primitive unit in phonological description is reconfirmed in, and perhaps has been sustained up to, Bloomfield (1926). He thought that there cannot be any phonologically relevant element more fundamental than a phoneme, when he defined the phoneme as "a minimum same of vocal feature".

However, if we take the view that a phoneme is atomic and indivisible unit of sound description, it can lead us to unsatisfactory explanations about phonological phenomena. Suppose we want to state the generalization in American English that all vowels are nasalized before a nasal consonant without breaking a phoneme into further units. Then we are forced to
take the following expression of nasalization as the simplest form:

(1) Vowel Nasalization – I

\[
\begin{array}{c}
/i/ \\
/e/ \\
/æ/ \\
/ä/ \\
/o/ \\
/õ/ \\
/вал/
\end{array} 
\rightarrow
\begin{array}{c}
/i/ \\
/è/ \\
/ê/ \\
/ã/ \\
/ö/ \\
/õ/ \\
/ãõ/
\end{array}
\]

\[
/ ____ {m, n, ɲ}\]

The rule given in (1) does not capture the generalization for vowel nasalization. It does not tell us what are the common characteristics of the inputs, outputs and the environments of the rule. Intuitively the phenomenon is that the vowels acquire nasality from the following nasal consonant: a case of anticipatory assimilation.

On the other hand, if we reject the idea that phonemes are atomic and assume that phonemes can be further decomposed into features, we may simplify (1) as in (2), while capturing the generalization of vowel nasalization:

(2) Vowel Nasalization - II

\[
[-\text{consonantal}] \rightarrow [+\text{nasal}] / ____ [+\text{nasal}]
\]

In fact, it has long been argued that phonological segments are composed of subsegmental elements and that those elements or features are the basic units of phonological description. This has been quite well demonstrated by Distinctive Feature Theory as proposed in Trubetzkoy (1939), Jacobson, Fant and Halle (1952) and also in SPE.
In the phonological theory introduced in SPE, a phoneme is represented by a feature bundle. For example, a phoneme /e/ has a bundle of features [+sonorant, -consonantal, +syllabic, -anterior, -coronal, -nasal, -back, -high, -round, -low]. One interesting observation that can be made here is that not all the features are absolutely necessary to show contrasts in the phonemic inventory of a language. In other words, there is a certain amount of redundancy in distinctive feature theories such as the one proposed in SPE. We can differentiate two different types of redundancies in feature theory: universal redundancy and language specific redundancy.

Universal redundancy can be well illustrated by the observation that nasal sounds are always voiced and it may not be imperative to put the information about voicing in the underlying representation of the nasals or for that matter of other sonorant consonants, unless there is a voiceless sonorant consonant. Another kind of universal redundancy may be due to the incompatibility of specified features: "definitional redundancy" is Lass' (1984: 79) term. A [+high, +low] combination is not allowed in the feature matrices. Here we can deduce that all the [+high] vowels are [-low] and all the [+low] vowels are [-high], though the reverse does not hold.

On the other hand, languages may have their own segmental structure constraints, which may or may not be found in other languages. For example, in English, all the front vowels are unrounded. The feature combination of [-back, +round], therefore, is not possible for English. The corollary of this observation is that [-round] is redundant if the segment carries the [-back] feature.

SPE noted that only the idiosyncratic properties are lexically specified and other predictable properties are derived. Since some of the features, as discussed above, are predictable, efforts have been made to find a systematic way to eliminate redundancy from underlying representation and derive the redundant features by rules. Further, it has been found that putting all the feature information in the underlying representation actually weakens
the explanatory power of phonology. This can be well illustrated by vowel coalescence phenomena in Tigrinya, an Ethiopian Semitic language. Here are some crucial examples from Buckely's (1991) observation:

(3) Tigrinya Vowel Coalescence
   
   a. \[ \lambda + u \rightarrow o \]
   
   b. \[ \lambda + i \rightarrow e \]

Here, we can see that the nonhigh vowel /\lambda/ has the effect of lowering the following vowel. The logical question, then, is why high vowels become nonhigh instead of the other way around. A similar question may be asked in (3b): the back vowel and front vowel are combined but the result is a front vowel. The backness of /\lambda/ has no effect on the coalescence. If we specify all the features underlingly, we do not have any natural explanation about these cases of vowel coalescence, and will have to come up with all sorts of feature changing rule which cannot but be *ad hoc* in nature. However if some features are left unspecified underlingly, then the resulting vowel in (3) might be seen as the combination of the specified features.

Such observations lead researchers in phonology to propose underspecification theories. The main idea of underspecification theory is that we should not have full specification of features in the underlying representation, and moreover, underspecification of features is viewed as persisting up to a certain level in the phonological derivation. Representative of these approaches is Contrastive Underspecification advocated by Clements (1987) and Steriade (1987b) and Radical Underspecification advocated by Archangeli (1984, 1988) and Archangeli and Pulleyblank (1987).
2.2. Contrastive Underspecification

The basic assumption of Contrastive Underspecification is that all the contrastive features should be specified in the underlying representation and that the underspecified segments are the input to phonological rules. In other words, a feature which distinguishes between two phonemes of the language is said to be contrastive and should be specified for these two phonemes while a feature which may not be contrastive remains unspecified. Archangeli (1988: 192) sums up the algorithm of Contrastive Underspecification as in (4):

(4) Algorithm for Contrastive Underspecification

a. fully specify all segments
b. isolate all pairs of segments
c. determine which segment pairs differ by a single feature specification
d. designate such feature specifications as 'contrastive' on the members of that pair
e. once all pairs have been examined and appropriate feature specifications have been marked 'contrastive', delete all unmarked feature specifications on each segment.
From this algorithm we can immediately see that contrastive underspecification takes the underlying representation of phonemes into consideration ignoring language particular phonological phenomenon. As a result, languages with identical five vowel system will have the same underlying specification. Let's consider a typical five vowel system which can be found in such languages as Spanish or Swahili and see how such a system would be analyzed using Contrastive Underspecification. This is shown in (5):

(5) Example of Contrastive Underspecification

a. Fully specified inventory

```
  i   e   a   o   u  
high  +   -   -   -   +
low   -   -   +   -   -
back  -   -   +   +   +
```

b. Contrastive features

- \{i, e\} and \{u, o\} contrast in [±high]
- \{a, o\} contrast in [±low]
- \{i, u\} and \{e, o\} contrast in [±back]

c. Contrastively specified underspecification

```
  i   e   a   o   u  
high  +   -   -   -   +
low   -   -   +   -   -
back  -   -   +   +   +
```

Steriade (1987b) assumes that [±round] can be derived from [±back] and suggests that [back] rather than [round] be specified in the underlying representation.
d. Redundancy rules

\[ [+ \text{high}] \rightarrow [+ \text{low}] \]
\[ [+ \text{low}] \rightarrow [+ \text{high}, + \text{back}] \]
\[ [- \text{back}] \rightarrow [- \text{low}] \]

Note in (5c) that some redundant features are present in the underlying representation. [-high] for /o/ can be derivable given that it has [-low] and [+back], which are sufficient to distinguish /o/ from the rest of the vowels. Steriade (1987b: 339) clarifies her position in this regard that she would "not assume that we must eliminate predictable information from lexical entries". Thus the contrastive algorithm does permit the specification of certain redundant features.

### 2.2.1. Transparency and Blocking Effects

One piece of strong support for Contrastive Underspecification comes from the observation of transparency and opacity of a segment in phonological rule application. Let's first consider an example. Steriade (1987b), in defence of Contrastive Underspecification, presents many interesting examples of transparency and opacity effects in natural languages. I will just illustrate her point with Latin liquid dissimilation. In Latin suffixation, a lateral in certain suffixes loses its laterality feature, if the stem has a lateral in it as the following examples show:

(6) Latin '-alis' Suffixation

a. nav - alis (naval)

b. sol - aris (solar)

Latin - aris (of Latin)
(6a) shows that the default suffix form is ‘-alis’. But as shown in (6b) the suffix added to
the stem with a lateral consonant is ‘-aris’. (6c) shows one more complication to the
observations made so far. If /ltl/ is placed between the lateral in the stem and suffix, the suffix
form is ‘-alis’. As a first approximation, we may say that if two lateral sounds appear the
second [+lateral] is deleted. What motivates [+lateral] deletion is the Obligatory Contour
Principle given in Goldsmith (1976). Below is the definition of the Obligatory Contour
Principle and the formulation of the Latin liquid dissimilation rule:

(7) Obligatory Contour Principle (OCP)

Adjacent identical elements are prohibited.

(No two identical elements are allowed to be adjacent
at the relevant level.)

(8) Latin Liquid Dissimilation Rule

When two [+lateral] elements are adjacent with each other, a violation of the OCP
results and consequently the [+lateral] delinking occurs as given in (8). Let us now consider
the feature specification of some coronal sounds in Latin within the Contrastive
Underspecification framework.

(9) Sample Underspecification of Latin Coronals

\[
\begin{array}{cccc}
  t & d & r & l \\
  \text{voice} & - & + \\
  \text{lateral} & - & + \\
\end{array}
\]

In (9), we see that [voice] is not contrastive between /r/ and /l/ and therefore [voice] will not be specified for liquids. On the other hand [lateral] is the feature that distinguishes /r/ from /l/ and the contrastive feature value must be specified for these phonemes. However, [lateral] is not contrastive in the case of stop sounds. As a result stop sounds do not have any feature value for [lateral].

Now, given the feature specification in (9), the suffix ‘-alis’ in (6a) will surface with an [r] as in (6b) having undergone the Latin liquid dissimilation rule in (8). The case of (6c) provides a strong argument for Contrastive Underspecification. In the words in (6c) /l/ intervenes between two lateral consonants. Given the contrastive feature specification in (9), where /l/ is [-lateral], the schematized structure will look like (10):

(10) Schematized Representation of the Words in (6c)

\[
\begin{array}{ccc}
  [+\text{lateral}] & [-\text{lateral}] & [+\text{lateral}] \\
  \text{C} & \ldots & \text{C} \ldots & \text{C} \\
\end{array}
\]

Here, the rule (8) cannot apply since there is no violation of the OCP. The two [+lateral] features are not adjacent due to the intervening [-lateral] feature of the consonant, /l/. The analysis given here strongly suggests that /l/ must be specified as [+lateral], /l/ as [-lateral].
Other coronal consonant should not be specified for laterality. This is clearly seen in a word like "Latin - aris" in (6b), where the /t/ cannot be specified for [-lateral]; were it to be specified as such, then the suffix would be predicted to surface with the [+lateral] feature as /l/, instead of occurring as the actual [-lateral] /r/.

2.2.2. Problematic Aspects of Contrastive Underspecification

Though Contrastive Underspecification may be a useful tool in explaining transparency and opacity in rule application, it is subject to various criticisms. First as discussed earlier, the main purpose of underspecification theory is to simplify the underlying representation. From this perspective, the very existence of redundant features in underlying representation suggests that the underspecification is not complete. Consider (5c) again. The segment /o/ may be specified without [-high] and still be contrasted from the other vowels. In this sense, we might say that [-high] is redundant for /o/. Just as some of the distinctive features are predictable, some of the contrastive features can be derived. Therefore the very basic principle of underspecification theory points out that Contrastive Underspecification is somewhat incomplete in that respect.

Another problematic aspect of Contrastive Underspecification is that some feature can have a three way contrast, specified for [+], [-] and [Ø] as illustrated with [lateral] in 2.2.1. Consider [±low] in (5c) for example: front vowels and high vowels are not specified for a [low] value while /a/ has [+low] and /o/ has [-low]. Many generative phonologists, notably Lightner (1963), Stanley (1967), and Ringen (1975), claimed that the apparent ternary use of the binary feature is not desirable for phonological description. This position is readily understandable given the definition of features in generative phonology. Unlike Trubetzkoy (1939) who employed features to show the contrasts between phonemes, the American generative phonologists use features for the categorization of phonemes. Each phoneme has to
be classified before the application of phonological rules. Therefore, in SPE, despite the effort to simplify the underlying representations, the assumption was adopted that all the features should be fully specified before the application of phonological rules.

The more serious problem of Contrastive Underspecification comes from the uniformity of the underspecified feature matrix of languages that have the same phonemic inventory. Every language with the same vowel inventory ends up with the same set of specified features. However, it has been argued by Archangeli (1984, 1985), Pulleyblank (1988a, b), and Abaglo and Archangeli (1989) that languages differ in picking one segment in the phonemic inventory to be treated as the least marked and therefore least specified sound. It is argued that such segments lack any specified features underlyingly. Crucially, the nature of the featureless segments differs across languages. For example, Swahili takes /i/ as a featureless vowel, while Japanese takes /u/ and Spanish takes /e/. This suggests that the feature specifications may differ from language to language, though they may have the same set of underlying phonemes.

However, in Contrastive Underspecification, there is nothing in the representation of the five vowel system which can explain this phenomena. The five vowel system would have the underlying specification shown in (5c), and the redundancy rules in (5d) would apply uniformly to them. Contrastive Underspecification is unable to predict that, depending on the language, different vowels behave as featureless with respect to various phonological processes.

One additional aspect to consider is markedness. Markedness as motivated in SPE is a tool to explain the naturalness of a phoneme or of the sound inventory of a language. Markedness is the property of universal grammar that is designed to capture the linguistically significant generalizations characterizing sound systems. Archangeli (1988) compared two languages with different five vowel systems: Swahili and Auca. These two languages have the following vowel sets shown with their specified features, given Contrastive Underspecification:
(11) Different Five Vowel System

a. Swahili

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<tr>
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<th>i</th>
<th>e</th>
<th>a</th>
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<tbody>
<tr>
<td>high</td>
<td>+</td>
<td>-</td>
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<td>+</td>
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<tr>
<td>low</td>
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<td>+</td>
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<tr>
<td>back</td>
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<td>+</td>
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</table>

[+ high] → [- low]

[+ low] → [- high, + back]

[- back] → [- low]

b. Auca

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<td>back</td>
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</tbody>
</table>

[+ high] → [- low, - back]

[+ low] → [- high]

[+ back] → [- high]
Archangeli (1988) cites Maddieson (1984) noting that more than 100 languages that have a five vowel system have the same vowel inventory as Swahili while the language, Auca, is unique in having the set of five vowels shown in (11b). We can safely say that the inventory in (11a) is less marked, more natural, and more frequently found in languages. However, markedness in underlying representation is not reflected in Contrastive Underspecification. The same number of features is used in both (11a) and (11b). Feature or rule counting does not help either. Both (11a) and (11b) have 10 marked features and again they both need three rules for feature filling. There is nothing inherent in the underlying representations or the rules that reflect upon the naturalness or markedness of phoneme inventories. Some other theoretical device independent of the underlying representation is necessary to encode the cross-linguistic generalization of markedness.

2.3. Radical Underspecification

Another approach in dealing with redundancy in underlying representation is advocated by Kiparsky (1982, 1985) and developed by Archangeli (1984) and Pulleyblank (1986, 1988a, b). This approach is called Radical Underspecification and it is based on the assumption that all and only phonologically idiosyncratic features should be specified in the underlying representation while feature redundancy should be captured by redundancy rules.

Archangeli (1984: 50) presents the following Feature Minimization Principle:

(12) Feature Minimization Principle

A grammar is most highly valued when underlying representations include the minimal number of features necessary to make different the phonemes of the language.
This principle is actually derivable from the evaluation matrix of simplicity and naturalness as presented in SPE. However, starting with this principle, Archangeli (1984) further argues that underspecification theory is not just an attempt to streamline the underlying representation. It is directly related to the phonological rule application or the lack of it. Some of the most important characteristics of Radical Underspecification which Durand (1990: 158 - 159) mentioned are in (13):

(13) Some Characteristics of Radical Underspecification

a. Only distinctive features are specified in the underlying representation,

b. The nondistinctive features are supplied by redundancy rules.

c. The choice of underlying features and their value is based on the language particular and universal phonological phenomena.

In the following subsections, I will discuss these characteristics of Radical Underspecification.

2.3.1. Minimizing Underlying Features and their Specification

The basic principle given in (12) is well represented in (13a). To pursue (13a) a little further, we might say that we do not have to specify both [+ ] and [-] of any given feature. Ringen (1975, 1988a) points out that the problem of using a partially specified feature matrix is that it involves the so-called ternary use of binary features.\(^2\) One way out from this criticism is

\(^2\)See Lightner (1963) and Stanley (1967) also for similar discussion in generative framework. For them, using full specification is adopted to prevent the ternary use of the binary features.
to disallow the specification of both features in the underlying representation. Suppose we posit a restriction that only one value of a feature be specified in underlying representation and the opposite value be derived by later rule. Then in underlying representation, with just one value specified, there cannot be ternary use of binary features, and after the derivation, both of the values will be specified, and therefore there cannot be any ternary contrast at any stage of the derivation.

Such an approach is well expressed in Sohn's (1987b: 15) proposal of the Nondistinct Marking Condition given in (14):

(14) Nondistinct Marking Condition

Binary use of a feature is prohibited in the underlying representation.

This condition will drastically reduce the underlying representation. If [$\alpha F$] is specified in the underlying representation, we should not specify [$-\alpha F$]. For example, if [-high] is needed in the underlying representation, (14) prohibits the use of [+high] in the underlying representation. In underlying representation, only a single value of a feature is allowed to be specified. One of the problematic aspects of Contrastive Underspecification was the ternary distinction with the binary feature specification. Radical Underspecification, however, strictly disallows the specification of both negative and positive values of a feature underlingly.

One aspect, though shared by both Radical and Contrastive Underspecification, is Inherent Underspecification, which, according to Archangeli (1988), is under-specification based on the properties of the features themselves. For example, [+high] always means [-low] and [+low] is always [-high]. Features provided by the default rules are of this type.

A factor that is important in selecting features for underlying representations with Radical Underspecification is the nature of underlying contrasts. In Yawelmani, there are four
vowels: /i/, /a/, /o/, /u/. This means that we need at least two features to distinguish one from the other. I will follow Archangeli (1984) that the least specified vowel in that language is /i/.

Now the question is: “which features do we have to choose from among [high], [low], [back], [round]?” The answer comes from the Feature Minimization Principle in (12). Radical Underspecification does not allow the use of three features if we can distinguish the phonemes with two features. The only possible way is to take [-high] and [+round] in the underlying representation. No other combination of two features shows the underlying contrasts. Consider the following possibilities:

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<td>i</td>
<td>a</td>
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<td>u</td>
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<tr>
<td>high</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>rnd</td>
<td>+</td>
<td>+</td>
<td>+</td>
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</table>

(15) Different Alternatives in Yawelmani Vowel Representation.

a. [-high] and [+round]

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<td>i</td>
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<tr>
<td>high</td>
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</tr>
<tr>
<td>back</td>
<td>+</td>
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</table>

d. [+low] and [+back]

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<td>low</td>
<td>+</td>
<td>+</td>
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Except for (15a), the other representations fail to make the underlying phonemic contrasts. In (15b), /a/ and /o/ are not distinguished. (15c) and (15d) fail to differentiate /o/ from /a/. Thus given the Feature Minimization Principle in (12), Radical Under-specification requires the selection of (15a) as the underlying representation of Yawelmani vowels.

Now, let’s turn to the second characteristic of Radical Under-specification. In (13b) and (13c), we find the crucial difference between Radical Under-specification and Contrastive Under-specification. As mentioned earlier, Contrastive Under-specification takes the phonemic inventory and finds the contrastive features and eliminates all the non-contrastive features in order to come up with the underspecified representation. As a result, two different languages with the same vowel inventory will have the same underspecified feature specification. Archangeli (1988) points out that such an approach proves to be problematic since different languages with the same vowel inventory single out different phonemes and treat them in a unique way. And as a result, two different languages with the same phonemic inventory can show different phonological behavior. We will see how this follows from Radical Under-specification.

Radical Under-specification says that a language may take one segment as the least marked in that language. For example, in Spanish, /e/ is taken to be the least marked vowel and is inserted in the process of syllabification when a vowel is structurally required especially in loan word phonology. For Swahili it is /i/ that has the same function as Spanish /e/. Again, in Japanese, /u/ seems to be the vowel that is the least marked. Archangeli (1984) tries to capture the difference by asserting that the least marked vowel is the least specified vowel: in other words, the least marked vowels may not have any feature specified in the underlying representation.
Given that the least marked vowel may differ from language to language and given Inherent Underspecification, we might have the following underlying representations of the three languages:

(16) Different Underlying Representations of Vowels$^3$

<table>
<thead>
<tr>
<th>Language</th>
<th>i</th>
<th>e</th>
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<tbody>
<tr>
<td>Japanese</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

b. Swahili

| high     | - | - |
| low      | + |
| back     | + |
|          | + |

Now, we see that the underlying representations of different languages having the same phonemic inventory can be different. The difference in the underlying representation is responsible for the different phonological behavior of vowels in the respective languages.

---

$^3$ Following Steriade (1987b), I assumed that $\pm$ round is derivable from $\pm$ back.
To sum up, with Radical Underspecification there are four basic principles in selecting the underlying features. These are shown below:

(17) Principles in Selecting Underlying Features.

a. The Nondistinct Marking Condition
   Only one value of a feature is present in the underlying representation

b. Inherent Underspecification
   A feature which can be supplied by the universal redundancy rules is not specified.

c. Feature Minimization Principle
   Underlying representations employ the smallest possible number of features to make underlying contrasts.

d. Phonological Behavior
   Phonological phenomenon should be considered in deciding the underlying features.

As shown so far, Radical Underspecification does not suffer from the criticisms levied on Contrastive Underspecification as discussed in 2.2.2. First in selecting the underlying feature, Radical Underspecification successfully gets rid of all the redundant features from the underlying representation with the four principles given in (17). Further, the Nondistinct Marking Condition given in (17a) and in (14) strongly prohibits the binary use of features in the underlying representation. Therefore there cannot be criticism about the ternary use of a feature in underlying representations. Further, by taking phonological phenomena of a language into consideration in selecting the underlying representation of that language, we can account for why in different languages the nature of the least marked vowels differs.
2.3.2. Redundancy rules

The second important concept in Radical Underspecification is that the redundant features are supplied by two rules: Default rules and Complement rules. Default rule is Archangeli’s (1984) term for universal redundancy rules. Default rules are part of Universal Grammar and they show various inter-feature dependencies. Default rules capture the natural correlation between features and unmarked feature co-occurrence restrictions.

On the other hand, complement rules are language specific. Complement rules assign the opposite value of a feature in the underlying representation. For example, if $[\alpha F]$ is underlingly present, any segment that has $[-\alpha F]$ does not have any specification with respect to the feature $[F]$ due to Nondistinct Marking Condition given in (14). Then in a later stage of the derivation, a complement rule will assign $[-\alpha F]$ to all the segments that do not have $[\alpha F]$.

An example will clarify the point. The underspecified feature matrix of vowels in Yawelmani, a Yokuts language, as in Archangeli (1984: 74) is given in (18):

(18) Yawelmani Vowels

a. Underspecified vowel matrix

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<th>i</th>
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<tbody>
<tr>
<td>high</td>
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<tr>
<td>round</td>
<td></td>
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</table>
b. Fully specified vowel features

<table>
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<td>high</td>
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<td>low</td>
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<tr>
<td>round</td>
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<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>back</td>
<td>-</td>
<td>+</td>
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<td>+</td>
</tr>
</tbody>
</table>

As discussed in the preceding subsection, [high] and [round] are enough to make the four way distinction in the underlying inventory. Default rules and Complement rules serve as a bridge to connect the underspecified matrix in (18a) to the fully specified matrix in (18b). The following is the list of redundancy rules necessary to come up with a fully specified matrix:

(19) Redundancy Rules for Yawelmani

a. [ ] → [+ high] (complement)

b. [ ] → [-low]/

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>+round</td>
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<tr>
<td>-high</td>
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(default)

c. [ ] → [-low]/

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<tr>
<td>+high</td>
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(default)

d. [ ] → [+low]/

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<td>-high</td>
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(default)
(19a) and (19f) are the complement rules and the rest are default rules. The default rules are derivable from the universal markedness conventions but the complement rules as shown in (19a) and (19f) are language specific. We can immediately see that the default rules and complement rules are intermixed with each other. Archangeli (1984) claims that the ordering of redundancy rules are determined by the elsewhere condition as proposed by Kiparsky (1982: 136 - 137) as given in (20):

(20) Elsewhere Condition

Rules A, B in the same component apply disjunctively to a form \( \phi \) if and only if

(i) The structural description of A (the special rule) properly includes
the structural description of B (the general rule),

(ii) The result of applying A to \( \phi \) is distinct from the result of applying
B to \( \phi \)

In that case A is applied first, and if it takes effect, then B is not applied.

The Elsewhere condition given in (20) says that if two rules are applicable to a given representation, then the rule with the more specific environment is applied first. Then the next
logical question is when the redundancy rules take effect. To paraphrase the question, we might ask how the redundancy rules interact with phonological rules. Archangeli (1984) makes the following claims on the interaction:

(21) Redundancy Rule Ordering

a. Default Ordering Principle

The redundancy rules begin their application in the latest stratum possible but they apply as early as possible within that stratum.

b. Redundancy Rule Ordering Constraint

A default or complement rule assigning \([\alpha F]\), where \([\alpha]\) is [+ or -], is automatically assigned to the first component in which reference is made to \([\alpha F]\).

(21) says that, unlike the claim made in SPE that all features should be specified before the application of any phonological rule, the underspecified matrix persists through the phonological derivation up to the point where the redundant value specification is absolutely required by the phonological rules. Another important assumption about the application of the redundancy rule is the Distinctness Condition proposed by Archangeli (1984):

(22) The Distinctness Condition

The input to a redundancy rule is not rendered distinct from the output by application of the redundancy rule.

The Distinctness Condition maintains that the redundancy rule is not feature changing. The
output of redundancy rules is simply a more detailed description of the input. To see how the Distinctness Condition can influence the interaction between redundancy rules and phonological rules, let's take a look at consonant voicing in Tangale, a North African language. In Tangale (see H-S. Sohn (1987b: 42-43) for relevant data), a voiceless consonant is voiced after a voiced consonant. We may posit the following voicing assimilation rule and complement rule:

(23) Tangale Consonant Voicing

a. Voicing assimilation

\[ \begin{array}{c}
\text{X} \\
\text{[+voice]}
\end{array} \]

\[ \begin{array}{c}
\text{X} \\
\text{[+voice]}
\end{array} \]

b. Complement rule

[ ] \rightarrow [- voice]

Let's suppose that in Tangale [+voice] is specified in the underlying representation and [- voice] is supplied by the complement rule given in (23b). Now if the voicing rule in (23a) is applied to a voiceless consonant, then the complement rule in (23b) does not apply since the segment is already specified as [+voice]. If the complement rule is applied to the outcome of the voicing rule, then the output is distinctly different from the input, since the complement rule change the value of the [voice] feature. Thus the complement rule applies only to those segment not specified for the [voice] feature as specified in the Distinctness Condition.

Finally the Redundancy Rule Ordering Constraint given in (21b) also works closely with phonological rules. Let's go back to Tangale consonant voicing again. All the sonorant consonants are [+voice]. Therefore the Feature Minimization Principle given in (12) does not allow the specification of [+ voice] to nasal consonants. But in Tangale, the nasal consonants
also trigger the voicing assimilation. How the nasal sound without the specification of [+voice] can spread its voicedness to the following consonants is answered by the Redundancy Rule Ordering Hypothesis. Since the voicing rule mentions about the feature [+voice], the rule to specify [+voice] should precede the voicing rule. Thus a nasal sound will get [+ voice] by the default rule and the inserted [+voice] feature participates as a trigger of the voicing rule.

2.3.3. Reviewing Radical Underspecification

Radical Underspecification seems to be well-motivated in the theory of phonology. Radical Underspecification theory is free of the criticisms levied on Contrastive Underspecification. With the Nondistinct Marking Condition given in (14), Radical Underspecification does not allow both values of a binary feature in the underlying representation which is a sure way to prevent the ternary use of features. Radical Underspecification claims that all the redundant features be eliminated from the underlying representation to achieve maximal simplicity in the underlying representation.

The strongest aspect of Radical Underspecification is that it can successfully explain the fact that different languages with the same phoneme inventories can have different segments acting as least marked. The least specified segments, or the most unmarked segments, play an important role in insertion and deletion processes with such segments typically being the ones that undergo such processes.

A remark on markedness is in order. Archangeli (1988) shows the difference between Swahili and Auca in vowel specification. Recall that in (11), we have shown that Contrastive Underspecification cannot tell the naturalness of the vowel inventories in these two different languages. Based on phonological phenomena of these two languages, Archangeli (1988) posits the following underspecified vowel matrices:
(24) Features of Different Five Vowel System

a. Swahili

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>a</th>
<th>o</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>back</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

b. Auca

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>æ</th>
<th>a</th>
<th>o</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>back</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

c. Universal Default Rule

\[
\begin{align*}
 [+ \text{low}] & \rightarrow [+ \text{back}] \\
 [+\text{low}] & \rightarrow [- \text{high}] \\
 [\phantom{+}] & \rightarrow [+\text{back}] \\
 [\phantom{+}] & \rightarrow [+\text{high}] \\
 [\phantom{+}] & \rightarrow [- \text{low}]
\end{align*}
\]

We see that the Universal Default Rules given in (24c) can supply all the missing values of Swahili vowel inventory. But the same Universal Default Rules fail to do the same to Auca. According to Archangeli, we need at least two more rules: one is to explain /æ/ and another to eliminate /u/. The observation leads us to the conclusion that from a viewpoint of Radical Underspecification, the vowel system in (24a) is less marked than the one in (24b)\(^4\).

\(^4\) It should be noted however that Archangeli’s explanation is not quite convincing. We do not need two
One of the most difficult problems for Radical Underspecification, though not insoluble, is the transparency and opacity effects which are employed in the argument in support of Contrastive Underspecification. Recall the discussion of Latin liquid dissimilation in 2.2.1. In order to explain the transparency effect of the non-liquid consonants in Latin, we have to say that all non-liquid consonants should not have any value for the feature [lateral]. On the other hand, we need to say that /r/ is specified for [-lateral] in order to incorporate the observation that /r/, if it comes between two laterals, can block the rule application. Archangeli suggests that the transparency and blocking effect can be explained in a principled manner with Structure Preservation and the Redundancy Rule Ordering Constraint. Since the Latin dissimilation rule refers to the feature [-lateral] then the [-lateral] supplying redundancy rule should precede the dissimilation rule. But the same feature [-lateral] should not be supplied to non-liquid consonants. Here Structure Preservation comes into play.

We may use Kiparsky’s (1985) proposal of Structural Preservation with the following interpretation:

\begin{align}
(25) \quad \text{Structural Preservation} \\
\quad \text{Phonologically non-contrastive features are not allowed to be specified in the course of lexical derivation.}
\end{align}
The Redundancy Rule Ordering Constraint places the [-lateral] specification rule before the dissimilation rule because the rule refers to [±lateral] in the rule description. However, the specification rule does not supply [-lateral] to all segments not specified for laterality. Note that [±lateral] is contrastive only in liquid sounds. So the liquids will be specified as [-lateral] as long as they are not [+lateral].\(^5\) On the other hand, no two nonliquid consonants are contrastive in laterality. In other words, laterality is a non-contrastive feature for obstruents or nasals and Structure Preservation Principle does not allow the specification of [-lateral] to obstruents. With these provisions, Radical Underspecification can deal with the transparency and blocking effects in phonological rules.

However, it should be noted that the interaction of the proposed Redundancy Rule Ordering Constraint and Structure Preservation may prove to be problematic in uniformly dealing with consonant voicing in Tangale (from Sohn (1987b)) and Russian (from Kiparsky (1985)). Nasal consonants behave differently in these two languages. Here are the typical examples of consonant voicing assimilation of both languages:

(26) Voicing Assimilations

a. Tangale

sim + simbe → si [m z] imbe (to meet repeatedly)
kemd + kemde → kemu [d g]emde (to fill repeatedly)

b. Russian

iz # mcensk + a → i [s mc] enska (from Mcensk)

ot # mzd + y → o [d mzd]y (from the bribe)

ot # nauki → o [t n] auki (from science)

---

\(^5\) As discussed in 2.3.2., redundancy rules are not feature changing, therefore the segment specified as [+lateral] will not be the input of the redundancy rules that supply [-lateral].
We can immediately see that nasals in the two languages show different behavior. In Russian, nasals are transparent and do not trigger voicing. The Russian voicing seems to involve a post lexical rule since it can be applied across word boundaries. In Tangale, nasals trigger progressive voicing harmony. And the process seems to be lexical in that it occurs due to the morphological process of reduplication. The data in (26a) reflects a violation of Structure Preservation, if we take the derivation as morphological. (26b) shows a problematic aspect of the Redundancy Rule Ordering Constraint. Since Russian voicing is not lexical, Structure Preservation does not work here, and the rule refers to [+voice] and therefore there is no reason why nasals are not specified for [+voice] and trigger voicing assimilation.

Another interesting observation regarding the Redundancy Rule Ordering Constraint comes from Korean vowel harmony in verb suffixation. Since it will be dealt with in great detail in Chapter 6, I will briefly sketch the problem here. Korean Vowel Harmony can be viewed as the spreading of [RTR] rightward. The [RTR] vowels in Korean are /o/, /a/ and /æ/. These are the triggers of vowel harmony in ideophones. But in verb suffixation, /æ/ does not trigger [RTR] feature spreading. One way to prevent /æ/ from participating in vowel harmony is to restrict the trigger to [+back] segments. For reasons to be discussed, [+back] is absent from the underlying representation. Here the Redundancy Rule Ordering Constraint will provide [+back] to all the back segments, which would correctly explain the lack of [RTR] spreading from the front low vowel /æ/. However, once we specify [+back] to all the vowel segments, we lose explanations in other area such as vowel fronting and vowel coalescence.

We have seen that the theory of Radical Underspecification is not without problems. However, Radical Underspecification theory does provide us with insightful explanations for a variety of phonological phenomena in many languages. In the next section, we will further pursue implications of Radical Underspecification and propose Monovalent Feature Specification.
2.4. Monovalent Feature Specification

The basic principle in Radical Underspecification is that the underlying matrices are not fully specified and the underspecified values are filled in by the application of redundancy rules which are subject to the Redundancy Rule Ordering Constraint. Let us now push the idea of underspecification even further and say that the redundant features are, for the most part, not specified throughout the phonological derivation. In other words, only one value is phonologically relevant in the description of the sound system and the sound changes in a language. The most radical way to achieve this maximal underspecification is to assume that all the features are monovalent in phonological description. In this subsection, I will carefully suggest that the monovalent feature system works better and obviates the problems posed by the Redundancy Rule Ordering Constraint.

It is worth mentioning that we do find that the non-binary systems are adopted in such non-feature approaches as Dependency Phonology (Anderson and Jones (1974), Anderson and Ewen (1987)), Particle Phonology (Shane (1984a, b)) and the Theory of Charm and Government (Kaye, Lowenstamm and Vergnaud (1985)). These approaches, though not dealt with in this study basically argue that the basic units of phonological description are not features and that they are not binary in nature. Thus there is no compatibility between these approaches and the binary feature system.
2.4.1. Motivating a Monovalent Feature System.

Sanders (1974) makes a detailed investigation into the empirical implications and explanatory values of the Simplex Feature Hypothesis (=SFH) and Complex Feature Hypothesis (=CFH). The SFH argues that the representation of the linguistic objects should be made of minimal independently-interpretable elements such as [NASAL] or [VOICE], and the CFH supports the idea that linguistic representation should include complex "two-element minimal constructions" such as [+nasal] and [-voice]. The monovalent feature system that I am going to propose is based on SFH, while the traditional SPE style of binary system as in [±nasal] and scalar feature system such as [1stress], [2stress] etc. are based on CFS. Sanders compares these two hypotheses against various phonological processes and concludes that the SFH "is found to have consistently greater explanatory value and to be strongly supported by a wide range of significant facts about natural languages".

Sanders finds that using monovalent features in linguistic studies is very effective in achieving linguistically significant distinctions in representation, in simplifying the underlying representations as well as rules and in positing natural classes. I will briefly consider the implication that the SFH has in defining natural classes. Consider the following natural classes in a hypothetical language that has six vowels, /i, e, a, o, u, ə/:

\[
\text{(27) Natural Classes}
\]

\[
a. \quad \text{[voc, high]} = /i, u/
\]
\[
\text{[voc, front]} = /i, e/
\]
\[
\text{[voc, round]} = /u, ə/
\]
The natural classes in (27a), which can be captured either by the monovalent feature system or by the binary feature system, are all confirmed to be linguistically significant with the well-motivated rules of languages. But Sanders (1974: 149) argues the natural classes in (27b) which are expressible only by the binary system, or by the complex feature system, "seems clearly less significant than" those in (27a). Here we clearly see the benefit of monovalent features in achieving linguistic significance of the concept of natural class in phonology.

I will pursue the line of Sanders' (1974) proposal and argue for the monovalent feature system in this study. We find the idea of a monovalent feature system in the literature on features or feature geometry. First consider Inherent Underspecification as introduced by Archangeli (1988). She posits that [round] may be monovalent, which means that the feature [round] does not have [+ ] or [- ] values. Therefore what matters here is the presence or absence of the feature in the underlying representation not its positive or negative value. Another example of Inherent Underspecification is node dependent underspecification, or nonspecification as in K-H. Kim (1987) in Feature Geometry. As will be discussed in Chapter 3, there seems to be a consensus among phonologists that the place features are monovalent. The labial consonant does not have to be specified for [coronal] or [dorsal] at all not only in the underlying representation but also throughout the phonological derivation.

Another interesting observation about the binary values of a feature is that the negative value can have two different meanings. Durand (1990: 74) observes that the distinctive features can be looked at in two different ways: "either as the 'presence' or 'absence' of a property or as attributes which have two 'polar', but mutually incompatible, values. In other words, the values of features can have two different interpretations as Trubetzkoy (1939)
suggested: privative and equipollent oppositions. When the [-] value is interpreted to mean the absence of a certain feature, the opposition thus made is privative. On the other hand, the negative value of X can mean the presence of some other feature Y.

This dual interpretation is challenged by Wilson (1966). He claimed that the binary value of a feature does "not merely mean the presence or absence of an attribute 'X' but that the absence of 'X' means the presence of another attribute 'Y' and that the presence of 'X' means the absence of the other attribute 'Y". Such an interpretation would lead us to the conclusion that all the binary features are to be understood as the representation of equipollent oppositions. Thus the binary value of a feature is the presence of two different and mutually incompatible attributes.

However, as Durand (1990: 76) points out, if we take a less concrete view, we may say that at least some of the binary values of a feature can be interpreted as the presence or absence of certain attributes. Durand's example is the feature [nasal]. Nasal segments have one additional resonator, which is the nasal cavity and which other oral consonants lack. Phonetically we might say that [-nasal] is the positive attribute of raising the velum to block the nasal cavity. But if we take the phonological view of nasality, oral consonants may not be characterizable by the absence of nasality.

The observations so far seem to suggest that at least at the stage of phonological derivation, we may posit monovalent features to obviate the ambiguity of the interpretation. Thus [-nasal] is simply the lack of nasality, and [-back] means the presence of another attribute which may be captured by [+front]. Seen from this perspective we may suggest that the presence of [nasal], [back] and [front] might be the relevant phonological properties and we do not have to mention the absence of any of these features in the underlying representation.
In the phonological literature, many researchers have proposed the possibility of using monovalent features in phonological description. As noted earlier, the advent of the theory of Feature Geometry makes it possible to use monovalent place features as in Clements (1985), Sagey (1986), and McCarthy (1988). McCarthy (1988) convincingly shows that using monovalent place features has more explanatory power than using binary features. Let's take a look at the four way distinction of place as in SPE:

(28) Four-way Distinction of Place

<table>
<thead>
<tr>
<th></th>
<th>+ant</th>
<th>+ant</th>
<th>-ant</th>
<th>-ant</th>
</tr>
</thead>
<tbody>
<tr>
<td>-cor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+cor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labial</td>
<td>Dental &amp; Alveolar</td>
<td>Alveopalatal</td>
<td>Velar</td>
<td></td>
</tr>
</tbody>
</table>

Firstly, McCarthy (1988: 100) talks about the grouping of [anterior] segments. He says that "it does not, by itself, characterize a class of segments referred to consistently by phonological processes". There do not seem to be phonological rules that involve [± anterior] only. Sagey (1986) also points out that using binary features for place distinction does not help in accounting for the occurrence of complex segments. She shows that the complex segments such as labio-coronal, corono-velar, and labio-velar cannot be properly characterizable with the two binary features. With these observations, both Sagey and McCarthy proposed three or four monovalent features for place of articulation.

Further in many languages alveolar sounds and alveo-palatal sounds are thought to be homorganic. For example, there is a root-morpheme co-occurrence restriction in Semitic languages where the occurrence of alveolar and alveo-palatal sounds is ruled out. McCarthy (1988) also cites the case of Yucatec Mayan where a stop sound becomes /h/ when it is followed by another homorganic stop. Here again /h/ becomes /h/ before /č/, which in turn
means that we need to group alveolar and alveo-palatal consonants together, since they are considered homorganic. This supports a widely accepted view in Feature Geometry that makes use of the three way distinction using three monovalent features [labial], [coronal], and [dorsal].

Turning to laryngeal features, [voice] seems to be a unary feature. This is noted by Mester and Itô (1989) in their explanation of the Rendaku blocking phenomenon in Japanese. In Japanese compounding, the first segment of the second morpheme is voiced if and only if there is no other segment in the second morpheme which is marked for [+voice]. Itô and Mester (1989) analyzed this as the case of OCP delinking which does not allow for two [voiced] features to be adjacent. But the [+voice] delinking persists even though there is a [-voice] segment between the two voiced segments. Mester and Itô (1989) argue that since [voice] is single-valued, there cannot be [-voice] specification in the representation. Further, Y. Y. Cho (1990a) surveys various voice-related phonological phenomena in many different languages and concludes that [voice] can be treated as a privative feature.

Lombardi (1991) surveyed the behavior of laryngeal features in neutralization in a variety of languages and concluded that laryngeal features are best expressed by using single-valued features without negative specification. She also notes that there is no co-occurrence restriction that makes use of negative values of laryngeal features. In addition, I know of no rule that takes [-constricted glottis] and/or [-spread glottis] as a trigger. That a feature is not phonologically active means that the feature may not be necessary for the phonological description of a language.

Lombardi (1991: 16) uses [voice], [glottalized] and [aspirated]. [Glottalized] can be equated with [constricted glottis] and [aspirated] with [spread glottis].

Taking all these into consideration, we can see that virtually all the features can be treated as monovalent. Four major exceptions of this generalization might be [± back], [± high], [± continuant] and [± ATR] in the literature. For these features, both the positive and the negative values seems to be active in the phonological derivation. If we posit [front] for [-back], [open] for [-high], [interrupted] for [-continuant] and [RTR] for [-ATR], we may argue that all the features can be privative in phonological description\(^8\).

We can also see that the monovalent features have often been employed in phonetic studies. Browman and Goldstein (1990) used their own phonetic features in explaining fast speech phenomena. Their tongue position features, palatal gesture features, and velar closing features are all one-valued. It seems quite possible that the [-] values may not be necessary in phonetics at least for some features.

Now we are faced with two choices: one is to use the binary feature system with dual interpretation of the negative value or to use a monovalent feature system and do not supply negative values to the absence of certain features. Given the fact that negative values of most features, such as [-voice], [-low], [-nasal], [-constricted glottis] and the like, are not

\(^7\)In the feature geometry framework, however, such as the one proposed by Lahiri and Evers (1991), the feature [-back] should be interpreted as [+front] in order to explain its interaction with other palatal consonants.

\(^8\)We will later use [palatal] instead of [front] for the unification of features of consonants and vowels. See Chapter 3 on Feature Geometry.
phonologically active, we might argue that using monovalent feature without supplying the negative value will significantly reduce the feature inventory as well as feature specifications.

2.4.2. Implications of Monovalent Features

One immediate result of using monovalent features is to reduce the redundancy rules significantly. Consider the Swahili vowel matrices with Radical underspecification and monovalent feature specification as in (29):

(29) Swahili Vowel Inventory

a. Radically underspecified features

\[
\begin{array}{cccc}
  & i & e & a & o & u \\
\text{high} & - & - & & & \\
\text{low} & & & + & & \\
\text{back} & & + & + & & \\
\end{array}
\]

\[ [+ \text{low}] \rightarrow [+ \text{back}] \]
\[ [+\text{low}] \rightarrow [-\text{high}] \]
\[ [ ] \rightarrow [+\text{back}] \]
\[ [ ] \rightarrow [+\text{high}] \]
\[ [ ] \rightarrow [-\text{low}] \]
b. Monovalent feature specification

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>a</th>
<th>o</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>open</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>low</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>back</td>
<td>+</td>
<td>+</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

\[ \text{[low]} \rightarrow \text{[open]} \]

Comparing (29a) with (29b), we can immediately see that we can do away with redundancy rules. The only rule, one that supplies [open] to low vowels, is truly universal in that all the low vowels should be pronounced with an open jaw and can be incorporated without any burden to the grammar. The so-called Complement rules are not necessary and thus the description of underlying features is significantly simplified.

Another implication of using monovalent feature is that all the phonologically active features should be present in the underlying representation. (29b) itself, in a sense, is a full specification of features for Swahili vowels. It claims that the phonologically active features in Swahili are [open], [low] and [back], and all the vowel segments can be correctly predicted from the combination of these three features. As a result, the phonologically inert features such as [+high], [-low] or [-back] have no place at all in the description of Swahili vowel phonology. Of course it might be necessary to supply [-back] to the above mentioned feature matrices to make it possible for the phonetic component to correctly interpret the place of articulation of the front vowels. This may not be problematic at all. We can postpone the [front] specification rule as late as possible perhaps at the end of the phonological derivation or we can even leave the specification to the phonetic component where [front] is inserted as the default feature for any segment without place specification.

---

9 Here [+] means the presence of the given feature.
As shown so far, I claim that monovalent feature specification is the natural extension of Radical Underspecification theory. Monovalent feature specification is the result of active incorporation of conditions and constraints posited for Radical Underspecification. Note here that the Nondistinct Marking Condition in (17a) does not have to be stipulated as a condition on representation. Monovalent features cannot make binary distinctions. Further, monovalent features, by definition, contain the notion of Inherent Underspecification in (17b). The default values of most features are left unspecified without hindering the correct interpretation of feature combinations. As such, monovalent feature specification is much simpler than Radical Underspecification in that we do not need to posit the Nondistinct Marking Condition and we can eliminate complement rules.

Turning to the Redundancy Rule Ordering Constraint, Mester and Itô (1989) argue that the Redundancy Rule Ordering Constraint is very unconstrained in that it can supply the necessary features any time in the course of phonological derivation. Mester and Itô (1989) observe Archangeli’s (1984) analysis of Yawelmani round spreading, where the feature [+round] spreads to the neighboring vowels if and only if both the trigger and the target of the round spreading rule agree in vowel height. Archangeli (1984) argues that since the rule refers to [ʰhigh], the Redundancy Rule Ordering Constraint can immediately provide [-high] to segments not specified for [high]. Mester and Itô (1989) take such a case as an ad hoc provision. According to Mester and Itô (1989: 266), "the importance of this observation for underspecification reveals itself when we turn to lexical cross-coefficient regularities holding in morpheme structure: by parity of reasoning BOTH values must be present at the point where the regularity is expressed, namely in underlying representation.” However, a more serious problem seems to arise from monovalent feature specification since there is no rule at all to supply [-high] to underlying vowel segment in Yawelmani.
I argue that the problem is only apparent and it can be dealt with from a different perspective. I will simply follow Archangeli and Pulleyblank (1991: 22) in arguing that the generalization of height dependent round spreading can be captured using biconditionals. What is meant by this is that we may posit a condition that "the target is [high] if and only if the trigger is [high]". This biconditional is adopted by Archangeli and Pulleyblank (1991) in explaining height dependent round harmony in Tiv. Such a biconditional approach stays away from the criticism of the ad hoc nature of the Redundancy Rule Ordering Constraints and opens the possibility of not supplying redundant features at all in the course of the derivation.

There is one final remark that I will make on redundant feature supplying under a monovalent feature system. It may be the case that [front] which might not be active in underlying representation, for example, in the Swahili vowel specification in (29b), would play an important phonological role in the course of a derivation. In this case, the feature [front] may be supplied in the course of a derivation. Given the nature of a monovalent feature system, there would just be one or two redundancy supplying rules, and therefore, it might not be a significant burden on the grammar if there is a relevant lexical stratum where [front] is to be specified. In some other cases, as will be seen with the vowel harmony of Korean verbal morphology, the feature might be introduced as a floating feature as a part of a morphological process.

2.4.3 Contour Segments in a Monovalent Feature System.

One of the challenging problems confronting a monovalent feature specification system is how to represent contour segments. According to Sagey (1986), contour segments are represented by using both the negative and positive value of one feature. For example, affricates are thought to be specified [-continuant] and [+continuant] which are chronologically
ordered within a segment. Another example is the prenasalized consonants widely found in African languages. Here again, Sagey (1986) argues that they can be represented by two ordered values of [nasal].

Let's begin by investigating the chronological ordering of two values of a feature in the representation of affricates. Sagey (1986) argues that affricates act like stops with respect to a preceding segment and like a fricative with respect to a following segment. However, this generalization is challenged by many phonologists notably by Lombardi (1989). Lombardi (1989) strongly argues that [+continuant] and [-continuant] are not chronologically ordered at all. I would contend that the same analysis is applicable to prenasalized sounds as well.

We have already noted that both values of [continuant] can be active in the underlying representation and suggest the use of [interrupted] instead of [-continuant]. Therefore, we might argue that affricates have both [continuant] and [interrupted] which do not have to be chronologically ordered. I am not claiming that affricates are universally specified for [continuant] and [interrupted]. On the contrary, in the majority of cases that I know, affricates pattern with stops and as Steriade (1989) and Lombardi (1990: 99) note, in many language affricates and stops are articulated in complementary places, though with some exceptions such as German /ts/ or /pf/. In English, there are no alveopalatal stops while there are alveopalatal fricatives. Affricates with both [continuant] and [interrupted] are thought to be more marked than affricates with [interrupted] only.  

Notice that we do not have the same kind of explanation for prenasalized consonants. We do not have a monovalent feature that is equivalent to [-nasal]. Note also that Durand (1990: 76) and Lass (1984: 45) argue against using [-nasal] or the equivalent in underlying representations.

\* It should also be mentioned that in unmarked cases [interrupted] is underspecified and in such case, affricates are non-distinct from stops as far as phonological derivation is concerned. In phonetic implementation, the place of articulation will give hints whether the given segment is a stop or an affricate due to the complementary distribution of stops and affricates in their places of articulation.
However, I argue that we do not have to specify [-nasal] at all for prenasalized consonants. Surveying the prenasalized sounds in African languages, we find an interesting gap in the combination of prenasalized segments. The stops in prenasalized segments are either voiced or aspirated. A plain stop cannot appear in the nonnasal part of prenasalized segments. The interesting observation here is that if we do not specify [-nasal] in prenasalized consonants, prenasalized sounds with plain voiceless stops are not distinguishable from plain nasals as shown in (30):

(30) Sample Specification of Prenasalized Segments

<table>
<thead>
<tr>
<th></th>
<th>nd</th>
<th>nt&lt;sup&gt;b&lt;/sup&gt;</th>
<th>nt</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>voice</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.G.</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasal</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>coronal</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

As can be seen in (30) both /nt/ and /n/ have the same feature specification. Given the claim that features are primitive and segments are derivative from feature combinations as in Archangeli (1988) and Archangeli and Pulleyblank (1991), there is no feature combination that can be interpreted as a prenasalized stop being comprised of nasal plus plain voiceless stop. What I argue here is that the nasal plus plain stop is systematically excluded, since they cannot be interpreted in the phonetic component. If we are to use both values of nasal in representing prenasalized consonants, we cannot explain why there is a gap in forming prenasalized consonants here. On the other hand using monovalent features make it possible to explain the systematic gap in the nasal and consonant combination.
2.4.4. Combinatorial Specification and a Monovalent Feature

Specification

Archangeli and Pulley blank (1991) propose Combinatorial Specification and claim that Combinatorial Specification is a logical development of Radical Underspecification. Combinatorial Specification is based on a strong claim that features are the basic unit of phonological description and the notion of segment is a "purely derivative one". Thus combinatorial specification takes features only and puts them in the underlying representation. And the combination of those features is interpreted to mean a segment. Therefore Combinatorial Specification has the following underlying mechanisms:

(31) Combinatorial Specification
   a. F-elements
   b. combinations
   c. conditions on combination

Here "F-element" is a positive or negative feature specification and content bearing articulator node such as [labial], [coronal] and [dorsal]. These roughly correspond to the traditional notion of features. These underlying features are combined with one another to derive the segments or phonemes. The combinations, though, are not always free. There are some restrictions in the process of combination. Some language like Barrow Inupiaq may not allow any combination at all. If that is the case, the number of surfacing segment equals the number of F-elements plus one. In other cases, languages allow the combination of features freely as is the case of Tiv. Then the maximum number of derivative segments may be $2^n$. 
However, in such a system, not all the feature combinations are interpretable. For example, [+high] cannot be combined with [+low], since these two features are phonetically incompatible.

To see how Combinatorial Specification works, consider the vowel system of Tiv as analyzed in Archangeli and Pulleyblank (1991):

(32) Tiv Vowel Features

a. F- elements: [+ high], [+ low], [+ round]

b. Combination

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>+high</td>
<td>+high</td>
<td>+high</td>
<td>+high</td>
<td>+low</td>
<td>+low</td>
<td>Ø</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+low</td>
<td>+low</td>
<td>+round</td>
<td>+round</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+round</td>
<td>+round</td>
<td>+round</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>?_1</td>
<td>?_2</td>
<td>u</td>
<td>i</td>
<td>e</td>
<td>a</td>
<td>o</td>
<td>e</td>
<td></td>
</tr>
</tbody>
</table>

c. Conditions on combination

If [+ high] then not [+ low]
If [+ low] then not [+ high]

The conditions given in (32c) will get rid of the combination 1 and 2 in (32b). And all six vowels in Tiv are correctly derived from the combination of given F-elements.

So far there may not be any significant difference between Combinatorial Specification and Monovalent feature specification proposed in this chapter. Truly both theories claim that only the phonologically active features are underlyingly present and the feature combination is interpreted to represent segments. But these two theories differ in one fundamental point.
Combinatorial Specification assumes that if there are twenty features in a universal phonological system, a language can pick any value of the features, which would result in the choice among forty feature values. However, monovalent feature specification theory claims that only those twenty are the choice for a language to pick from.

Let's consider [-low] for example. Combinatorial Specification argues that there may be a language in which [-low] can play an active role in the phonological derivation, since [low] is a binary feature and a language can pick either the positive or negative value of the feature [low]. But Monovalent Feature Specification says that no language can pick [-low] as an active underlying feature, since there is no feature like [-low] in the inventory of monovalent features.

Both Combinatorial Specification and Monovalent Feature Specification are natural extensions of Radical Underspecification eliminating the undesirable problems arising from complement rules and the Redundancy Rule Ordering Constraint. I further claim that Monovalent Feature Specification achieves significant simplification in the universal inventory of features by getting rid of all the features with negative values which never actively participate in the phonology of a given language. In the Combinatorial Specification framework, it is assumed that either binary value of a feature can be posited as the underlying feature in a given language. However, the Monovalent Feature Specification theory argues that the negative value of many of the features is not phonologically active and thus cannot be posited underlyingly in any natural language. The four exceptions as discussed in 2.3.1. were [-continuant], [-high], [-ATR] and [-back], which in the theory proposed here would be equivalent to the monovalent features [interrupted], [open], [RTR] and [front]. A survey of the phonology literature confirms the conclusion that the negative value of other features such as [-nasal], [-low], and [-sonorant], or the like does not have to be specified in the underlying representation since they are universally inert features. Taking this into consideration, we might say that Monovalent Feature Specification theory is much more constrained than
2.4.5. Latin Liquid Dissimilation

I have shown that the monovalent feature is more explanatory than either the Contrastive Underspecification or Radical Underspecification. As we have noted, Latin Liquid Dissimilation discussed in 2.2.1. clearly argues for the necessity of using both the negative and positive value of a feature. We also observed in 2.2.3. that Radical Underspecification approach has difficulty in resorting to the Redundancy Rule Ordering Constraint. In this subsection I will briefly explain how the present proposal can deal with Latin liquid dissimilation. The present monovalent feature system can explain the dissimilation without resorting to the Redundancy Rule Ordering Principle. However, we need to incorporate certain hierarchical representation of features or Feature Geometry which will be explored in more detail in the next chapter. I propose that laterals are represented by [liquid] which dominate [lateral] while /r/ is represented by [liquid] without the dependent feature. Thus two laterals with intervening /r/ will be represented as in (33):

(33) Representation of /l .. r .. l/ Sequence

```
    C   ....   C   ....   C
   [liquid]   [liquid]   [liquid]
   [lateral]   [lateral]
```
Here we can see that the two laterals are not adjacent in the [liquid] tier. It is true that two laterals are adjacent if we scan the [lateral] melodic tier. However we assume that the relevant level of adjacency is the [liquid] tier. With this I propose that the Latin Liquid Dissimilation works on [liquid] level adjacency as shown in (34):

(34) Latin Liquid Dissimilation Rule

\[
\begin{array}{c|c}
\text{[liquid]} & \text{[liquid]} \\
\hline
\text{[lateral]} & \text{[lateral]} \\
\end{array}
\]

Condition: Liquid tier adjacency

The rule given in (34) says that if the two laterals are adjacent on the [liquid] tier, the second [lateral] is deleted. Once [lateral] is deleted, the segment with specified [liquid] which does not dominate [lateral] will be interpreted as /r/ in Latin. However the intervening /r/ as shown in (33) does not make the two lateral consonants adjacent on the [liquid] tier. From this analysis, we find that we do not have to specify [-lateral] in /r/ to block the dissimilation process.

Thus we find that it is not the specification of the negative value of [-lateral] but the representational characteristics of /r/ and /l/ that are responsible for Latin liquid dissimilation. The present monovalent feature system along with Feature Geometry can account for this without adopting the specification of the [-] value of [lateral].
2.5. Feature Specification of Korean Vowels

The discussion so far leads us to the conclusion that two different aspects are to be considered in positing underlying features. One is that phonologically active features should be underlyingly present, and another is that phonologically inert segments should be least specified. With that in mind, we come to Korean vowels and we find out that /i/ is the least marked and therefore the least specified segment. This observation will be confirmed again in our discussion of vowel harmony in Chapter 6 and Korean vowel coalescence in Chapter 8.

We may posit the following feature specification for the Korean vowel inventory:

(35) Vowel Feature Specification

<table>
<thead>
<tr>
<th>i</th>
<th>e</th>
<th>æ</th>
<th>ə</th>
<th>a</th>
<th>i</th>
<th>u</th>
<th>o</th>
</tr>
</thead>
<tbody>
<tr>
<td>open</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>front</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>round</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Following K-O. Kim (1977), H-S. Sohn (1987b), I assume that Korean has an eight vowel system. The front round vowels /ü/ and /ö/ are assumed to be derived by the postlexical operation of merger, the so called "Nucleus degemination" as in Sohn (1987b: 315).

The features used in this specification need some explanation. We can compare the vowel specification in (35) with Sohn's (1987b) radically underspecified feature specification as given in (36):
(36)  a. Sohn's Radical Underspecification of Korean vowels

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>æ</th>
<th>ø</th>
<th>a</th>
<th>i</th>
<th>u</th>
<th>o</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>low</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>round</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>back</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

b. Redundancy rules

[+low] → [-high]
[ ] → [+high]
[ ] → [-low]
[ ] → [-round]
[ ] → [+back]

In (35), the feature [open] is used instead of [-high], the feature [front] is used instead of [-back]. This much is self-explanatory. The real difference between what I posit in (35) and Sohn's specification in (36) is the introduction of the [RTR] feature and the elimination of the [low] feature. [RTR] is motivated by the fact that vowel harmony in many languages, notably West African Languages (cf. Archangeli & Pulleyblank, 1991), involves the spreading of the tongue root feature whether it be [-ATR] ([RTR]) or [+ATR]. Y-S. Kim (1988) and J-W. Kim (1988) have also suggested that Korean vowel harmony can be explained as [+RTR] spreading.

The elimination of [low] comes from the following considerations. First, it comes from the economy of features in underlying representations. Since all the segments are effectively contrasted with one another, it is completely redundant to specify [low] in the underlying representation. Second is the functional consideration. The feature [low] in
Korean does not have any role to play in phonological derivation. If in positing monovalent features, we use as a principle the elimination of features without phonological function, then this prevents us from putting [low] in the phonological specification of features.

Further, there is phonetic motivation for eliminating the feature [low] in Korean. So far, at least some phonologists working on the Korean language seem to have agreed that /æ/ is a low vowel and /α/ is a mid vowel. (McCarthy (1983), Sohn (1986, 1987a,b), Y. Y. Cho (1990b), etc.). However, the Korean phoneme represented as /æ/ is different than the pronunciation of /æ/ in English. Some actually used the symbol /ɛ/ instead, which more accurately reflects the pronunciation of the phoneme (cf. C-W. Kim (1968) and K-O. Kim (1977)).

There may be some controversy on the [RTR] nature of the open round vowel /o/. It may be viewed just as ad hoc as making /o/ a low vowel as in McCarthy (1983). However, given the fact that a human tongue is an incompressible mass, we can see that a change in shape in one part of the tongue results in the compensatory change in other parts of the tongue. Take a look at the schematized tongue shape as in (37):

(37) Tongue position in /u/ and /o/

As shown in (37), the lowering of the tongue height results in the retraction of the tongue root, and therefore /o/ has a more retracted tongue root than /u/. In Archangeli and Pulleyblank's (1991) term, the [open] and [RTR] combination is physically grounded.
Further, there are many cases, where /o/ behaves as an RTR vowel as in Hall and Hall's (1977) analysis of Nez Perce vowel harmony or Archangeli and Pulleyblank's (1991) analysis of vowel harmony in various West African languages as well as in Chukchi, Menominee and Maasai.\textsuperscript{11}

We can also see in (35) that there are certain relationships that hold among the features that comprise segments. Following Archangeli and Pulleyblank (1991), the relations are expressed as Path conditions as in (38):

\begin{equation}
\text{(38) Path Conditions}
\end{equation}

\begin{enumerate}
\item [a.] if [\text{RTR}], then [\text{open}]
\item [b.] if [\text{front}], then not [\text{round}]
\end{enumerate}

The Path Conditions are utilized in different ways. First they account for feature co-occurrence restrictions. The negative condition (38b) does not allow a [\text{front, round}] combination in the underlying representation. The Path Conditions also serve as the interpretive mechanism by relating the different feature combinations. For example /o/ is represented by the combination of [\text{round}, [\text{open}], and [\text{RTR}]. The Path Condition correctly predicts the redundancies of [\text{open}] in [\text{RTR}] segments and helps the interpretation of the feature combinations. For example, /o/ may also be represented by [\text{round}, \text{RTR}] or by [\text{round}, \text{open}] or by the combination of three relevant features [\text{round}, \text{open}, \text{RTR}]. Faced with such a choice, we may refer to the Principle of Simplicity based on Archangeli and Pulleyblank (1991) as given in (39):

\begin{equation}
\text{I thank Diana Archangeli for pointing out to me these languages which treat /o/ as a lateral vowel.}
\end{equation}
(39)  Principle of Simplicity

Unless motivated otherwise, a simpler representation is favored.

The Principle of Simplicity will not take [round, open, RTR] or [open, RTR] as the primitives for /o/. Further, given the importance of the [RTR] feature in Korean vowel harmony, being the active feature in the derivation, the simplest representation for /o/ would be [round, RTR]. Given the path condition (38a) and (38b), we can correctly interpret the different combinations of /o/. Consequently, we can posit the underspecified matrix of Korean vowels as in (40):

(40)  a. Underspecification of Korean vowels

    |   i   |   e   |   æ   |   ə   |   a   |   i   |   u   |   o   |
    |-------|-------|-------|-------|-------|-------|-------|-------|
open  | +     | +     |        |        |       |       |       |       |
front | +     | +     | +     |        |        |       |       |       |
round | +     | +     | +     |        |        |       |       |       |
RTR   | +     | +     | +     | +     |        |       |       |       |

b. Redundancy rules

[RTR] → [open]

Comparing (35) with (36), we might say that (36) is simpler in that less feature values are represented in (36). However, it should be noted that (35) is the full specification, and with the help of Path Conditions given in (38), we come up with the underspecified features as in (40). Notice that (40) has the same number of feature specification as in the radical underspecification given in (36) and the simplicity argument does not hold in the number of features. On the other hand, consider the number of rules necessary for full specification. As
shown in (36b), the radically underspecified feature matrix needs five redundancy rules while (40) has only one. Here, the simple counting of features and rules will support the simplicity of using monovalent specification in Korean. The specific inventory posited in (40) will be supported in the second part of the dissertation.

2.6. Summary

In this chapter, we have discussed the specification of features. In an earlier stage of modern phonology, all features were thought to be binary and all the feature values were supposed to be filled in before the application of phonological rules. However, with the advent of the underspecification theory, researchers began to take interest in the idea of using less specified features as the input to phonological rules for a variety of reasons, but at the same time it was necessary to stay away from the ternary use of binary values.

Radical Underspecification seems to be on the right track in dealing with underspecification. However one can ask whether we have to use binary features at all which is still maintained in a Radical Underspecification system. In adopting a Monovalent Feature Specification system, a strong claim is made that we do not have to supply the opposite values of underlying features, at least in the phonology. In the view of the Monovalent Feature Specification proposed here, each language has its own way of picking phonologically active underlying features. And the combination of these features is interpreted as the segmental inventory of that language. Seen from this perspective, monovalent feature specification is in line with combinatorial specification. Further, monovalent feature specification makes one stronger claim than combinatorial specification. Monovalent feature specification theory argues that the negative value of many of the features is not phonologically active and thus will
never be posited in any language. This is systematically expressed in the Monovalent Feature Specification system by eliminating the phonologically inert features from the universal inventory of features.
3.0. Introduction

Recent research in phonology reveals that a segment is not just an unorganized bundle of features, but that features have their own internal organization. This is well reflected in feature geometry theory proposed by many researchers including Clements (1985), Sagey (1986), Halle (1986, 1989), McCarthy (1988) and others. In this chapter, I will discuss the feature geometry proposals. I will briefly discuss the rules and representations in SPE and survey the proposed theories in Feature Geometry.

I will begin by examining the early proposals of Feature Geometry and I will develop their idea by incorporating the proposals of McCarthy (1988), Clements (1989), and Lahiri and Evers (1991). Elaborating on these, I will propose that the place node should be separated into two different class nodes: one that groups together the place of articulation features such as [labial], [coronal], and [dorsal] and the other the tongue position features that include such features as [open], [low] and [RTR].

After the discussion on Feature Geometry, I will combine Feature Geometry with monovalent underspecification discussed in the previous chapter, in order to offer a comprehensive sub-segmental representation in phonology. The Feature Geometry that will be proposed in this chapter is shown in (1):
One of the main characteristics of the model presented in (1) that will be discussed is that the Place Node has two branching class nodes, the Articulator Node and the Tongue Position Node. I will also talk about parameterization in Feature Geometry. The discussion in this chapter will be limited to place features. It will be shown that the hierarchical versus flat structure parameter that I propose for the Articulator Node is much better motivated than Cho's (1990b) parameterization which uses different definitions for feature interpretation.

3.1. Background

It has been pointed out by many non-linear phonology researchers, such as Sagey (1986) and McCarthy (1988) that there are several problems with SPE-type assimilation rules. Firstly, it has been claimed that SPE rules for assimilation fail to capture why certain sets of features work as a group. McCarthy (1988: 85 - 86) gives us the following nasal assimilation rule found in many languages:
The problem here raised by McCarthy (1988) is that the special set of features \([\text{coronal}], [\text{anterior}], \text{and} [\text{back}]\) does not have privileged status in the SPE type of linear representation. But there are certain feature sets such as \([\text{coronal}], [\text{anterior}]\) and \([\text{back}]\) that recur in phonological rules as has been noted by many other researchers such as Mohanan (1983), and Sagey (1986). Not any three features in the feature inventory can work as a unit, which is well demonstrated by the following impossible rule:

\[
\begin{align*}
(3) \quad \text{Impossible rule - I} \\
x \rightarrow & \quad \left[ \begin{array}{c}
\alpha \text{ coronal} \\
\beta \text{ nasal} \\
\gamma \text{ voice}
\end{array} \right] / ____ \quad \left[ \begin{array}{c}
\alpha \text{ coronal} \\
\beta \text{ nasal} \\
\gamma \text{ voice}
\end{array} \right]
\end{align*}
\]

In the SPE framework, features are represented as a bundle without any internal hierarchy. From this perspective, there is no reason why \([\text{coronal}], [\text{nasal}]\) and \([\text{voice}]\) do not comprise a set in the same way that \([\text{coronal}], [\text{anterior}]\) and \([\text{back}]\) do like in (2). This discrepancy is left unexplained without giving some special status to the latter group of three features. Intuitively we may say that the assimilation rule given in (2) is the formal expression that a nasal acquires the place of articulation of the following consonant: a clear case of place assimilation. However without the internal structure that groups place features together, the simple intuition cannot be formally described.
Another problem that emerges from an SPE-type view in which the phoneme lacks internal feature structure is that assimilation rules cannot be characterized in a systematic way. Sagey (1986: 23) contends that in SPE a feature changing rule can "change neighboring segments to opposite values of the context feature or change the value in an unrelated feature or even affect segments not in the immediate environments." Truly there is no device in the SPE framework that can prevent the following impossible rules:

\[
\begin{align*}
\text{Impossible rules – II} \\
\text{a. [nasal]} & \rightarrow \begin{array}{c}
\alpha \text{ coronal} \\
\beta \text{ anterior} \\
\gamma \text{ back}
\end{array} / \_ \_ \rightarrow \begin{array}{c}
\alpha \text{ coronal} \\
-\beta \text{ anterior} \\
-\gamma \text{ back}
\end{array} \\
\text{b. [nasal]} & \rightarrow \begin{array}{c}
\alpha \text{ coronal} \\
\beta \text{ anterior} \\
\gamma \text{ back}
\end{array} / \_ \_ \rightarrow \begin{array}{c}
\alpha \text{ anterior} \\
\beta \text{ back} \\
\gamma \text{ coronal}
\end{array}
\end{align*}
\]

Here, it is shown that the SPE type of rule formalism is not constrained enough to rule out impossible rules in phonology. SPE suffers from the problem of over-generation in rule description. One way to prevent this over-generation of impossible rules is to adopt the view that there are subsegmental structures in feature organization. The idea is that if we group place features together under a certain node and reanalyze assimilation like (2) as the spreading of that node to the preceding nasal (cf. Hayes (1986b)), then the impossible rules given in (3) and (4) will turn out to be impossible because only a certain set of features, i.e. place features in case of nasal assimilation, can spread to the preceding segment, and the value of those place features cannot be changed at all. Accordingly we might reformulate nasal assimilation as the spreading of place features as
given in (5):

(5) Geometrical Analysis of Nasal Assimilation

Now, we can easily see why (3) and (4) are impossible rules. (3) is not possible because the grouping of [coronal], [nasal] and [voice] does not represent a single group in the internal hierarchy, since [coronal] is a place feature, [nasal] is a manner feature, and [voice] a laryngeal feature. By the same reasoning, (4a) and (4b) are not possible because the assimilation-as-spreading analysis says that a certain set of features and the exact value of those features spread to the preceding nasal segment.

A third type of problem for an SPE-type system of representation arises when we consider complex segments found in many African languages. Complex segments are sounds that involve multiple simultaneous place features which are realized with the multiple occlusions in articulation. Given in (6) are some of Sagey's (1986) examples of complex segments:

(6) Examples of complex segments

<table>
<thead>
<tr>
<th>Combination</th>
<th>Language</th>
<th>Examples</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. labial + coronal</td>
<td>Bura</td>
<td>[ptá]</td>
<td>an animal</td>
</tr>
<tr>
<td>b. labial + velar</td>
<td>Yoruba</td>
<td>[akpá]</td>
<td>arm</td>
</tr>
</tbody>
</table>
c. coronal + velar Nzema [opti] it is sick

d. labial + coronal + velar Shona [tkwana] little children

Complex segments, according to Sagey (1986), have the place combinations of coronal, labial, and velar with no other combination being witnessed. Consider the SPE type of place features on the other hand. The two place features, [±coronal] and [±anterior], give us the four way distinctions as in (7):

(7) Four Way Place Distinctions

<table>
<thead>
<tr>
<th>a.</th>
<th>b.</th>
<th>c.</th>
<th>d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ ant</td>
<td>+ ant</td>
<td>- ant</td>
<td>- ant</td>
</tr>
<tr>
<td>- cor</td>
<td>+ cor</td>
<td>+ cor</td>
<td>- cor</td>
</tr>
<tr>
<td>labial</td>
<td>dental &amp; alveolar</td>
<td>alveo-palatal</td>
<td>velar</td>
</tr>
</tbody>
</table>

Sagey (1986) argues that the four way distinction cannot predict the constraint on the complex segment formation. A priori, there is no reason in (6) why alveo-palatals do not appear in complex segment. Sagey (1986) takes such an observation as strong support for the three monovalent features for place instead of using two binary features.

All the problems examined so far come from two theoretical assumptions in SPE; the lack of internal structure of features and the use of binary features in place features. The first part of the problem may be solved if we assume that a segment is not just a bundle of features but has internal hierarchical structure and the second type of problem can be solved by positing three monovalent place features.
The idea that features have their own internal grouping has also been noted in earlier research. Even in SPE, there were internal divisions in features such as major class features, manner features and place features. But those feature groupings in the SPE framework are just for convenience and they are not formally distinct. Ladefoged (1971) distinguished four independent processes in speech production: the air stream process, the phonation process, the articulatory process, and the oro-nasal process. The air stream controls the direction of air flow, ingressive or egressive. The phonation process involves the movement of the vocal cords, which is relevant to the production of voiced and voiceless sounds as well as aspirated and non-aspirated sounds. The articulatory process takes care of the gesture control of articulation, the place features and the vowel height features. Finally the oro-nasal process is involved in producing the nasal sounds.

The basic assumption behind such feature groupings is that a segment can be further divided into several relatively independent groups, while features within a group are related with one another, they do not enjoy the independence like that of a feature group. Further it has been noted that such grouping can capture the generality of phonological processes. For example, consider Lass’ (1976) historical account of consonant weakening. Stop consonants such as /p/, /t/, and /k/ are often weakened to become glottal stops, /ʔ/, thereby causing a historical depletion of the consonant inventory. The same is relevant for English, especially in child language where a glottal stop derived from a stop consonant can sometimes completely disappear. Such a reduction process can also be found in synchronic dialectic variation as Wells (1982: 325) observes in Cockney English, where the intervocalic voiceless stops, taps and glottal stops completely vanish. If we recognize the internal grouping of features within segments, we can simply describe the change as the loss of groups of features step by step as shown in (8):
(8) Weakening Process of Voiceless Stops

As graphically shown here, the weakening process involves the deletion of sets of features one by one. First the place features are lost, and then the category features are lost to completely deprive the stop sounds of any phonetic content.

Without the internal structure, we might have to say that the consonant weakening process involves the different combination of two feature changing rules that entail different sets of features at times. But such an approach cannot tell us why only certain features work at a time and how the feature values change. On the other hand, (8) gives us a clearer picture of what happens when consonant weakening of this kind takes place: it is the loss of a certain feature group. First the stop segment loses its place of articulation and becomes a glottal stop. Then the categorial features are lost and the segment has no features; as a result, it is not pronounced.

The idea is further developed in Clements (1985). He contends that a segment is represented by internal hierarchical structures and that the features should be grouped into laryngeal, supralaryngeal, place and manner features as shown in (9):
As shown in (9), Clements (1985) recognizes that there are three major feature groups, laryngeal features, manner features and place features, which Clements calls Class Nodes. He also assumes that the Manner Node and Place Node are combined together to make another internal hierarchical group under the Supralaryngeal Node. Clements uses the term tier to refer to the internal structural unit. Two tiers constitute a plane and phonological rules can be expressed as changes in association lines on specified planes. Similarly, Halle (1986) groups features according to the particular articulators that are involved in executing those features and comes up with the Laryngeal Node, the Place Node and the Soft Palate Node as shown in (10):
Halle's (1986) Feature Geometry, unlike Clements', does not have the Manner Node. Halle assumes that [nasal] and [lateral] are separate features that do not make up a natural class. Nonetheless, there is general agreement among researchers (including Halle and Clements) that there are at least a place node and a laryngeal node.

### 3.2. The Feature Groups

Taking Clements' (1985) and Halle's (1986) proposal as the starting point of the discussion, I will consider the proposed three feature groups that includes laryngeal features, place features and manner features. I will accommodate the major observations in Feature Geometry theories and come up with a comprehensive version of feature geometry, with reference to data from different languages.
3.2.1. The Laryngeal Node

Laryngeal features control the vibration of the vocal cords and other relevant operations of the larynx such as producing aspirated or unaspirated sounds. From an articulatory point of view, we can see that the operations related to the larynx are relatively independent from supralaryngeal processes that involve articulators above the larynx.

Following Sagey's (1986) proposal, we may separate three features that can be grouped under Laryngeal node as in (11):  

(11) Features under Laryngeal Node

![Diagram](1985: 241), I will assume that tone features are relatively independent from laryngeal features and therefore are not included in the laryngeal features.
Not only is this grouping of laryngeal features articulatorily justified but also they are proven to be phonologically important. McCarthy (1988) suggests that if a certain group of features works together in a single phonological rule, then that provides phonological evidence that those features should be grouped together. What is behind this proposal is that a phonological rule involves only one node in Feature Geometry. Such an assumption is widely shared among phonologists such as seen by Clements (1985), Hayes (1986b), Pulleyblank (1988a) and H-S. Kim (1990). H-S. Kim (1990) proposes the following Constituent Principle by slightly revising Pulleyblank's (1988a) Constituent Spreading Principle:

(12) Constituent Principle

A single phonological rule may spread/delink no more than a single node of the Feature Geometry.

With the Constituent Principle in mind, let's consider Greek voicing and aspiration spreading. McCarthy (1988: 90) observes that, in Greek, stop clusters reggressively assimilate in both voicing and aspiration. If we are to capture the regressive assimilation as a single phonological process, we will have to say that the assimilation is realized by spreading a node that dominates both the voice and aspiration features, which, in turn, justifies the existence of the Laryngeal Node. Further, in Thai and in Korean, aspirated sounds (which have the [SG] feature) and unaspirated glottalized sounds (which have the feature, [CG]) are neutralized in syllable final position. Here are some examples of Korean neutralization:
If we do not assume the Laryngeal Node, we will have to posit at least two deletion rules, [SG] deletion and [CG] deletion. With the Laryngeal Class Node, however, we can simply explain the neutralization as the delinking of the Laryngeal Node as shown in (14):

(14) Korean coda neutralization as laryngeal node delinking

Here, we see that laryngeal features may operate as a unit independent of other features with respect to phonological rules. And with the preceding observation, we can say that separating out laryngeal features and grouping them under a class node has phonetic motivation in that the execution of laryngeal features is done by the larynx, which is independent from other articulators. In addition, it has been shown that positing a Laryngeal Node also has phonological motivation in that the laryngeal features work together as a unit in phonological processes.
3.2.2. The Place Node.

3.2.2.1. Place Features

Sagey (1986) strongly argues that there should be three and only three place articulators for the description of human language sound structure. She bases her argument on the possible and impossible complex segments found in languages and points out that the SPE style of using two binary features cannot give a proper explanation to the types of complex segment structures that are found. As discussed in 3.1., the four way distinction made by two binary features as given in (7) does not capture the generalization about complex segments, since alveo-palatals do not have independent status as a place articulator in complex segment formation. That is, for example, there are no complex segments like /ʃx/. Alveopalatals' lack of independent status as a separate place articulator is also evidenced by other phenomena. For example, McCarthy (1988: 100) cites Yucatec Maya consonant reduction phenomena. In a sequence of two homorganic consonants, the first one is reduced to [h]. In this language a /tc/ sequence becomes [hc] meaning that alveopalatals are thought to be homorganic with dentals/alveolars. Thus, three monovalent place articulators are better motivated in capturing the generalization concerning place features than binary place features. Sagey (1986) proposes the following internal structure of a place node:

$$\text{(15) Place Features}^2$$

```
Place Node
   / | \
  [labial] [coronal] [dorsal]
```

^2Although in Sagey (1986), Labial, Coronal and Dorsal represent articulator nodes, I will treat them as features since they can be the terminal elements in a feature tree. This will be further discussed in 3.2.4. Clements (1989, in press) also views these as features, but he views them as potentially being binary, while I view them as being monovalent.
From an articulatory point of view, [labial] is executed by the lips, [coronal] by the tongue blade and [dorsal] by the tongue body. One brief illustration will show the phonological motivation of grouping these features together under a place node. Nasal assimilation is a good case in point. Nasal sounds acquire the place of articulation from the following consonants as discussed in 3.1. A nasal is realized as labial before a labial consonant, as coronal before a coronal consonant and as velar before a velar consonant. The common characteristics of these changes may not be captured if we posit three different rules to explain them. However we can easily see that these three changes can be generalized as Place Node spreading from a consonant to the preceding nasal as schematically shown below:

(16) Place Node Spreading

\[
\begin{array}{c}
N \\
\text{Place Node} \\
\text{Place feature}
\end{array}
C
\]

Such a spreading approach to the explanation of assimilatory phenomena (cf. Hayes (1986b)), can significantly simplify the concept of rules in phonological processes. Further we might also see that the place node has motivation in explaining historical consonant weakening processes discussed in 3.1 (cf. (8)). The deletion of [dorsal] from velar consonants, [coronal] from dental/ alveolar/ alveopalatal consonants and [labial] from labial consonants can be simply described as the delinking of the Place Node as shown in (17):
In addition to these features, some finer distinctions among the place features are necessary not only to make differentiations among vowels but also among coronal sounds. For coronal consonants, features such as [anterior] and [distributed] are employed for finer distinctions. The feature [round] is necessary under labial to describe the round vowels and their interaction with labial consonants in consonant rounding. Also the vowel features [high], [low], and [back] would be under [dorsal]. The rough picture would look like (18):
vowel features spread, then it must be expressed by the spreading of the [dorsal] node, given the Constituent Principle in (12). This, in turn, means that the vowel spreading can be blocked by an intervening dorsal consonant but never by a coronal or a labial consonant. This follows from the well-formedness constraint, which McCarthy (1988) terms the Line Crossing Prohibition, in Autosegmental phonology: association lines may not cross. Given in (19) is the more precise definition of McCarthy's (1988: 86) Line Crossing Prohibition:

(19) Line Crossing Prohibition

No association lines between two same autosegmental tiers may cross.

Now consider the case of a the vowel feature spreading across a dorsal consonant given the Feature Geometry in (18). The schematic representation is given in (20):

(20) The Spreading of Dorsal Features

We can immediately see that the [dorsal] spreading from $V_2$ to $V_1$ in (20) results in a line crossing violation. The Feature Geometry in (18) also predicts that dorsal consonants interact with vowels and labial consonants interact with labial vowels but coronals may not interact with any vowels since they do not have any features in common.

These predictions seem to be too strong. Clements (1989: 9) claims that "no case of blockage of the spreading of the vowel features [back, high, low] by velar consonants has yet been discovered". The second prediction that there is no interaction between coronal consonants and vowels has been widely disputed. In
Korean, umlaut, the fronting of a vowel by the influence of the following high front vowel /i/ can be blocked by an intervening coronal consonant. (See also Hume (1990)). The palatalization of coronal consonants found in many languages also shows the interaction between coronal consonants and front vowels.

The problem concerning the failure of velar consonants to block vowel spreading can be remedied by positing a separate node exclusively for vowel features as given in Steriade (1987a):

(21) Separate Node for Vowels

```
Place Node
    ├── [labial]
    │    └── [round]
    ├── [coronal]
    │    └── [anterior] [distributed]
    ├── [velar]
    └── [dorsal]
          └── [high] [low] [back]
```

Here, the [velar] node is for velar consonants such as /k, g, x/, and the [dorsal] node is exclusively for vowels. By separating out vowel features from consonant features and grouping them under the [dorsal] node, the feature geometry given in (21) can effectively explain the interactions between vowels across intervening consonants, since such an interaction involves dorsal nodes and consonants do not have a dorsal node. One of the asymmetries observed in this geometric representation is that labials are different from other nodes in that the [labial] node has both the consonant and vowel features while others are exclusively for vowels or consonants.
3.2.2.2. The Branching Place Node

Archangeli and Pulleyblank (1987) have gone one step further and posit that all the features for vowels are grouped under a secondary place node as shown in (22):

(22) Archangeli and Pulleyblank's Place Features

```
Place Node
  Labial  Coronal  Dorsal  Radical  S-place
    [round]  [high]  [low]  [back]  [ATR]
```

(S-place : secondary place node)

This representation is free from the incorrect prediction of Sagey (1986) that velar consonants may prevent vowel features from spreading. Odden (1991) proposes a more elaborate version of vowel place features as shown in (23):

(23) Odden's Vowel Place Features

```
Place
  Labial  Coronal  Dorsal  Vowel Place
    Height  Back-Round
      ([low])  [ATR]  [high]  [round]  [back]
```

Odden groups the secondary features further into two class nodes: Height Node and Back-Round Node. This
feature geometry model makes predictions that [back] and [round] are grouped to the exclusion of the vowel height features and that vowel height features are independent from [back] and [round]. However, these representations (22) and (23) cannot explain the close interaction between [labial] and [round] features and between [coronal] and [-back] vowels.

Clements (1989) observes that vowels interact not only with other vowels but also with adjacent consonants and maintains that the same features should be used both for vowels and consonants. Clements (1989) accordingly proposes the following geometrical representation of place features:

(24)  Clements' Unified Feature Representation

Consonants are separated from vowels in their features but they both dominate virtually the same set of features. The articulatory value of the sub-level features is dependent upon the nature of the Place Node. For example, [+labial] under the C-Place Node means a labial consonant, but the same feature under the V-Place Node indicates a round vowel. Another noticeable difference is that front vowels are represented by [+coronal] under the V-Place Node. This properly incorporates the often observed interaction between front vowels and coronal consonants.

Lahiri and Evers (1991) see redundancies in Clements' representation and suggest the simplification of the representation as in (25):
The basic spirit behind Lahiri and Evers' (1991) proposal is that there is no need to specify all the features under C-Place and repeat them under the V-Place node. The better way is to make a node which can group together those features that are not shared by the C-Place Node. Labial covers a labial consonant and a round vowel, Coronal represents either a coronal consonant or a front vowel while Dorsal means a velar consonant or a back vowel.

Here, we will have to consider the result of conflating C-Place and V-Place Nodes of Clements (1989). By making front vowels coronal, Lahiri and Evers' proposal can explain the interaction between coronal and front vowels. But the representation indicates that vowel to vowel interactions can be affected by the intervening consonants.

Lahiri and Evers support their representation with palatalization data found in many languages. They differentiate two different types of palatalization, primary and secondary palatalization and argue that the different palatalization processes may not be captured by other types of geometrical theories. Primary palatalization is the spreading of the articulator node of a coronal vowel to the preceding dental/alveolar

---

3Since back vowels are dorsals, the traditional [+back] spreading is interpreted as dorsal spreading in Lahiri and Evers' Feature Geometry, which in turn means that the intervening velar consonants, which are specified as dorsal, will surely block the spreading. However in Clements' (1989) theory, the spreading of [+back] is interpreted as the spreading of [dorsal] under V-place node and since the velar consonants do not have a V-Place Node, the long distance vowel assimilation can be explained neatly.
consonant which results in its contraction and secondary palatalization can be described as the spreading of Tongue Position node of a high vowel. But if we do assume that front vowels are [coronal] then apparently it does not explain why an existing coronal sound is retracted by the influence of the following front vowel.

A slight revision of the feature geometry given in (25) will solve the problem and simplify the description. I will introduce [palatal] under the coronal node and [back] under the dorsal node. The feature [palatal] which has been already employed by Gorecka (1990) is the monovalent equivalent of [-anterior]. The preceding discussion leads us to the following feature geometrical representation.

\[\text{It may not be fair to say that Lahiri and Evers' Feature Geometry is totally unable to explain primary palatalization. They might say that alveolars are [+anterior] and the spreading of [coronal] will cause the delinking of the pre-existing coronal node, and a later rule will insert the default value [-anterior] to the unspecified coronal which will surface as an alveopalatal. The derivation is as follows:}\]

\[\text{Such an analysis can not be incorporated into the present framework, since the least specified segment in many languages is } /\text{i}/, \text{ which is [+anterior] and therefore the feature [+anterior] is viewed as underspecified. Therefore the redundant feature supplying rule will supply [+anterior] instead of [-anterior].}\]

\[\text{Languages may have additional features such as [distributed] under the place features.}\]
In addition to positing [palatal] under [coronal], (26) differs from (25) in that the feature [radical] is subsumed by [pharyngeal]. Consider, further, the finer distinction within dorsal articulator features as shown in (27):

The geometry given in (26) incorporates Clements' (1989) observation that back vowel interaction is not blocked by velar consonants and it also incorporates Sagey's (1986) observation that there is no complex segments formed by combining [pharyngeal] with other place features.

3.2.2.3. On [pharyngeal] in Feature Geometry

One final remark on the feature [pharyngeal] is in order. Goad (1991) makes an interesting claim that [ATR] and [RTR] are different features and that [RTR] should be dependent on the Pharyngeal Node. Let's consider Goad's feature Geometry as given in (28):
Comparing (28) with the Feature Geometry given in (26), we can see that there are certain differences between the two proposals. The most noticeable among them is the location of the [RTR] feature in Feature Geometry. In (26) [RTR] is placed under the TP node, while in (28) it is under Pharyngeal. Another interesting difference is the location of the [pharyngeal] feature. Goad treats [pharyngeal] as another place articulator while in (26), it is placed under the [dorsal] node. The Vo node can be equated to the TP node. Goad maintains that the Vo node is exclusively for vowels, and as a result there should be another place node that will explain the interactions between vowels and consonants. Two of her representative examples in support of her proposal are from Arabic Emphasis and Chilcotin flattening.

Arabic emphasis has been analyzed as the spreading of "emphasis" from an emphatic consonant to other consonants and vowels. Though there are dialectal differences in terms of the consonants that contrast for emphasis and the constraints on spreading, as Goad (1991: 167) notes, the process can be explained by [RTR] harmony. (29) shows some examples from Cairo Arabic:
(29) Cairo Arabic Emphasis Contrasts (data from Lehn (1963: 32))

<table>
<thead>
<tr>
<th>Plain</th>
<th>Emphatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>rab it sprouted</td>
<td>ṛab Lord</td>
</tr>
<tr>
<td>?ax brother</td>
<td>ḵ?x (an interjection)</td>
</tr>
<tr>
<td>tiin figs</td>
<td>ṭiin mud</td>
</tr>
</tbody>
</table>

The key observation here is that the uvulars also show Emphatic contrasts as illustrated by [?ax] and [羟x] in (29). Goad's main argument is that uvulars should be differentiated from emphatic uvulars. With the geometry given in (28), Goad (1991: 168) makes the following geometrical distinctions of pharyngeals and velars:

(30) Distinctions of Plain and Emphatic Consonants

<table>
<thead>
<tr>
<th>Place</th>
<th>Place</th>
<th>Place</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phar</td>
<td>Phar</td>
<td>Dor</td>
<td>Dor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phar</td>
<td>+rtr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Goad (1991) argues that by placing [rtr] under the pharyngeal node, the distinction between plain pharyngeals and pharyngealized pharyngeals can be shown as in (30a). Goad maintains that the Emphatic words in Cairo Arabic involve the spreading of the Pharyngeal feature. The main observation that Goad makes

---

Ghazeli (1977) shows that the emphatic consonant has the constriction in the upper pharynx just like uvulars. Goad (1991), citing Czaykowska-Higgins (1987), also says that the emphatic sounds are uvularized not pharyngealized. However, I will not be concerned about the exact phonetic properties of emphatic consonants and continue to call the process "pharyngealization".

---

6The dot under the segments means that the sound is pharyngealized.
is two-fold. First since Vo features are especially reserved for vowels, the consonant pharyngealization should not be represented by using Vo features. Second, the pharyngealization, the narrowing of the pharyngeal cavity, is physically implemented by retracting the tongue root. Therefore the [RTR] feature should be treated as the dependent feature under the pharyngeal node.

Another argument for the need to separate [RTR] and [ATR] features comes from Chilcotin, where Goad argues that both [±RTR] and [±ATR] are active. There are two flattening processes, sibilant flattening and dorsal flattening in Chilcotin vowels that involve the spreading of [+RTR]. Further she argues that there are tense-lax vowels in Chilcotin, and suggests that [±ATR] is the relevant feature to show the tense-lax contrast.

I argue that the present FG proposal can account for Goad's major observations without resorting to the separation of [RTR] and [ATR] to different nodes. Concerning the distinction between pharyngeals and Emphatic pharyngeals, I argue that the geometry in (26) can also show the contrast as shown in (31):

(31) Distinctions of Plain and Emphatic Consonants - II

<table>
<thead>
<tr>
<th>a. Pharyngeals</th>
<th>b. Dorsals(^7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain</td>
<td>Plain</td>
</tr>
<tr>
<td>Art</td>
<td>Art</td>
</tr>
<tr>
<td>[dorsal]</td>
<td>[dorsal]</td>
</tr>
<tr>
<td>[pharyngeal]</td>
<td>[pharyngeal]</td>
</tr>
<tr>
<td></td>
<td>Emphatic</td>
</tr>
<tr>
<td></td>
<td>[dorsal]</td>
</tr>
<tr>
<td></td>
<td>[RTR]</td>
</tr>
<tr>
<td></td>
<td>[dorsal]</td>
</tr>
<tr>
<td></td>
<td>[RTR]</td>
</tr>
</tbody>
</table>

\(^7\)One potential problematic aspect of the representation given here is that it cannot incorporate McCarthy's (1991) observation that pharyngeals, uvulars, and laryngeals form a natural class in Arabic languages.
The representation in (31) is contrary to Goad’s (1991) proposal that the vowel height node should not be used to explain vowel - consonant interaction. I argue that there is no special node exclusively reserved for explaining vowel interactions. The secondary palatalization phenomena, documented by Lahiri and Evers (1991) clearly shows that the height feature is spread onto the preceding consonant from vowels. I do not know any plausible way to explain the secondary palatalization if we are to insist that the height node should be exclusively used for vowel to vowel interaction.

Goad’s second argument for [RTR] under the pharyngeal node is that since the pharyngealized sounds are produced by retracting the tongue root, [RTR] should be under the pharyngeal node. I agree with her observation that pharyngealization is implemented by retracting the tongue root but I do not think it necessarily supports her claim that [RTR] is a consonantal feature. Consider a velar stop pronunciation. In order to obstruct the air flow, the tongue body should be raised to touch the velum. If I follow Goad’s line of argument, I will have to say that [high] is a consonantal feature since tongue raising is used to produce stop sounds. It is true that some stop sounds are made by raising the tongue but this does not mean that [high] is the relevant consonantal feature to describe the velar stop, at least on the phonological level⁸. By the same logic, I would say that though pharyngealized sounds are produced by retracting the tongue root, [RTR] does not have to be a consonantal feature.

Once we accept [pharyngeal] as the dependent feature of [dorsal], the Chilcotin flattening is interpreted as [pharyngeal] spreading while the tense/lax alternation can be expressed as an [RTR]/[ATR] alternation. Thus I conclude that the present proposal of the place node given in (26) can account for the major observations in Feature Geometry.

⁸In the phonetic component, we might assign [+high] to velar sound as suggested by Keating (1988) for the enhancement of consonant pronunciation.
3.2.3. Manner Features

Clements (1985), whose work served as the starting point of the discussion in this subsection, groups all the manner features together under a manner node and groups the manner node with the place node under the supralaryngeal node as shown in (9). Here are Clements' (1985) manner features and the location of the manner node in FG.

(32) Manner Features and Manner Node in Clements

\[
\text{Root} \quad \text{LG} \quad \text{SL} \\
\text{Manner} \quad \text{Place} \\
\text{nasal} \quad \text{cont} \quad \text{sonorant} \quad \text{consonant} \quad \text{lateral} \\
\text{(SL = supralaryngeal)}
\]

Clements (1985: 238), noted that there is little evidence to suggest that the manner tier itself functions as a unit. McCarthy (1988: 90), noting Clements' observation, suggests that the manner features are directly hanging from the root node. He also suggests that once the Manner Node is eliminated, then the Supralaryngeal Node is superfluous. Iverson (1989) carefully surveys data from different languages and asserts that the SL Node can be eliminated without confounding any of the arguments for internal feature grouping and shows that the apparent SL phenomena can be reinterpreted without a SL node.

Other researchers such as Halle (1986, 1989) and Rice and Avery (1991) argue that supralaryngeal is necessary to incorporate [lateral] and/or [nasal] under the Supralaryngeal Node. Halle (1986) who based his
feature structures on articulatory observations posited that since [nasal] is executed by the soft palate, the feature
[nasal] should be dependent under a Soft Palate Node which in turn is the dependent on the SL Node. Another
interesting proposal made by Rice and Avery (1991) is that a Spontaneous Voicing (=SV) Node, dominated by
the SL Node, is needed to explain various phenomena which involve such sonorant features as [sonorant],
[nasal] and [lateral]. I think that the necessity of the SV Node does not necessarily mean the existence of SL
node. Taking Iverson's (1989) reanalysis of [lateral] and [nasal], we might say that the SV node is directly
dominated by the Root Node.

McCarthy (1988) further argues that the features [consonant] and [sonorant] do not seem to participate
either in spreading or in delinking and do not show OCP effects. He interprets such absence as supporting
these features' different status from the rest of the manner features and suggests that these features be specified
in the root itself.

However, the feature [sonorant] may be delinked in some language. Yagaria, a language of the East
New Guinea Highlands discussed in Renck (1967, 1975), Levin (1988) and Rice and Avery (1991), is the case in
point. In this language, there are sonorant - obstruent alternations. Consider the following data:

(33) Yagaria Sonorant Obstruent Alternation

a. aʔ (female) + maʔ (pivotal) → abaʔ (woman)
b. gipaʔ (door) + lo (adhesive) → gipato (at the door)
c. niʔ (water) + viti (elative) → nipiti (out of water)
As seen in the examples in (33), the alternations involve m-b, l-t and v-p. A morpheme initial sonorant becomes an obstruent when the morpheme is suffixed to a closed syllable. The simplest way to explain this alternation is to say that the sonorant feature is deleted to make a sonorant into a plain voiceless stop. Rice and Avery (1991) actually present an SV node delinking analysis to explain the sonorant - stop alternation.

This alternation provides partial support to the observation that sonorant features be specified outside of the root node so that it can participate in various phonological rules such as assimilation (as in Toba Batak sonorant assimilation - see Hayes (1986b), Rice and Avery (1991)), and deletion (as in Yagaria post glottal sonorant deletion). That leaves the feature [consonantal] only in the root node. In order to incorporate the binary nature of [consonantal] feature I suggest that [vocalic] be specified inside the root too. A root node would then have either [consonantal] or [vocalic] but not both.

3.2.4. The Integrated Picture of Feature Geometry

Having discussed the separate nodes in Feature Geometry, we may come up with the overall picture of Feature Geometry by putting the different class nodes together under a root node. The comprehensive picture of Feature Geometry is presented in (34):

Following Rice and Avery (1991: 110) I assume that /v/ is a sonorant consonant in Yagaria. It should also be noted that a glottal stop is the only allowable coda segment (Renck (1975: 8)). Therefore we might say that the sonorant - obstruent alternation is triggered by a preceding, heteromorphemic glottal stop.

Kaisse (1992) proposes that [consonantal] can also spread and thus should be specified outside of the root.
This is the geometry that I will adopt in this dissertation. It will be shown in Part II that the geometry given in (34) plays an important role in properly explaining major phonological phenomena of the Korean vowels. A remark is in order about the representation. Some of the nodes are represented without brackets, while others are inside the brackets. I assume that the nodes without brackets are organizational in nature, as Sagey (1986: 34) argues, which means that the presence of the nodes "should not be looked as adding a node to the representation." The presence of those organizing nodes is to provide a path "through which features may be linked to the structure." To put it differently, we might say that the organizing node cannot be terminal in the representation, since they are meaningful only if they serve as a linker of a feature to the root. This may be captured by the Node Convention given in (35):

\[\text{(35)}\]

Archangeli and Pulleyblank (1991: 3) make a different claim that all the organizing nodes are entirely predictable and thus can be underspecified in the underlying representation.
Non-terminal nodes are organizational in nature and an organizational node cannot be terminal.

We have to note that some features, especially place features, are in a unique position. They are features with specification of different place of articulation and at the same time they serve as an organizational node to link their dependent features to the root. For example, in order to describe a round vowel, we will have to assign the feature [round]. Given the feature geometry in (34), the feature [labial] should also be specified so that the feature [round] can be "hooked up" to the root. At the same time the feature [labial], itself, serves as the terminal features for the description of labial consonants such as /p/, /b/, or /m/.

Rice and Avery (1991) make a similar distinction of two major types of nodes: organizing nodes such as Place, LG, SV and content nodes such as [labial], [palatal], etc. The major difference between these two groups is that the content node can spread but the organizing nodes cannot. Rice and Avery argue that SV is an organizing node, which would also mean that there is no rule that involves the spreading of the SV node. But as will be seen in 3.4, we can see that there are actually lots of data that support the spreading of the [sonorant] node. The solution to this contradiction is to posit the feature [sonorant] for relevant languages which have dependent features such as [lateral] and [nasal].

It should be mentioned here that Feature Geometry may be different from language to language along certain specified parameters. The broken line in the representation is where the parameterization comes in. I will show that this is the area where we need parameterization of FG in light of phonological data from natural languages. We will come to parameterization in 3.3.4.
3.3. Combining Feature Geometry with Underspecification

In this section, we will present a comprehensive feature theory by combining the theory of feature underspecification in Chapter 2 with Feature Geometry given in (34). We have to consider three different aspects of feature representation here: inherent underspecification, monovalent underspecification, and inherent redundancy.

3.3.1. Inherent Underspecification

In the monovalent system, features are either present or absent. In this case we do not have to specify the absence of features. The feature [round] may present a simple illustration. A segment may be specified for [round] or may be left unspecified, but there is no segment marked by [-round]. All the unround segments do not carry any information about [round]. Again, with three monovalent place features, we do not have to specify that a labial consonant is neither coronal nor dorsal. Under such a system, there cannot be a segment marked [-coronal] or [-dorsal]. Therefore a non-complex labial segment carries no other place feature such as [coronal] or [dorsal]. To put this differently, we might say that the features [coronal] and [dorsal] are inherently underspecified for a labial segment.

We can find another instance of inherent underspecification: inherent node dependent underspecification. Consider a labial segment again. A labial segment is not specified for [coronal] and [dorsal] features. This inherent underspecification may be interpreted as "having no relationship with the coronal or dorsal node". In
this case, we can see that if a segment has nothing to do with certain place features, it also has nothing to do with the features dominated by the inherently underspecified features. This means that for labials, the dependent features of [coronal], such as [anterior] and [palatal], or of [dorsal], which are [back] and [pharyngeal], must also be underspecified. This may be the natural result of the feature representation.

Two different perspectives converge together to support node dependent underspecification. First, node dependent underspecification is deducible from Inherent underspecification. As discussed in 3.2.2.2, the dependent features [anterior] and [palatal] are used for the finer distinction within coronal sounds. Therefore if a segment has nothing to do with [coronal], it is only natural that the segment in question also has nothing to do with the finer distinctions within [coronal]: hence the underspecification of coronal along with its dependent features.

Secondly, we may explain the node dependent underspecification from the characteristics of nodes in Feature Geometry. Suppose we want to specify [anterior] or [palatal] for labial segments. In order to link the feature in the feature geometry, we need a path through which the features should be linked to the root. The immediate path for [anterior] or [palatal] linking is the node [coronal], but due to Inherent Underspecification, there is no [coronal] node for labial consonants, since there is no [coronal] node, the features [palatal] or [anterior] cannot be linked up to the root and therefore cannot be represented in the feature geometry.

These two observations lead us to the conclusion that the node dependent underspecification is the natural extension of Inherent Underspecification theory. Given the fact that all the features are monovalent in the present framework, the effect of Inherent Underspecification is even more extensive than Archangeli (1988: 191) mentions. All the so called negative values of features are inherently underspecified. Such a proposal will result in the elimination of almost all default rules. We can see that the use of unary features will significantly reduce the underlying representation in comparison with the binary feature system.
Another instance of Inherent Underspecification is the underspecification due to the lack of contrast in the underlying representation. Underlying features as mentioned in Chapter 2 have two different functions: they are active participants of phonological rules and they serve to make the contrast in the underlying representation. In other words, if a feature is neither contrastive nor active in phonological rules, it should not enter into the underlying representation. Consider the laryngeal quality of a vowel. In the majority of languages, vowels are voiced sounds, therefore the presence of voice does not differentiate one vowel from another. This is also true in sonorant consonants, since all sonorant consonants do not contrast in the [voice] feature with one another. This observation demands the underspecification of LG features, and therefore the LG node itself by the Node convention given in (35).

### 3.3.2. Phonological Underspecification

Another type of underspecification, we have to consider is phonological underspecification which helps to explain the phonological phenomena in which certain segments are treated as the least specified. Each language may pick a certain segment and regard it as the least specified sound in that language as supported by such phonological phenomena as insertion, deletion or assimilation as discussed in Chapter Two.

Consider the typical case of phonological underspecification. Coronal consonants and round vowels will be represented as in (36), taking only inherent underspecification into consideration:
Suppose that there is a language that picks a coronal consonant and treats it in a unique way in phonological rules such as consonant insertion or consonant deletion, and that the best way to deal with such phonological behavior of a coronal segment is to underspecify [coronal]. Then the feature [coronal] will not be specified in the representation (36a). Now the Articulator node, an organizational node to link up [coronal] is no longer necessary. Then the Node Convention in (35) requires Art Node and Place Node to be eliminated. That leaves only the Root Node and its feature [consonantal]. In (36b), if the feature [round] is phonologically underspecified, we do not need [labial] whose function for a vowel segment is to link up [round] to the root. So the feature [labial] is organizational in nature for round vowels and will be erased along with the Art Node by Node Convention. Whether the Place Node will be erased or not depends on the Tongue Position (=TP) features. If a round vowel in question does not have any TP features, the TP Node along with Place Node will be erased from the representation. Thus, Node Convention and underspecification together make a significant contribution toward the simplification of the underlying structure.

12 However, phonologically underspecified features are assumed to be supplied at a later stage.
3.3.3. Inherent Redundancy

The third aspect that we will have to consider in combining feature underspecification and Feature Geometry is that radical underspecification does not eliminate all the redundancies in FG. An illustration will clarify the point. Suppose [coronal] is underspecified in a given language, as is the case in Korean, and there are two finer distinctions among coronals as shown in (37):

(37) Alveolar and Alveopalatal distinction

a. Alveolar consonants
   R[con]  
   |  place  
   |  Art  
   |  [coronal]

b. Alveopalatal consonants and front vowels
   R[con], or [voc]  
   |  place  
   |  Art  
   |  [coronal]  
   |  [palatal]

Since [coronal] is underspecified in (37a), an alveolar consonant may have nothing but a root node. If this language has alveopalatal consonants, then how will they be represented? In (37b), [coronal] constitutes a nonterminal node and it serves as an anchor for [palatal] to be linked up to the root. If there is no [coronal] then alveopalatal cannot be hooked up to the root and will be erased out by Stray Erasure Convention. This will bring about an insoluble conflict between Feature Geometry and Underspecification theory\(^\ref{13}\). What I suggest here is that there is inherent redundancy in the feature representation. As discussed in the previous subsection, the place features have dual function. First they are terminal features which by themselves can

\(^{13}\)One may suggest that [palatal] be linked up to the Art node directly without the help of [coronal]. However, given the plane and tier distinction in the three dimensional representation of Feature Geometry as given in (9a), such a suggestion may not be incorporated in the present framework.
categorize a given segment. Secondly, they can serve as an organizational node to link up to the dependent features. When a feature is used as an organizational node, then the feature must be present in the feature geometry. Therefore in (37b) the [coronal] node should not be underspecified, though the feature [coronal] is phonologically underspecified for alveolars.

But we have to note that the inherent redundancy is not just for convenience. That it is very important can be illustrated by considering Chinese co-occurrence restrictions. Yip (1988: 81 - 82) illustrates three different types of labial disharmony found in Chinese syllables. First no onset labial consonant can be followed by a front round vowel. Second, no labial consonant can follow a round vowel in a rhyme. And third, no two consonants can be labial within a syllable. These three constraint might be explained by positing a single constraint as in (38):

(38) Chinese labial co-occurrence restriction (from Steriade (1987b: 349)

*[

Notice that such a co-occurrence restriction does not work for the first two cases, unless it is assumed that the round vowels have the [labial] feature as well as the [round] feature.

Korean vowel fronting is another case in point. The detailed analysis will be given in Chapter 7. Roughly speaking, Korean back vowels become front vowels when they are placed before a high front vowel /i/. What is interesting is that consonants between vowels may affect the process. Alveolar consonants do not block the process, which means that the vowel fronting is the spreading of the [coronal] feature from /i/ to the preceding vowel and that the alveolars are not specified for [coronal]. An interesting matter here is that the alveopalatal consonants block the process of [coronal] spreading. If we assume that [coronal] is underspecified for alveopalatals too, we do not have any explanation for the blocking effect of alveopalatal consonants in the process of vowel fronting.

---

14Yip (1988) does not give any specific data. I will just briefly summarize Yip's description of the morpheme structural constraint accepting the validity of her observation.
I take these two phonological phenomena as strong support for the inherent redundancies in Feature Geometry. Phonological underspecification and inherent underspecification significantly simplify the feature representation. But it is also shown that Feature Geometry allows for a certain amount of redundancy in the feature representation, and that redundant representation plays an important role in phonological processes.

3.3.4. Parameterization of Feature Geometry

It has been noted that languages differ in feature representation. This does not mean that there is no language universal Feature Geometry in phonology. However, the phonological phenomena found in language after language demand the Feature Geometry be different in different languages. I will try to incorporate the different suggestions about a feature's place in the Feature Geometry by taking a parametric approach. It will be shown that such difference is not random but that the apparent language particular necessity can be minimized by positing parameterization of feature geometries along restricted parameters. I believe that there are at least two different aspects in Feature Geometry to consider for parameterization: Place features and independent features. Independent features are those features that are dominated directly by a root node, such as [lateral], [nasal] and [continuant]. However, I will limit the discussion to the Place Node parameterization since it is directly relevant to the Korean vowel phonology to be discussed in this dissertation.\(^\text{15}\)

\(^{15}\)See 7.2.3. for brief discussion of independent feature parameterization in Korean.
The complex segment formations as observed by Sagey (1986) provide fairly strong support for the three monovalent place features. Also McCarthy (1988) claims that the traditional binary place features, [anterior] and [coronal] fail to capture general observation concerning the co-occurrence restriction in Arabic. However, it has been observed that the flat Articulator feature structure, with no hierarchical structure among [labial], [coronal] and [dorsal], is not desirable for the phonological explanation of data from many languages. This does not mean that we have to abandon the place feature structure discussed in the previous section. On the contrary, I will argue that languages have an option to choose from two parameterized universal place feature structures.

Consider Korean consonant place assimilation. The Korean language has the following consonant place assimilation phenomena:

\[(\text{39}) \quad \text{Korean Consonant Assimilation.} \]
\[
\begin{align*}
\text{a.} & \quad \text{tat + ko} & \rightarrow & \text{takko} & \quad \text{(to close and)} \\
& & & \text{kot + poŋ} & \rightarrow \text{kappoŋ} & \quad \text{(envelope)} \\
& & & \text{hankaŋ} & \rightarrow \text{hanŋkaŋ} & \quad \text{(the Han river)} \\
\text{b.} & \quad \text{cap + ko} & \rightarrow & \text{cakko} & \quad \text{(to hold and)} \\
& & & \text{kam + ki} & \rightarrow \text{kaŋki} & \quad \text{(cold)} \\
& & & \text{cac + ko} & \rightarrow \text{cakko} & \quad \text{(be often and)} \\
\text{c.} & \quad \text{sak + pal} & \rightarrow & \text{ sakpal, *sappal} & \quad \text{(to be hairless)} \\
& & & \text{kaŋ + patak} & \rightarrow \text{kaŋpatak, *kampatak} & \quad \text{(river bed)} \\
& & & \text{kak + to} & \rightarrow \text{ kakto, *katto} & \quad \text{(angle)}
\end{align*}
\]
(39a) shows that the coronal sounds are assimilated to the following consonant. (39b) show that labials are assimilated to velar consonants, but (39c) shows that the velar consonants are not assimilated to following labial or coronal consonants. We can explain (39a) by saying that a coronal sound is underspecified in its place feature so that the following consonant can spread its place feature to the preceding coronal sounds. What troubles us is how to explain (39b) and (39c). Labials assimilate to velars but not vice versa. In order to explain all the data in (39) with one spreading rule, we will have to posit two delinking processes, coronal delinking before labials and velars, and labial delinking before velar. But as Y.Y. Cho (1991: 173) points out, there is no explanation why velar consonants trigger labial node delinking. Such a delinking rule cannot be independently motivated in Korean consonantal phonology.

In order to explain Korean consonant place assimilation without resorting to unmotivated delinking rules, I propose that the Art node has the following hierarchical representation in Korean (This is somewhat similar to Halle (1986) shown in (10):

(40) Hierarchical Structure of Articulator Node

```
    Art
   /\  
  ([coronal]) [peripheral]
   \ /  
([labial]) [dorsal]
```

(The underspecified values are in the parentheses)

With the given Art structure in (40), we can explain Korean consonantal assimilation without resorting

---

16 It should be mentioned that the feature [peripheral] could be replaced by the acoustic feature [grave] proposed by Jacobson, Fant and Halle (1952). Hyman (1973) introduces "peripheral" and "medial" which are equivalent to [+grave] and [-grave] respectively.
to ad hoc delinking rules. Combining the Feature representation with underspecification, we see that the Korean obstruent can have one of the following structures: (41):

(41) Korean consonant assimilation\(^{17}\)

a. Consonant representation

\[
\begin{array}{ccc}
\text{Labial} & \text{Coronal} & \text{Dorsal} \\
\mid & \mid & \\
[\text{peripheral}] & [\text{peripheral}] & [\text{dorsal}] \\
\end{array}
\]

b. Assimilation rule

\[
\begin{array}{c}
\circ \\
\mid \\
[\text{peripheral}] \\
\end{array}
\]

The slight change of the internal structure of the place node can greatly simplify the assimilation process. Following Mester (1986), I will assume that when a feature spreads, the dependent feature also spreads. Therefore if [peripheral] spreads from a dorsal consonant to the preceding consonant, the feature [dorsal], which is dominated by [peripheral], also spreads. We can also notice that the assimilation rule does not involve delinking.\(^{18}\) However we may need an interpretation device that can help us understand what it means for

\(^{17}\)An open dot will be used throughout this dissertation to represent the abbreviation of irrelevant feature geometry.

\(^{18}\)Apparently the coronal node is delinked in the third word of (39b). The alveopalatal consonant is specified for [coronal] which dominates [palatal] in the geometry. However, there is a place neutralization rule in Korean that deletes [coronal] at the end of a syllable. (cf. 7.2.3.) As a result the alveopalatal consonant is underspecified in its place feature. I assume that the assimilation rule takes place after syllabification and neutralization.
[peripheral] to spread onto a node that already has the specified [peripheral]. I will adopt Redundant Feature Interpretation proposed by Buckley (1991: 13) and expand it as in (42):

(42) Redundant Feature Interpretation

\[
\begin{array}{c}
\text{is interpreted as} \\
[F] \\
([G]) \\
\end{array}
\quad \begin{array}{c}
[F] \\
([G]) \\
\end{array}
\]

This interpretation device will simplify the redundancy that might result from the spreading rule. Alternatively we may adopt feature fusion as in Mester (1986). What is crucial here is that by positing the internal hierarchical node [peripheral] we are able to explain the consonantal assimilation in Korean as [peripheral] spreading without invoking any delinking process.

What I am proposing by considering the examples of Korean consonant assimilation is there are two parametric options in the Place Node, and each language can chose one or the other for consonant representation as in (43):

(43) Parametric Variations in the Art Node.

a. Flat Structure  b. Hierarchical Structure

\[
\begin{array}{c}
\text{Art} \\
[\text{labial}] [\text{coronal}] [\text{dorsal}] \\
\end{array}
\quad \begin{array}{c}
\text{Art} \\
[\text{coronal}] \\
[\text{peripheral}] \\
[\text{labial}] [\text{dorsal}] \\
\end{array}
\]
Flat place structures are useful to explain the complex segment formation as discussed in Sagey (1986) and are applicable to languages where there is no "strength" hierarchy among the three place nodes. The hierarchical structure of the Articulator Node in (43b) is for languages which have strength sensitive assimilation rules like the one found in Korean.

Though we have limited our discussion to Korean consonantal assimilation, the parameterization of the Place Node is not just for Korean consonants. Processes grouping velars and labials together (i.e. where the Peripheral Node would be relevant) have been well documented. Here are some such examples:

(44) Examples of Labial and Dorsal grouping

a. In Old English (Lass and Anderson (1975)), voiced labials and velars become fricatives in intervocalic position. But coronals are not subject to the continuancy adjustment rule.

b. In Korean (Lee (1971)) an epenthetic vowel /i/ becomes a round vowel /u/ after velar and labial consonants but never after coronal.

c. In Tibetan (Odden (1978)), Labial and Dorsal stops become voiced fricatives but Coronals are not subject to this lenition process.

Y.Y. Cho (1990b, 1991) makes similar observations and claims that languages differ in the internal structure of the Place Node. According to her, languages have the option to choose one of the two place internal structures shown in (45):
(45) Two theories for place node.

a. Place of Articulation Theory (PT)

\[ \text{Place} \]

\[ \pm \text{cor} \quad \pm \text{ant} \]

b. Articulator Theory (AT)

\[ \text{Place} \]

\[ \text{Labial} \quad \text{Coronal} \quad \text{Dorsal} \]

These two different Place Node structures were also discussed by McCarthy (1988). He compares the two place structures as a way of presenting two types of possible outcome from the SPE type of feature specification when translated into the frameworks of Feature Geometry. McCarthy makes a detailed comparison between these two Place Node types and concludes that the Sagey (1986) style of three place articulator nodes in (45b) is a much better theory than PT in (45a) in many respects. He supports his claim with Sagey's (1986) observation of the limited combinational possibilities of complex segments, articulatory independence of the three place features and the co-occurrence restrictions found in Arabic roots, all of which the PT fails to account for.

Y.Y. Cho (1990b), however, claims that there are two different types of place features and languages may pick either PT or AT for the Place Node. While Cho may be right in observing the necessity of parameterizing the place features, I claim that her proposal is not free from the criticism that McCarthy (1988) levied on the structure in (45a). Further one can point out the inconsistency of feature interpretations in Cho's (1990) proposal. In Place of Articulation Theory (= PT), [coronal] is used as a binary feature and different languages choose different values [+] or [-] for [coronal] and [ant] features. But in Articulator Theory (=AT), she claims that coronal is a monovalent feature. This means that the parameterization involves the different definition about the feature [coronal]. Further, the feature [ant] in PT and in AT have different interpretations.
[-Ant] in PT includes alveopalatal and velar consonants while the same feature in AT does not include velar consonants. Thus there are three different variations between PT and AT. The structure differs, the value of coronal differs, and the meaning of [-ant] differs. If these are the parameters that are needed for a natural language, we are forced to explain the lack of other possible parametric combinations other than the two given in (45)\textsuperscript{19}.

Y.Y. Cho (1991: 162) defended the different use of features and their values in PT with the following observations of natural groupings by binary values of the two place features [± anterior] and [±coronal] and the phonological processes that make use of those natural classes:

\begin{itemize}
\item[(46)] The natural groupings (Cho (1991: 162))
\begin{itemize}
\item[a.] [±ant] : labials and dentals
\begin{itemize}
\item Philadelphia English /æ/ tensing (Ferguson (1975), Labov (1981), Kiparsky (1988))
\item Klamath syllabification (Levin (1985))
\end{itemize}
\item[b.] [-ant] Palatals and Velars (often as the feature [+high])
\item[c.] [+cor] : Dental, palatal and retroflex
\begin{itemize}
\item Baule vowel fronting (Vago (1976))
\item Fe?fe? vowel backing, Igbo vowel reduplication (Hyman (1973))
\end{itemize}
\end{itemize}
\end{itemize}

\textsuperscript{19}For example, we might think of an Articulator node that has monovalent place feature [coronal] with equivalent binary place feature [±anterior] where [+anterior] groups labial, dental and alveolar sounds and [-anterior] characterizes alveopalatal and velar sounds. However such a structure is not attested in languages.
d. [-cor]: Labials and velars

Korean vowel rounding (Lee (1971))

Hungarian lenition (Collinder (1965))

Old English lenition (Lass and Anderson (1975))

Now these phonological phenomena clearly show that a uniformed universal flat structure for a place node is doomed to failure. If Cho's (1988, 1991) observations are right then they would certainly argue for PT. (46a) and (46b) are the crucial cases. (46c) represents the natural class with [coronal] and the observation in (46d) can be captured by hierarchical articulator structure given in (43b). It is the feature [peripheral] that groups labials and velars together. Thus I will limit my discussion to (46a) and (46b). In (46b), Cho says that palatals and velars work as a natural class. I do not know a rule that might necessitate the grouping of palatals and velars excluding alveolar consonants. But if what she meant by grouping coronals and velars is the interactions found among high vowels, I might say that it is not [-ant] but the vowel features such as [high] that groups high vowels.

We are left to account for (46a). I will present the facts in Philadelphia English 3/4 tensing and Klamath syllabification and discuss whether the facts really support Cho's claim. Regarding the facts about æ -tensing in Philadelphia English, Ferguson (1975: 262) summarizes that "only æ occurs before word-final or preconsonantal /m, n, f, θ, s/; only æ occurs elsewhere". He formulates the following æ-tensing rule:

---

20 Cho (1991) does not give us any concrete phonological rules that treat palatal consonants and velar consonants as a natural class.
We can see here that /m, n, f, θ, s/ are [+anterior] segments and Cho's argument for (46a) is based on this observation. However, we have to note that these do not constitute an exhaustive list of [+anterior] segments in English. The phonemes /p, b, t, d, v, ŋ, z, r, l/ according to SPE are all [+anterior] but they do not trigger æ tensing. There does not seem to be a plausible way to group the five triggering segments into a natural class.

We also have to note that there are complicated morphological conditions in æ tensing as well. (cf. Furguson (1975), Tucker (1944)) Moreover, Labov (1981) shows that Philadelphia æ-tensing involves lexical diffusion and not rule-like change. With this I argue that motivating the [+anterior] place node on the basis of Philadelphia English æ-tensing is indecisive and at most very weak.

Another piece of supporting data for positing [+anterior] comes from Klamath syllabification. Levin (1985) posits the following sonority hierarchy for Klamath coda incorporation:

(48) Sonority scale in Klamath

<table>
<thead>
<tr>
<th>Coda</th>
<th>Sonority</th>
</tr>
</thead>
<tbody>
<tr>
<td>w, y</td>
<td>[-cons]</td>
</tr>
<tr>
<td>l, m, n</td>
<td>[+cons, +son]</td>
</tr>
<tr>
<td>h, s</td>
<td>[+cons, -son, +cont]</td>
</tr>
<tr>
<td>p, t</td>
<td>[+cons, -son, -cont, +ant]</td>
</tr>
<tr>
<td>c, k, q</td>
<td>[+cons, -son, -cont, -ant]</td>
</tr>
</tbody>
</table>
Levin's basic idea is that coda clusters should have a decreasing sonority scale and that [+anterior] is considered more sonorous than [-anterior], hence the necessity to group anterior consonants into a natural group. However, Levin (1985: 157) further notes that there are systematic exceptions to the sonority scale, which involve /t/ and /s/. These two segments can be added to coda cluster disregarding the sonority scale given in (48) as exemplified in (49):

(49) Coda Clusters with /s/ and /t/  
\[
\begin{array}{cccccc}
hs & st & pt & tk & kt & qt \\
sk & pk & ts & ks & qs \\
ps & tks & kst & qst \\
pkst & tst \\
\end{array}
\]

The point is that /s/ and /t/ can violate the given sonority scale in Klamath. With underspecification, we might say that the [coronal] is underspecified and thus not subject to the sonority scale given in (48). Getting rid of /s/ and /t/ from the sonority scale, we come up with the following revised sonority scale for Klamath under a monovalent feature system:

(50) Revised Sonority Scale in Klamath  
\[
\begin{array}{cccc}
w, y, & [voc] \\
l, m, n & [son] \\
h & [cont] \\
p & [labial] \\
c, k, q & ([coronal], [dorsal]) \\
\end{array}
\]
Thus it is clearly shown that the apparent grouping of the [+anterior] segments in Klamath sonority scale is reinterpreted in the present framework without resorting to [+anterior] and without a special provision for /s/ and /t/ in the sonority scale.

So far, I have shown that the two cases Y.Y. Cho (1990b, 1991) cites to support the [+anterior] feature in phonology, the Philadelphia æ-tensing, and the Klamath syllabification, are either inconclusive or interpretable. Moreover, we have seen that the proposed Hierarchical Articulator Structure can replace Cho's (1991) PT without being inconsistent in using the features and their values in two different types of articulatory structure. Thus I believe that the parameterization given in (43) captures the natural phonological processes observed by Cho (1991) without resorting to the different use of features and their values.

3.4. Summary

In this chapter, I have discussed various Feature Geometry proposals. The traditional SPE-type view that a segment is just a bundle of features without any internal organization fails to account for natural phonological phenomena such as assimilation, deletion and neutralization. The need for hierarchical organization at the sub-segmental level brought about proposals for Feature Geometry theories.

The major observations made in connection with proposals concerning Feature Geometry by Clements (1985), Halle (1986), Sagey (1986), McCarthy (1988), Rice and Avery (1991), Lahiri and Evers (1991), and Goad (1991) have been reviewed and an integrated Feature Geometry has been proposed. The Feature Geometry proposed in this chapter has a branching place node: it dominates the Articulator node and the Tongue Position node. The Articulator node has a well established three way distinction of place features, [labial], [coronal] and [dorsal]. The Tongue Position node includes such tongue height features as [high] [open] and [low] in addition to the tongue retraction position features [RTR] and [ATR]. The Feature Geometry proposed in this chapter is repeated below in (51) and will be adopted throughout this dissertation:
In presenting the integrated model of the Feature Geometry proposed here, I have discussed the integration of Feature Geometry and Feature Underspecification. It has been shown that there are two different types of Underspecification in the Feature Geometry model: Inherent Underspecification and Phonological Underspecification. Inherent Underspecification is the natural result of using a monovalent feature system and Phonological Underspecification further simplifies the structure. It has been also shown that there is a certain amount of redundancy in Feature Geometry seen from the theory of underspecification, and it has been argued that such redundancy is very important for phonological explanations.

Further, it has been shown that there is a need for allowing constrained variations in Feature Geometry in order to accommodate a variety of data from different languages. Thus I proposed a parameterizing feature geometry model. More specifically I argued that languages have options to chose from two different structures for place of articulation: a flat structure and a hierarchical structure. Also, I compared the parameterization proposed in this chapter with that in Cho (1988). It was shown that the proposal presented here is much more consistent than Cho's both in the interpretation of the features and of their values.
In this chapter and in the preceding one, we have discussed the subsegmental features and their organizations in Feature Geometry. In the next chapter, I will move onto syllable structure to finish laying out the theoretical foundations necessary for the explanation of vowel phonology in Korean which will be dealt with in Part II of this dissertation.
Chapter 4

Syllable Structure

4.0. Introduction

The concept of the syllable has been with phonologists for a long time. However, it seems that there has been no agreement whether to take "syllable" as a legitimate unit of phonological description. An interesting observation concerning this is that Ladefoged (1975: 281) defines syllable as "a unit of speech for which there is no satisfactory definition". This seems to reflect the problem that phoneticians and phonologists face in dealing with the syllable. However, more recent work in phonological theory has demonstrated that the syllable should be incorporated as a relevant domain in rule description and rule application. For example, Kahn (1976) succinctly showed that syllables play a very important role in describing the generalizations of some phonological phenomena found in English.

With renewed interest in the syllable in phonology, researchers have proposed various syllable structures and syllabification processes. The aim of this chapter is to make a brief survey on different proposals of syllable structure and syllabification processes. Also in this chapter, I will adopt McCarthy and Prince's (1986) moraic syllable structure. One of the difficult problems of adopting McCarthy and Prince's (1986) syllable structure for Korean is that many past and present scholars in Korean phonology have defended Body-and-Coda structure such as the one proposed by Wheeler (1981) and Vennemann (1984). I will review some of the argument for Body and Coda structure in Korean and show that the arguments are not convincing. Further, I will show that there are some phonological phenomena that
crucially refer to moraic syllable structure, which include "li" irregular verb phonology. With brief discussion on such phonological phenomena found in Korean, I will argue that McCarthy and Prince's syllable structure best serves for a consistent analysis of Korean vowel phonology.

4.1. Background

In SPE, we do not find any specific explanation about the role of syllable in phonological description. As a matter of fact, the SPE style of phonological representation consists of the linear arrangement of segments which are separated by boundaries. Even before SPE, scholars such as Kohler (1966: 207) claimed that the syllable is "either an unnecessary concept... or an impossible one... or even a harmful one". Though SPE does not recognize the syllable, it needs some device to refer to syllabic segments among the string of segments. The feature [±syllabic] is introduced in SPE to overcome the inadequacy of eliminating the syllable from phonology.

One major phonological argument for doing without the syllable that emerges from SPE is that phonological descriptions seem to be satisfactorily done without the concept of syllable if segmental information is fully exploited. As shown in the comprehensive analysis of the English sound system in SPE, all the major phonological observations may be described without resorting to the syllable. It is quite understandable that SPE and Kohler (1966) do not recognize the syllable because, as Halle and Keyser (1971:141) point out, the notion of syllable is used as "the equivalent of sequence of speech sounds consisting of one syllabic sound preceded and followed by any number of consecutive non-syllabic sounds".
Another difficulty in introducing the syllable in the formal description of phonological phenomena is that while it is true that the syllable peak or the syllabic segment plays an important role in phonology, the major problem for those analyses is that it seems to be totally impossible to break down the sequence of segments into syllables. This is reflected in the early major papers that argue for the necessity of the syllable such as Haugen (1956), Hoard (1971), Vennemann (1972a), and Hooper (1972) who disagree with one another in how to set the syllable boundary.

The latter problem is dealt with in Kahn (1976). He presents a comprehensive framework for syllable division and syllabification and applies his theory to English phonology. Kahn argues against the strict linear arrangement of segments and boundaries: he suggests that phonemes and syllable nodes are on separate tiers and the two tiers are linked to each other by association lines. Kahn (1976: 22-24) posits the following syllabification rules:

(1) Syllabification Processes.
   a. Rule I
   
   With each [+syllabic] segment of the input string, associate one syllable.

   b. Rule II
   
   i) \[ C_1 \ldots C_n V \rightarrow C_1 \ldots C_i \ C_{i+1} \ldots C_n V \]

   where \( C_{i+1} \ldots C_n \) is a permissible initial cluster but \( C_i \ldots C_n \) is not.
ii) $V \ C_1 \ldots \ C_n \rightarrow V \ C_1 \ldots \ C_j \ C_{j+1} \ldots \ C_n$

Where $C_1 \ldots C_j$ is a permissible final cluster

but $C_i \ldots C_{j+1}$ is not.

Here the concept of the "permissible initial cluster" and the "permissible final cluster" provide a framework for positing syllable division. An illustration will clarify the point. Consider the syllabification process of the following permissible and impermissible words.

(2) English Syllabification Examples.

<table>
<thead>
<tr>
<th>a. combat</th>
<th>b. bcombat</th>
<th>c. comdbat</th>
</tr>
</thead>
</table>

Rule I:

\[
\begin{array}{ccc}
S & S & S \\
\text{combat} & \text{combat} & \text{combat}
\end{array}
\]

Rule II (i):

\[
\begin{array}{ccc}
S & S & S \\
\text{combat} & \text{combat} & \text{combat}
\end{array}
\]

Rule II(iii):

\[
\begin{array}{ccc}
S & S & S \\
\text{combat} & \text{combat} & \text{combat}
\end{array}
\]

The most important observation that we make here is that in the application of Rule II to the words in (2b) and (2c), we find that /bc/ and /db/ are not permissible initial clusters in a sense that no English words begin with /bc/ or /db/ and that /md/ is not a permissible final
cluster. The presence of unassociated segments in (2b) and (2c) renders these potential English words as ill-formed. Focusing on (2c), since /dB/ is not a possible word initial cluster, it cannot be a permissible syllable initial cluster, and since /md/ is not a possible syllable final cluster, it cannot be a possible syllable final cluster. This type of attempt in accounting for clusters can be useful in providing wider support for the syllable as the major unit of phonological description.

Further Selkirk (1982: 337) strongly argues that syllable structure is necessary for "the most general and explanatory statement of phonotactic constraints", for "the proper characterization of the domain" of phonological rules, and for "an adequate treatment of suprasegmental phenomena such as stress and tone". Let's consider these arguments one by one. First of all, in English, we find that no words begin with a /tl/ sequence (thus "tlass" is not a permissible word), though the same sequence is allowed morpheme internally as in "atlas" or "cutlass" as observed by Kahn (1976). This may not be easily captured if we entirely rely on segmental strings. The correct generalization is that no syllable can begin with a /tl/ cluster in English. This strongly suggests that the syllable is essential in the formal description of phonotactic constraints.

Secondly, Selkirk talks about the "proper characterization of the domain" of phonological rule application. One good example as pointed out by Kahn (1976) is that there are many different phonological rules in SPE, that are applied either before a word boundary or before a consonant. Kahn's (1976: 10-11) example of the so-called r-less dialects of English show that /r/ is not pronounced in such words as "car", "cart", or "war", while /r/ appears in "rack" and "carry". We may say that /r/ deletes before a consonant or word boundary. Kahn points out that the environment ____ {C, #} is "problematical because the class of consonants and word boundary do not form a natural class". Kahn's solution to this problem is to introduce syllable in describing the rule environment. He argues that the environment {C, #}
can be often collapsed into a syllable boundary.

Another Example given by Vennemann (1972a) clearly supports the syllable analysis. In Icelandic, vowels are lengthened in certain environments. Consider the following examples:

(3) Icelandic Vowel Lengthening

\begin{itemize}
  \item \textbf{a.} hatur \[\text{haːtYr}\] hatred
  \text{titra} \[\text{tʰiːr} \text{bra}\] shiver

  \item \textbf{b.} ofsi \[\text{ofːsi}\] violence
  \text{hattur} \[\text{hatːYr}\] hat
\end{itemize}

The first example in (3a) shows that vowels are lengthened before CV, while the examples in (3b) show that they cannot be lengthened before CCV. However as the second example in (3a) shows, vowels can be long before CCV if the second consonant is /r/ (or /j/ or /v/). The vowel lengthening rule based on segmental phonology would look like (4):

(4) Vowel Lengthening in Icelandic – I

\[
\begin{align*}
  \text{V} & \quad \rightarrow \quad \text{[+long] / } \text{___ C1 (C2) V} \\
\text{Conditions : } & \quad C_2 = r, j, v ; \text{ if present} \\
& \quad C_1 = p, t, k, s,
\end{align*}
\]

The rule given in (4) does not tell us anything about the motivation for vowel lengthening. However, knowing that an obstruent plus /r, j, v/ constitute a permissible onset cluster, we may easily understand that what happens in (3) is an instance of vowel lengthening in an open
syllable. Further the segmental approach may need another rule to account for the consonant
lengthening witnessed in the examples in (3b). The segmental approach looses the significant
generalization that the final segment of the stressed syllable is lengthened regardless of whether
it is a consonant or vowel. This can be easily captured in the syllable based approach as
shown in (5):

(5) Lengthening in Icelandic – II

\[
\begin{array}{c}
\sigma \\
[+\text{seg}] \rightarrow [+\text{long}] / \_
\end{array}
\]

Finally we see that the syllable also plays a very important role in stress assignment. This is clearly reflected in the work in metrical phonology. Even SPE tacitly recognized the role of syllable in stress placement. It introduces the notion of "strong" and "weak" clusters for stress phenomena. The SPE (1968: 83) formulation of a weak cluster is as follows:

(6) SPE Weak Cluster

\[
\begin{bmatrix}
V \\
-\text{tense}
\end{bmatrix}
\begin{bmatrix}
C^1 \\
\alpha_voc \\
\alpha_{cons} \\
-\text{ant}
\end{bmatrix}
0
\]

A weak cluster is a sequence of a lax vowel followed either by a single consonant or by two consonants if the second consonant is either a glide or a liquid and the first one is an obstruent. Thus given the syllable the consonant sequence in a weak cluster can be viewed as the sequence which can come in the onset position, strong clusters can be viewed as heterosyllabic consonant
sequences. SPE argued that the division into strong and weak clusters is very important in explaining several phonological phenomena found in English.¹

SPE (241) observed that "an important generalization ... that consonant liquid and consonant-glide strings function as single consonants" is left unexplained and admitted that the repetition of weak clusters in the environment of several rules indicates that SPE "failed to capture important properties of strong and weak clusters and thus points to a defect in our theory that merits further attention". The "defect" in SPE is proven to be the absence of syllable. Scholars such as Vennemann (1972a) and Hoard (1972) turned to the syllable to find more realistic generalizations in phonological description.

The different theories on stress assignment such as Hayes (1981), Selkirk (1984), Prince (1983), Halle and Vergnaud (1987) and Hayes (1991) agree with one another in that the stress placement is dependent on syllables and syllable internal structure. The strong and weak clusters can be defined on the basis of syllable internal structure. All these combined provide unyielding support for the importance of the syllable in phonological description.

Once the syllable is accepted as a formal unit of phonological description, different proposals on the syllable internal structures have been suggested. Davis (1985) gives three of these proposals as shown in (7):

(7) Different Syllable Internal Groupings².

¹The concept of weak cluster is also employed in SPE to explain Tensing Rules (Auxiliary reduction rules, t-tensing and tensing before CIV) and Laxing Rules (precluster laxing).

²Some researchers such as Liberman and Prince (1977) or Kiparsky (1977) use s/w (strong, weak) instead of the name of the internal constituents. I will just take the s/w theory as an equivalent to the proposed syllable structure in (7a). The syllable structure proposed in the frameworks of Dependency Phonology will not be dealt with.
a. Rhyme-Structure Analysis

```
   Syllable
     /\    \\
    /  \   /  \\
   Rhyme /   \ /   \\
      Onset Nucleus  Coda
```

b. Body-Structure Analysis

```
   Syllable
     /\    \\
    /  \   /  \\
   Body /   \ /   \\
      Onset Nucleus  Coda
```

c. Level Syllable Structure

```
   Syllable
     /\    \\
    /  \   /  \\
      Onset Nucleus  Coda
```

The structure in (7a) is strongly supported in Selkirk (1982) and in Halle & Vergnaud (1980). They claimed that the constituent Rhyme is universal. The structure in (7b) shows the grouping of onset and nucleus. McCarthy (1979) says that the syllable structures in (7b) as well as (7a) are needed for his explanation of Estonian. Wheeler (1981) proposed the structure in (7b) to explain the phonotactic constraints in Korean. The syllable structure in (7c) is supported by Davis (1985). He reviews all the claims made by the supporters of the structure in (7a) and (7b) against various language data such as stress, phonotactic constraints and language games and concluded that "Rhyme" does not have to be universal and argues for the

\[\text{\footnotesize Fudge (1987: 360) wrongly claimed that the syllable structure in (7b) had never been previously proposed.}\]
Another approach adopted by Clements and Keyser (1983) is to posit a CV tier between the phoneme (or segmental) tier and the syllable tier, wiping out internal hierarchical syllable structure\(^5\). The English word "plant" may have the following structure according to Clements and Keyser (1983):

\[
\begin{array}{c}
\sigma \\
C C V C C \\
| | | | \\
p l a n t
\end{array}
\]

The representation in (8) is just like Kahn's (1976) flat structure except that it has an intermediate CV tier between segments and syllable nodes. In a sense Clements and Keyser's proposal is closer to the syllable structure given in (7c) than to that in (7a) or in (7b) in that the syllable structure in (8) as well as that in (7c) does not allow the binary branching hierarchical structure. The major departure from (7) is that the CV approach does not take "onset" or "coda" as legitimate syllable internal constituents. Clements and Keyser (1983), however, notice the necessity of the nucleus as part of the internal structure of the syllable which should be represented on a different tier. In the CV framework, either a VV or a VC sequence within

\(^4\)Clements and Keyser (1983) also strongly oppose the branching structures such as those in (7a) or in (7b) by saying that unconstrained binary branching theory is in need of substantive constraints.

\(^5\)The original CV tier approach was first adopted by McCarthy (1979). But for McCarthy (1979) the CV tier was not a part of the syllable structure. The CV tier was proposed as a separate morphemic plane.
a syllable constitutes a heavy syllable for the purpose of stress assignments. According to Clements and Keyser (1983), such sequences would be projected as part of the nucleus projection for stress assignment.

Further work in syllable structure requires us to accept the necessity of treating CVC and CVV sequences in a language particular way. As noted by Hyman (1984, 1985), McCarthy and Prince (1986), and Hayes (1989), onset segments do not contribute to the weight of a syllable and the syllable weight may differ from language to language. For example, some languages, such as Latin and English, take CVV and CVC as heavy syllables and CV syllables as light, while in other languages, such as the Australian language Lardil only the CVV syllable is heavy and CVC and CV syllables are both light. In light of these observations, the CV theory of syllable structure should have an additional condition apart from the syllable structure that will define what heavy and light syllables for each language are.

In order to capture the language specific difference in defining heavy syllable, a moraic theory of syllable structure was proposed. The basic assumption in moraic phonology is that languages differ in assigning moraic structures. For example a language such as English assigns two moras both to CVV and CVC syllables and only one mora to CV syllables, while Lardil assigns two moras to a CVV syllable and just one mora to a CVC or CV syllable. In

---

6Another variant of the CV tier is the X-tier proposed by Levin (1984, 1985). Levin proposed to use an X tier instead of a CV tier. She further proposes to use elaborate syllable structure employing N-bar theory. For Levin, a syllable is the maximal projection of the nucleus. The English word "plan" would have the following structure according to Levin:

```
            N''
            /   \
          N   N'
         /     \    
       X   X   X   X
        /     \   \   
      p   l   a   n
```

I would take Levin's structure as a hybrid of the CV structure and the structure given in (7a).
this framework, we do not need any conditions in interpreting a heavy syllable. A syllable will be universally considered heavy if it has two moras.

4.2. Moraic Syllable Structure

In this section, I will present the case for moraic syllable structure by summarizing the main points put forward by the advocates of that theory. I will also talk about three different proposals on syllable structure within a moraic framework and try to compare these proposals. I will defend the syllable structure proposed by McCarthy and Prince (1986). Afterwards, I will briefly discuss the syllabification process.

4.2.1. Motivations for Moraic Syllable Structure

We have already discussed a problem of CV theory of syllable structure in defining a heavy syllable in languages that have a quantity-sensitive stress system (Hyman (1984)) that does not arise in the moraic theory. In addition to that, the moraic theory of the syllable has been proven to be quite effective in explaining compensatory lengthening (Hayes (1989)) and reduplication phenomena (McCarthy and Prince (1986)).

Hayes (1989) presents very convincing evidence for the moraic theory from the asymmetry in compensatory lengthening. What he observes is that the deletion of a segment does not always result in compensatory lengthening. According to Hayes, the onset consonants do not have moras. Simplifying somewhat, Hayes claims that the deletion of a moraic segment results in a floating mora and that compensatory lengthening is the result of a
vowel segment spreading to the mora. Thus a vowel is linked up to two moras. However onset consonant deletion does not leave any empty mora, hence onset deletion does not trigger compensatory lengthening. In CV or X theory, the deletion of an onset segment would leave an empty slot, so compensatory lengthening may be predicted to occur as a result of such deletion. Thus Hayes (1989) convincingly shows that the moraic syllable structure theory is more effective than CV structure or X theory in handling compensatory lengthening and points out that both CV and X theory are inadequate in that they don't really differentiate between onset consonants and weighted coda consonants.

Hayes (1989) further argues that the compensatory lengthening by glide formation can be neatly explained by adopting the moraic theory of syllable structure. Glide formation is a process of delinking a moraic segment, and as a result the mora which dominated the glide is left unfilled and the following vowel segment spreads to the empty mora to make a well-formed syllable\(^7\) as schematically shown in (9):

\[
\begin{array}{c}
\sigma \sigma \\
\mu \mu \\
C \{i\} V
\end{array} \rightarrow 
\begin{array}{c}
\sigma \sigma \\
\mu \mu \\
C \{i\} V
\end{array} \rightarrow 
\begin{array}{c}
\sigma \\
\mu \mu \\
C \{i\} V
\end{array}
\]


\(^7\)This can be easily explained by positing the following Satisfaction Condition as in McCarthy and Prince (1986: 6):

Satisfaction Condition.
All elements in a template are obligatorily satisfied.
reference to the CV-tier. They point out that Marantz’s analysis is problematic and that reduplication does not support the CV-tier but a moraic theory of syllable structure. For example, Marantz’s theory fails to capture the invariance in reduplicated forms. Consider the Ilokano partial reduplication data in (10):

(10) Ilokano Partial Reduplication

| /basa/  | ag - BAS - basa | (be reading) |
| /adal/  | ag - AD - adal  | (be studying) |
| /trabaho/ | ag - TRAB - trabaho | (be working) |

The CV approach has to set up a CCVC template to account for the three words in the data. Note that in terms of a CV-tier the reduplicated forms vary from word to word: CVC, VC, and CCVC. There is no explanation why such variation exists. Such a CV segmental approach cannot capture the generalization that what reduplicates in Ilokano is a bimoraic syllable.

Further, McCarthy and Prince argue that the CV approach does not properly constrain templates in prosodic morphology in general since the CV approach may suggest impossible templates. For example there is no CVCCCV template in Arabic, but the CV theory cannot explain the absence of such a template in Arabic. For a prosodic approach, such a template is naturally excluded since Arabic syllabification disallows a CCC sequence.

In sum, Hayes (1989) and McCarthy and Prince (1986) have presented strong evidence to motivate a moraic-type syllable structure as opposed to one consisting of CV or X-slots.
4.2.2. Different Proposals

Recent studies in syllable internal structure in the framework of moraic phonology give rise to the following three possibilities as exemplified with English word "plant".

(11) Different Moraic Syllable Structures

a. Mora-only (=MO) Structure

```
  σ
 /\  \\
/   \ /   \ \
μ   μ p   a   n   t
```

b. Weighted-segment (=WS) Structure

```
  σ
 /\  \\
/   \ /   \ \
μ   μ p   l   a   n   t
```

c. Onset and Mora (=OM) Structure

```
  σ
 /\  \\
/   \ /   \ \
μ   μ p   l   a   n   t
```

All three structures are severely impoverished in that they do not have any elaborate internal structures. Moras are recognized as the legitimate and only internal constituents within a syllable. The structure in (11a) is proposed by Hyman (1985) and further elaborated in Zec (1988). This structure does not allow any segment to be directly linked to the syllable node. All the segments should be linked to the mora first and only moras are linked to the
syllable nodes. We will call this MO structure here. The syllable structure in (11b), which we will call WS structure, was adopted by McCarthy and Prince (1986) in explaining templatic morphology including reduplication in various languages. Hayes (1989) introduced the structure in (11c) for his explanation of compensatory vowel lengthening in many languages. We will call this OM structure.

The MO structure differs from this OM structure in that syllable initial consonants are directly linked to the syllable node in the latter, while in the former they are linked up to the mora. The MO structure shows that non-moraic syllable initial segments or more traditionally onset consonants are dominated by the mora while syllables dominate nothing but moras.

The MO and OM structures are different from the WS structure in the way they treat syllable final consonant clusters. In the former these are viewed as being attached to the second mora, not directly to the syllable. The WS structure, on the other hand, makes a very strong claim that only true moraic segments (like vowels) are associated to moras and all others are linked to the syllable directly, regardless whether the non-moraic segments are in syllable initial position or syllable final position.

McCarthy and Prince's (1986) WS syllable structure will be adopted in this paper. Basically it seems up to personal preference in choosing one out of the three proposed structures. But there is a certain amount of phonological evidence that seems to argue for WS structure. I will briefly present some phonological data which can be better explained by using WS structure.

### 4.2.3. The Weighted Segment Structure

To my knowledge, Steriade (1988:97) makes the first brief observation of the difference of the predictions that the MO and OM structures make in her discussion of Sanskrit
phonology. To recapitulate it in short, Sanskrit has an /a/-deletion rule that deletes /a/ in an unaccented syllable. If this rule is applied to /siand/, the resultant structure after the application of vocalization is not */sind/ but /syad/. Now if we take the MO structure, /a/-deletion may result in the wrong surface form as in (12):

(12) A-deletion in MO Structure

\[
\begin{array}{c}
\sigma \\
\mu \\
\mu \\
s i a n d \\
\rightarrow \\
\sigma \\
\mu \\
\mu \\
s i n d \\
\end{array}
\]

(=*sind)

According to Steriade, the OM or WS syllable representations along with the rule of vocalization can derive the correct phonetic form as in (13):

(13) A-deletion in WS and OM Structure

\[
\begin{array}{c}
\sigma \\
\mu \\
\mu \\
s i a n d \\
\rightarrow \\
\sigma \\
\mu \\
\mu \\
s i n d \\
\end{array}
\]

(synd→syad)

Though, there are things left unexplained here\(^9\), this opens the possibility of comparing the different predictions that each of the different syllable structures make.

---

\(^8\)The vocalization rule ensures that there is a nucleus segment in a syllable throughout the phonological derivation. Steriade mentions that there are three mechanisms behind the vocalization rule as summarized below:

a. At every stage in the derivation, the nucleus is the leftmost rhyme segment.
b. Only a sonorant can be nuclear.
c. Restructuring:
   A syllable lacking a well-formed nucleus is restructured by reassigning an onset segment to the rhyme.

\(^9\)For example, it is curious why a mora is deleted in (13), while it remains in (12) and how to explain the change from syllabic /l\ to /l/.
In what follows, I will make a few more comparisons among these structures. First we will talk about the phonological nature of the onset consonants in Western Aranda stress rules and in language games. These data seem to indicate that linking non-moraic syllable initial segments directly to the syllable node (the OM and WS structures) provides a much better and more concise explanation than the MO structures. Afterwards, I will consider coda consonants and how they are linked to syllable nodes. Especially, I will argue that there are some phonological rules that have as their environment two weighted segments. This can be most simply expressed with the WS structure. Such an observation renders support to the WS structure.

Davis (1985, 1988) noted that there are cases where onset consonants play an important role in stress assignment. Western Aranda, an Arandic language of Australia, is one such language. In this language stress is assigned to the first syllable in disyllabic words and in the case of words with three or more syllables, stress falls on the first syllable if the word in question begins with a consonant; otherwise the stress is assigned to the second syllable as shown in (14):

(14) Western Aranda Stress (data from Strehlow: 1942)

a. bi-syllabic words
   lái          go (imperative)
   gúra         bandicoot
   ílba         ear
   wúma         to hear

b. vowel initial words with three or more syllable
   inánga       arm
   ibá:tja      milk
ergúma seize
utnádawāra place name
c. consonant initial words with three or more syllable.
kútungūla ceremonial assistant
túkuma ulcer
wórätāra place name
ráiangkàma to utter the raiangkintja call

The generalization seems to be straightforward. In two syllable words primary stress falls on the initial syllable. In words of greater length, primary stress falls on the first syllable containing an onset consonant; secondary stress goes to every other syllable that follows the syllable with primary stress, but the last syllable is never stressed. Following Hayes (1991), we may formulate the following stress rules:\(^{10}\):

(15) Western Aranda Stress Assignment

a. Mark a vowel initial syllable extrametrical on the left edge.

b. Build trochees from left to right, with degenerate feet forbidden absolutely.

c. Word layer: End rule left.

(15a) and (15b) together guarantee that the first consonant-initial syllable carries a stress as well as every other syllable thereafter. The ban on degenerate feet (Hayes (1991: 82)) forces the final syllable to be stressless, even if it is potentially in a metrically strong position. (15c) places the primary stress on the head of the left-most trochee. Below are some sample derivations.

\(^{10}\)For different analyses, please refer to Archangeli (1986), Halle and Vergnaud (1987), and Davis (1988).
In (16a), the first syllable is marked extrametrical, and the syllable trochee is built from the second syllable, resulting in placing the primary stress on the second syllable. In (16b), the first syllable is not extrametrical since it is not vowel initial, and the stress is placed on the first syllable. Notice that the second trochee cannot be built on the final syllable since there is a ban on degenerate, or monosyllabic, feet. (16c) is an interesting example. The extrametricality cannot be applied to this string, since without the first syllable, there is only one syllable and there is a ban on degenerate feet. Such a case causes the revocation of extrametricality to keep the foot binary; hence in (16c) stress is on the first syllable though it is vowel initial.

Now the major concern for us is how to represent the extrametricality of the vowel initial syllables. For OM and WS, the description is simple and direct. It is the mora initial syllable at the left margin of a word which is extrametrical. Therefore we may formulate the
following rule to indicate the extrametricality:

\[(17) \quad \text{Western Aranda Extrametricality (OM & WS version)}\]

\[
\begin{align*}
\sigma & \rightarrow <\sigma> / \text{word } \mu \mu \\
\mu & \mu \mu \mu \mu \mu \mu \\
\end{align*}
\]

(A mora initial syllable at the left edge of a word is extrametrical.)

This formulation is not available to the MO structure, because all syllables, whether they are V-initial or C-initial, are mora initial. Actually with the MO, the syllable dominates only moras. In other words, the syllable begins and ends with a mora without exception. It seems to be extremely difficult to formalize the extrametricality of a vowel initial syllable at the beginning of a word in terms of the MO style of syllable structure.

I will briefly explore the difficulty in defining the extrametrical syllable with the MO structure. The only conceivable way to define the vowel initial syllable extrametricality is to claim that vowel initial syllables have non-branching moraic structure with the assumption that the coda consonants are moraic segments. This will give rise to the following structures:

\[(18) \quad \text{Word Structures in the MO Framework}\]

a. erguma b. utnatawara

\[
\begin{align*}
\sigma & \sigma & \sigma & \sigma & \sigma & \sigma & \sigma & \sigma \\
\mu & \mu & \mu & \mu & \mu & \mu & \mu & \mu \\
\end{align*}
\]

erguma utnatawara
But such a move causes some unwanted problems: First of all we have to note that
assigning moraic status to the syllable final consonant, Margin Creation Rule (Hyman, 1985:
18) or Weight by Position (Hayes, 1989: 258) is normally limited to those languages that treat
CVC syllables as heavy for such phonological phenomena as stress assignment or
compensatory lengthening. Here we can find a theory internal contradiction: no moraic status
should be assigned to syllable final consonants in Western Aranda because this language does
not have a quantity sensitive stress system where CVC is treated heavy for the purpose of stress
assignment, however the final consonant should not be incorporated to the first mora for the
description of extrametricality.\footnote{Another possibility is to treat the consonant after a vowel as
an onset consonant of the following syllable. This, however, leads to the violation of sonority
contour principle that onset consonants should have rising sonority (Zec, 1989: 110). In "erguma"
\textit{ltl} is more sonorous than \textit{lg}, so that the syllable boundary should come between
\textit{ltl} and \textit{lg}. This rules out the possibility of syllabifying "erguma" as in (e)· (rgu)· (ma)· · ·}

Thus, we can see that the OM or WS structures provide a much more straightforward
account of the extrametricality in the stress system of Western Aranda than the MO structure.

Another difficulty for the MO structure concerns the language games that McCarthy

(19) Echo words (data from McCarthy and Prince (1986: 85)

a. English

\begin{itemize}
  \item table-shmable
  \item book-shmook
  \item apple-shmapple
  \item strike-shmike
\end{itemize}
b. Kamrupi

ghar-sar (house)
gharaa-saraa (horse)
khor-sori (fuel)

The analysis given by McCarthy and Prince for the data in (19) involves reduplication followed by melody detaching of the initial consonants and replacing or overwriting them by *shm* (as in English) or by *s* (as in Kamrupi). The question in point is how to formalize the detaching process here. To put it in terms of a Selkirk (1982) type of syllable structure, it is the onset cluster of the word initial syllable in both languages that detaches. With the OM or WS structures, we can easily identify what are the onset elements. Therefore the onset delinking process can be described as getting rid of any pre-moraic consonants. Here again, the MO structure may find difficulty in formally capturing the generalization of the onset deletion process.

Another important observation to make concerning the difference in the geometrical representation of a syllable comes from the fact that there are rules that involve two weighted segments. Korean umlaut, which will be discussed in Chapter 7 in detail, is a case in point. A back unround vowel is fronted if the following vowel is /i/. But the process is blocked if a geminate consonant intervenes between the two vowels. In order to explain the blocking effect of the intervening geminate consonant, we have to say that the rule operates on moraic tier adjacency. Nongeminate consonants are not moraic and the moraic tier adjacency can skip such intervening consonants. It is graphically shown in (20):
(20) Geminate and Nongeminate Consonant Representation

a. \( \sigma \sigma \mu \mu \mu \mu \)

b. \( \sigma \mu \mu \mu \mu \)

(to be sucked) (kettle)

In (20a), the two vowels, /a/ and /i/ are not adjacent with each other on the moraic tier, since another moraic segment intervenes between them. Compare (20a) with (20b). We notice that the two moraic segments are adjacent with each other without any intervening moraic segment. Interestingly, it is only the word in (20b) that undergoes vowel fronting to become [n\(\ddot{\mathrm{a}}\)mbi]. What is crucially important here is to locate the weighted segments in the geometrical representations. But the OM or MO structures do not show it directly on the representation itself. Consider the following representations expressed in the MO and OM structures:

(21) The Representation of "kettle" in the MO and OM Structures

a. The MO Structure

b. The OM Structure

One can not readily point out which are weighted segments in the representations given in (21). Though it is not impossible to define weighted segments with the MO or OM structures such as a condition that the target should be a head of a mora, there would be need to resort to ad hoc conditions on the umlaut rules for Korean.
With the preceding observations, we come to the conclusion that the weighted segments should be graphically represented and one way to do so is to link all and only the weighted segments to moras and other consonants to the syllable node directly. While none of the observations are crucial in choosing one structure over the other, I think there is a reasonable preference for McCarthy and Prince’s weighted segment structure.

4.2.4. The Nature of the Mora

In this subsection, I will briefly consider the nature of the mora in syllable structure. I show that the mora is autosegmental in nature, it is a subconstituent of the syllable and it is a prosodic unit. In our discussion of compensatory lengthening, it is tacitly assumed that the moraic segment deletion leaves the mora intact. A mora may not be deleted even when the segments to which it is associated is deleted by the application of a phonological rule. In other words, moras are autonomous from segmental features. Compensatory lengthening is due to this autosegmental nature of the mora. Syllable weight and vowel length can be expressed because of the autosegmental nature of a mora.

At the same time, a mora is a structural constituent of a syllable. Within moraic phonology it can be viewed as the only legitimate constituent that a syllable has. I further suggest that the mora is an obligatory constituent of the syllable. A syllable without a mora is illformed. I will suggest the following syllable condition:

\[ (22) \quad \text{Syllable Wellformedness Condition} \]

\[
\begin{array}{c}
\ast \sigma \\
\Uparrow \\
x \\
x
\end{array}
\]

(A syllable without a mora is illformed.)
Itô (1986) calls a syllable without an obligatory constituent a degenerate syllable. Degenerate syllables are not allowed at the surface level. Epenthesis is a process to make a degenerate syllable wellformed as argued in Itô (1986, 1989). In the present theory, epenthesis is the result of the Syllable Wellformedness Condition along with underspecification. Suppose that a consonant is left unsyllabified. This unsyllabified consonant is subject to one of two processes: Stray Erasure or Mora Projection. Stray Erasure (Steriade (1982), Itô (1986)) is a process that eliminates unsyllabified segments to make sure that all the segments are properly incorporated into syllables. The second process, Mora Projection, is another way to make the stray segment syllabified or the degenerate syllable wellformed. It is schematically shown in (23):

\[
(C) \quad \text{Mora Projection}
\]

\[
\begin{array}{c}
C \\
\rightarrow \\
C
\end{array}
\]

First consider that there is another possible structure that can come out of Mora Projection as shown in the parenthesis of (23). I will note that the CV structure is more natural than the VC structure and therefore it is the less marked form which will be universally adopted over the marked forms. We can see that the stray segment is incorporated into a wellformed syllable. But notice that the mora is left unfilled. I suggest that the unfilled mora is interpreted as the least specified vowel segment in the language.

Finally, we find that a mora is a prosodic unit as argued in McCarthy and Prince (1986), Zec (1988) and Bullock (1991). McCarthy and Prince convincingly show that a mora can constitute a prosodic template in the reduplication process as in the case of core syllable
reduplication. Zec (1988) and Bullock (1991) argue that a mora is a prosodic unit that can prosodically license moraic segments.

Thus we see that the mora is simultaneously an autosegmental unit, a subsyllabic unit and a prosodic unit. The mora therefore has multiple functions in the phonology.

### 4.2.5. Syllabification Process

There are two major assumptions about the syllabification process: one is that all the segments should be incorporated into syllables (Steriade (1982) Cairns and Feinstein (1982), Selkirk (1982), Itô (1986) among others) and that syllabification is predictable. The first assumption is well expressed in Itô’s (1986: 2) Prosodic Licensing condition given in (24):

(24) Prosodic Licensing

All phonological units must be prosodically licensed, i.e. belong to higher prosodic structure (modulo extraprosodicity).

The "higher prosodic structure" here surely includes syllables and thus all the segments should be syllabified with the exception of extraprosodic elements at the edge of a sequence.

The second assumption leads to the proposals on the syllabification procedure. There are mainly two different approaches to syllabification: the templatic approach (Selkirk (1982), Itô (1986)) and the rule based approach (Steriade (1982), Hyman (1985), McCarthy and Prince (1986)). In the templatic approach, the syllable structure is represented on a separate tier and segments are mapped onto the terminal constituents by association lines, while the rule based approach builds syllables on top of the melodic tier. Given that the syllable structure is very

---

12Hyman (1990) makes a different proposal that syllabification may not be exhaustive.
simple and mechanically predictable, I will adopt the rule based approach in this dissertation.

It is generally agreed that the syllable building process can be divided into two independent processes: moraification and syllabification. Moraification is a process that identifies the moraic segment in the given string and the syllabification process takes the moraic and non-moraic segments and incorporates them into syllables. Bullock (1991) argues that there is an ordering between these two processes. She identifies three different ordering relations: Moraification before Syllabification, Syllabification before Moraification, and Moraification and Syllabification at the same time. Bullock's argument is based on the concept that Moraification is part of the derivational process. However, if we take Hayes' (1989) assumption that all the moras are projected in underlying representation, then syllabification cannot precede moraification.

4.2.5.1. Moraification

Different proposals have been made concerning moraification. Hyman (1985) and Bagemihl (1991) argue that underlyingly all segments are linked to single moras but a later rule "demoraifies" the "non-moraic" segment. Here is an example of demoraification from Bagemihl's (1990) work on Bella Coola:

(25) Moraification in Bella Coola

a. Underlying Structure

```
<table>
<thead>
<tr>
<th>µ</th>
<th>µ</th>
<th>µ</th>
<th>µ</th>
<th>µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>q</td>
<td>c</td>
<td>i</td>
<td>l</td>
</tr>
</tbody>
</table>
```
b. Demoraification and Syllabification

One brief observation we can make here is that the demoraification rule is strange given the autosegmental nature of a mora. The demoraification process has redundancies in that the moras are always deleted from a consonant which is before a vowel. Given the predictable nature of demoraification, I will argue that you do not have to link the non-moraic segments to moras in the underlying representation.

Zec (1988) takes a different approach. Zec (1988) shows the typological distribution of moraic and syllabic segments and argues that each language defines the moraic segments on the basis of universal principles related to sonority constraints. According to her, there are four typologically different languages as shown in (26):

(26) Typology of the Sonority of the Mora

a. Type One (syl < mora = segment)
   All the segments can be moraic but not all moras can be syllabic.
   (Cairene Arabic, Aklan, English ...)

b. Type Two (syl = mora < segment)
   Only the vowels are moraic. (Khalkha Mongolian, Ilokano ...)

c. Type Three (syl < mora < segment)
   All the vowels and a certain set of consonants can be moraic.
   (Danish, Lithuanian, Kwakwala ...)

---

13 A < B means that the set A is properly included in the set B.
d Type Four (syl = mora = segment)

Even obstruents can be syllabic. (Imdlawn Tashlhiyt Berber ...)

With the parameterization of moraic segments and syllabic segments, Zec (1988) argues that only the moraic segments can project a mora. This does not mean that all the consonants are moraic in languages like in (26a). Zec (1988) provides a constraint on mora projection as given in (27):

(27) Zec's Moraification

Given a sequence $S$ of unlinked segments $S_1$, $S_2$, ...$S_i$, ... $S_n$, Link $S$ to mora iff

a. $s_i$ is more sonorous than $s_{i-1}$

b. $s_n$ is a member of the set of moraic segments

c. $s_n$ is not immediately followed by a more sonorous segment.

McCarthy and Prince (1986) maintain that moras are projected from vocalic segments and that long vowels and geminate consonants carry one mora underlingly. Thus hypothetical words, "paama" and "pamma" will be represented differently underlingly as shown in (28):

(28) Examples of Mora Projection

\[
\begin{array}{ccc}
\mu & & \\
p & a & m & a & p & a & m & a \\
\end{array}
\]

\footnote{It should be noted that Zec (1988) adopts the MO syllable structure proposed by Hyman (1985) which is illustrated in (11a).}
Long vowels and geminate consonants have one mora underlyingly and the later moraification will project moras from moraic segments. Thus there are two different processes in moraification. Some moras are already projected in the underlying representation and other moras will be projected by later rule.

Hayes (1989) does not recognize the later rule of moraification. He would take the forms with all the moras projected as the underlying forms. Hayes (1989: 259) claims that putting all the moras underlyingly provides "the simplest description of possible contrasts in mora counts". He cites two examples of three way contrasts in mora counts. Kimatuumbi (Odden (1981)) and Gokana (Hyman (1985)) permit long syllabic nasals. Therefore a nasal, a geminate nasal, and a long syllabic nasal makes a three way contrast. Another example comes from languages where glides are underlyingly contrastive with high vowels. In such a language, /yl/, /i/, and /i:/ make a three way contrast. This may be problematic for McCarthy and Prince's (1986) mora projection approach. Assuming that glides are underlying vowels, the mora projection as in McCarthy and Prince (1986) cannot satisfactorily explain such three way contrasts as shown in (29), since (29a) and (29b) would both be moraless in underlying representation in McCarthy and Prince's theory:

(29) Three Way Contrasts in Vowels

\[
\begin{array}{ccc}
\mu & \mu & \mu \\
\mu & \mu & \mu \\
i & i & i
\end{array}
\]

\[
\begin{array}{ccc}
\mu & \mu & \mu \\
\mu & \mu & \mu \\
i & i & i
\end{array}
\]
Korean is one of the languages that show surface glide and high vowel contrast. Consider the following data:

(30) Glide High Vowel Contrast in Korean

<table>
<thead>
<tr>
<th>Language</th>
<th>Syllabification</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. suim</td>
<td>(swi)σ(əm)σ (intermittently)</td>
</tr>
<tr>
<td></td>
<td>(su)σ(yəm)σ (beard)</td>
</tr>
<tr>
<td>b. kiun</td>
<td>(kyun)σ (germ)</td>
</tr>
<tr>
<td></td>
<td>(ki)σ(un)σ (energy)</td>
</tr>
<tr>
<td>a. iun</td>
<td>(yu)σ(ən)σ (will)</td>
</tr>
<tr>
<td></td>
<td>(i)σ(wən)σ (dichotomy)</td>
</tr>
</tbody>
</table>

In order to explain the surface contrast, we will have to assume either that the segments are syllabified fully in the underlying representation or that moras are present underlyingly. Given the general assumption that syllabification is predictable, putting the mora in the underlying representation is a simpler and better analysis. The exemplary derivation of the first word in (30) is given in (31):

(31) Exemplary Syllabification

<table>
<thead>
<tr>
<th>Language</th>
<th>Syllabification</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. &quot;intermittently&quot;</td>
<td>(swi)σ(əm)σ (intermittently)</td>
</tr>
<tr>
<td></td>
<td>(su)σ(yəm)σ (beard)</td>
</tr>
</tbody>
</table>

\[ \text{For the moment, I will not be concerned with how to geometrically represent the glides. I will return to this in Chapter 5.} \]
As shown in (31), the underlying structures differ in the two words with respect to moraic status. The following syllabification is automatic and gives the correct surface forms. With these observations, I will adopt Hayes' (1989) proposal on underlying morafication\textsuperscript{16}. Therefore the theoretical assumption adopted in this study is a hybrid of Hayes (1989) and McCarthy and Prince (1986). Notice that the McCarthy and Prince's (1986) proposal of the syllable structure along with Hayes' (1989) morafication assumption is adopted here.

\textbf{4.2.5.2. Syllabification}

Syllabification operates on the projected moras. I assume the following processes in syllabification\textsuperscript{17}.

\begin{enumerate}
\item[(32)] Syllabification Rules
\begin{enumerate}
\item a. Syllable Projection (=SP)
\item b. Weight by Position (=WP)
\item c. Syllable Incorporation (=SI)
\item d. Stray Syllabification (=SS)
\end{enumerate}
\end{enumerate}

\textsuperscript{16}It should be noted here that positing the mora in the underlying representation does not mean that all necessary moras are present underlyingly. There are other rules that assign a mora in the course of syllabification as will be discussed later in this subsection. Weight by Position rules and Stray Syllabification are processes of projecting moras in syllabification which is not present in the underlying representations.

\textsuperscript{17}Part of the syllabification algorithm that I do not talk about here is the direction of syllabification, like the directionality parameter discussed by Itô (1986), or the leftward and rightward strategies by Kaye & Lowenstamm (1981).
The syllable projection rule is equivalent to the CV rule in Steriade (1982) and the Universal Core Syllable Condition in Itô (1986: 5). This process groups a moraic segment and the preceding nonmoraic segment to form a syllable. Syllable projection is schematically shown in (33):

(33) Syllable Projection

\[
\begin{array}{c}
\sigma \\
\mu \\
R R R R \\
\end{array} \rightarrow 
\begin{array}{c}
\mu \\
R R R R \\
\end{array}
\]

(R stands for "Root Node").

The Weight by Position rule (Hayes (1989), or the Margin Creation rule (Hyman (1985)), is a language-particular rule that makes closed syllables heavy in languages where CVC syllables are considered heavy for the purpose of stress assignment. Hayes (1989: 258) assigns a mora to a coda consonant by means of the Weight by Position rule given in (34):

(34) Weight by Position

\[
\begin{array}{c}
\sigma \\
\mu \\
\alpha \beta \\
\end{array} \rightarrow 
\begin{array}{c}
\sigma \\
\mu \mu \\
\alpha \beta \\
\end{array}
\]

where \( \alpha \) dominates only \( \mu \)

The rule of Weight by Position assigns a mora to a nonsyllabified segment in a monomoraic syllable and it is incorporated to the syllable making that syllable bimoraic. I assume that this

---

I assume that if the moraic segment does not have a preceding segment, the moraic segment alone makes an onsetless syllable.
rule is applied only after syllable projection rules. Therefore a prevocalic consonant will never get a mora by the Weight by Position rule since the preceding rule, syllable projection will make the prevocalic consonant as an onset.

Syllable Incorporation in (32c) is the process that links non-moraic consonants to the syllable. In this sense, we may say that the process includes both the onset rules and coda rules of Steriade (1982: 78-79). Following, Kahn (1976), Selkirk (1982), Vogel (1977) and many others, I will assume that there is an Onset Maximalization Principle, which prohibits a possible onset sequence from being a coda of the preceding syllable.

Another relevant aspect of syllabification comes from Prosodic Licensing. Suppose that there is a left-over segment after syllabification, which cannot be incorporated to the coda of the preceding syllable nor to the onset of the following syllable. Languages have options in this case: Stray Erasure or Stray Syllabification. Stray Erasure is a way to get rid of the unsyllabified segment in order to make all the segments prosodically licensed as discussed in detail in Steriade (1982) and Itô (1986). Another option is to put the unsyllabified segment into a syllable along with the necessary projection of a mora and the subsequent insertion of a vowel. Consider a schematized sequence of segments after syllabification given in (35):

(35) Unsyllabified Segments

\[ \begin{align*}
\text{a.} & & \sigma & & \sigma & & \mu & & \mu \\
& & C & & V & & C & & C & & V \\
\text{b.} & & \sigma & & \sigma & & \mu & & \mu \\
& & C & & V & & X & & X & & C & & V
\end{align*} \]

Suppose that the unsyllabified consonant in (35) cannot be a coda nor can it constitute a part of complex onset of the following syllable, and Stray Erasure is not applicable in this language. The only way to make the string well-formed is to incorporate the stray segment
into another syllable. Then Stray Syllabification takes the unaffiliated segment and incorporates it into a syllable as in (36a). There are cases just like in (35b) where two segments are unaffiliated to syllable nodes for language specific reasons. If Stray Erasure is not operative at this level, and the second unassociated segment can be a rhyme member, then it can also be incorporated to a syllable as shown in (36b).

(36) Stray Syllabification (=SS)

The stray segments are linked up to a syllable node. This degenerate syllable is not well-formed. (cf. (22)) A mora is then projected from the syllable to make the syllable well-formed. Finally the mora will be filled with the least specified vowel in this language or by spreading of features from the surrounding segments. In the case of (36b) the output should conform to the well-formed syllable template. Otherwise Stray Syllabification will be applied twice in (36b). The mechanism may sometimes produce more than one possible output. Consider the different syllabifications illustrated in (37):
(37) Hypothetical CVCCV Syllabification.

a. Syllable Projection and Syllable Incorporation

```
µ µ
C V C C V
```

sp

```
µ µ
C V C C V
```

si

```
µ µ
C V C C V
```

b. Syllable Projection and Stray Syllabification

```
µ µ
C V C C V
```

sp

```
µ µ
C V C C V
```

ss

```
µ µ
C V C C V
```

In (37a), the unsyllabified segment is syllabified as a coda of a preceding syllable, while it triggers Stray Syllabification in (37b). If the language does not allow coda consonants, then (37b) is the only well-formed syllabification. But if this language allows coda consonants, then which is the correct syllabification? There may be two ways to constrain the syllabification process. First we may say that there is an intrinsic ordering relationship between Syllable Incorporation and Stray Syllabification, since Stray Syllabification applies only when there is a segment which is not incorporated into the syllable. Or we may refer to general principle of syllabification as proposed in Kiparsky (1979: 432-433)\(^\text{19}\):

\(^\text{19}\)Lowenstamm (1979: 97) also makes an identical proposal in one of his two basic principles of syllabification, as given below:

Basic Principles of Syllabification

Principle I - Minimize the number of syllables.
Principle II - Minimize the degree of markedness of each syllable.
(38) The Principle of Maximal Syllabification

Given alternative syllabifications for a string, choose the one that
minimizes the total number of syllables.

Either of the approaches can correctly predict that the syllabification in (37a) is always
preferable to that in (37b) in languages that allow a coda segment on the level of
syllabification.

4.3. Syllable Structure in Korean

In this section, I will discuss the syllable structure in Korean. So far we have
discussed that the moraic theory of syllable structure is well motivated for the explanation of
compensatory lengthening, partial reduplication and stress placement. The Korean language,
however, does not have a rich templatic morphology to motivate the use of mora, nor does the
Korean language have a quantity sensitive stress system. However, I argue that these
observations do not necessarily mean that moraic syllable structure is not motivated in Korean.

I will first briefly discuss the proposals made for Korean. Body (or Core) structure
which is most extensively argued for Korean will be reviewed with the discussion on the major
arguments for the structure. Then I will talk about the motivation for moraic structure in
Korean. We have already seen that the surface contrast of a glide with a high vowel provides
a good motivation for moraic structure in Korean. Further we have discussed that there is a
vowel fronting rule in Korean that crucially refers to the weighted segments in Korean. I will
further argue that the phonology of "li" irregular verbs in Korean and the obligatory nature of
glide formation for some verbs strongly argue that there should be a moraic representation in the underlying representation.

### 4.3.1. Branching Structures

Two main hierarchical syllable structures proposed for Korean are the Left branching (Body/Coda) structure and the Right branching (Onset/Rhyme) structure. These two proposals are geometrically represented in (39):

\begin{align*}
(39) & \quad \text{Two Hierarchical Syllable Structures Proposed for Korean} \\
\text{a. Left Branching} & \\
\text{b. Right Branching}
\end{align*}

The structures on the left side show the traditional syllable structure with the specified constituent names, and the structures on the right are the translations of the structures in the

The language acquisition data are presented by Gim (1987) and S-C. Ahn (1988b) to argue for the Body-Coda structure for Korean. They observe that native children acquire CV forms before CVC and argue that the Body-Coda division is motivated in the language learning process. Gim (1987:23) and S-C. Ahn (1988b: 345-346) further argue that the syllable structure is reflected in explaining segment combinations. For example, when an adult teaches the pronunciation of /son/ (hand), there may be three different ways of explaining the pronunciation as illustrated in (40):

(40) Explaining the Pronunciation of /son/

a. [so] plus [n] makes [son].

b. [s] plus [o] plus [n] makes [son].

c. [s] plus [on] makes [son].

The basic assumption that Gim takes is that if (40a) is the most frequent way of explaining the pronunciation, it means that the Korean syllable has the left branching structure. (40b) will support a flat structure such as Kahn's (1976) or Clements and Keyser's (1983). (40c), on the other hand, will support the right branching structure. Pointing out that (40c) is not possible in explaining the pronunciation of /son/, Gim and S-C. Ahn concluded that the right-branching structure cannot be motivated in children's recognition of a CVC syllable.

However, it should be noted that the CV syllable is universally unmarked regardless of
the difference in syllable structures of languages, as Lowenstamn (1979: 62), Steriade (1982: 78), Noske (1982: 271) and many others argue. Even in languages in which the right branching syllable structure is quite well motivated, such as English and French, children acquire CV syllables before VC syllables. The point is that it is not the syllable structure but the degree of markedness that explains the order of acquisition of different syllable types. Further, if we define the order of acquisition on the basis of syllable structure, which is untenable, we come to the conclusion that Korean children learn CGV syllables before CVC syllables. A brief survey of the Korean child's language shows that there are CVC monosyllabic words such as /kom/ (a bear), or /nun/ (eye) but no CGV monosyllable words. Again, assuming that the CV syllable is the most natural utterance unit, (40a) seems to be the natural way of explaining the sound combination. However, syllable structures may not be directly related to the method of explaining the acquisition of sound combinations.

The second argument for left branching syllable structure comes from language game data. Gim (1987) introduces two different language games: Popuri language game (CV insertion) and "nosa" insertion games. What is interesting in these language games is that the insertion site for CV or "nosa" is always after a nucleus. In other words, the inserted forms can separate the nucleus and the coda but they never break up the onset and rhyme. Some of the examples are given in (41):

(41) Korean Insertion Language Games

a. Popuri language

salam (man) → sapalapam

20Noske (1982: 271) sets up a markedness scale, where a CCV syllable is more marked than a CVC syllable. Thus the markedness theory can explain why children learn CVC syllables before CCV syllables.

21"Popuri" means a stutterer in Korean.
I will not attempt to present the comprehensive analysis here of the CV insertion language game, since it will be discussed in Chapter 5. I will simply show that the insertion site is not directly related to syllable structure. As Davis (1985: 167) and Y-S. Kang (1991: 47-48) point out, the insertion site is decided by the structure of the sequence to be inserted. Y-S. Kang (1991: 48) shows that since the inserted form is CV or CVCV, it cannot be inserted between C and V since such an insertion would result in an unsyllabifiable string of segments. Consider the two different insertion sites in a CVC word as shown in (42):

\[ (42) \text{ Schematized Insertion Sites.} \]
\[ \text{a. Between Onset and Rhyme} \]
\[ \text{CCVVC} \]
\[ \text{b. Between Rhyme and Coda} \]
\[ \text{CVCVC} \]

(The bold faced parts are inserted)

Since the Korean language does not allow a CC cluster in syllable initial position, unless the second one is a glide, the segmental string in (42a) cannot be syllabified. As a result, such an insertion makes the whole string unpronounceable.

Further, Davis (1985) clearly shows that the insertion sites are decided by the nature of the inserted segments regardless of the language particular syllable structures. Consider the...
summary of insertion language games from Davis (1985: 164-166):

(43) Examples of Insertion Language Games

a. Tagalog -pi- insertion after a vowel (Laycock (1972: 70))
   tubig → tupibipi

b. English -gV- insertion after a vowel (Laycock (1972: 74))
   away → agawagay

c. Spanish -fV- insertion after a vowel (Sherzer (1982: 187))
   grande → grafandefe

d. Chinese -ayk- insertion after an onset consonant (Yip (1982: 640)
   pey → paykey

e. English -ap- insertion after an onset consonant (Burling (1970))
   hiy wil (=he will) → hapiy wapi

The generalization we can draw from (43) is that if the inserted sequence begins with a consonant, it is inserted after a vowel and if the inserted sequence is vowel initial, the insertion site is after a consonant. Seen from this, it is only natural that the insertion site for CV insertion and "nosa" insertion language games is after a rhyme segment (a vowel) just as in Tagalog "pi" insertion language game and Spanish "fV" insertion language game. Thus I argue that the language game data fail to support the left-branching syllable structure in Korean.

Another type of evidence for the left-branching structure comes from CV deletion in fast speech. S-B. Cheon (1980: 20) observes that there is CV deletion in the fast speech of Korean and suggests that such deletion phenomena might reflect on the Korean syllable structure. His examples are given in (44):
These data, if they are proven to be CV deletion, may support the left-branching syllable structure in Korean. However, I carefully call for reanalysis of the data given in (44). All the examples in (44) demonstrate that the second syllable is deleted in the fast speech and that the input is usually a tri-moraic word. I argue that the phenomena involve the deletion of a syllable in the weak position of a foot\(^\text{22}\). The deletion can be represented schematically as in (45):

\[
\text{(45) Deletion in Fast Speech.}
\]

\[
\begin{array}{c}
\text{F} \\
\mu_1 & \mu_2 & \mu_3 \\
\end{array} 
\quad \rightarrow 
\begin{array}{c}
\text{F} \\
\mu_1 & \mu_3 \\
\end{array}
\]

The deletion results in the loss of a mora along with the dependent moraic segment, and the independently motivated cluster simplification rule will clean up the consonant clusters. An exemplary derivation is given in (46):

\[\text{22I thank Stuart Davis for suggesting the alternative analysis given here.}\]
The mora in the weak position of the foot is deleted and the consonants /s, p/ are left unsyllabified. Since the cluster is not allowed in the coda in Korean, the cluster simplification process gets rid of the coronal consonant, /s/ in the exemplary derivation and the remaining /p/ is incorporated to the coda of the first syllable.²³

Now consider the additional fast speech forms given in (47):

(47) Additional Data from Fast Speech

\[ \text{akści} \rightarrow \text{akci (}\ast\text{aksi)} \quad \text{(forceful)} \]
\[ \text{amɔnί} \rightarrow \text{amni (}\ast\text{ɔnі)} \quad \text{(mother)} \]

The CV deletion may predict the ill-formed outputs shown within parentheses in (47). However the foot-based deletion approach correctly predicts that the onset of the second syllable will surface as a coda segment of the first syllable.²⁴

²³See Y.Y. Cho (1988) for a detailed analysis of the cluster simplification.

²⁴It should be noted that there are other rules that interact with the fast speech deletion rule. For example, another fast speech phenomenon of /h/ deletion may be applied to such word as sohoksɛŋ (small planet) before weak mora deletion. (See also the example given in (44c).) Here the apparent CV deletion can be reanalysed as the interaction of two independent rules, /h/ deletion and weak vowel deletion. Further it seems that the second mora resists deletion if it dominates a segment more sonorous than the moraic segment in the first mora.
Though a detailed analysis on setting up the correct environment for these deletion phenomena has not yet been done, we can at least say that there are alternative explanations other than resorting to syllable structure.

Pointing out some of the possible problems and presenting alternative explanations, however, does not lead us to accept the right-branching syllable structure for Korean. I am not familiar with any strong argument for the right-branching structure other than pointing out the demerits of the left-branching structure.

One traditional argument for Rhyme structure in phonology comes from metrical phonology in differentiating heavy and light syllables. If there is just one element in the Rhyme (=N'), the syllable is light. If there are two or more segments in the rhyme, the syllable is considered heavy. However, as discussed earlier, we have to note that one of the strong motivations for moraic structure of the syllable is the correct generalization concerning heavy versus light syllables which varies from language to language.

So far, we have seen various arguments for the hierarchical syllable structures in Korean. It has been observed that the motivation for either of the two hierarchical structures is not that strong. In the following subsection, I will try to show that the moraic structure is crucially important in explaining "li" irregular verb phonology.

4.3.2. "li" Irregular Verbs : A Case of /i/ Insertion

In this section, I will show that "mora" can effectively explain the alternations found in Korean "-li" final verb stems. There seem to be two different kinds of "-li" final stems as the following examples show:
"li" Final Verb Stems

(a) Verb

Verb | Infinitive (-ə) | Effective (-ini)
--- | --- | ---
chili (to pay) | [chira] | [chirini]
t’ali (to follow) | [t’ara] | [t’arini]
kapali (to be steep) | [kaphari] | [kaphari]

(b) nuli (to press) | [nulla], [nullini]
puli (to call) | [pulla], [pullini]
kali (to divide) | [kalla], [kallini]

The words in (48a) show /i/ deletion in the course of morphological derivation. But the words in (48b), so called "li" irregular verbs, show optional /l/-gemination in effective forms. I will limit the discussion to the words in (48b), since (48a) can be explained straightforwardly by coalescence, which will be discussed in Chapter 8.

Kim-Renaud (1974, 1982), noting that the /l/-gemination in (48b) is much more frequent and productive, proposed that the underlying forms of the words in (48b) has a geminate /l/. She then proposed an optional rule of degemination to explain the existence of

---

25There is another kind of "li" final verb, the "li" irregular verbs, which show yet another difference from (48a) or (48b). Some examples are given below:

ili (to reach) | [iriro] | [iririni]
phuli (to be blue) | [phuriri] | [phuririni]

The unique irregularity in these words is that another /l/ is added before /i/ or /ini/.

For the purpose of expositional simplicity, I will not show the consonantal changes in the representation. The relevant consonantal change in the data is /l/ to [r] in syllable initial position.

26To be more specific, I would say that the relevant process is not /i/ deletion but syllabification and stray erasure which will be dealt with in Chapter 8 in detail.
two different forms in the effective formation. Y-S. Kim (1984: 69), however, opposes Kim-Renaud's analysis by saying that if the geminate /l/ is posited underlyingly with optional degemination rules, then "geminate /l/ is equally acceptable as one with a single l which seems not to be the case". He presents the following nominalized forms and argues that the forms with geminate /l/ are much less acceptable than those with a single /l/. Some of his examples are given in (49):

(49) Derivations of "lā" irregular Verbs

kei-lī (to be lazy) + m (noun ending)  kei-līm,  "kei-līm
pulī (to call) + m (Noun ending)  pulīm,  *pullīm

Now, we have to explain three different things here: why nominalized forms and dictionary forms do not have geminated /l/, why the effective forms have two different surface forms, and finally why the infinitives do not have variants with non-geminate /l/. Neither underlying /l/ nor underlying /ll/ can satisfactorily answer all these three different problems.

However, I contend that the moraic syllable structure can account for these three phenomena without resorting to any ad hoc conditions. But before I present the analysis, I will briefly talk about geminate structure in moraic phonology. There are at least two different ways to produce a moraic consonant: in the underlying representation and by Weight by Position (Hayes (1989: 258)). The examples of these two moraic segments are shown in (50):

---

27 The dictionary forms are made by suffixing "-ta" to the stem. I call this dictionary forms because that's how the verbs are listed in the dictionary.

28 For example, if we suppose that the underlying forms have a geminate, we have to introduce the degemination rule. The problem is that the degemination rule should not be applied to infinitive forms, it should be optional for effective forms and further it should be obligatory for nominalized forms.
The moraic consonants are shown in bold face. The moraic consonant in (50a) is doubly linked both to the mora of a syllable and to the next syllable. This is the typical representation of an underlying geminate. The structure in (50b), on the other hand, is derived by applying the Weight by Position rule which assigns a mora to a non-syllabified consonant that follows a monomoraic syllable. Notice that the Weight by Position rule is ideally only applied to quantity sensitive stress languages that treat a CVC syllable as heavy for the purpose of stress assignment. Since Korean lacks quantity sensitive stress, we would not expect to find a consonant with a single association to a mora, as shown in (50b) in Korean. Therefore I propose a moraic consonant wellformedness condition as given in (51):

(A moraic consonant linked to one syllable node is ill formed.)

In order to interpret the condition given in (51), we need Hayes' (1986b) Linking Constraint given in (52):
(52) Linking Constraint

Association lines in structural descriptions are interpreted as exhaustive.

Note that there is only one line that links the consonantal root to syllables. Going back to the examples in (50), we can see that the condition in (51) allows the structure in (50a), while it rejects the representation in (50b).

With such an assumption on moraic consonants, I propose that the words in (48b) have an underlying moraic /l/ in the stem final position. Thus the words in (48b) have the following underlying representations:

(53) Underlying Representations of \textit{li} Irregular Verbs

<table>
<thead>
<tr>
<th>a.</th>
<th>b.</th>
<th>c.</th>
</tr>
</thead>
<tbody>
<tr>
<td>μ μ μ μ</td>
<td>μ μ μ μ</td>
<td>μ μ μ μ</td>
</tr>
<tr>
<td>n u l</td>
<td>p u l</td>
<td>k a l</td>
</tr>
<tr>
<td>(to press)</td>
<td>(to call)</td>
<td>(to divide)</td>
</tr>
</tbody>
</table>

Now, we will see how the representations in (53) explain the alternations of verbs in (48b). First, consider the dictionary forms and nominalized forms. The dictionary forms and nominalized forms have nongeminate /l/. I propose that this follows naturally from the representation and the surface form of the geminate consonant. Consider the dictionary forms with "ta" added to the stem as illustrated in (54) with the word in (53b):

(54) "ta" Affixation

\[
\begin{array}{c}
\mu \mu + \mu \\
p u l t a
\end{array}
\xrightarrow{\text{syllabification}}
\begin{array}{c}
\sigma \\
p u l t a
\end{array}
\]
The next stage is to incorporate the moraic segment /l/ to the syllable. Here, we may not link the moraic segment to the first syllable, since the outcome, given in (55a), violates the syllable condition given in (51):

(55) Ill-formed Syllable Structures

\[
\begin{array}{c}
\text{a.} \\
*\sigma & \sigma \\
\mu & \mu & \mu \\
p & u & l & t & a
\end{array}
\quad
\begin{array}{c}
\text{b.} \\
*\sigma & \sigma \\
\mu & \mu & \mu \\
p & u & l & t & a
\end{array}
\]

As can be seen in (55b), the double linking will not solve the problem, because the sequence /lt/ is not a possible onset cluster in Korean and for that matter in many other languages. Thus a stalemate is created by positing moraic consonant in the underlying structure. The only way out is to delink /l/ from the mora and syllabify /l/ as given in (56):

(56) Mora Delinking and Syllabification

\[
\begin{array}{c}
*\sigma & \sigma \\
\mu & \mu & \mu \\
p & u & l & t & a
\end{array}
\quad
\begin{array}{c}
*\sigma & \sigma & \sigma \\
\mu & \mu & \mu \\
p & u & l & t & a
\end{array}
\]

The empty mora will be realized as the least specified vowel, which is /i/, in Korean to given the form /pulita/. The same explanation can be offered for the nominalized forms. The exemplary derivation of the nominalized form of the word "to call" is given in (57):

---

29Notice that the sequence violates the sonority hierarchy.
Thus we can neatly explain that the "li" irregular verbs disallow the geminate /l/ in the nominalized forms and lexicon forms. Now let's consider the infinitive forms. The infinitive forms are made by adding /ə/ to stems. Since /ə/ does not have an onset it will take the preceding /l/ as the onset and thus the mora that dominates /l/ can be associated with the first syllable. The process is given in (58):

For effective forms, and conditional forms, there are alternations in the surface forms: forms can either have geminate /l/ or nongeminate /l/. The alternations can be neatly derived from the fact that the suffix initial vowel /i/ is weightless.³⁰ Thus there are two options in the process of derivation as given in (59):

³⁰See 8.3 for more discussion on the nonmoraic vowels.
In (59a), the mora which dominates /l/ does not syllabify and causes /l/ delinking. Then the syllable incorporation process takes the unsyllabified /l/ as an onset and the mora is left unlinked to the melodic tier. The unsyllabified /i/ is hooked up to the empty mora to give the output [puli\textsuperscript{ni}]. What if syllable incorporation process takes place before /l/ delinking? The answer is given in (59b). That the sequence of word internal /li/ is left unsyllabified triggers syllable incorporation. The /li/ forms a syllable with subsequent mora projection from the syllable node. Now the /l/ is doubly linked and the mora that dominates /l/ can be associated to the first mora resulting in the surface form [pu lli\textsuperscript{ni}].

With the moraic syllable structure, we are able to explain the difference between regular verbs and "li" irregular verbs both of which have stem final /li/. The apparently unpredictable variations of "li" irregular verbs are neatly explained without irregularity. Seen from this point what is irregular in the so called "li" irregular verbs is not the derivational
processes but the representation itself. As McCarthy (1988: 84) claims if the representations are right, then simple and general rules can explain the complexity of derivations in a consistent way. Such an analysis is possible only when moraic syllable structure is adopted, and I believe that the "li" irregular verbs provide fairly convincing evidence for the moraic theory of the syllable in Korean phonology.

Notice that all the syllabification processes are in conformity to the universal principles discussed in 4.2.3. The analysis given in this subsection crucially refers to the moraic syllable structure, which is absent in both the right and left branching structure. Another important observation is that we do not formulate /i/ insertion rules at all in explaining "li" irregular verbs. The apparent /i/ insertion phenomenon is actually the natural result of syllabification.

4.4. Summary

In this chapter, we have talked about different proposals regarding syllable structure. Unlike the claims made in SPE, syllables are important in the theory of phonology. Scholars have been interested in finding a suitable syllable structure. Kahn (1976) says that segments are directly linked up to syllable nodes while others suggest hierarchical syllable structure. Representative of such hierarchical structures are Selkirk (1982) and Wheeler (1981).

Clements and Keyser (1983) posit the CV tier in between segments and syllable nodes, which greatly simplifies the syllable structure by eliminating such constituents as onset or coda and replaces them by C or V. Levin (1984, 1985) further developed the idea of CV theory and presents the X’ theory of syllable structure.

However it has been found that such CV or X tier structure fails to account for the observations made in stress assignment and reduplicative processes. Hyman (1985) and Hayes
(1989) note that languages may differ from one another in defining a heavy syllable for the purpose of stress assignment. Further Hayes (1989) convincingly argues that the deletion of a segment does not always trigger compensatory lengthening and claims that the CV tier syllable structure cannot account for this. McCarthy and Prince (1986) show that Marantz's (1982) analysis of reduplication with reference to the CV tier is not constrained enough.

All these observations converge towards the proposal of moraic syllable structure. Moraic syllable structure argues that moras are the only legitimate syllable internal constituent thus eliminating the CV tier, the X tier and other types of syllable-internal constituents such as onset, rhyme or coda. While moraic syllable structure is well motivated in explaining stress assignment, compensatory lengthening, and templatic morphology, scholars do not agree on the precise nature of the internal structure of a syllable. There are three basic proposals on moraic syllable structure. Hyman (1985) and Zec (1988) propose that the syllable dominates only moras, and onset and coda consonants are associated with moras. McCarthy and Prince (1986) argue that only the weighted segments are affiliated with moras and other nonmoraic segments are directly linked up to the syllable nodes. Hayes (1989) makes reference to the syllable structure where onset consonants are directly linked to syllable node, while coda consonants are linked to moras.

I have considered data from stress rules and language games along with Korean vowel fronting to argue that McCarthy and Prince's (1986) proposal of moraic syllable structure can best handle the data. Though the analyses given here are not decisive, the McCarthy and Prince (1986) type syllable structure is adopted here.

Two processes of syllable building, moraification and syllabification were also discussed. Hayes' (1989) claim that all the moras are projected in the underlying representation is adopted here, though there are other proposals made by Hyman (1985), Zec (1988) and Bullock (1991). Hayes' proposal, however, seems to handle the underlying contrast of high
vowels and glides as well as geminate consonants and syllabic consonants.

I have also considered the proposals on Korean syllable structure. I argue that the data which were thought to be the evidence for the body-coda structure of the Korean syllable are not strong enough or they can be reinterpreted with respect to moraic structure in the present framework. The "li" irregular verb phonology supports the moraic syllable structure and the underlying moraic representation.

In Part I, we have discussed feature specification, Feature Geometry and syllable structure. In Part II, I will present a comprehensive analysis of the vowel phonology in Korean on the basis of the theoretical assumptions laid out in Part I.
PART TWO

A COMPREHENSIVE ANALYSIS OF

THE VOWEL PHONOLOGY OF KOREAN
Chapter 5

On-glides

5.0. Introduction

In Part I, we have reviewed the various theoretical frameworks in a consistent analysis of the vowel phonology of Korean will be presented. These include feature underspecification theory, feature geometry and syllable structure. We have developed a theory of monovalent underspecification and have proposed a feature geometry that incorporates a branching Place Node along with the possibility of parameterization in the Place Node. We have also adopted McCarthy and Prince's (1986) moraic syllable structure.

In Part II, four different vowels related phenomena in Korean phonology will be dealt with. These include the location of the Korean on-glide in syllable structure, vowel harmony in both ideophones and verbal suffixation, vowel fronting, and vowel coalescence. Each topic will be discussed in separate chapters.

In this chapter, I will discuss the location of on-glides in the syllable structure and the glide formation process. A glide is represented as part of the vowel in the Korean orthographic system. And traditionally, perhaps due to the way glides are represented in Korean orthography, glides have been treated as vowels, and therefore, a sequence like /ya/ is called "diphthong" in prescriptive grammar books. With the re-emergence of the role of the
syllable in phonological description, however, many Korean phonologists have proposed different syllable structures for the description of the Korean syllable, and the status of glides with respect to syllable structure has become one of the interesting issues in Korean phonology.

B-G. Lee (1982), S-C. Ahn (1985) and Gim (1987) propose that the glide is an onset segment, while Kim-Renaud (1978), J-M. Kim (1986), H-S. Sohn (1987a, b), H-Y. Kim (1990), and Y-S. Kang (1991) argue that the glide is a nucleus segment. Sohn (1987b: 104) sums up the controversy concerning the location of the glide in the syllable by observing that a CGVC sequence can be represented in two different ways as shown in (1), which incorporates Levin's (1985) view of syllable structure:

(1) The Different Representations of a Glide

\[ \text{a. Glide in the Onset} \quad \text{b. Glide in the Nucleus} \]

In (1a), the glide is located outside of the nucleus (N), while in (1b) it is represented

\[ \text{I will not deal with two other logically possible representations of an on-glide as shown below:} \]

\[ (a) \quad \text{N} \quad \text{N} \quad \text{N} \]
\[ \text{x} \quad \text{x} \quad \text{x} \quad \text{x} \]
\[ \text{C} \quad \text{G} \quad \text{V} \]

\[ (b) \quad \text{N} \quad \text{N} \quad \text{N} \]
\[ \text{x} \quad \text{x} \quad \text{x} \quad \text{x} \]
\[ \text{C} \quad \text{G} \quad \text{V} \]

J-S. Lee (1992) assumes that a glide can be represented as part of the onset consonant just like in (a), and de Hass (1988) proposes (b) for his explanation of Korean vowel coalescence.
inside of the nucleus. The structures given in (1) can be translated into McCarthy and Prince's
(1986) type of moraic syllable structure as in (2)\(^2\):

\begin{equation}
(2) \quad \text{Moraic Representation of a Glide}
\end{equation}

\begin{itemize}
  \item a. Glide in the onset
  \item b. Glide under a mora
\end{itemize}

\begin{center}
\begin{tabular}{c c}
  \begin{tabular}{c c c c c}
    C & G & V & C \\
   \end{tabular} & \begin{tabular}{c c c c c}
    C & G & V & C \\
   \end{tabular} \\
\end{tabular}
\end{center}

Putting aside certain differences between the representations (1) and (2), which are not
directly relevant to the discussion in this chapter, I will use the syllable structures in (2)
throughout this chapter. One characteristic of McCarthy and Prince's (1986) style of moraic
representation is that the structure is, in some sense, impoverished. There are no intermediate
constituents such as onset, nucleus or coda. I do not think any of these intermediate units have
any formal status in phonological theory. However I will use these terms for the sake of
convenience and in the following manner as they apply to Korean:

\begin{itemize}
\item There are other types of moraic representation of a syllable such as in Hayes (1989) or Hyman (1985) as
discussed in 4.2. (See also Zec (1988).) If we adopt Hyman's (1985) mora-only representation, the
controversy over the location of a glide in the syllable structure is trivialized since both the onset and
nucleus elements are dominated by a mora as shown below:

\begin{center}
\begin{tabular}{c c c c c}
  \begin{tabular}{c c c c c}
    C & G & V & C \\
   \end{tabular} \\
\end{tabular}
\end{center}

Since, the topic of this chapter is the structure of onset, I will not be concerned about Hyman's
syllable structure.
(3) Description of the Terminology

Onset : Any segment (or segments) that is placed before a mora in a syllable.

Nucleus : Any segment (or segments) dominated by a mora

Coda : Any segment that follows a mora in a syllable.

The aim of this chapter is mainly to compare the structures in (2a) and (2b) against various data in Korean to see which representation is more adequate in describing Korean phonology. Previously, Sohn (1987a, b) claimed that glides should be represented as a part of the nucleus on the basis of phonotactic data and language game data. For her, (1b) or (2b) is the correct representation. I will call this approach the Nucleus Hypothesis (= NH). H-S. Sohn (1987b), Kim and Kim (1990) and H-Y. Kim (1991) present a comprehensive array of data that argue for the NH. However, in this chapter, I will make a different claim by arguing that glides should not be represented as part of the nucleus rather they should be represented as part of the onset. This Onset Hypothesis (= OH) is reflected by the representation (2a).

After the discussion on these two hypotheses, I will briefly discuss glide formation in Korean in 5.3. The focus of the discussion is on obligatory glide formation which is not accompanied by compensatory lengthening. As an extension of the discussion in 4.3.2, I will propose that exceptional glide formation can be explained by positing nonmoraic vowels in underlying representation.³

³The discussion in 5.1 and 5.2 is based on the earlier version of Y. Lee (1992b).
5.1. The Onset Hypothesis

In this section, I will introduce the arguments from vowel clash, vowel harmony, onset simplification, (i.e. nucleus degemination), language game data, and phonotactic constraints that will be shown to support the onset hypothesis for Korean glides.

5.1.1. Hiatus Resolving

Hiatus, or vowel clash, is strongly avoided in many languages. Translating the vowel clash into syllable phonology, we may say that hiatus resolving is the process of minimizing onsetless syllables. This is well expressed by Itô’s (1989:227) onset principle:

(4) Onset Principle
Avoid $\sigma | V$

The Onset Principle, though it is not obligatory in Korean, can be viewed as the basic guideline for syllabification and resyllabification. Whenever onsetless syllables are encountered in the course of phonological derivation, certain changes take place to conform to create a syllable with an onset element such as consonant insertion, glide formation or vowel deletion.

With this in mind, let’s consider vowel clashes in Korean. In Korean, when two heterosyllabic vowels are adjacent on the melodic tier, one of the following changes takes place to resolve the vowel clash:
Resolving Hiatus in Korean

a. Glide Formation:

(Make the first vowel into a glide if it is less sonorous than the second.)

\[ \text{chi} - u \rightarrow \text{chiw} \] (to clean)

\[ \text{mo} - a \rightarrow \text{mwa} \] (to gather)

b. Vowel Coalescence

\[ \text{thinte} \rightarrow \text{thente} \] (perhaps)

\[ \text{kail} \rightarrow \text{ka:l} \] (Fall)

c. Glide Insertion

\[ \text{Minsu} - a \ (\text{vocative}) \rightarrow \text{minsuya} \ (\text{Oh, Minsu}) \]

\[ \text{phae - ø} \rightarrow \text{phæyaø} \] (to come to ears)

It is seen from the data that the outcome of glide formation and glide insertion do not violate the Onset Principle; they can be understood as a result of (4) in that there is no onsetless syllable. Such an explanation is possible only when we take the glide to be an onset segment in Korean. Notice that if glides are nucleus segments, the changes are left unexplained, since, then, glide formation or glide insertion would not help to resolve the vowel clashes. Consider the schematized glide formation under the Nucleus Hypothesis as given in (6):

(6) Glide Formation in NH
The output of glide formation in (6) creates another onsetless syllable. The NH cannot explain why glide formation would take place in Korean. Further the glide insertion in (5c) is left unexplained. The OH has a simple explanation that glides are inserted to get rid of onsetless syllables in surface representations. Seen from this point, glide insertion makes the output less marked in terms of their syllable structure. The NH has no explanation for glide insertion. Notice that glide insertion has no motivation under the NH and thus cannot point to the generalization that glides are inserted only between two vowels. The output of glide insertion, as is the case in glide formation is another onsetless syllable. These changes are viewed as very natural given the Onset Principle in (4).

5.1.2. Vowel Harmony

Vowel harmony in Korean will be extensively dealt with in Chapter 6. In this subsection, I will concentrate on the relevant vowel harmony phenomena related to the issue of the location of Korean on-glides in syllable structure. I also hope that the discussion in this subsection will serve as an introduction to Chapter 6.

In Korean, the light vowels, /æ/, /a/ or /o/ alternate with the dark vowels /e/, /ə/ or /u/ in ideophonic expressions and in the verbal morphology. High vowels /i/, /ɪ/ and possibly /u/ alternate with the light vowels in the initial syllable of ideophonic words but they remain unchanged in the non-initial syllable as exemplified in (7):

---

4Following the discussion in 4.3.2, I assume that some of the vowels are represented without moras in the underlying representation. (See 5.3 and 8.3 for further discussion on nonmoraic vowels.)
(7) **Ideophone Vowel Harmony**

<table>
<thead>
<tr>
<th>Dark forms</th>
<th>Light forms</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>hintil</td>
<td>hantil</td>
<td>waving</td>
</tr>
<tr>
<td>pisil</td>
<td>pæsil</td>
<td>staggering</td>
</tr>
<tr>
<td>puphul</td>
<td>pophul</td>
<td>swelling</td>
</tr>
</tbody>
</table>

It is generally agreed (see Sohn (1987b), and Y-S. Kim (1988)) that the forms with dark vowels are thought to be the base and the light forms are derived from the dark forms by the following processes:

(8) **Light Form Derivation**

a. Introducing a harmony feature as a part of a morphological process and linking the harmony feature to the first vowel.

b. Spreading of the harmony feature to the subsequent syllables, skipping high vowels.

Deferring the relevant discussion to Chapter 6, I will assume that the harmony feature is [RTR] in Korean. The target of the linking is the moraic or nucleus segment. Now if a glide is part of the onset, the prediction is that the glide will not be the target of harmony feature linking or spreading. But if a glide is treated as a vowel, in other words, if it is in the nucleus, we might expect that these glides will participate in the vowel harmony in the linking process in (8a). 

---

5 H-S. Sohn (1986, 1987b) and McCarthy (1983) say that the harmony feature is [+low], while Y-S Kim (1984, 1988) and J-W. Kim (1988) claim that the harmony feature is [+RTR] (or [+DVR]). The controversy does not concern us here. Vowel harmony will be dealt with in Chapter 6.

6 By virtue of being underlying high vowels, glides will not participate in the harmony spreading in (8b), regardless of their location in the syllable.
Now, observe the following dark and light vowel ideophones:

(9) Dark and Light Ideophone Alternation

<table>
<thead>
<tr>
<th>Dark ideophone</th>
<th>Light ideophone</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>kh(w)uŋ</td>
<td>kh(w)uŋ</td>
<td>banging</td>
</tr>
<tr>
<td>wiŋ wiŋ</td>
<td>wæŋ wæŋ</td>
<td>buzzing</td>
</tr>
<tr>
<td>wucicik</td>
<td>wacicik</td>
<td>cracking</td>
</tr>
<tr>
<td>syuŋ syuŋ</td>
<td>syoŋ syoŋ</td>
<td>whizzing</td>
</tr>
<tr>
<td>(y)ilkucta</td>
<td>yalkucta</td>
<td>queer</td>
</tr>
<tr>
<td>hwi hwi</td>
<td>hwæ hwæ</td>
<td>round about</td>
</tr>
<tr>
<td>kʰwi kʰwi</td>
<td>kʰwæ kʰwæ</td>
<td>foul smelling</td>
</tr>
</tbody>
</table>

In all of the above examples, glides are not affected by the harmony process. This is quite straightforward given the Onset Hypothesis. We may define that the linking target is a moraic segment, and since glides are part of the onset, they are not the target of the [RTR] linking. Here is the sample derivation with the last word of (9):

(10) Sample Derivation with "foul smelling"

The harmonic feature [RTR] is linked to the first moraic segment. Seen from this
viewpoint, glides do not participate in the harmony process, simply because they are not moraic. Under the NH, the derivation would be like (11):

\[ (11) \quad \text{Wrong Derivation Predicted by NH} \]

\[ \begin{array}{c}
\text{k}^h & \text{u} & \text{i} \\
\text{[rnd]} & \text{[front]} & \text{[RTR]}
\end{array} \rightarrow
\begin{array}{c}
\text{k}^h & \text{o} & \text{i} \\
\text{[rnd]} & \text{[front]} & \text{[RTR]}
\end{array} \]

(\* k^h \text{ oi})

We see here that the NH makes the wrong prediction that glides will also participate in the harmony process since they are part of the nucleus and there is no way to distinguish a vowel from a glide either by structural description or by feature combination.

Perhaps under the NH, it would be possible to redefine the target of the harmony feature linking. I would not venture into this possibility. In any case, it is neither the first vowel nor the first nucleus segment or the first moraic segment. It may not be an easy task to define the target of the harmony feature linking under NH without introducing the head of a mora.

On the other hand, the OH can provide quite simple and consistent explanation to the vowel harmony data. The target is the moraic segment of the first syllable. With the OH, it is shown here that the vowel harmony process is very sensitive to the structural information of segments within a syllable. Therefore the OH can provide a much more consistent and general analysis for the vowel harmony data, and such is not available for the NH.
5.1.3 Onset Simplification

A glide and vowel sequence is often fused into one segment in Korean, which Sohn (1987a, b) refers to as nucleus degemination. This phenomenon is witnessed in colloquial standard Korean as well as in the Kyungsang (=KS) dialect.\(^7\) Consider the following examples:

(12) Examples of Nucleus Degemination

\[
\begin{align*}
\text{p'yam} & \sim \text{p'æm} \quad \text{(cheek)} \\
\text{kyə} & \sim \text{ke} \quad \text{(chaff)} \\
\text{pinyo} & \sim \text{pine} \quad \text{(a stick hair pin)} \\
\text{myorni} & \sim \text{menili} \quad \text{(a daughter-in-law)} \\
\text{pyəlak} & \sim \text{pelak} \quad \text{(thunder)}
\end{align*}
\]

H-S. Sohn (1987a, b), refuting C-W. Kim's (1968) metathesis analysis claims that the process can be viewed as merging two nucleus segments into one as schematically shown in (13):

(13) Nucleus Degemination

\[
\begin{array}{c}
\text{N} \\
\text{X} \\
\text{X} \\
\text{F} \\
\text{[F]} \\
\text{G} \\
\text{[G]}
\end{array}
\quad \begin{array}{c}
y \\
\text{[front]} \\
\text{open}
\end{array}
\quad \quad + \\
\quad \begin{array}{c}
\theta \\
\text{[front]} \\
\text{open}
\end{array}
\quad \rightarrow \\
\quad \begin{array}{c}
e \\
\text{[front]} \\
\text{open}
\end{array}
\]

\(^7\)In the KS dialect the nucleus degemination is obligatory, while both forms co-exist in Standard Korean.
One interesting observation we can make here is that the output of the nucleus degemination is a short vowel, unlike the case of coalescence in which two nucleus segments get together to make one long vowel. Thus Sohn formulates a double delinking rule for the nucleus degemination that involves the deletion of features as well as the deletion of an x-slot. However I argue that the process is actually an onset simplification process, which is schematically shown in (14):

(14) Onset Simplification

Though both the Nucleus Degemination analysis and Onset Simplification analysis can successfully account for all the variation in (12), these two analyses make very different predictions about the triggering factor of the phonological change. The Nucleus Degemination says that the presence of the two different elements under a nucleus triggers the process, while the Onset Simplification argues that the preceding consonant is the trigger. There is no example of a Korean word where a word initial GV sequence undergoes the Nucleus Degemination. This is more dramatically shown in the KS dialect where the Onset Simplification is obligatory as shown in (15):

(15) More Examples on Nucleus Degemination

a. kyọca ~ keca (mustard)
Examples from the KS dialect clearly support the Onset Simplification analysis by showing that in spite of the obligatory nature of the Nucleus Degemination process in the KS dialect, the word initial GV syllable does not undergo the process and that the optional degemination is not applicable to GV syllables in the Standard dialect. My proposal for the KS dialect is that there is a syllable onset constraint that there must be just one onset consonant in the KS dialect, which I will call the Single Onset Consonant Constraint (=SOCC). The Onset Simplification, then, can be viewed as a process of making syllables less marked; it is obligatory in the KS dialect and optional in the Standard dialect.

On the other hand, the NH will have to make a certain *ad hoc* provision that the nucleus degemination is not applicable to onsetless syllables or that glides are syllabified into the onset when it is not preceded by any other consonant in the same syllable and they are syllabified into the nucleus when they follow a consonant within a syllable. No such provision is needed under the Onset Hypothesis to account for the failure of nucleus degemination in glide-initial words. Given these comparisons, we see that the OH is much superior to the NH in explaining the interaction between glides and consonants.

### 5.1.4. Language Game

In this subsection, we will consider language games in Korean and will discuss how these data are related to the location of glides in syllable geometry. In Korean, there is an interesting language game that duplicates each syllable with some operations on the duplicated
syllables. Following Gim (1987), I will call this CV insertion language game "Popuri" language. First observe the following data:

(16) Popuri Language Forms

<table>
<thead>
<tr>
<th>Lexical Word</th>
<th>Reduplicated Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>satali (ladder)</td>
<td>sa-pa-ta-pa-li-pi, sa-ka-ta-ka-li-ki</td>
</tr>
<tr>
<td>camsil (place name)</td>
<td>ca-pam-si-pil, ca-kam-si-kil</td>
</tr>
<tr>
<td>salam (man)</td>
<td>sa-pa-la-pam sa-ka-la-kam</td>
</tr>
</tbody>
</table>

Roughly speaking, the Popuri language forms are derived from lexical words by adding CV at the end of each vowel segment. I will follow McCarthy and Prince's (1986) syllable reduplication analysis: a core syllable is reduplicated after each syllable with coda consonant being extrametrical and the phonemic overwriting process will delink onset elements of the reduplicated syllable and link certain specified consonants such as /p/, /k/ or /s/. Here is the sample derivation of the language game form of the last word of (16):

(17) Exemplary Derivation of Popuri Form with "man"

(Reduplicated syllables are represented in bold face.)

---

8Please refer to Marantz (1982) for a different analysis in the CV framework.
Now, suppose the input of the Popuri language has a glide. We can see that the OH and the NH make different predictions in this case. The OH predicts that the glide will not appear in the reduplicated syllable, since the glide will be delinked, or erased, in the phonemic overwriting process. Onset delinking will delink any onset segment including glides. On the other hand, the NH will predict that the glide will appear in the reduplicated syllable, since glides are not subject to the onset delinking process by virtue of the fact that they are part of the nucleus.

Observe the language game forms of word that contain glides in (18) (See also Gim (1987), Y-S. Kang (1991), J-S. Lee (1992), Y. Lee (1992a)):

(18) Additional Popuri Language Forms

hakkyo (school) → ha-pak-kyo-po *ha-pak-kyo-pyo
yŏŋkam (grandpa) → yŏ-ŋ-ka-pam *yŏ-ŋ-ka-pam
kwŏ nthu (boxing) → kwŏ-ŋ-tḥu-pu *kwŏ-ŋwŏ-ŋ-tḥu-pu
hyŏŋkwănțiŋ (florescent lamp) → hyŏ-ŋ-kwa-ŋ-ťiŋ-piŋ

* hyŏ-ŋ-kwa-ŋwŏ-ŋ-ťiŋ-piŋ

It is clear from the data in (18) that the phonemic overwriting process overwrites not only consonantal onset segments but also glides, if there is any in the reduplicated syllable. I take this as relatively strong evidence that glides are part of onset in the Korean language.

One problem that arises is Kim and Kim's (1990) data (also reflected in H-S. Sohn (1987b), H-Y. Kim (1991)) of the same language game. They claimed that Popuri language forms support the Nucleus Hypothesis. In their data, the acceptable and unacceptable forms are reversed. Consider some of their data:
Different Output of Popuri Language Forms.

yaku (baseball) → ya-pya-ku-pu \(^*\)ya-pa-ku-pu

kwonse (power) → kwɔ-pwɔn-se-pe \(^*\)kwɔ-pan-se-pe

cwasok (seat) → cwa-pwa-sɔ-pɔk \(^*\)cwa-pa-sɔ-pɔk

If these data are correct, it would weaken the argument in this subsection. I do not have any explanation for how to incorporate Kim and Kim's data to the present theory. However, I think I can make a couple of observations for the language game data in (19).

The CV insertion language game has been widely used for some age group among Koreans. Many of them used to play this language game from their preschool days throughout their elementary school days and even after. I have surveyed many Korean speakers who know this language game, and almost all of their language game forms show that glides do not appear in the reduplicated syllables. Therefore I have reasonable doubt about the source of the data in (19).

If the data in (19) came from the speakers not accustomed to this language game, then I will venture to make the second observation which is related to Korean orthography. Most Korean native speakers, as was mentioned in the introduction, were taught that glides are vowels and a glide plus vowel sequence is a diphthong. Further, Korean glides are represented either as part of a vowel or as a separate vowel in Korean orthography. The round glide has the same shape as the vowel /o/ or /u/\(^9\). And the front glide [y] is represented by adding one short bar, either horizontal or vertical, to the vowel. Here are some examples of orthographic representation of glides:

\(^9\)To be more specific, I will have to say that the round glide has two different forms in the Korean orthography. [w] is represented in the orthographic form of /o/, when it is followed by /a/ or /e/, otherwise it is represented in the orthographic form of /u/.
If a Korean subject who does not know this language game is asked to insert a consonant-vowel sequence after each vowel, then chances are that the person, being unable to give the instant output of the language game form, may stick to the graphic forms of Korean letters and will literally draw out the language game outputs with conscious effort. And in the course of doing this, they will simply copy the vowel shape onto the reduplicated syllable. The result is the inadvertent transfer of the entire vowel shape, including glides, hence the appearance of glides in the resultant Popuri language output. The point is that, in this type of experiment, what the subjects are doing is the manipulation of the written symbols. They are not dealing with the linguistic units of pronunciation. Seen from this viewpoint, given the orthographic representation of glides, it is quite understandable that some who do not know the language game will produce (19).

10 I would offer a similar account to the vowel switching language game introduced by Sohn (1987b). Sohn argues that glides are nucleus elements with the following language game output:

\[
\begin{align*}
\text{kalyŋ} \text{ (if)} & \rightarrow \text{kyəlŋ} & \text{*kəlyŋ} \\
\text{həyəl} \text{ (cooling)} & \rightarrow \text{hyəəl} & \text{*həyəəl} \\
\text{sunyu} \text{ (nun)} & \rightarrow \text{syənu} & \text{*sənyu}
\end{align*}
\]

As Sohn admits, the vowel switching game is not a natural language game. I have found that this is a very difficult game for me and for many other Korean speakers as well. Given the difficulty of the game and the orthographic forms of glides, I would say that what the subjects are operating on in such a language game is written symbols and not speech segments. The language game data, from this point of view, can be treated as an artifact from the orthographic forms.
One piece of supporting evidence for the observation made here is the language game data that I collected from preschool children. Informally, I made group contact with seven Korean speaking children, ages between four and seven living in Bloomington, Indiana, who did not yet have full control of Korean orthography. I gave them the exemplary derivations with control words that did not contain glides. When they became comfortable with the language game, I asked them to produce the language game forms for the words with glides. The targets words, words with glides, were interspersed among other control words that did not have glides.\footnote{The control and target words are as follows:  
\begin{tabular}{lll}
Control words: & salam (man) & tali (leg) \\
 & kunin (soldier) & iŋki (ink) \\
 & æhyim (morning) & Æmma (mother) \\
 & kamca (potato) & Æmi (ant) \\
Target words: & hakkYo (school) & yœca (woman) \\
 & sakwa (apple) & waŋ (king) \\
\end{tabular}}

There were individual differences in their performance. Three of them were quite good at this language game, while others, especially the youngest one, seemed to have difficulty in producing the language game outputs.\footnote{The typical type of mistake was to insert -pa- after every vowel.} The interesting result is that the language game forms produced by the three good performers do not have glides in the reduplicated syllable in such target words as /hakkYo/ (school), /yœca/ (girl), /sakwa/ (apple) and /waŋ/ (king). I take this result as strong evidence that glides are not copied onto the reduplicated syllable, and so they are not part of the nucleus.

To sum up, if we take out the possible interference of the orthographic forms from the language game discussed in this subsection, and/or if we collect data from those who are quite accustomed to Popuri language, we can safely say that the data given in (18) truly reflect the
syllable structure of Korean. The careful analysis of the language game, therefore, actually supports the Onset Hypothesis.

5.1.5. Phonotactic Constraints

Sohn (1987a,b) claims that there is no phonotactic constraint, or co-occurrence restriction, that holds between consonants and glides. She said that the lack of phonotactic constraints between a consonant and the following glide provides an argument *ex silentio* against the Onset Hypothesis. Further, she argues that any consonant can be followed by any "diphthong" (the diphthong here means a glide-vowel sequence). However it should be pointed out that there are underlying constraints that hold between consonants and glides in Korean. Given in (21) are the impossible sequences:

(21) Phonotactic Constraints between Consonants and Glides

a. labial consonant - round glide (*[labial] [labial])
   *pw, *mw (/pu/ and /mu/ are wellformed sequences.)

b. alveolar consonant - palatal glide (*[coronal] [coronal])
   *sy, *chy (/si/ and /ch'i/ are well formed sequences.)

We might also say that there is a very strong constraint in a Korean onset cluster under the Onset Hypothesis: the second member of a consonant cluster should be a glide.

H-S. Sohn (1987a, b) focuses on introducing some phonotactic constraints that hold between glides and vowels (in her term, between two nucleus segments). Her observation can be summarized as in (22):
(22) Phonotactic constraints between glides and vowels

a. *[+high, -round] [+high, -round] (*yi, *yi)

b. * [+round] [+round] (*wu, *wo)

Now we have the argument from both sides. There are phonotactic constraints between consonants and glides as well as between glides and the following vowels. However, the phonotactic constraints given in (21) and (22) are very different from each other. In the examples given in (21), the constraint disallowing pw, sy while permitting pu, si clearly shows that the glides are different from vowels. Since [w] and [u] as well as [y] and [i] are both supposed to share the same features the difference should be incorporated by its location. I argue that the phonotactic constraints in (21) are the real evidence for the subsyllabic structure of a syllable.

Turning to (22), we find that we have [yi] sequence at least in the ideophone in order to explain the ilkucta ~ yalkucta alternation as shown in (9). If we exclude yi from the constraints in (22), we see that all the three remaining impossible combinations (yi, wu, and wo) are the sequence of phonetically very similar segments. The occurrence of such sequences (especially yi and wu) is rare cross-linguistically. Ohala and Kawasaki (1984: 122) claim that the combination of these two similar sounds fails acoustically to create "minimal difference" or "minimal modulation" and that is why the sequence is universally rare. Therefore the constraint in (22) can be explained by the universal tendency of avoidance of non-optimal sounds. Further we find that not only wu or yi, but also the heterosyllabic uu or ii are rarely found in Korean. I take these observations as relatively strong evidence for the Onset Hypothesis.
5.2. Re-examining Data Supporting the Nucleus Hypothesis

In this section, we will examine some other data that are supposed to support the NH. We will discuss coda cluster simplification, the l/r alternation, and reduplication data from ideophones. We will show either that these do not constitute a strong argument against the OH or that the data can be reanalyzed under the OH without any additional complication or exception.

5.2.1. Cluster Simplification

In Korean, only one obstruent is allowed in the onset and one in the coda. Kim and Kim (1990) used cluster simplification to argue for the Nucleus Hypothesis. Let's first briefly review their arguments. Observe the following data from Kim and Kim (1990):

(23) Cluster Simplification

a. kaps "price" kaps -i (Nom), but kap-man "price only"

b. noks "spirit" noks -i (Nom), but nak-to "the soul also"

c. ilk- "to read" ilk -ala (Imp), but ik-ca "let's read"

d. cølm- "young" cølm -in (adj), but cøm-ciman "though young"

(24) Lack of Cluster Simplification

a. ol-pyo "this year's crop"

b. kak-pyo "each vote"

c. sil-kwa "fruit"

d. cøl-myo "exquisiteness"
According to Kim and Kim's (1990) analysis of (23), one of the first two consonants disappears when they are immediately followed by a third consonant. In (23a) and (23b), the second consonant is deleted, while in (23c) and (23d), the first consonant is deleted. In (23a), when /ps/ is followed by a vowel, a nominative marker in this example, both consonants appear. However if another consonant, /m/, follows, all of a sudden /s/ disappears. Now the crucial data are given in (24). Here the segment that follows the two consecutive consonants is a glide. If glides are vowels, then we won't get cluster simplification, just like in the second column of (23). However, if glides are consonants, then we are supposed to find the same cluster simplification process as in (23). The data (24) show that if the third segment is a glide, no consonants are deleted. Kim and Kim interpret this to mean that glides are not consonants, which in turn mean that glides are not onset elements.

There is one thing we have to note here. I think the analysis given above presupposes that consonant cluster simplification is a rule that refers to the sequence of consonants. If so, the analysis clearly reflects the demerits of a rule approach to consonant cluster simplification. Also notice that the rule approach cannot say anything about when two consonants are placed at the end of a word. The analysis would say that cluster simplification takes place when two consonants are followed by the third consonant or by a word boundary. In other words, the environment of cluster simplification is "_____ {C, #}". Kahn (1976) convincingly showed that whenever "_____ {C, #}" serves as the environment of a rule application, that rule can be reanalyzed in reference to the syllable structure.

Cluster simplification is not a separate rule but a natural result of the syllabification process. Consider the syllable structure proposed by the OH and the NH in (25):
The NH can explain the data neatly with the structure in (25b). According to the NH, only a single consonant is allowed both in the onset and in the coda in Korean. Therefore if there are three consonants in a row, all of them cannot be incorporated into a syllable, and unincorporated consonants are doomed to be erased by the Stray Erasure Convention as in Itô (1986). Since glides are not counted as consonants, the two consonants that precede the glide will be syllabified: the first one will be syllabified as a coda of a syllable and the second consonant will be syllabified as an onset of the next syllable. And if there are two consonants at the end of a word, one of them will be erased since Korean syllable structure allows no more than one element in the coda.

Notice, however, the OH can also equally handle the data. There is a constraint that a second member of an onset is a glide. When three consonants come together, one of them cannot be syllabified, given the syllable structure in (25a). But if the third one is a glide, then the syllable template allows a consonant-glide cluster in the onset and therefore all three can be syllabified, unless, of course, such a sequence is located at the beginning of a word.

As such, both the OH and the NH can explain the cluster simplification. That the NH can explain the data given in (23) and (24) does not mean only the NH can provide a correct account. Therefore the argument against the OH on the basis of cluster simplification is not strong enough.
A final remark on the onset consonant cluster is in order: in the literature, there is a generally accepted assumption that clusters are allowed neither in onset nor in coda in Korean (cf. Kim-Renaud (1978), H-S. Sohn (1987b) and J-W. Choe (1986)). This assumption is generated under the traditional notion that glides are nucleus elements. Under the view that a glide is part of the onset, a glide could be preceded by another consonant in a syllable as the syllable structure (25a) shows. Further, by allowing this type of consonant cluster in the onset, it does not mean that any two consonants can come together in an onset. The second member of the onset cluster should be a glide. This can be easily formalized by positing a Syllable Structure Constraint that disallows the sequence of two consonantal root nodes pre-moraically within a syllable.

5.2.2.  l/r Alternation

In Korean, the l/r contrast is not phonemic. These two sounds are in mutually exclusive environments. Traditionally, it is thought that [l] is the underlying segment and this sound becomes [r] when it is placed in between two vowels. Kim and Kim (1990) reanalyzed the l/r alternation in Korean and suggest that the liquid is realized as [l] in the syllable coda position and as [r] when it is placed in the onset position of a syllable. Observe the data from Kim and Kim (1990):

(26)  l/r Alternation in Korean

<table>
<thead>
<tr>
<th></th>
<th>a. kil (street)</th>
<th>kil-to (street also),</th>
<th>cf. kil-e [kire] (the street (Loc.))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tal (moon)</td>
<td>tal-pi^h (moon-light),</td>
<td>cf. tal-i [tari] (the moon (Nom.))</td>
</tr>
<tr>
<td></td>
<td>pul (fire)</td>
<td>pulk'oe^h (flame),</td>
<td>cf. pul-i [puril] (fire (Acc.))</td>
</tr>
</tbody>
</table>
Kim and Kim (1990) say that the data in (26) argue for the NH. Onsetless syllables are highly marked universally, and glides are syllabified into a nucleus. Therefore whenever the glide is preceded by a consonant, that consonant should be syllabified in the onset position. Their analysis is very simple and consistent. I will not argue that their analysis is wrong in this subsection.

However, I claim that the data in (26) are not incompatible with the OH. It must be made definitely clear that both the Onset Hypothesis and the Nucleus Hypothesis will take the liquid and make it as a part of the onset as the following structure shows:

(27) The Representation "Sunday"

As shown in (27), both approaches observe the Maximal Syllable Onset Principle. An additional observation comes from Kyungsang dialect variation. In the KS dialect, the words in (26b) are pronounced with the [l] sound instead of [r] unlike the prediction made by the NH. In other words, KS dialect speakers' pronunciation corresponds to the asterisk-marked pronunciation of the words in (26b).
Under the OH, we can see that the explanation is straightforward. Given the Single Onset Consonant Constraint in the KS dialect (cf. discussions in 5.1.3.), the liquid sound will be syllabified as a coda consonant as shown in the following example:

\[(28) \quad \text{The Syllable Structure of "Sunday" in the KS Dialect}\]

\[
\sigma \\
\mu \\
i
\sigma \\
\mu \\
i
\sigma \\
\mu \\
i
\sigma \\
\mu \\
i
\]

We can see that the liquid segment in question cannot become an onset element of the second syllable in (28) because of the Single Onset Consonant Constraint (SOCC) that holds in the KS dialect. The SOCC forces the liquid to be syllabified as a coda of the first syllable as shown in (28). Therefore it is fully predictable that liquid segments which come before glides will be realized as [l] in the KS dialect. Of course, it is correctly predicted that the KS dialect pronunciation of liquids in the words in (26a) are exactly like the standard dialect.

On the other hand, the NH may not successfully handle the KS dialect, without the assumption that glides are onset segments in the KS dialect but a nucleus segment in the Standard dialect (cf H-Y. Kim (1991: 12-13)) or that the KS dialect allows and actually prefers onsetless syllables. Neither of the alternatives can be incorporated in the present framework. The second alternative cannot be taken since it goes against Itô's (1989) and Steriade's (1988) claim that the unmarked setting of the onset parameter is the obligatory onset. The overall phonology of the KS dialect and Korean phonology in general for this matter actually argues against the internal onsetless syllable structure.

One other piece of evidence supporting the Onset Hypothesis comes from J-S. Lee's
(1992) observation regarding the l/r alternation in the Standard dialect. She argues that onset incorporation across the word boundary is optional in Korean. Consider the following examples:

(29) Optional l/r Alternation (data from J-S. Lee (1992: 42))

\[
\text{mul (water) + oli (duck) } \rightarrow \text{ [mulori] or [murori]}
\]

\[
\text{sikol (country) + ai (kid) } \rightarrow \text{ [sikolai] or [sikorai]}
\]

J-S. Lee (1992) observes that [r] appears in normal speech and [l] appears in slow and careful speech. The [r] forms, however, do not show up if the second member of the compound is glide initial as shown in (30):

(30) Lack of Alternation

\[
\text{hæmul (see food) + yoli (dish) } \rightarrow \text{ [hæmulyi] or *[hæmuryi]}
\]

\[
\text{sikol (country) + y`ca (woman) } \rightarrow \text{ [sikoly`ca] or *[sikory`ca]}
\]

If vowel initial syllables and glide initial syllables are both nucleus initial, the NH cannot deal with the data given in (30) since the NH would predict that vowel initial and glide initial syllables should behave the same way. However, with the Onset Hypothesis, we can argue that the process in (29) is to provide an onset to the vowel initial syllable of the second member of the compound. Consequently the process is not applicable to (30) since the second member of the compound already has an onset.

It has been clearly shown that the OH and not the NH can handle all the relevant data on the l/r alternation. This strongly suggests the correctness of the OH.
5.2.3 Reduplication and Onset Deletion

In Korean, there are many interesting reduplicative ideophones. Consider the following examples:

(31) Reduplicated Ideophones

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>hintil-hintil</td>
<td>sway</td>
</tr>
<tr>
<td>mallan-mallan</td>
<td>flabby</td>
</tr>
<tr>
<td>chullon-chullon</td>
<td>overflowing</td>
</tr>
<tr>
<td>pintun-pintun</td>
<td>loafing</td>
</tr>
</tbody>
</table>

The first and the second parts of the ideophones which are separated by hyphens in the examples are exactly identical to each other. Further, there are some ideophones that seem to show other processes in addition to reduplication. Observe the following data:

(32) Ideophones with an Additional Process

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>aki-caki</td>
<td>sweet</td>
</tr>
<tr>
<td>osun-tosun</td>
<td>friendly</td>
</tr>
<tr>
<td>ulkit-pulkit</td>
<td>colorful</td>
</tr>
<tr>
<td>alluk-tolluk</td>
<td>stained</td>
</tr>
<tr>
<td>als'onen-tals'onen</td>
<td>ambiguous</td>
</tr>
</tbody>
</table>

Looking at the data, we can see that some other process than simple reduplication occurs here. What is interesting to note is that the first part of the words in (32) is vowel initial, while the second part is consonant initial. As a matter of fact, the first part is exactly
the same as the second part except that there is no consonant in the initial position. One way of analyzing these data is to say that the second part is the base form. And these base forms undergo the process of prefixal full reduplication with the onset of the reduplicated forms being lost, presumably by an ideophone specific rule of onset deletion. I would not try to formalize the process here. All we have to note here is that there is $\emptyset$–C contrast between the first and the second halves of the ideophones.¹³

Now suppose that there is an ideophone that contains an initial consonant-glide cluster along with the type of reduplication in (32). Kim and Kim (1990) assume that if the glides are treated as an onset, it will not appear in the ideophone initial position, and if they are truly nucleus segments, they will not be deleted. Kim and Kim (1990) present the following additional data:

(33) Additional Reduplicated Ideophones

<table>
<thead>
<tr>
<th>English</th>
<th>Korean</th>
</tr>
</thead>
<tbody>
<tr>
<td>tasty</td>
<td>yam-nyam</td>
</tr>
<tr>
<td>vivid</td>
<td>yak-lyak</td>
</tr>
<tr>
<td>teasing</td>
<td>yon-nyon</td>
</tr>
</tbody>
</table>

Apparently, the glides in the examples in (33) do not seem to be deleted in the word-initial position. These data, therefore, may be used to argue for the Nucleus Hypothesis, if they belong to the ideophones in (32). But we have to take into consideration some restricted distribution of the type in (33) along with other phonological processes that can be found in Korean. We have to pay attention to the fact that all the ideophone examples in (33) have front glides [y] in the stem. There is no single example of this type that has a round glide in it. Further, the ideophone stems of this type all begin either with a coronal nasal or with a

¹³Please refer to J-S. Lee (1992: 126-128) for detailed discussion.
liquid. We cannot find any example of this type that begins with any other consonant. Since these gaps are so systematic, we will have to reconsider the analysis of the ideophones in (33). What I claim here is that the ideophones in (33) do not belong to the category of ideophones in (32). Rather, they belong to the ideophones in (31).

This claim is supported by other phonological processes that can be found in Korean. In the Korean language, all liquids are alveolar sounds, and those liquids are changed into the homorganic nasal, [n], on the surface level, when they are placed in word initial position as exemplified in (34):

(34) l/n Alternation in Word Initial Position

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>khwæ</td>
<td>- lak</td>
<td>(pleasure)</td>
</tr>
<tr>
<td>kiŋ</td>
<td>- lo</td>
<td>(work)</td>
</tr>
<tr>
<td>mi - læ</td>
<td>(future)</td>
<td></td>
</tr>
<tr>
<td>maŋ - lu</td>
<td>(a watch tower)</td>
<td></td>
</tr>
<tr>
<td>nɐk - wən</td>
<td>(paradise)</td>
<td></td>
</tr>
<tr>
<td>no - tʊŋ</td>
<td>(labor)</td>
<td></td>
</tr>
<tr>
<td>nɐ - il</td>
<td>(tomorrow)</td>
<td></td>
</tr>
<tr>
<td>nu - kɐk</td>
<td>(a pavilion)</td>
<td></td>
</tr>
</tbody>
</table>

Another relevant phonological process that we have to note here is the alveolar nasal deletion phenomena in Korean. When [n] is placed in word initial position and is followed by a front vowel or a front glide, they do not appear in the surface forms. The relevant examples are given in (33):

(35) Alveolar Nasal Deletion in Korean.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>su - nyo</td>
<td>(nun)</td>
<td></td>
</tr>
<tr>
<td>paŋ - nyo</td>
<td>(urination)</td>
<td></td>
</tr>
<tr>
<td>sip - nyoŋ</td>
<td>(ten years)</td>
<td></td>
</tr>
<tr>
<td>yə - ca</td>
<td>(woman)</td>
<td></td>
</tr>
<tr>
<td>yo - to</td>
<td>(urethra)</td>
<td></td>
</tr>
<tr>
<td>yəŋ - mal</td>
<td>(year end)</td>
<td></td>
</tr>
</tbody>
</table>
Now, if the liquid is placed in the word initial position and is followed by a front vowel or a front glide, that liquid will become an alveolar nasal by the process shown in (34) and that nasal will be delinked by the process which is responsible for the alternation in (35). Therefore a liquid sound or an alveolar nasal will not appear in word-initial position before a front glide in the surface representation of any Korean word.

With these observations, let's reconsider the data given in (35). All the examples in (35) have either liquids or nasals, and they are followed by front glides. We do not have a single ideophone of this type, which has a consonant other than a liquid or an alveolar nasal. Given such restrictions, we may say that the deletion of liquids or alveolar nasals may not be the result of the ideophone specific onset deletion process. The examples in (33), therefore, can be reanalyzed, as full reduplication like those in (31), but they additionally undergo liquid to nasal change along with nasal deletion in word initial position.

As such, if we take into consideration other phonological processes in Korean, the examples of ideophones in (39) can be explained naturally within the Onset Hypothesis. These examples thus do not exclusively support the Nucleus Hypothesis.

5.3. Glide Formation

Having discussed the location of Korean on-glides in the syllable structure in the previous sections, I will briefly discuss the glide formation process in Korean. Glide formation takes place when two moraic vowels get together in the process of morphological derivation. Thus as discussed in 5.1.1, it can be viewed as a process of eliminating vowel clash. Glide formation involves delinking a moraic segment, if it is a possible candidate for becoming a glide, i.e. a high vowel or a round vowel, and as a result, the mora which dominated the glide is
left unfilled, then the following vowel segment spreads to the empty mora to make a
well-formed syllable as schematically shown in (36):

(36) Glide Formation

\[ \sigma \sigma \quad \rightarrow \quad \sigma \mu \mu \quad \rightarrow \quad \sigma \]

C \{i\} V \quad C \{i\} V \quad C \{i\} V
\{u\} \{u\} \{o\} \{o\}

It should be noted that the vowel should not be less sonorous than the preceding high or
round vowel in order to trigger glide formation. For example, the word /moi/ (feed) may not
become [mwi] since the preceding vowel /o/ is more sonorous than the following vowel.
Further it is interesting that the front vowel /e/ never undergoes glide formation though it may
be followed by a more sonorous segment such as /æ/ or /a/.

The glide formation given in (36) shows that vowel length can only be stated in terms
of the moraic tier. All and only long vowels are associated to two moras. This seems to
represent another advantage over Levin's (1985) style of syllable representation as adopted by
H-S. Sohn in Korean. We can make an interesting observation from Sohn's proposal. She
argues that long vowels are represented as a vowel linked to two x slots in the surface
representation as shown in (37):

(37) Sohn's Representation of Glides and Long Vowels

a. Glide and Vowel

\[ \text{N} \quad x \quad x \]
b. Long Vowel

\[ \text{N} \quad x \quad x \]
Putting (37a) and (37b) together, we come to a conclusion that a glide-long vowel sequence, often derived by the application of glide formation in Korean as in B-G. Lee (1979a), or in E. Han (1990) has to be represented as in (38):

(38) Glide-Long Vowel Sequence

One problematic aspect of the structure in (38) is that Sohn's syllabification algorithm does not allow three x-slots under a nucleus. Thus the representational inadequacy found in the representation of a glide and long vowel sequence as in (38) seems to argue against the NH.

Turning back to glide formation, we find that glide formation is optional for some verbs while it is obligatory for others in infinitive formation. Consider the following data from E. Han (1990):

(39) Glide Formation

a. Optional

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>po</td>
<td>poA</td>
<td>pwA: (to see)</td>
</tr>
<tr>
<td>ki</td>
<td>kiA</td>
<td>kyA: (to crawl)</td>
</tr>
<tr>
<td>k'u</td>
<td>k'uA</td>
<td>k'wA: (to dream)</td>
</tr>
</tbody>
</table>

b. Obligatory

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>o</td>
<td>*oA</td>
<td>wA (to come)</td>
</tr>
<tr>
<td>keu</td>
<td>*keuA</td>
<td>kewA (to vomit)</td>
</tr>
<tr>
<td>moi</td>
<td>*moiA</td>
<td>moyA (to gather)</td>
</tr>
</tbody>
</table>
Before getting into the analysis of the data given in (39), I will simplify the data by eliminating some of the peripheral problems in the analysis. First the segment represented by /A/ is realized as [a] after /o/ or /a/, and as [ə] elsewhere. The alternation will be discussed in Chapter 6. Second, we see that there are alternations in the vowel length in the data. I will follow B-G. Lee (1979a), Kim-Renaud (1982) and others in assuming that vowel length is contrastive only in word initial syllables.

Consider the data in (39). The basic question that Han (1990) raises is why glide formation is obligatory in (39b) and why such obligatory glide formation is not followed by compensatory lengthening. The key examples are the first words in (39a) and (39b), since in these cases both words are monosyllabic and thus we cannot resort to non-initial vowel shortening. E. Han (1989) argues that syllabification is postponed until after the suffixation for the words in (39b) but syllabification takes place very early for the words in (39a). The derivations of the first words in (39a) and (39b) are given in (40):

(40) Early vs. Late Syllabification

a. Early Syllabification ([pwa:])

```
   σ         σ
  ∏   ∏   ∏
  o + A     o A
Syll → GF & CL → resyll

   σ         σ
  ∏   ∏   ∏
  o A     o A
```


b. Late Syllabification ([wa])

As shown here, E. Han (1990) claims that syllabification takes place very early for the words in (39a), while the late syllabification is applied to the words in (39b). In (40b), the morpheme "o" (to come) is syllabified only after the suffixation of infinitive forms and the syllabification process takes /o/ as the onset. And since the morpheme "o" does not have a mora there is no compensatory lengthening.

Thus Han's (1990) distinction between early and late syllabification can explain both the obligatory nature of the glide formation and the lack of compensatory lengthening in the words of (39b). There are two interrelated problems in E. Han's (1990) explanation. Firstly given the fact that the syllabification process is predictable from the underlying representation, we might say that the process is mechanical which is applied across the board. Under such a framework, it is very difficult to accept that words or word groups differ from each other in the same language with respect to the level of syllabification. Secondly, even though we accept the assumption, we are faced with another problem, how to incorporate information on the level of syllabification in the underlying representation.

These problems can be obviated by taking Hayes' (1989) proposal that the underlying representation carries information on the mora. To be more specific, I argue that not all the vowel segments are underlyingly moraic. We have already seen that there is a high vowel and glide contrast on the surface level and suggest that glides are represented without an underlying mora. Following this line of argumentation, I suggest that the words in (39b) contain nonmoraic vowels in the underlying representation. This does not mean that we cannot predict whether a vowel is moraic or not. Surely the non-moraic vowels are limited to high vowels
and round vowels. Thus it is assumed that the stem final vowels are moraless in the underlying representation. Consider the following derivation of the second word in (39b):

(41) Sample Syllabification

\[
\begin{array}{c}
\mu \\
\text{Syll} & \rightarrow & \sigma \\
\mu \\
\text{k e u + A} & \rightarrow & \sigma \\
\mu \\
\text{k e u A}
\end{array}
\]

As shown in (41), the stem final vowel /u/ is nonmoraic in the underlying representation. Thus the syllabification process takes this moraless vowel as the onset of the second syllable. Here glide formation is a part of the syllabification process and the derivation is quite different from that in (36) in that glide formation in (36) is a process that applies after syllabification. This explains why glide formation witnessed in the words given in (39b) is obligatory and why there is no lengthening effect. Now compare the derivation of the first words in (39a) and (39b):

(42) Moraic vs. Nonmoraic Vowels

\[
\begin{array}{c}
\mu \\
\text{Syll} & \rightarrow & \sigma \\
\mu \\
\text{p o + A} & \rightarrow & \sigma \\
\mu \\
\text{p o A}
\end{array}
\]

There seems to be a certain correlation between the moraic status of a vowel and its co-occurrence restriction with respect to the preceding glides. We find that only four vowels /i, i, u, o/ can be nonmoraic in the underlying representation. Notice that these are the four vowels which cannot come after a glide as described in 5.1.5. To be more specific /i, i/ do not appear after [y] and /u, o, i/ do not appear after [w].
The vowel /o/ in "po" (to see) is associated to a mora in the underlying representation, while the same vowel in "o" (to come) is underlingly nonmoraic. Therefore in (42a), the vowel can appear as a head of a syllable. However in (42b), since the stem vowel is nonmoraic, it can only appear as a glide.

As seen in (42), we do not have to resort to early and late syllabification to explain the obligatory nature of glide formation and the lack of compensatory lengthening. With the moraic representation in the underlying structure, the automatic process of syllabification can effectively explain the glide formation for (39a) and (39b). Such underlying contrast is not possible in any other framework such as CV or X tier analysis. The obligatory glide formation effect in the examples given in (39b) is exceptional and the best way to capture the exceptionality of these vowels is not to posit some specific derivational rules such as late syllabification, but to represent the peculiarity of these words underlingly without resorting to diacritic features. I take this a strong support for the representation based approach of phonological explanation and for the moraic syllable structure in Korean.\(^{15}\)

\(^{15}\)The non-moraic status of high vowels will be discussed again in 8.3.
5.4. Conclusion

In this chapter, I have discussed two different hypotheses on the location of the prevocalic glide in Korean syllable structure: the Onset Hypothesis and the Nucleus Hypothesis. The Onset Hypothesis claims that glides should be represented as onset segments in the syllable structure, while the Nucleus Hypothesis argues that glides should be represented as part of the nucleus. In this chapter, we discussed two different sets of data and argued for the Onset Hypothesis. The first set of data consisted of four phonological phenomena that render relatively strong support for the Onset Hypothesis. The second set of data were those that have been used to support the Nucleus Hypothesis and it was shown that they can either be reanalyzed within the Onset Hypothesis or that they may not actually support the Nucleus Hypothesis.

The first set of data includes vowel clash resolving, vowel harmony in ideophones, onset simplification, language games and phonotactic constraints in Korean. First we observed that the onsetless syllables are eliminated by glide formation or glide insertion. If the glides are nucleus segments, then the hiatus resolving should be interpreted anew since inserting a glide or making a vowel into a glide does not help to get rid of the onsetless syllables. But if the glide is a consonant then glide formation or glide insertion gets rid of the onsetless syllable.

In the vowel harmony processes, glides are ignored. They do not participate in harmony feature linking. Vowel harmony involves the phonological change of vowels. The corollary of this observation is that if a segment does not participate in the vowel harmony, then the segment may not be a vowel. In Korean, all vowels in the initial syllables are the targets of harmony feature linking. Therefore if glides are treated as vowels, they should behave just
like other high vowels. But the data presented in this chapter clearly show that glides are not the targets of harmony feature linking. As such vowel harmony in Korean actually goes against the Nucleus Hypothesis and supports the Onset Hypothesis.

The Single Onset Consonant Constraint with respect to the KS dialect was motivated in this chapter, and we saw that the constraint can successfully explain the difference between glide initial syllables and consonant initial syllables with respect to the onset simplification. The Onset Hypothesis can successfully explain the obligatory nature of the onset simplification in the KS dialect as well as the lack of so called nucleus degemination in glide initial syllables in both the KS dialect and the Standard dialect.

The CV insertion language game provides another type of supporting evidence for the OH. There apparently is some uncertainty about the data of this language game. The data presented in this chapter and those introduced by Kim and Kim (1990) are not compatible with each other. However, if we carefully analyze the characteristics of the language game and the orthographic representation of the Korean alphabet, we can see that the discrepancy of the presented data may no longer be problematic. The data from Koreans who used to play the language game and from Korean children who do not know the Korean orthography show that glides do not appear in the reduplicated syllables, thus rendering full support to the OH.

Finally we saw that the phonotactic constraints provide support for the OH. There are constraints that hold between a consonant and a glide as well as between a glide and a vowel. But it has been argued that the two constraints are different in nature. The explanation of the constraints between a glide and the following vowel is universal based on acoustic factors, while the co-occurrence restrictions between a consonant and a glide are genuine subsyllabic constraints.
In addition, the data usually quoted in the literature to support the Nucleus Hypothesis were re-examined. Consonant cluster simplification does not support the Nucleus Hypothesis. This phonological phenomenon can be perfectly reanalyzable with the Onset Hypothesis. That glides are onset segments does not mean that there cannot be any other consonant before glides within a syllable. The syllable template given in this chapter allows for a consonant plus glide cluster in the onset.

Further, the l/r alternation in the KS dialect in connection with the Standard dialect was discussed. In morpheme internal position, the liquid sound is realized as [r] in between two vowels, but it is realized as [l] when it is placed between a vowel. An interesting observation here is that liquids are necessarily realized as [l] in the KS dialect when they come between a vowel and a glide, and that they remain as [l] before a glide across a word boundary. This simply means that the glides are syllabified into onset and that in the KS dialect the onset is restricted to one member. These data are better handled with the OH. Further the failure of the optional onset incorporation across the word boundary for glide initial morphemes in the standard dialect clearly reflects that glides are different from vowels in their behavior with respect to the l/r alternation.

Finally, an ideophone specific onset delinking phenomenon was considered. Some ideophones that contain glides apparently do not go through an onset deletion process. This was taken by Kim and Kim (1990) as crucial evidence that glides are not part of the onset. However in this chapter, it was shown that such a conclusion was due to the misanalysis of the given data. Taking other relevant phonological processes in Korean into account, we concluded that those ideophones do not go through the onset deletion process, but that the deletion is due to the nasal deletion rule that is also witnessed outside of ideophones.

The discussion in this chapter clearly shows that the Onset Hypothesis is much better motivated than the Nucleus Hypothesis. In spite of the traditional view influenced by the
orthographic representation that glides are part of the nucleus, the Nucleus Hypothesis is not supported by the facts of Korean phonology.

Finally, it was also shown that the exceptional behavior of high vowels and round vowels with respect to glide formation can be best explained not by rules but by their representations. High vowels and round vowels may come into the underlying representation without associated moras. In these cases, since they are not moraic, they can appear only as glides and they cannot trigger compensatory lengthening because a lengthened vowel should necessarily have two moras.
Chapter 6

Vowel Harmony

6.0. Introduction

In this chapter, I will investigate the vowel alternations in ideophonic expressions and in words displaying /차/ suffixation in Korean. These vowel alternations are considered to be the result of harmony processes. Traditionally, Korean vowels are divided into three harmonic groups, neutral vowels, dark vowels and light vowels, as shown in (1):

(1) Korean Vowel Division

```
<table>
<thead>
<tr>
<th>neutral vowels</th>
<th>dark vowels</th>
<th>light vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>i ü i u</td>
<td>e ö e o</td>
<td>æ a</td>
</tr>
</tbody>
</table>
```

Neutral vowels can co-occur either with dark or with light vowels. However, an ideophonic expression may not have both light and dark vowels. Consider the following
examples:

(2) Light and Dark Ideophones

<table>
<thead>
<tr>
<th>Light</th>
<th>Dark</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. challaŋ</td>
<td>chullŋ</td>
<td>splashing</td>
</tr>
<tr>
<td>b. hamp'ak</td>
<td>himp'ak</td>
<td>thoroughly</td>
</tr>
<tr>
<td>c. posilak</td>
<td>pusilak</td>
<td>rustling</td>
</tr>
<tr>
<td>d. alĩn</td>
<td>alĩn</td>
<td>flickering</td>
</tr>
</tbody>
</table>

The examples in (2c) and (2d) show that the neutral vowels /i/ and /u/ can co-occur either with dark or light vowels but dark and light vowels appear in mutually exclusive environments. The dark ideophones are thought to be heavier, more intensive and bigger in motion than their light counterparts.¹ For example, /challaŋ challaŋ/ represents a light speedy and small scale repetitive motion of water, while /chullŋ chullŋ/ expresses a heavy and big splashing motion of wave.

Vowel harmony (henceforth VH) was once a very productive phonological phenomenon in the history of Korean (S-N. Lee (1947), C-W. Kim (1978) B-H. Ahn and K-H. Lee (1990: 64-65)). However Modern Korean does not have general harmonic process like that found in many other Altaic languages. VH is merely kept in ideophonic alternations and in /a/ suffixation of verbs and adjectives.²

¹Martin (1962: 184) presents the following semantic distinction of light and dark ideophones:

<table>
<thead>
<tr>
<th>Light forms</th>
<th>Dark forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>small -- petty, paltry, insignificant, dinky</td>
<td>heavy -- weighty, ponderous, clumsy, unwieldy, bulky</td>
</tr>
<tr>
<td>fragile -- unsubstantial, flimsy, flighty, frivolous silly</td>
<td>dark -- gloomy, inaccessible.</td>
</tr>
</tbody>
</table>

²It should also be noted that there are sporadic vowel harmony phenomena in different parts of the
We will return to the historical development of the vowel system shortly. But before doing that, let's consider the possible vowel alternations found in the sound symbolic expressions and in verb/adjective suffixation:

(3) Vowel Alternations in Ideophones

a. /i/ - /æ/ alternation

pisil ~ pæsil (staggering)
pitbĭl ~ pætbĭl (staggering)
kilc’uk ~ kælc’uk (tall & slim)

b. /e/ - /æ/ alternation

kel kel ~ kæl kæl (exhaustively)
ek’ecilōk ~ k’æcilak (half-heatedly)
t’ekul ~ t’ækul (rolling)

c. /ɨ/ - /a/ alternation

k’ıtok ~ k’atak (nodding (one’s head))
silc’ok ~ salc’ak (stealthy)
hintil ~ hantil (waving)

d. /ɔ/ - /a/ alternation

olluk ~ alloc (colorful, stained)
totak ~ tatak (in clusters)

vocabulary. We find vowel alternations with different shades of meaning in nouns (kəcis mal ~ kacis mal (a lie)), verbs (kincili ~ kancili (to tickle), kîlk ~ kalk (to scratch)) adjectives (nuloh ~ nolah (yellow), molc’aŋ ~ malc’aŋ (neat)), and also in adverbs (silmyasi ~ salmyasi (stealthily)).

³There are other vowel alternations than what is listed here. I will come back to these in 6.2.3.
e. /u/-/o/ alternation

- cul～col (flowing)
- pusil～posil (drizzling)
- k'umthil～k'onthil (wriggling)

f. /ü/-/ö/ alternation

- hü hü～hö hö (round about)
- k'ücücü～k'öcöcö (extremely shabby)

(4) Verb suffixation

- a. kæ + ø → *kæa, kæø (be clear)
- b. s'ø + ø → s'øa, *søø (shoot)
- c. mak + ø → maka, makø (block)

Given these vowel alternations, we come up with the following graphic representation of the vowel alternations:

(5) "Vowel Alternation" Chart (from Kim-Renaud (1976: 398))

Looking at (3), (4) and (5), we find that there are several interesting points that need to be addressed in the study of VH. First of all, we find that the so called neutral vowels are not
always neutral. There are /i/ - /æ/ alternations as shown in (3a) and /i/ - /a/ alternations as in (3c). A closer look at the data reveals that these neutral vowels are not neutral when they are placed in morpheme initial syllables, and they are neutral only in non-initial syllables. In addition to /i/ and /æ/, we also observe that /u/ sometimes remains neutral as the third example of (3a) shows. What I mean "sometimes" here is that /u/ neutrality is much more restricted than in the case of two other unround high vowels /i/ and /i/>. We will have to account for such deviant behavior of high vowels. Another problem is how to relate the vowel harmony in ideophones and verb suffixation. The harmony process in vowel harmony differs from ideophone vowel harmony in at least two points: the vowel harmony appears to be optional in some specific environments in verb suffixation and the front low vowel /æ/ is treated as a dark vowel, i.e. there is no harmony agreement between /æ/ and the following dark vowel /ə/. To sum up, any study on vowel harmony has to deal with the following aspects:

(6) Problems in VH

a. What is a harmonic feature?

b. How to explain the dual status of high unround vowels: their non-neutrality in initial syllables and neutrality in non-initial syllables.

c. How to explain the /u/ - /a/ alternation in non-initial syllables.

d. How to relate affixal VH to ideophone VH.

The complexity of the harmony process in Modern Korean may be understood, if we take into consideration the historical development of the Korean language. Historically, there was a period when vowels show one-to-one correspondence between dark and light vowels in Korean. It is generally assumed that the contrast between the light and dark vowels reflect the
contrast between back vowels and central vowels\textsuperscript{4} W-J. Kim (1963) studied *Hunminjeongeum Haerye* (a book that explains the alphabetical composition of Korean letters published in 1443) and postulated the following vowel system based on its explanation:

(7) Vowel Chart based on *Hunminjeongeum*\textsuperscript{5}

<table>
<thead>
<tr>
<th>tongue unretracted</th>
<th>tongue somewhat retracted</th>
<th>tongue retracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>u ← → o</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i ← → Λ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o ← → a</td>
<td></td>
</tr>
</tbody>
</table>

(bidirectional arrows represent harmonic pairs)

As shown in (7) the vowels were distinguished on the basis of "tongue retraction" in *Hunminjeongeum Haerye*. W-J. Kim interpreted the tongue retraction as the tongue body retraction, so that the unretracted sounds are front vowels, somewhat retracted sounds are central vowels and retracted sounds are back vowels. W-J. Kim (1963) further suggests that clock-wise vowel shift took place among central and back vowels, while keeping harmonic contrasts, resulting in the following vowel contrast:

\textsuperscript{4} The back/non-back (palatal) harmony is generally assumed in Korean. The palatal harmony is a regular feature of Altaic languages to which Korean belongs (K-M. Lee (1972)). However, it should be noted that there are other proposals which assume that the light dark distinction is low and non-low distinction as in K-M. Lee (1971), and B-G. Lee (1973). Please refer to S-O. Lee (1984) for the detailed survey of Korean vowel harmony studies.

\textsuperscript{5} The phonetic value of the representation should be interpreted from their position in the chart not by the orthographic forms.
The vowel shift hypothesis is generally accepted among scholars on Korean phonology (Ramstedt (1939), W-J. Kim (1963, 1967), K-M. Lee (1969, 1972), C-W. Kim (1978)), though there are differences of opinion as to when the vowel shift took place and what caused the vowel shift.\(^6\) In the later stage, the low unround back vowel \(/\u0100/\), or the low \(/a/\), merged into \(/a/\) or \(/\u0100/\),\(^7\) depriving \(/\u0100/\) of its light counterpart. Such derived neutrality of \(/\u0100/\) adds to the complexity of VH in Korean (cf. K-M. Lee (1968: 387). Further the historical vowel raising from \(/\o/\) to \(/\u/\) destroyed the vowel harmony regularly kept in underived nouns. The two front vowels \(/e/\) and \(/\ae/\) derived by the monophthogization of \(/\ai/\) and \(/\ai/\) respectively (cf. Huh (1952), S-N. Lee (1954)) further complicated the already skewed vowel harmony contrast.

\(^6\)W-J. Kim (1963) assumes that the vowel shift took place in the middle of the 18th century, while K-M. Lee (1968) argues that the vowel shift took place in as early as the 13th century. Further K-M. Lee (1972) presented a slightly different version of the earlier vowel chart and the vowel shift as shown below:

\begin{center}
\begin{tabular}{|c|c|c|}
\hline
 & /u/ & /o/ \\
\hline
/i/ & & \\
\hline
\hline
\end{tabular}
\end{center}

K-M. Lee explains that the centralization of \(/\u/\) caused the push-chain vowel shift as shown in the chart.

\(^7\)W-J. Kim (1963:226) notes that \(/\u/\) merged into \(/a/\) in initial syllables and into \(/\u/\) in non-initial syllables, though this generalization is not without exceptions.
Massive borrowing from Chinese which does not have the vowel harmony system also worsened the situation. (cf. C-W. Kim (1978))

The historical development is the reason why it is so difficult to formally capture the vowel harmony in Korean. Accordingly, S-N. Lee (1947: 109) says that VH is now disappearing from Korean phonology and will be completely gone "in a few centuries". C-W. Kim (1978) also argues that the vowel harmony in Korean is disappearing due to the disrupted vowel system in Korean. However vowel harmony is still very interesting phenomena in Korean phonology, which must be properly accounted for. In this chapter, I will attempt to present a systematic synchronic explanation to the vowel harmony in Korean within the theoretical framework laid out in Part I.

I will argue that the light vowels can be grouped into a natural class by using the feature [RTR] and that the transparency of high vowels in non-initial syllable can be deduced from the formal description of the vowel harmony itself. Following H-S. Sohn (1987b), I will assume that there are two separate processes in vowel harmony: morphemic feature linking and feature spreading. All the vowels in initial syllables including high vowels are targets for the feature size morpheme. But they are transparent to harmony feature spreading because the spreading makes reference to the Tongue Position node adjacency and high vowels do not have Tongue Position nodes.

I will also argue that the /a/ - /a/ alternation in verb suffixation is also due to the feature spreading which is similar to harmony feature spreading but it has an additional condition on the trigger that the trigger should be a back vowel.
I will briefly survey representative previous studies in vowel harmony in the next section and present the proposed analysis of the Korean vowel harmony in the following subsections.  

6.1. Previous Studies

In this section, I will introduce several representative studies on VH in Korean. The survey will be divided into two groups: the generative approach and the non-linear approach. I will discuss C-W. Kim (1973b) and Kim-Renaud (1976) for the generative account of VH. McCarthy (1983), Y-S. Kim (1988) and Sohn (1986, 1987b) will be discussed as the representative studies in the non-linear framework. The discussion will be focused on how those proposals account for the problematic aspects laid out in (6).

6.1.1. Generative Approach

One of the earliest generative accounts of Korean VH is found in C-W. Kim (1973b). He limits his discussion to affixal VH. Consider the following examples:

\[
(9) \quad /a/ - /a/ \text{ Alternations}
\]

a. light form /a/.

\[
\text{po - ala (look-imp.)}
\]

\[
\text{phal - ala (sell-imp.)}
\]

b. dark form /a/

\^The discussion in this chapter is based on Y. Lee (1991) with further expansion and elaboration.
The light vowel /a/ appears if the verb stem final vowel is either /o/ or /a/. Noting that both /a/ and /o/ are back vowels, C-W. Kim (1973b) assumes that presence of the [+back] feature in the verb stem final syllable provides the environment in which /a/ appears. However one more back vowel /u/ is not followed by /a/ (see the last example of (9b)). C-W. Kim's solution to this problem is to posit the following Adjustment Rule:

(10) Adjustment Rule
\[ u \rightarrow \hat{i} \]

This rule has the effect of undoing the vowel shift in the history of the Korean vowels (cf. (7) and (8)). His idea is to reflect the regularity of vowel harmony that existed before the vowel shift to the contemporary analysis of affixal VH. By treating /u/ as non-back with the adjustment rule in (10), he was able to characterize the VH rule as referring to the natural class [+back]. The Adjustment Rule in (10) can also explain why /u/ is followed by /a/ instead of /a/. To insure the correct explanation, the rule in (10) should be crucially applied before the VH rule. The vowel /i/ which comes from /u/ by the rule (10), however, should be readjusted to /u/. Thus he proposed the following readjustment rule:

(11) Readjustment Rule
\[ \hat{i} \rightarrow u \]
Again, this readjustment rule should be ordered after the VH rule. C-W. Kim also notes that the rule (11) applies only to /ʉ/ that is derived by the rule (10). Otherwise the powerful neutralization rule has the effect of eliminating all high unround back vowels from the surface representation. Thus though C-W. Kim presented an explanation of the affixal VH in the generative framework with the extrinsically imposed rule ordering, adjustment rule - VH rule - readjustment rule, he admits that the proposed explanation has several unsatisfactory aspects: the arbitrary nature of the adjustment and readjustment rules, the necessity of the historical trace of the rule application to deal with the non-application of the readjustment rule to /ʉ/, which is not the result of the rule (10), and so forth.

The adjustment and readjustment rules are too powerful. Kim-Renaud (1976: 404) points out that "any unnatural rules can be made natural by making certain segments temporarily something else". Another problematic aspect of C-W. Kim's proposal comes from the ideophone VH. In the sound symbolic VH, not only /a/ and /o/ but also /æ/ (and /ʊ/) are considered to be light. However, as S-C. Ahn (1985: 186) correctly points out, the proposed [+back] cannot group these four vowels, since /æ/ and /ʊ/ are truly [-back] vowels.

The major problem in dealing with VH is how to group light vowels excluding dark and neutral vowels into a natural class. Kim-Renaud (1976), noting that Korean VH may not be fully explained with the SPE style of features suggests two semantic features [+dark] and [+light]. Kim-Reanud (1976: 399) asserts that these features are "not arbitrary markers made up just to classify the vowels into two different groups". Her argument is that these are semantically justifiable features and have a fixed universal interpretation. Let's first consider her formulation of the VH rule in ideophones:
(12) Sound Symbolic Vowel Harmony

a. \([+\text{yll}] \rightarrow [+\text{light}] / C_0 \ldots \) SS

b. \([-\text{high}, -\text{round}] \rightarrow [-\text{dark}] / C_0 VC_0(VC_0) \ldots \) SS

c. \([+\text{dark}] \rightarrow [+\text{light}] \ldots [+\text{light}] C_0 ([-\text{dark}, -\text{light}] C_0)^0 \ldots \) SS

(SS = a sound symbolic word)

Kim-Renaud assumes that the dark forms are basic and the light forms are derived by the three rules given in (12). (12a) is a process of converting dark vowels in the initial syllables into light. (12b) insures that high unround vowels, /i/ and /u/, are specified for [-dark, -light] in non-initial syllables. Since these vowels are marked as [-dark], they will not be the inputs to the rule given in (12c). The rule in (12c) shows the process that converts all the vowels except /i/ and /u/ into light vowels in ideophones. (12c) should be ordered after (12b). The three different rules in (12) thus explain (6a) and (6b).

Note that /u/ is not neutral in Kim-Renaud's explanation. The high back round vowel /u/, therefore, is subject to (12c). Consider the following examples:

(13) /u/ - /o/ Alternations

<table>
<thead>
<tr>
<th>Dark forms</th>
<th>Light forms</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. məlt'uŋ</td>
<td>malt'uŋ, malt'oŋ</td>
<td>with open eyes.</td>
</tr>
<tr>
<td>silc'uk</td>
<td>sæl'cuk, sæl'cok</td>
<td>grudging</td>
</tr>
<tr>
<td>b. t'ekul</td>
<td>t'ækul, *t'ækol</td>
<td>rolling</td>
</tr>
<tr>
<td>nap'hol</td>
<td>nap'hol, *nap'hol</td>
<td>flapping</td>
</tr>
</tbody>
</table>

As shown in the examples (13), /u/ sometimes alternates with /o/ as in (13a) or apparently
sometimes remains unchanged as in (13b). Kim-Renaud (1976) cites K-M. Lee's (1968: 387) observation that /o/ tends to become /u/ in non-initial syllables and proposed an optional /o/-raising rule. The ideophones that show the /u/ - /o/ alternation in non-initial syllables are the result of the optional /o/ raising rule. As for the words in (13b) and other similar examples which do not show the /u/ - /o/ alternation, Kim-Renaud (1976: 400) explains that they are simply not subject to the VH rule in (12c) and suggests that such information should be marked in the lexical entry of those examples.

Kim-Renaud introduces an entirely different use of the feature [light] to explain affixal VH. The feature [light] is considered to have scalar values in affixal VH where /ə/ initial suffixes are added to verbs or adjectives. /o/ is [3light], /a/ is [2light] and /æ/ is [1light]. In other words, /o/ is the lightest of all the light vowels and /æ/ is the least light. With these scalar values of the feature [light], Kim-Renaud proposes the following affixal VH rule:

(14) **Affixal Vowel Harmony**

\[
\begin{array}{c}
+\text{back} \\
-\text{high}
\end{array} \rightarrow [+\text{light}] / [2\leq \text{light}] [-\text{syll}]o& \\
\end{array}
\]

(where & is a verb stem boundary)

Since /æ/ is [1light], it cannot be included in the conditioning environments of the VH rule in (14). Therefore the rule in (14) correctly prevents vowel harmony from being triggered by /æ/. However we have to note that Kim-Renaud's explanation of affixal VH and ideophone VH does

---

\(^9\)Kim-Renaud (1976: 401) makes use of this rule to explain the optionality of vowel harmony as illustrated in (4c), which shows that the suffix can surface either as /a/ or as /æ/ after the verb stem final vowel /a/ with the following condition to (14):

Condition: optional if [2 ≤ light] = [2light] and [-syll] = [+cons]

This condition added to the rule in (14) makes the rule optional if the suffix vowel is preceded by /a/, which is [2light], and one or more consonants intervene.
not satisfactorily capture the relationship between these two harmony systems. Notice that the feature [light] is binary in ideophone VH but it is multivalued in affixal VH.

One may improve the rule (14) by using binary feature [light]. The sole purpose of introducing scalar values of the feature [light] is to get rid of /æ/ from the harmony triggering vowels. A more direct way to achieve that goal may be simply limiting the triggering vowels to [+back] vowels. This can be done by postulating [+back] in the environment as shown in (15):

(15) Revised Affixal VH

\[
\begin{array}{c}
\text{[+back]}
\end{array}
\quad \rightarrow \quad [\text{[+light]} \cap \text{[+back] \& [-syll]}]
\]

(where & is a verbal stem boundary)

Now with the slight revision in the affixal VH rule, we can do away with the ill-motivated scalar values for the feature [light]. Truly Kim-Renaud's treatment of VH in Korean is the most comprehensive done in the framework of generative phonology. Her analysis covers all the important aspects of VH as shown in (6), though there is no explanation about the relationship between ideophone VH and affixal VH.

One major criticism levied on her analysis is the introduction of two semantic features, which do not have any role to play outside of VH in Korean. Anderson (1977: 7) regards highly the phonetic motivation in the theory of VH by saying that "vowel harmony processes stipulate requirements of identity with respect to features that have independent phonetic motivation and validity." Y-S. Kim (1988: 453) in a similar context points out that it would be much more desirable if we can find a solution to VH "without resorting to such an undesirable move", meaning without unmotivated semantic features.
6.1.2. Non-linear Approach

Recent studies on VH strongly argue that VH can be best explained by an autosegmental analysis (Anderson (1977), Clements (1981), McCarthy (1983), Archangeli (1985), Ringen (1988b) and others). The basic idea of the autosegmental analysis is to represent the harmonic feature on a separate tier and operate autosegmental linking and/or spreading of the feature within specified domains.

McCarthy (1983) deals with VH in Korean by taking such an autosegmental approach. The first thing he has to do is to define the harmonic feature. McCarthy (1983: 145-146) starts with straightening out the curved division line between light vowels and dark/neutral vowels in (16a) to make a somewhat abstract division with a straight line as in (16b):

\[(16) \quad \text{Surface and Abstract Representation} \]

a. Surface Representation

\[
\begin{array}{c}
\text{i} & \text{ü} & \text{i} & \text{u} \\
\text{e} & \text{ö} & \text{o} \\
\text{æ} & \text{a} \\
\end{array}
\]

\text{dark vowels}

\text{light vowels}

b. Abstract Representation

\[
\begin{array}{c}
\text{i} & \text{ü} & \text{i} & \text{u} \\
\text{e} & \text{ö} & \text{e} \\
\text{æ} & \text{o} & \text{a} & \text{æ} \\
\end{array}
\]

\text{dark vowels [-low]}

\text{light vowels [+low]}
The representation in (16b) is "abstract" in that there is an underlying segment /ɔ/ which never surfaces in Korean and in that the front non-low vowel /ö/ is represented as [+low]. McCarthy (1983: 146) deals with the problem of abstractness by setting up a context free neutralization rule that changes [+round] to [-low] after the application of the VH rule.\(^\text{10}\)

McCarthy views the harmonic feature [low] as a feature size morpheme, i.e. a morpheme which is smaller than a segment (cf. Diffl oth (1976: 261)). This morphemic feature is introduced as part of the morphological derivation. Since the feature is viewed as constituting a different morpheme, it is represented on a separate tier. In other words, all vowels in ideophones are specified for [high], [back] and [round] but they are not specified for [low]. These vowels receive specification of [low] by means of autosegmental linking and spreading. An exemplary representation from McCarthy (1983: 146) is shown in (17):

(17) Light and Dark Ideophone Derivation –I

<table>
<thead>
<tr>
<th></th>
<th>a. Light ideophone</th>
<th>b. Dark ideophone</th>
</tr>
</thead>
<tbody>
<tr>
<td>[low]</td>
<td>V</td>
<td>[-low]</td>
</tr>
<tr>
<td>s [+back]</td>
<td>p [+back]</td>
<td>k [+back]</td>
</tr>
<tr>
<td>-rnd</td>
<td>-rnd</td>
<td>-rnd</td>
</tr>
<tr>
<td>-high</td>
<td>-high</td>
<td>-high</td>
</tr>
</tbody>
</table>

/sapak/     /sapak/

\(^{10}\text{Such an absolute neutralization rule is generally disfavored in phonological theory (Kiparsky (1968)). Ahn (1985: 189) suggests the relative vowel height feature [±L] instead of the actual vowel height feature [±low] in order to obviate the problem of the absolute neutralization. However this is criticized by H-S. Sohn (1987b: 178) who notes that though [±L] eliminates the absolute neutralization rule, it does so at the cost of using "a phonologically unmotivated feature". Kiparsky (1968: 18) also argues that "the purely diacritic use of phonological features and the phonological use of diacritic features" should be excluded.}\)
McCarthy assumes that both values of the feature [low] are harmonic features. There is no derivational relationship between light and dark ideophones. The underlying representation is neutral and they surface as light ideophones if [+low] is associated to them and as dark ideophones if the associated morphemic feature is [-low]. McCarthy shows that the harmony process and harmony feature can be simply derived out from the abstract vowel representation in (16b) and the autosegmental operation in (17).

McCarthy's autosegmental analysis of VH results in the feature contradiction that in the ideophones, high vowels in the light ideophones are specified for both [+high] and [+low] by means of [+low] association. Consider (18) which shows the light and dark form derivation of an ideophone that has a high unround vowel in the initial syllable:

\[
\begin{align*}
\text{(18) Light Ideophone Derivation -II} \\
\text{a. Light ideophone} & \quad \text{b. Dark ideophone} \\
& \quad [+\text{low}] \\
V & \quad V \\
k & \quad k \\
\begin{array}{l}
-\text{back} \\
\text{-rnd} \\
\text{+high}
\end{array} & \quad \begin{array}{l}
+\text{back} \\
\text{-rdn} \\
\text{+high}
\end{array} & \quad \begin{array}{l}
\text{+back} \\
\text{-rdn} \\
\text{+high}
\end{array} & \quad \begin{array}{l}
\text{+back} \\
\text{-rdn} \\
\text{-high}
\end{array} \\
/kæcak/ & \quad /kic\text{æk}/ \\
\end{align*}
\]

The first vowel of the light ideophone /æ/ is specified as [+high, [+low]. To resolve the feature incompatibility, McCarthy (1983: 146) assumes that the newly introduced feature [+low] "overrides an incompatible lexical specification of [high]". Therefore the autosegmental association of [+low] to high vowels changes [+high] to [-high]. However, as Y-S. Kim (1988: 454) points out, McCarthy's proposal for dominance of the spread feature over
the prespecified feature may not be well-motivated in light of the data from Akan reduplication, which show that the pre-attached feature wins out. (cf. Marantz (1982: 449))

McCarthy further assumes that high unround vowels are not specified for [-low] in initial syllables but they are specified for [-low] in non-initial syllables. With this context sensitive feature specification (cf. Ao (1991)), McCarthy argues that fully specified vowels will not associate with the autosegmental feature values and remain neutral (cf. Clements (1981)).

As to the relationship between ideophone VH and affixal VH, McCarthy (1983: fn 13) abandons establishing a relationship between the two by saying that the affixal harmony is "not accountable as an assimilation rule."


(19) Kim's Light - Dark Vowel Division

\[
\begin{array}{c|ccc|c}
& i & ü & i & u \\
\hline
\text{[-DVR]} (=\text{dark}) & e & ö & ø & o \\
\text{[+DVR]} (=\text{light}) & æ & a \\
\end{array}
\]

By using [±DVR], Kim can eliminate the abstract vowel representation, offering a more realistic account for the harmonic feature. Note also that Y-S. Kim's analysis is not free from

---

11 The term "deep voice resonance" comes from *Hunminjeoneum* Haerye (1443). "Deep voice resonance" is equated to "tongue retraction" in that book. Y-S. Kim interprets the term "tongue retraction" as the tongue root retraction instead of tongue body retraction (cf. (7)) and explains that [±DVR] can be used interchangeably with [±RTR].
the problematic feature conflict. The high front vowel, /i/, after harmony feature spreading will be specified for [+DVR, +high], a feature combination which does not exist in the Korean vowel inventory. Y-S. Kim proposes an interpretive rule as shown in (20) to provide the correct vowel height to [+DVR] vowels:

(20) Vowel Height Interpretive Rule (Y-S. Kim (1984: 180))

\[
\begin{array}{c}
V \\
\alpha \text{ rnd}
\end{array} \rightarrow \begin{array}{c}
\text{-high} \\
\alpha \text{ low}
\end{array} / \begin{array}{c}
\text{[+DVR]}
\end{array}
\]

This rule nonetheless does not make Y-S. Kim's analysis any better than McCarthy's spread feature dominance convention. The rule in (20) cannot be understood as a simple interpretive rule. It is a feature changing rule. Notice that the rule (20) takes [+back, -rnd, +high] as input and produces [+back, -rnd, -high] if it is linked to [+DVR]. What the rule actually does is to change the value of the feature [high].

J-S. Lee's (1992) version of ideophone VH is more elaborated than McCarthy (1983) or Y-S. Kim (1988). She uses two monovalent features [RTR] and [ATR] instead of [±low], thus satisfying Anderson's (1977:7) phonetic motivatedness. J-S. Lee adopts Calabrese's (1988) Underlying Filters, which define possible and impossible sounds for each language. The Underlying Filters virtually have the same function as language particular co-occurrence restrictions. Calabrese (1988) further suggests that clean up rules or repairing rules, such as fission, delinking and negation, are invoked to "repair" ill-formed outputs.\(^\text{12}\)

\(^{12}\)It should be noted that Calabrese's proposal of Underlying Filter is criticized by Myers (1991). Myers (1991: 336) contends that restrictions on prosodic units are due to "persistent rules", which are not accountable by filters.
J-S. Lee (1992) is different from McCarthy and Y-S. Kim in dealing with high vowels in non-initial syllables. Both McCarthy (1983) and Y-S. Kim (1984, 1988) assume context-sensitive feature specification, i.e. high vowels in non-initial syllables are fully specified for the harmony feature and therefore is not subject to harmony feature spreading. However, J-S. Lee assumes that the harmony feature is linked and spread to all the syllables in ideophones. Such an approach creates the ungrounded feature combination [(+) high, (+) RTR].

J-S. Lee (1992: 253-254) proposes two different repair strategies to deal with the ungrounded feature combinations as shown in (21):

(21) Repair Strategies

a. Linking Process

[(+) high] delinking

b. Spreading Process

[(+) RTR] delinking

What the strategies in (21) does is to change [+high, +RTR] into [-high, +RTR] in initial syllables and into [+high, -RTR] in non-initial syllables. As for the /u/-/o/ alternation in non-initial syllables (see examples (2c) and (2d)), J-S. Lee (1992: 250) argues that the alternation is achieved by a lexically marked process. The normal clean-up process in

---

13In Pulleyblank (1991) and Archangeli and Pulleyblank (1991), the phonetic relations between features are expressed as "grounded conditions". The relevant conditions are RTR/hi and ATR/hi conditions which are reproduced below:

RTR/hi condition:  
- if -ATR then not +hi  
- if -ATR then -hi

ATR/hi condition:  
- if +ATR then not –hi  
- If +ATR then +hi
harmony spreading is to delink [(+) RTR] as shown in (21b). However in some lexically marked cases, the repair strategy set for the linking process, delinking [(+) high], operates on the spreading process to make potential /u/ into /o/. While the strategies in (21) correctly describe the different behavior of high vowels, these strategies seems to be merely stipulative. The different repair strategies for the same feature combination in different processes of vowel harmony are further weakened by the lexically marked strategies.

All the three analyses given above, McCarthy (1983), Y-S. Kim (1984, 1988) and J-S. Lee (1992) do not discuss the derivational relationship between light and dark ideophones. The base forms are neither light nor dark. And two harmony features are linked to the base forms by two separate processes, light form derivation and dark form derivation. However, H-S. Sohn (1986, 1987b) proposes the derivational relationship between light and dark forms. She argues that the dark forms are basic and light forms are derived by light form derivation.

Sohn (1986, 1987b) presents the most comprehensive non-linear analysis of VH in Korean. She adopts radical underspecification of Korean vowels based on the observation that /u/ is the least specified vowel in Korean. Her vowel specification is given in (22):

(22) Radical Underspecification of Korean Vowels

<table>
<thead>
<tr>
<th>i</th>
<th>e</th>
<th>æ</th>
<th>ø</th>
<th>a</th>
<th>i</th>
<th>u</th>
<th>o</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>low</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>round</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>back</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

One interesting observation we can see from the vowel specification in (22) is that the radical underspecification is not compatible with J-S. Lee's (1992) analysis. The radical
underspecification does not allow [+high] to be specified in the underlying representation. Eliminating [+high] from the underlying representation is well motivated from the phonology of Korean. [+high] is a feature which characterizes the least specified vowel /i/. Vowel coalescence data from Korea, which will be discussed in Chapter 8, also strongly argues that [+high] should not be specified in the underlying representation. However J-S. Lee's repairing strategies crucially rely on the existence of [+high]. With J-S. Lee's feature specification, we lose our account of the fact that the inserted or deleted vowels in normal speech Korean are almost always /i/, thus arguing against her feature specification. 14

With the vowel specification in (22), Sohn argues that the morpheme-size feature is [+low]. For Sohn (1986, 1987b), light and dark ideophones are in a derivational relation. To be more specific, Sohn (1987b) argues that dark ideophones are basic and light forms are derived by introducing a feature-size morpheme [+low]. This is a very meaningful departure from McCarthy (1983), S-C. Ahn (1985), Y-S. Kim (1984) and J-S. Lee (1992). The reason why she assumes that dark ideophones are basic is twofold. First, the radical underspecification of Korean vowels does not allow the presence of [-low]. Therefore the underlying forms of neutral ideophones are indistinguishable from dark forms both of which are not specified for [+low]. This naturally predicts that the underlying forms, forms without [+low], are dark forms. Second, another piece of supporting data for the derivation of light forms from dark forms comes from a rather systematic distributional asymmetry between dark and light ideophones. Sohn (1986: 167) observes that "there are dark ideophones that do not have light counterparts, but there are no light ideophones that do not have dark counterparts." Though this claim is too strong, 15 Sohn's assumption that dark forms are basic is in the right

14 Though J-S. Lee does not deal with this incompatibility, it may be possible to argue that the ideophone feature system may be different from the "regular" lexical feature system. This can be deducible from J-S. Lee's (1992: 49, 298-299) proposal of different syllable structures for ideophones and for regular lexical words.

15 J-S Lee (1992:107-108) observes that there are light ideophones that do not have dark counterparts and claims that the existence of such ideophones weakens Sohn's (1987b) argument for the derivational analysis. Some examples of light ideophones that do not have corresponding dark forms are given
direction in that the ideophonic variations can be explained by one process instead of two separate nearly identical processes.

We see that the proposed feature [+low] does not group all the light vowels in (22). This is because adding [+low] to the high round vowel /u/ does not produce /o/ which is neither high nor low. In order to solve the feature contradiction, Sohn (1987b: 184) proposes the following phonetic implementation rule:

\[
\begin{align*}
(+\text{low}) &\rightarrow (-\text{low}) / [\text{+round}] \\
\end{align*}
\]

(23) Phonetic Implementation

below:

\begin{align*}
\text{hantil} &\rightarrow *\text{hantil} \rightarrow \text{moving lightly} \\
\text{nakis} &\rightarrow *\text{nakis} \rightarrow \text{tender and soft} \\
\text{os'}ak} &\rightarrow *\text{os'}ak \rightarrow \text{filling chilly} \\
\text{kalki} &\rightarrow *\text{kalki} \rightarrow \text{torn into pieces} \\
\end{align*}

However, the presence of the light ideophones which do not have dark forms does not necessarily invalidate the assumption that light forms are derived from dark forms. We can simply specify [+low] in the underlying representations of these ideophones. Since they are already specified for [+low], we observe that they are not subject to light ideophone derivation or that they have undergone the light ideophone derivation vacuously.

Likewise, there are some ideophones which do not have light counterparts as shown below (data from J-S. Lee (1992: 108)):

\begin{align*}
\text{nilis} &\rightarrow *\text{nilis} \rightarrow \text{slowly} \\
\text{musi} &\rightarrow *\text{mosi} \rightarrow \text{spooky} \\
\text{apaŋ} &\rightarrow *\text{apaŋ} \rightarrow \text{timid, dumb} \\
\end{align*}

J-S Lee argues that the absence of the light forms of these ideophones is due to “the intrinsic AUGMENTATIVE connotation that these expressions possess.” I agree with her that there can be semantic restrictions on the morphological derivation.
This rule makes the round low vowel into /o/. Sohn argues that the rule (23) applies very late, i.e. at the phonetic level. In other words, the light vowel /o/ is regarded as [+low] in the course of ideophone derivation.16

Sohn then proposes that there are two distinct stages in the light ideophone derivation. First the feature [+low] is introduced as part of the morphological process of light form derivation. The newly introduced feature [+low] is associated to the leftmost vowel of the base by the Universal Association Convention (Archangeli (1985: 339)) as shown in (24):

(24) Universal Association Convention (=UAC)

Map a sequence of melody elements onto a sequence of anchors,

a. one-to-one

b. left-to-right

The UAC has the effect of linking the floating [+low] feature to the vowel in the first syllable. The next stage is spreading. Sohn (1987b: 182) formulates the following Harmony Spreading Rule:

(25) Harmony Spreading (=HS)

N N N N
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
x x x x

[+low]

16Notice that the rule (23) has the effect of making round vowels non-low, which is quite equivalent to McCarthy’s absolute neutralization (or Y-S. Kim’s Interpretive rule) which was subject to Sohn’s (1987b: 178) criticism.
By positing two separate processes in VH in ideophones, linking and spreading, Sohn can offer an account of the asymmetric behavior of high unround vowels. Since these two are different rules, we can say that these rules may have different conditions. All vowels in initial syllables, including high unround vowels, are subject to the linking process, but high vowels are transparent in spreading. Given the fact that the harmonic feature [+low] is linked to vowels in the first syllable and the feature is associated to vowels in non-initial syllables by spreading, we can understand why the high unround vowels change in initial syllables (in linking) and remain unchanged in non-initial syllables (in spreading).

Now let's consider how Sohn (1987b) explains the transparency effect of high vowels in non-initial syllables. As observed by many researchers on VH (Vago (1977) Clements (1977, 1981), Archangeli and Pulleyblank (1987), etc.) some vowels may remain unaffected by the harmony process. Sohn (1987b: 191), proposes the Neutral Blocking filter as shown in (26):

(26) Neutral Blocking

\[
\begin{array}{c}
\sigma \\
\Downarrow \\
\text{[-back]} \\
\text{[ ]}
\end{array}
\]

The Neutral Blocking in (26) says that [+low] should not be linked to [-back] vowels and [ ] vowels. [-back] represents /i/ and [ ] represents /ɨ/. However given that not only
/l/ but also /e/ is [-back], we may need an additional condition that [-back] is the exhaustive specification in order to prevent the wrong prediction that /e/, which is [-back, -high] according to Sohn's feature specification given in (22), is also transparent in a non-initial syllable.

The empty matrix [ ] presents another problem. [ ] means a segment without any specified feature. Here, Sohn refers to the absence of the feature in defining the rule application environment. However, referring to the absence of features may constitute "the misuse of blanks" as mentioned by Ringen (1975). Moreover, Sohn does not discuss the /u/-/o/ alternation in non-initial syllables in light ideophones.

Regarding the affixal vowel harmony, VH in verb suffixation, Sohn (1987b: 198) gives us the following spreading rule:

(27) [+low] spreading

\[
\begin{array}{c}
N \quad N \\
| \quad | \\
x \quad x \\
\hline \\
[+low]_Y \quad [-high]
\end{array}
\]

where Y is a verbal stem.

Sohn sees that there are two possible problems in the spreading rule in (27). The rule wrongly predicts that [+low] will spread from a front low vowel /æ/. Secondly since /o/ is not a [+low] vowel (see Sohn's vowel specification in (22)), it is predicted from the rule in (27) that the suffix /ə/ will remain unchanged if the verb stem final vowel is /o/. Both of these problems are dealt with in Sohn (1987b).

In order to exclude /æ/, Sohn (1987b: 199) proposes her feature geometry model as given in (28):
With the geometry model given in (28), /æ/ is different from /a/ in that /æ/ is specified for [+low, -back] while /a/ is specified only for [+low]. Since [low] and [back] are on the same tier, the spreading rule in (27), if applied from the stem final vowel /æ/, spreads not only [+low] but also [-back] since both of the features are specified on the same tier. Sohn (1987b: 199) maintains that due to “the free ride spreading” of [-back], the spreading of [+low] from a vowel which is specified for another Back-tier features is prohibited.¹⁷

17Sohn (1987b) invokes the same feature geometry and the prevention of free-ride spreading in her explanation of consonant palatalization, and glide formation in Korean.
The situation worsens as we consider her explanation of vowel alternation after verb stem final vowel /o/. Sohn says that the appearance of /a/ after the stem final vowel /o/ is not related to the [+low] spreading rule given in (27). Instead Sohn (1987b: 201) proposes another rule of /a/ lowering after /o/ as given in (30):

(30) Vowel Lowering

\[
\begin{align*}
[ & ] & \rightarrow & [\text{+low}] / o \}_{X} \left[ \begin{array}{c}
\text{-high} \\
\end{array} \right] \\
\end{align*}
\]

(where X is a verbal stem)

By posing two rules [+low], spreading in (27) and /a/ lowering in (30), Sohn's analysis results in the loss of a unified account of affixal harmony.\(^{18}\)

As discussed above, in spite of the comprehensiveness of the analysis, Sohn (1987b) does not provide satisfactory answers to the problematic aspects of VH pointed in (6). In the following sections, I will present a unified analysis of vowel harmony phenomena in ideophones and in verb-suffixation.

\(^{18}\)It would have been much simpler to simply put /a/ in the environment of the vowel lowering rule in (30) instead of positing two different rules to explain the affixal vowel alternation as given below:

\[
\begin{align*}
[ & ] & \rightarrow & [\text{+low}] / \{a, o\}\}_{X} \left[ \begin{array}{c}
\text{-high} \\
\end{array} \right] \\
\end{align*}
\]

(where X is a verbal stem)

The rule given above, a variant of Kim-Renaud's affixal harmony rule, can at least offer a unified account for affixal VH.
6.2 Vowel Harmony in Ideophones

In the preceding section, we have seen that the previous studies fail to account for one or more problematic aspects of VH as pointed out in (6). In this section I will show that the VH in ideophones can be explained systematically with the theoretical assumptions laid out in Part I. The feature specification of Korean discussed in 2.4 and the feature geometry model presented in 3.2.4 will be combined in this section to present a straightforward analysis of VH in ideophones. The discussion in this section will also provide additional evidence for the Tongue Position node in Feature Geometry.

6.2.1. Harmony Processes

The first thing we are faced with is to identify the common characteristics of light vowels in terms of features. As discussed in the previous section, Both the semantic feature [±dark] and [±light] and the phonetic feature [±low] have internal defects in their application to the explanation of VH in Korean. Consider the monovalent feature specification in Korean discussed in 2.4, reproduced in (31) and the schematized vowel alternation from (5) given in (32):

(31) Underspecification of Korean Vowels

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>æ</th>
<th>ə</th>
<th>ɪ</th>
<th>ʊ</th>
<th>ɔ</th>
</tr>
</thead>
<tbody>
<tr>
<td>open</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>front</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>round</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>RTR</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

[Table of vowel features and their specifications]
Given the feature specification in (31) and the dark and light vowel correspondences in (32), we can immediately notice that what is common in all the vowels used in the light ideophones, /æ/, /a/ and /o/, is that they can be understood as being [RTR] vowels. This has three implications: first, it is [RTR], not [low] that is responsible for VH in the spreading analysis. Second, since [ATR] ([−RTR] in a binary feature system) is not specified, the underlying forms are indistinguishable from dark forms as Sohn (1987b) correctly observes. Third, we cannot ignore the historical aspects of the vowel harmony. In *Hunminjeoneum Haere*, the VH in Korean is explained as the opposition of central and back vowels, which can be explain by the degree of tongue retraction.

Characterizing the VH in modern Korean by tongue root retraction has some implication for the vowel shift in Korean. The occurrence of vowel shift in Korean may have been concomitant with the change from tongue body retraction contrast to tongue root retraction contrast.

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19 There are alternations other than those listed here such as the /u-/ /a/ alternation and the /i-/ /a/ alternation. I will discuss these cases in 6.2.3.

20 Note that the feature [palatal] is used here instead of [front]. As discussed in 3.3.3., the feature [palatal] groups alveopalatal consonants and front vowels.
Following Sohn's (1987b) analysis of VH, I will propose that dark ideophones are basic and light ideophones are derived from dark ideophones by adding the feature-size morpheme [RTR]. The floating feature [RTR] is linked to the first moraic segment, a non-glide vocalic segment, by the Universal Association Convention and then the second process is Harmony Spreading. I assume that the Harmony Spreading works on Tongue Position (=TP) node adjacency. The harmonic feature [RTR] spreads to a segment which is adjacent to the trigger on the TP tier. Therefore any intervening segment without a TP node will be skipped in the spreading processes. These two rules are formulated in (33) and (34):

(33) Light Ideophone Derivation

Morpheme : floating [RTR] (meaning "lightness" of ideophone)

Linking target : First moraic segment.

(34) Harmony Spreading (= HS) in Ideophones

\[\text{Argument : [RTR]}\]

\[\text{Target moraic segment}\]

\[\text{Mode non-iterative}\]

\[\text{Direction left to right}\]

\[\text{Condition TP node adjacency}\]

\[\text{(33) Light Ideophone Derivation}\]

\[\text{Morpheme : floating [RTR] (meaning "lightness" of ideophone)}\]

\[\text{Linking target : First moraic segment.}\]

\[\text{(34) Harmony Spreading (= HS) in Ideophones}\]

21J-W. Kim (1988) suggests that "the tongue retraction" in *Huminjeoneum* Haerye should be interpreted as "tongue root retraction". He surveys the vowel harmony systems found in the West African and Altaic languages and suggests that the "tongue root retraction" feature can relate all these vowel harmonies.

22I use a rectangle to graphically indicate the adjacency condition. This rule can be rewritten in the framework developed by Archangeli and Pulleyblank (1991) as given below. However I will continue to present the rules in graphic forms which I think is easier to see how the rule works.
Linking is done by creating necessary higher nodes for anchoring the feature [RTR], as discussed in Part I. (See Node Convention (34) in Chapter 3 and the relevant discussion there). For example, /i/ is not specified in terms of [open] or [RTR] and therefore by the Principle of Simplicity, it should not have a TP node. If a TP node is present it violates the Node Convention by making the organizational node terminal. However, [RTR] needs an anchor. Here it is assumed that the TP node creation is the natural consequence of linking [RTR] to /i/.

Then the second process is the harmony spreading. As the rule in (34) shows, the harmony feature is spreading rightward under the condition of TP node adjacency. Let’s take a look at the sample derivation as in (35):

(35) Example of Light Ideophone Derivation

a. \( \text{pit}^{h} \text{i} \text{il} \sim \text{pet}^{h} \text{et}^{h} \text{i} \text{l} \) (staggering)
In (35a), [RTR] is introduced as a part of the morphological process, and the [RTR] linking results in the creation of the TP node. However, the harmony feature cannot spread, because there is no segment which is adjacent to the first vowel with respect to the TP node. In (35b), the second vowel has the [open] feature, and therefore it has a TP node, and so the first and second vowels are adjacent on the TP tier. [RTR] then spreads to the second vowel to make
it /a/. (35c) is an interesting case. The [RTR] introduction is the same as the previous examples, but the harmony spreading process is not like the (35b) example. The second vowel /i/ does not have any TP feature, and therefore it does not possess a TP node. But the third vowel /a/ has a TP node and this vowel is adjacent to the first vowel on the TP tier. Thus the harmony feature [RTR] can spread through the second vowel to the third vowel as predicted by the harmony feature spreading rule as given in (34).

The common characteristic of high vowels, according to the Feature Specification in (31) is that they have neither [open] nor [RTR]. Those two features are dependent upon the TP node. The absence of both [open] and [RTR] on high vowels naturally means they do not have the TP node as discussed with the Node Convention in 3.2.4. and the Inherent Underspecification in 3.3.1. And if the spreading is done on the TP tier, it is only natural that the segments without a TP node, all consonants and high vowels, should be transparent.

The HS rule in (34) can successfully explain the different behavior of high vowels from non-high vowels. A vowel, whether it be high or non-high, is the target for the anchoring of a floating [RTR] feature. Anchoring results in the creation of a TP node, if the target does not already have one. However, HS is operated under TP node adjacency as shown in (34), and therefore it skips over all the consonants and high vowels, both of which do not have TP nodes.

**6.2.2. High Vowel Transparency.**

So far, we have talked about the transparency of high unrounded vowels in non-initial positions and under the present framework, their transparency is attributed to the lack of a TP node. We do not need the context sensitive feature specification as in McCarthy (1983) or in Y-S. Kim (1988) or the Neutral Blocking rule as in Sohn (1987b). With the vowel specification in (31) and the harmony processes given in (33) and (34), we see that the
transparency effect of high vowels in non-initial syllables naturally falls out from the feature geometry proposed for Korean.

Now we will turn to the behavior of /u/ in ideophone VH. We see that the high round vowel, /u/, lacks the TP node because it neither has [open] nor [RTR] specifications. Therefore the HS rule (34) predicts that even the high round vowel should also be transparent in non-initial position. Consider the data in (36):

(36) /u/ Transparency

\[
\begin{align*}
\text{kilc'uk} & \sim \text{kælc'uk, ?kælc'ok} & \text{(tall & slim)} \\
\text{p'it'ul} & \sim \text{p'æt'ul, *p'æt'ol} & \text{(in zigzags)} \\
\text{kəmus} & \sim \text{kamus, *kamos} & \text{(black)}
\end{align*}
\]

As expected, non-initial /u/ remains unaffected by the spreading rule and they are transparent in HS. The transparency of /u/ has been a major problem for all the analyses that I have discussed in 6.1. The traditional three way distinction, light, neutral, and dark, which classifies /u/ as a dark vowel, fails to capture the seemingly strange behavior of the high round vowel /u/. The explanation in the present framework is pretty straightforward: they are transparent because they have no TP node.

What may be apparently problematic in the present analysis is the fact that sometimes high round vowels seem to be affected by the harmony processes. Sometimes there are two light counterparts to one dark ideophone which contains /u/. These are illustrated in the following data:
(37) /u/ - /o/ alternation in non-initial positions

a. /o/ Only

hululuk ~ hololok, *holulok, *hololuk (sipping)


supuk ~ sopok, *sopuk (heaping fully)

sukun ~ sokon, *sokun (whispering)

b. Both /u/ and /o/

silc'uk ~ sælc'uk, sælc'ok (grudging)

k'æŋhunŋ ~ k'æŋhunŋ, k'æŋhunŋ (hopping)

patunŋ-patonŋ, patunŋ (struggling)

umphuk ~ omphok, omphuk (dented)

c. /u/ Only

t'ekul ~ t'ækul, *t'ækol (rolling)

hicuk ~ hæcuk, *hæcok (grinning)

puphul ~ pophul, *pophul (swelling)

naphul ~ naphul, *naphol (flapping)

The data in (37c) does not need further explanation since they show the predicted behavior of /u/. Let’s first consider the data given in (37a). There are many examples of this type. In order to understand the data in (37a), we will have to discuss briefly about the partial reduplication phenomenon found in Korean. Consider the examples of partial reduplication in (38):
Partial Reduplication

asak → asasak (munching)
huluk → hululuk (devouring)
culuk → cululuk (dripping)
utuk → ututuk (crunching)

The most recent analysis of (38) as in McCarthy and Prince (1986, 1990) is the reduplication of a core syllable (a CV syllable) as a suffix at the end of a word with the final consonant being extraprosodic. In the terminology of McCarthy and Prince (1990), the final consonant in the base form, if any, is "circumscribed" and a CV syllable or a core syllable is reduplicated as a suffix to the "residue of the circumscription." The step by step derivation of the first word in (38) is given in (39):

(39) Partial Reduplication Derivation

The circumscribed stem final consonant /k/ is marked as extraprosodic in (39a). To the residue a monomoraic syllable template is introduced as a suffix in (39b). (39c) shows the reduplication process. The melodic tier of the base is reduplicated to the attached suffixal template with the association from right to left. Finally the extraprosodic segment /k/ is
reassociated to the coda of the reduplicated syllable to produce /asasak/.

If we adopt this approach, we can immediately see why the /o/~u/ alternations in the non-initial syllable are illformed in these words. "hololok" comes from "holok" by partial reduplication: It does not come from "hululuk" by the spreading of the harmony feature. Thus the base forms of the first two words are disyllabic as the rest of the words in (37a). The interesting thing about the base forms given in (37a) then is that there is just one vowel in each of the base forms. The simple explanation is that these words have unspecified vowel slots in non-initial positions and acquire their phonemic content by root spreading from the initial position as illustrated with the last word of (37a), "sukun":

(40) Root Spreading$^{23}$

---

$^{23}$The second mora is underlingly present. Following Archangeli (1984: 34) I use a circle to represent an unliked element. Therefore the surface form of the dark ideophone will be [sukun] and not *[suukn]. Further it should be noted that I do not assume that all the disyllabic ideophones with identical vowels have such linked structures. Notice that the second vowel /u/ in /ump$h\hat{u}k/ or /pup$h\hat{u}l/ is not obligatorily changed into /o/ in these words, which is evidence that they should not have the linked vowel structure. J-S. Lee (1992: 216) criticizes this approach as "problematic" because the postulation of linked and unlinked structure is set by "looking ahead to the morphological behavior" and there is "not any clear way to determine (the structure) beforehand". However this may not be a valid criticism because we cannot do any phonological analysis without "looking into" the phonological behavior, and nothing, neither rules nor representations, can be fixed before considering the data. (See principles in selecting underlying features given in (17) in Chapter 2.)
(40) shows that Root Spreading is operating on the moraic tier adjacency, or on the maximal scansion in Archangeli and Pulleyblank's (1987: 21) terms. Consequently the analysis can be falsified if the second vowel is obligatorily changed into /o/ after a geminate consonant, because the intervening geminate will have moraic status and as a result, the first and the second vowel is no longer adjacent on the moraic tier. But as far as I know, there is no ideophone data of this kind that has a moraic segment between two high round vowels.  

Further, there is one piece of supporting evidence for this analysis. Root Spreading is not the only option allowable for /sukun/. What I mean is that the second mora can just remain unfilled. Then this maximally underspecified vowel slot will be interpreted as /i/ according to the feature specification given in (31). Then we may expect that /sukin/ and /sokin/ should be also acceptable as Korean ideophones and truly these forms co-exist with the alternations given in (37a).

Now the final problem: the marginal cases in (37b) need to be explained here. Excluding the ideophones with a linked vowel structure in (37a), we find that there is an implicational relationship between forms with non-initial /u/ and those with non-initial /o/. There is no ideophone which has /o/ only in the non-initial syllable except when the non-initial vowels show the doubly linked structure as in (37a). In other words, the fact that a light ideophone has /o/, which is derived from /u/ in non-initial syllables, implies that it also has the

---

24J-S. Lee (1992: 217) presents two words that have the same round high vowel in the first and second syllables separated by a moraic consonant as shown below:

<table>
<thead>
<tr>
<th>pulluk</th>
<th>pollok,</th>
<th>*polluk</th>
<th>(burging)</th>
</tr>
</thead>
<tbody>
<tr>
<td>k'ulluk</td>
<td>k'o'llok,</td>
<td>*k'o'lluk</td>
<td>(coughing)</td>
</tr>
</tbody>
</table>

She uses these data to argue against the proposal made here. I do not have an explanation for these data. However I would like to add that I do not agree with her judgments especially for the second word. *k'o'lluk] seems to be well-formed and [polluk] is also marginally acceptable for me especially with an initial tense consonant as in [p'olluk]. If my judgement on the well-formedness of these two words is not wrong, these do not constitute a counter-example to the present analysis.
/u/ variant, but not vice versa as (37c) shows. It should also be noted that the light forms with /u/ are more widely accepted and more frequently used than those with the /o/ forms. I assume that this constitutes evidence that there is another ideophone specific optional rule applicable to a handful of light ideophones, excluding the words in (37c) that lowers round vowels in the final position, which is reminiscent of the high vowel lowering in Tiv as given in Archangeli and Pulleyblank (1991). The vowel lowering can be formulated as in (41):

\[
(41) \quad \text{[open] Insertion}^{25}
\]

Now, since there is just one round open vowel in Korean, the phonetic component will correctly interpret the [open, round] combination as /o/. This solution allows us to maintain the consistency in using the TP node as the target of spreading. This analysis will be falsified if there is any /u/ to /o/ alternation in morpheme internal position, in other words, the

---

\[^{25}\text{I do not have any objection to treat (41) as a morphological rule as J-S. Lee (p.c.) points out. Consider that \{k'æŋ\} is even lighter than \{k'æŋ\}, it is not unreasonable to treat (41) as another subsidiary morphological rule of light form derivation which is applicable only to light ideophones. If we suppose that the rule is morphological in nature, we may say that the inserted feature is \{RTR\} instead of [open] in order to keep the morphosemantic consistency of the feature [RTR].}\]
non-initial and non-final position. In initial syllables of ideophones, the high vowels are the
target of [RTR] linking, and in final syllables, /u/ is subject to the lowering rule as described in
(41). Therefore, the rule given in (41) will predict that /u/ in morpheme internal position, i.e.
in neither initial nor final syllables, is always transparent. Interestingly this prediction is born
out in the actual data as shown in (42):

\[(42) /u/ \text{ Transparency in Ideophone Internal Syllables.} \]
\[
\begin{align*}
\text{cumullok} & \rightarrow \text{comullak}, *\text{comollak} & \text{(kneading)} \\
\text{k'upuc\text{-}\text{\'}o} & \rightarrow \text{k'opuc\text{-}a\text{\'}}, *\text{k'opoca\text{-}a} & \text{(hunch backed)} \\
\text{hapucak} & \rightarrow \text{hapucak}, *\text{hapocak} & \text{(floundering)} \\
\text{umullak} & \rightarrow \text{omullak}, *\text{omollak} & \text{(chewing)}
\end{align*}
\]

The data given in (42) truly show that the high round vowel /u/ is always transparent
when it is placed in non-marginal (neither initial nor final) syllables, thus they provide
supporting evidence for the vowel lowering rule given in (41).

Here we will have to think about the historical implication of the vowel lowering rule
given in (41). Historically we find that /o/ is raised to /u/, as K- M. Lee (1968) observes,
which is reflected by Kim-Renaud's explanation of the /u/-/o/ alternation. Some examples of
historical back round vowel raising are given in (43):

\[(43) \text{Historical Round Vowel Raising}^{26} \]
\[
\begin{align*}
\text{namo} & \rightarrow \text{namu} & \text{(tree)} \\
\text{salko} & \rightarrow \text{salku} & \text{(apricot)}
\end{align*}
\]

\[^{26}\text{I consulted A Dictionary of Yi Dynasty Korean by C-D. You (1964) for the data given here.}\]
The rule given in (41) runs counter to the historical development as illustrated in (43). One may conclude that the rule (41) is totally unmotivated given the fact that the direction of change is quite opposite to the historical change. However we find that such reversed direction of change is fairly prevalent in historical linguistics. Vennemann (1972b) named such reversal of the direction of change "rule inversion" (see also Schuh's (1972) discussion of Chadic rule inversion). In short rule inversion takes place when a historical change A > B / X __ Y is reflected by a synchronic rule B \rightarrow A/ X __ Y.

I argue that the reversed description of the vowel height change given in (41) is not unmotivated in the study of phonology. As a matter of fact, I argue that the /u/ - /o/ alternation in Korean ideophones can be explained only by positing /u/ in the underlying representation. Consider Kim-Renaud's vowel raising again. Though she did not give us the exact rule formulation of the vowel raising rule, the rule somehow has to incorporate information that the vowel raising is obligatory in non-marginal syllables for the data in (42) and optional in ideophone final syllables as in (37b), and back to obligatory in final syllables in some cases shown in (37c).

However by positing /u/ - lowering rule as given in (41), the analysis given here can explain the historical change of the status of VH and high vowels in Korean, and also explains the status of /u/ as becoming a neutral vowel in Korean (cf. J-S. Lee (1992: 252)).

---

27I thank P. Newman for bringing rule inversion to my attention. Vennemann (1972b) argues that rule inversion takes place not only in phonology but in other areas including morphology and syntax.

28Vennemann (1972b) quotes from Andersen (1968) and presents a case of rule inversion in Slavic. Historically Slavic /x/ is derived from /s/ (s \rightarrow x / {r, u, k, i}). However with the subsequent historical changes that includes palatal k's merger with /s/, the /x/ ~ /s/ alternation is predictable from an underlying /s/ but not from /s/. Vennemann also notes that the rule inversion has another effect of simplifying the morphophonemic system of Slavic, which is also true in Korean.
Finally, Y-S. Kim (1988) has maintained that [-RTR], or [-DVR] in his feature system, is specified for high unrounded vowels if they are not in the initial position. Such a view is problematic in our analysis since it would not allow us to account for the transparency of high unrounded vowels in non-initial positions. According to him, high unrounded vowels are not specified in terms of [RTR] in initial position but [-RTR] is specified in non-initial position. His explanation is problematic in translating the observation into the present framework in two ways. First, his explanation makes use of the three way contrasts of binary features. By positing [+RTR] for light ideophones, [-RTR] for dark ideophones and non-initial high unround vowels and [\^RTR] for high unround vowels in initial syllables, he is subject to the criticism of the ternary use of binary features. (cf. Archangeli (1984)).

Further there is no explanation why only the high vowels are subject to context sensitive underspecification of [RTR]. Notice that the absence of a TP node is witnessed only in high vowels in the present analysis. Moreover the special behavior of high vowels naturally falls out from the fact that VH operates on the TP tier adjacency. Therefore we do not need any stipulation about the specificity of these vowels.

6.2.3. Additional Vowel Alternations

So far we have discussed five different vowel alternations in VH. The schematized light and dark vowel pairs discussed in 6.2.2. are given in (44):
(44) Schematized Vowel Alternation (Reproduction of (32))

<table>
<thead>
<tr>
<th>Dark/ Neutral</th>
<th>Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>æ</td>
</tr>
<tr>
<td>e</td>
<td>æ</td>
</tr>
<tr>
<td>i</td>
<td>a</td>
</tr>
<tr>
<td>ø</td>
<td>o</td>
</tr>
</tbody>
</table>

However, we find that there are other light and dark pairs in Korean ideophones as illustrated in (45):

(45) Additional Vowel Alternation

a. /u/ - /a/ Alternation

pulk'ın  palk'ın  (in a fit of passion)
mullọŋ  mallaŋ  (flabby)

b. /i/ - /a/ Alternation

cilk'ın  calc'ın  (chewing)

b. /i/ - /a/ Alternation

There might be other vowel alternations as given below:

| yaki | yoki | (here) |
| koki | koki | (there) |
| coki | coki | (over there) |
| ikọt | yokọt | (this thing) |
| kikọt | kokọt | (the thing) |
| cokọt | cokọt | (that thing over there) |

Here we find /ọ/ - /ọ/ alternations. However I do not think these alternations are due to VH, since these alternations clearly do not show the semantic contrast of light and dark pairs and the second vowel does not show vowel alternations thus showing quite deviant behavior from other harmonic pairs. We see that the second vowel does not change at all as illustrated by the last example. These are examples of what J-S. Lee (1992) calls "the ideophonization of prosaic words".
c'lis  c'alís  (tingling)

c. /u/ - /wa/ Alternation
khɨŋ  kʰwaŋ  (exploding)
ucikɨn  wacikɨn  (breaking)

d. /i/ - /ya/ Alternation
kiut'ʊŋ  kyaut'ʊŋ  (tilting)
icuk  yacuk  (gabbling)

Apparently the light forms /(y)a/ is not derivable from /u/ or /i/. However, following Y-S. Kim (1988), I argue that these can also be explained within the present framework. I rely on Y-S. Kim for the analysis of the data given in (45). Y-S. Kim (1988: 458 - 459) observes the distributional restrictions of these vowel alternations. Let's first discuss (45a) and (45b). Notice that all the ideophones given in (45a) begin with a labial consonant and all the dark forms in (45b) begin with an alveopalatal consonant. In other words, we find that the examples in (45a) and (45b) show that the initial consonant and the following vowel share the same place features.

Y-S. Kim accordingly suggests that the underlying vowels in the initial syllable of (45a) and (45b) are /i/. Therefore the apparently irregular vowel alternations, {/i/, /u/} - /a/, is the surface manifestation of the underlying /i/ - /a/ alternation. Given that /i/ is the maximally underspecified vowel in Korean, we can easily understand that the place of articulation feature from the consonant can be spread to the unspecified vowel slot as shown in (46):
The rule in (46) has the effect of providing the place feature to the underspecified vowel /i/. 30

In (45a), the place feature [labial] is spread to the unspecified vowel and the labial vowel will be interpreted as /u/. Also in (45b), the rule will spread [coronal] along with its dependent feature [palatal] turning the unspecified vowel into /i/.

Once we accept the analysis given for (45a) and (45b), the rest of the data in (45) can also be systematically explained. We may assume that the surface /i/ - /ya/ and /u/ - /wa/ alternation is the realization of /yi/ - /ya/ and /wi/ - /wa/ alternations respectively. Therefore these can be viewed as the regular /i/ - /u/ alternation. Given that /w/ is labial and /y/ is palatal, we see that (45c) and (45d) are the extensions of (45a) and (45b) respectively. The same rule given in (46) will also be applied to these words to produce /wu/ and /yi/ in the dark ideophones. However these forms are not well-formed as discussed in 5.1.5. I propose the following delinking rule as the repair strategy for the string that violates the OCP:

30Y-S. Kim (1988) posits two rules, the /i/ rounding rule and /i/ fronting rule. He argues that these two rules have independent motivation. For example /phu + a/ becomes [phə] not * [phuə] or [phwa]. One viable explanation is to say that the underlying form is /phi/ and /i/ subsequently becomes /u/ by /i/ rounding. We can also find the historical change from /fi/ to /fu/ after labial consonants as noted by W-J. Kim (1963: 229). However the rule should somehow be restricted in its application so that it may not be applicable to such lexical words as /cilpi/ (abundant) or /cilki/ (enjoy) in the standard dialect of Korean.
The rule is obligatory because not applying the rule results in a sequence that violates the phonotactic constraints of Korean as discussed in Chapter 5. The stray root node will be erased by the Stray Erasure Convention. Therefore the derived /wu/ and /yi/ will surface as /u/ and /i/ respectively.\(^{31}\)

Thus it is shown in this subsection that the apparent irregular vowel alternation shown on the surface is actually a reflection of the underlying regular dark-light alternation affected by other rules such as place feature spreading and glide delinking which are independently motivated in Korean phonology.

Finally, in some cases we see that there are two different vowel alternation pairs with different meaning as exemplified in (48):

(48) Different Surface Pairs

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. puti</td>
<td>pati</td>
<td>trembling</td>
</tr>
<tr>
<td>puti</td>
<td>poti</td>
<td>soft</td>
</tr>
<tr>
<td>b. kun</td>
<td>kwon</td>
<td>exploding</td>
</tr>
<tr>
<td>kun</td>
<td>kon</td>
<td>hitting</td>
</tr>
<tr>
<td>c. mullon</td>
<td>mallon</td>
<td>flabby</td>
</tr>
</tbody>
</table>

\(^{31}\)Notice that (47) can also explain the non-appearance of /wo/ on the surface.
With the preceding discussion, we may simply say that the underlying forms of these pairs are different, the first of each example with the /i/ vowel in the first syllables. The underlying representations of the examples given in (48a) are illustrated in (49):

(49) Different Underlying Representations
   a. piti - trembling
   b. putil - soft

With these different representations we see that (49a) belongs to the examples given in (45a), while (49b) shows the regular /u/ - /o/ alternations as discussed in the preceding subsection. The same explanations can also be given to the rest of examples in (48).32

32 There are examples that show three way contrasts like the following:

pusilak posilak ~ pasilak

For these alternations I assume that these are due to the light form derivation either before or after the place spreading given in (46) as illustrated below:

Sohn (1987b: 185-186) explains these alternations in a slightly different way. She posits /pusilak/ as the underlying form and /posilak/ is derived through the regular process and a [round] delinking rule is applied to /posilak/ to produce /pasilak/. However, her explanation cannot be incorporated to the present analysis since her geometry as given in (28) shows that place features are dependent on [round] features and the delinking of round from the feature geometry automatically results in the delinking of the dependent place features, which would wrongly predict that the result of round delinking from /o/ is /u/ instead of /a/.
6.3. Vowel Harmony in Affixation

In previous studies, the affixal vowel harmony which can be witnessed in /ə/ suffixation in Korean has been dealt with separately from ideophone VH. The vowel harmony process in verb/adjective suffixation is very similar to the ideophone vowel harmony discussed in the preceding subsections. One major difference is that the front light vowel /æ/ does not trigger harmony feature spreading. However as discussed in 6.1, the affixal VH has been generally ignored or it has been treated quite differently from ideophone VH. In this subsection, I will show that the affixal vowel harmony can also be analyzed within the same principle laid out for ideophone vowel harmony. Let's first observe the data given in (50):

(50) Vowel Harmony in Suffixation

<table>
<thead>
<tr>
<th>Infinitive</th>
<th>past</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>cip-ə</td>
<td>cip-əs'</td>
<td>(to pick)</td>
</tr>
<tr>
<td>pe-ə</td>
<td>pe-əs'/</td>
<td>(to cut)</td>
</tr>
<tr>
<td>kæ-ə</td>
<td>kæ-əs'</td>
<td>(to fold)</td>
</tr>
<tr>
<td>kɨ -ə</td>
<td>kɨ -əs'</td>
<td>(to draw)</td>
</tr>
<tr>
<td>cuk-ə</td>
<td>cuk-əs'</td>
<td>(to die)</td>
</tr>
<tr>
<td>mak-ə</td>
<td>mak-əs'</td>
<td>(to eat)</td>
</tr>
<tr>
<td>k'op-a</td>
<td>k'op-as'</td>
<td>(to insert)</td>
</tr>
<tr>
<td>mak-a</td>
<td>mak-as'</td>
<td>(to block)</td>
</tr>
</tbody>
</table>

The data given here are simplified. It should be also noted that the stem can be polysyllabic. There are optional variations between /ə/ and /a/, which will be dealt with later.
Both the infinitival forms and past tense forms of verbs and adjectives normally take
the suffix vowel /ə/. But if the stem final vowels are /o/ or /a/, the infinitive or past suffixes
appear as [a], as shown in (50).

We can make an assumption that the underlying forms of the suffixes are /ə/ (infinitive)
or /əs/ (past) but the suffix initial vowel /ə/ is changed into [a] if the stem-final vowel has the
[RTR] feature. Given that /a/ is [RTR], while /ə/ is not, we may explain the vowel change as
the result of spreading [RTR] from the stem final vowel onto the target vowel in the suffix. An
interesting diversion from the ideophone harmony is that the front RTR vowel /æ/ does not
trigger [RTR] spreading as the third word in (50) shows. The process is very similar to that of
Harmony Spreading in ideophones except that the front open RTR vowel /æ/ does not
participate as a trigger.

There is a simple historical reason why /æ/ is excluded. As explained earlier in 6.0,
Middle Korean has only one front vowel which is /i/, two other front vowels /e/ and /æ/ are
derived from the historical coalescence of /a + i/ and /a + ɨ/ respectively. (cf. Huh (1952))
Therefore if we see the affixal vowel harmony in the Middle Korean vowel system, we can
easily understand that all the [RTR] vowels triggered the affixal vowel harmony and that
regularity is kept in spite of the presence of another newly introduced [RTR] vowel /æ/.

The simplest way for the contemporary explanation of the affixal VH is to limit the
triggers to /o/ and /a/ by positing a condition that the triggers should be back vowels. But in
our feature specification for vowels we did not posit the [back] feature in the underlying
representation, and referring to the absence of the feature is generally disfavored in phonology.
Here, I will assume that the infinitive suffix actually consists of two parts: the vowel /ə/ and the
floating [back] feature:
Infinitive suffix derivation

i) Morpheme: floating [back] + /ə/

ii) Linking target: last moraic segment of a stem.

iii) Condition: if [front], then not [back]

The past suffix derivation is exactly like (51) except that the morpheme is the floating [back] feature and /ə/.

This condition will prevent the linking of [back] to stem-final front vowels. The unassociated [back] feature, then, will be erased by the Stray Erasure Convention (It™ (1986)) before moving onto the next cycle. Now with the introduction of the [back] feature we can formulate the affixal harmony as an assimilation rule. As with ideophones, the feature that spreads is assumed to be [RTR] as shown in (52):

(52) [RTR] Spreading

Now, we can see that the spreading of [RTR] is virtually identical in both the verbal affixation and in ideophones. The only difference is that in the former, the trigger should be a

---

This rule crucially is non-iterative as the perfective forms given below illustrates.

| Noun | Plural | Perfective | Perfective
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>po - əs' - əs'</td>
<td>po-as'-əs', *po-as'-as'</td>
<td>(had seen)</td>
<td></td>
</tr>
<tr>
<td>naka - əs' - əs'</td>
<td>naka-as'-əs', *naka-as'-as'</td>
<td>(had gone out)</td>
<td></td>
</tr>
</tbody>
</table>
[back] segment. The analysis given here may be problematic. The feature which is introduced by morpheme concatenation is [back], which was not necessary in the underlying representation, and which is supposedly redundant given that [back] is identical to the negative value of [front].

One may suggest that [back] should be specified in the underlying representation rather than introducing it in the process of morphological derivation. However positing [back] in the underlying representation causes several problems. First the underlying presence of [back] would play havoc with the vowel coalescence analysis. As will be discussed in Chapter 8, whenever back and front vowels are fused, the outcome is a front vowel. If there is [back] we have to posit a coalescence-cum-delinking rule that delinks the [back] feature. And still, we are left with the problem to explain why it is [back] but not [front] which is delinked. A more serious problem comes with the spreading rule. There is no clear evidence of [RTR] spreading in underived words as shown in (53):

(53) Lack of [RTR] Spreading in Underived Words

<table>
<thead>
<tr>
<th>Word</th>
<th>Non-spreading Form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>apəm</td>
<td>*apam</td>
<td>(father)</td>
</tr>
<tr>
<td>tocahi</td>
<td>*tocahi</td>
<td>(by no means)</td>
</tr>
<tr>
<td>tasas'</td>
<td>*tasas'</td>
<td>(five)</td>
</tr>
<tr>
<td>mochələm</td>
<td>*mochalam, *mochələm</td>
<td>(after a long time)</td>
</tr>
</tbody>
</table>

If [back] is underlyingly present, the words in (53) meet the environment of [RTR] spreading given in (52). But the resultant forms are ill-formed. My explanation here is that the first vowels in (53) do not have the [back] feature and therefore it does not meet the environment of [RTR] spreading. Here we see that the introduced feature [back], though phonetically motivated, has a diacritic function that only the derived words are subject to the
spreading rule.

Consequently, under the present analysis, one can ask why shouldn't [back] be inserted to all the vowels in the derived environment or by the Redundancy Rule Ordering Constraint. Here again, the evidence against inserting [back] to all vowels is that vowel harmony takes place only in the infinitive and past forms but not in other types of verbal suffixation; e.g. when the suffix begins with a consonant, as shown in (54):

(54) Lack of [RTR] Spreading in Derived Words

<table>
<thead>
<tr>
<th>Stem</th>
<th>Suffix</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>ka(go)</td>
<td>kəla(imp.)</td>
<td>*kakala (go!)</td>
</tr>
<tr>
<td>po(see)</td>
<td>kəla(imp.)</td>
<td>*pokala (see!)</td>
</tr>
<tr>
<td>thəa(get on)-kətən (if)</td>
<td>*thəakatən (if .. get on)</td>
<td></td>
</tr>
<tr>
<td>ca(sleep)-tən(rel-past)</td>
<td>*catən (that slept)</td>
<td></td>
</tr>
<tr>
<td>kap(pay)-təla(recollection)</td>
<td>*kaptəla (noticed that ..pay)</td>
<td></td>
</tr>
</tbody>
</table>

As clearly seen in (54), the [RTR] spreading takes place between the stem-final vowel and the suffix, if the suffix starts with /ə/. (51) and (52) successfully capture the limited distribution of vowel harmony in regular lexical derivation without losing the uniformity of explanation of vowel harmony in general in Korean. Therefore I argue that the introduction of [back] is lexically marked for these suffixes, and it serves as a diacritic function to the effect that only those marked as such are subject to [RTR] spreading. Notice that the analysis provides evidence that some features such as [back] in Korean are active only in derivational processes while remaining inert, and therefore unspecified, in the underlying representation.

One final remark should be made on the optionality of the [RTR] spreading in verb/adjective suffixation. Consider the following examples:
Optionality of [RTR] Spreading

a. Stem final front vowels and non [RTR] vowels

\begin{align*}
\text{salli} + \varepsilon & \quad \text{sallio} (\text{sallyo}), *\text{sallia} \\
\text{me} + \varepsilon & \quad \text{meo} (\text{me:}), *\text{mea} \\
\text{c’okæ} + \varepsilon & \quad \text{c’okæo} (\text{c’okæ}), *\text{c’okæa}
\end{align*}

(b) Stem final [RTR] Back Vowels

\begin{align*}
\text{k’op} + \varepsilon & \quad \text{k’opa}, \ ? \text{k’opæ} \\
\text{s’o} + \varepsilon & \quad \text{s’oa} (\text{s’wa:}), *\text{s’oæ} \\
\text{naka} + \varepsilon & \quad \text{naka}, *\text{nakaæ} \\
\text{mak} + \varepsilon & \quad \text{maka}, \ \text{makæ}
\end{align*}

Only /a/ forms are allowed in (55a) and some variation between /a/ and /a/ is witnessed in (55b). The data in (55a) provide indirect evidence that the VH in suffixation is derived by [RTR] spreading. It is clearly shown that in all the examples in (55a) /a/ suffixes are ruled out without any exception. In (55b) we find an interesting observation that the [RTR] spreading seems to be optional if the verb stem ends with a consonant, and obligatory if the stem ends with a vowel, as correctly noted by K-M. Lee (1972: 11) and Kim-Renaud (1976: 398).

My explanation is that the [RTR] spreading is optional in contemporary Korean. The apparent obligatory nature of [RTR] spreading as shown in the second and third examples in (55b) can be explained by referring to other independently motivated processes in the vowel phonology. Notice that as explained in 5.1.1, Korean strongly disfavors vowel clash and if there is an option to do away with vowel clash, it is usually taken in Korean. As explained in 5.1.1, Korean has several options, two of the most popular being glide formation and vowel coalescence. We see both of the processes with suffixation. In the second example of (55b) we find a glide formation process, and in the third example in (55b) we find a coalescence.
process to which I will return in Chapter 8. It may suffice to say that /a/ which is [RTR] and /ə/ [open] are fused into an [RTR, open] segment which is again /a/. Thus it is shown that the apparent obligatory nature we see in the third example in (55b) is actually a case of coalescence since either /a/ - /a/ or /a/ - /ə/ sequence can be fused into /a/ with subsequent shortening in non-initial syllables.35

6.4 Conclusion

Though vowel harmony in Korean has been predicted to disappear from the language, it is still a very interesting phenomenon that should be properly explained. However all the previous studies in Korean VH discussed in this chapter do not offer a comprehensive account for the phenomena.

Vowel harmony in Korean is analyzed as a combination of two different processes in this chapter: linking a floating [RTR] feature and the subsequent spreading of the harmony feature [RTR]. The target of the morphemic feature linking is the first syllable in ideophones. Therefore all vowels in initial syllables, regardless of their vowel height, are subject to [RTR] linking. However the second process the Harmony Spreading operates on the TP node adjacency. There are two underlying features under the TP node in Korean: [open] and [RTR]. High vowels, /i/, /i/ and /u/, do not have either [open] nor [RTR], and therefore, according to

35The obligatory nature of the affixal VH between a stem that ends in /o/ and the suffix initial /ə/ is left unexplained here. One may speculate that the application of [RTR] spreading makes the second vowel more sonorous than the first, thus the first vowel /o/ can turn into a glide. In this sense the application of [RTR] spreading feeds glide formation which successfully eliminates the vowel clash. Seen from this perspective, [RTR] spreading helps to resolve hiatus. Thus we might say that the avoidance of vowel clash forces the application of [RTR] spreading in the second word in (55b) to produce a wellformed sequence.
Inherent Underspecification embodied in the Principle of Simplicity, those vowels do not have TP nodes in the underlying representation. Since VH requires the condition that the trigger and the target should be adjacent on the TP tier, it is only natural that these high vowels are transparent to HS.

The analysis given in this chapter says that the high round vowel /u/, which is traditionally thought to be a dark vowel in the VH system, is also neutral because it does not have a TP node by virtue of being a high vowel just like /i/ or /iː/. Truly it is shown that the high round vowel /u/ behaves as if it is neutral with respect to HS. There are, however, a handful of exceptions to the generalization about the VH: the apparent effect that HS has on the high round vowel /u/. It is suggested in this paper that such exceptional cases can be accounted for by introducing ideophone-specific [open] insertion, or vowel lowering, which applies to the high round vowel /u/ in the final syllable of a light ideophone. This enables us to maintain the unified and simple explanation of VH in Korean as well as to correctly explain that /u/ will not be affected by Harmony processes, if it is neither the first nor the last vowel in an ideophone.

The vowel harmony in verb/adjective suffixation is slightly different from that in ideophones in that the front low vowel, /æ/, does not trigger [RTR] spreading, another problematic aspect of VH. In this paper, the introduction of a redundant feature [back] as a part of the morpheme concatenation process and subsequent condition of [RTR] spreading that only the [back] segment triggers the [RTR] spreading are shown to interact with each other to give a proper explanation of VH in verbal morphology and the difference from VH in ideophones.

In spite of the above-mentioned differences, we find that there are many things in common between HS in ideophones and [RTR] spreading in suffixation. Both processes can be explained by [RTR] spreading, the same kind of assimilation rule is in operation for both HS and [RTR] spreading. The spreading of [RTR] operates on the TP tier adjacency and the
spreading is non-iterative both in ideophones and verbal suffixation. These common characteristics which have been ignored or left undisussed in previous studies are captured in the analysis presented in this chapter.

To recapitulate, the analysis presented in this chapter properly deals with the four problematic aspects in the discussion of VH as pointed out in (6). The harmony feature is [RTR]. The different behavior of high vowels in initial and non-initial syllables is due to their lack of TP features and the TP node. The difference of /u/ from the other high vowels is that there is another process that lowers the ideophone final vowel /u/. Thus the analysis given in this chapter correctly explains that /u/ behaves just like dark vowels in initial syllables, and it is subject to a lowering rule in final syllables but will remain unchanged in non-initial and non-final syllables. Further the connection between ideophone VH and affixal VH is established in this chapter by identifying similarities and differences of these two harmony phenomena.

The interactions of the different theories of feature geometry and under-specification are shown to be indispensable in explaining VH in Korean correctly and coherently. What is crucial for the explanation given in this chapter is the separation of the TP node from the Place node. Seen from the Korean VH data, the notion of the TP node is absolutely essential for a unified account for VH.
Chapter 7

Vowel Fronting

7.0 Introduction

In Korean a back vowel can optionally become a front vowel when it is followed by the high front vowel /i/. This process is called vowel fronting or umlaut.\(^1\) Vowel fronting is understood to be the result of regressive assimilation from a high front vowel as illustrated in (1):

(1) Examples of Vowel Fronting

a. a ~ æ

/aki/ [agi], [ægi] (baby)
/nampi/ [nambi], [næmbi] (kettle)

b. æ ~ e

/əmi/ [əmi], [emi] (mother)
/mək+hi/ [məkʰi], [mekʰi] (to be eaten)

\(^1\)I will use the terms vowel fronting and umlaut interchangeably. Some scholars like W-J. Kim (1963: 219) try to differentiate the use of umlaut and vowel fronting. Others sometimes use the term "i-regressive assimilation" (cf. B-G Lee (1976)).
The examples in (1) show that all unround back vowels /a, ə, i/ can undergo vowel fronting to become front vowels before a high front vowel /i/. On the other hand, the round back vowels usually fail to undergo vowel fronting as the examples in (2a) show:

(2) Back Round Vowels

a. Unumlauted

nok+i [nogi], *[nögi] (to melt)
culi [curi], *[cüri] (to starve)
suk+i [sugi], *[sügi] (to stoop)

b. Umlauted

sok+i [sogi], [sögi] (to deceive)
koki [kogi], [kögi] (meat)
cuk+i [cugi], [cügi] (to kill)

I will limit the discussion of vowel fronting to unround back vowels and return to the cases of round vowels in section 7.4.3. The main reason for excluding round vowels as possible targets of umlaut may be ascribed to the instability of the phonemic status of front round vowels in Korean.
It should also be noted that the umlauted forms are used in a very casual and informal style of speech among the speakers of the standard dialects\(^2\). Thus a speaker of the standard dialect who is used to the umlauted forms may not use them in a formal speech context. Besides such sociolinguistic restrictions, there are other phonological and morphological constraints in vowel fronting. Therefore unlike the impression that the examples in (1) might give, vowel fronting in standard Korean may not be explained simply by positing a regressive assimilation rule from the high front vowel /i/ to the preceding unround back vowels.

What are most conspicuous about umlaut are the morphological restrictions. Umlaut applies both to derived and underived words. In a derived environment, only the causative/passive marker (/i/, /hi/, /li/, /ki/) and nominalizer suffix /i/ trigger vowel fronting while other suffix forms with a front high vowel, such as adverbial /i/, gerundive /ki/, nominative marker /i/, and the copula /ita/ do not trigger umlaut as shown in (3):\(^3\)

\[
\text{(3) Morphological Constraints.}
\]

---

\(^2\)This does not mean that vowel fronting takes place only in the standard dialects. On the contrary, vowel fronting is much more productive and it is found in much broader range in southern dialects that include Chungcheong dialects (S-H. Toh (1986)), Cholla dialects T-Y. Choi (1978) and S-K. Kee (1983)) and also Kyeongsang dialect (Y-C. Chung (1968) K-H. Chun (1979)). However, in these southern dialects, umlaut seems to be obligatory, since unlike in the standard dialects, the unumlauted forms are not found.

\(^3\)In southern dialects (Cholla, KS, and Chungcheon dialects) the nominative marker /i/ and the copula /ita/ can trigger umlaut too as shown below (cf. Y-K. Han (1980), Y-C. Chung (1968)):

<table>
<thead>
<tr>
<th>Word</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyp (law) + i (Nom)</td>
<td>[pebi]</td>
</tr>
<tr>
<td>cam (sleep) + i (Nom)</td>
<td>[cæmi]</td>
</tr>
<tr>
<td>pyp (law) + ita (cop)</td>
<td>[pebida]</td>
</tr>
<tr>
<td>som (island) + ita (cop)</td>
<td>[semida]</td>
</tr>
</tbody>
</table>
a. Umlaut Applied

i) Nonimalizer /i/

<table>
<thead>
<tr>
<th>Stem</th>
<th>Vowel Shift</th>
<th>音</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>mək + i</td>
<td>[mɔgi], [megi]</td>
<td>(food)</td>
<td></td>
</tr>
<tr>
<td>son cap + i</td>
<td>[sonjæbi], [sonjæbi]</td>
<td>(handle)</td>
<td></td>
</tr>
</tbody>
</table>

ii) Passive/causative marker

<table>
<thead>
<tr>
<th>Stem</th>
<th>Vowel Shift</th>
<th>音</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>cap + hi</td>
<td>[çæpʰi], [çæpʰi]</td>
<td>(to be caught)</td>
<td></td>
</tr>
<tr>
<td>mək + hi</td>
<td>[mekʰi], [mekʰi]</td>
<td>(to be eaten)</td>
<td></td>
</tr>
</tbody>
</table>

b. Umlaut Not Applied

i) Nominative /i/

<table>
<thead>
<tr>
<th>Stem</th>
<th>Vowel Shift</th>
<th>音</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>salam + i</td>
<td>[sarami], *[saræmi]</td>
<td>(a man + Nom.)</td>
<td></td>
</tr>
<tr>
<td>cam + i</td>
<td>[cami], *[cæmi]</td>
<td>(sleep + Nom.)</td>
<td></td>
</tr>
</tbody>
</table>

ii) Adverbial /hi/ /i/

<table>
<thead>
<tr>
<th>Stem</th>
<th>Vowel Shift</th>
<th>音</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>məl + li</td>
<td>[məlli], *[melli]</td>
<td>(far away)</td>
<td></td>
</tr>
<tr>
<td>kak’a + i</td>
<td>[kak’æi], *[kak’æi]</td>
<td>(near)</td>
<td></td>
</tr>
</tbody>
</table>

iii) Gerundive /ki/

<table>
<thead>
<tr>
<th>Stem</th>
<th>Vowel Shift</th>
<th>音</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>cap + ki</td>
<td>[çæpk’i], *[çæpk’i]</td>
<td>(catching)</td>
<td></td>
</tr>
<tr>
<td>nəh + ki</td>
<td>[nekʰi], *[nekʰi]</td>
<td>(putting in)</td>
<td></td>
</tr>
</tbody>
</table>

iv) Copula /ita/

<table>
<thead>
<tr>
<th>Stem</th>
<th>Vowel Shift</th>
<th>音</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>kam + ita</td>
<td>[kæmida], *[kæmida]</td>
<td>(is a persimmon)</td>
<td></td>
</tr>
<tr>
<td>pal + ita</td>
<td>[pærida], *[pærida]</td>
<td>(is a foot)</td>
<td></td>
</tr>
</tbody>
</table>

In underived contexts, umlaut applies only to nouns and verbs. Umlaut also does not take place in compounding (cf. Ahn (1989: 167) or in Sino-Korean words (W-J. Kim (1963: 221)). Thus we find that umlaut takes place mainly in two different parts of speech, in nouns and in verbs. S-C. Ahn (1989: 167) observes that all these restrictions show that umlaut is a
lexical rule which has cyclical (derived) and non-cyclical (underived) application domains. I follow S-C. Ahn in claiming that umlaut is a lexical rule which is not applicable in the post-lexical domain.

There are phonological constraints as well. Firstly the intervening consonants between the target and the trigger of umlaut can block the umlaut process as exemplified in (4):

\[(4) \quad \text{Consonant Blocking} \]

<table>
<thead>
<tr>
<th></th>
<th>[kasi], *[kæsi]</th>
<th>(thorn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>kæci</td>
<td>[kaçi], *[keji]</td>
<td>(beggar)</td>
</tr>
<tr>
<td>anni</td>
<td>[ɔnni], *[enni]</td>
<td>(sister)</td>
</tr>
<tr>
<td>tæchï</td>
<td>[tæchï], *[tæc hï]</td>
<td>(to be hurt)</td>
</tr>
<tr>
<td>alli</td>
<td>[alli], *[ælli]</td>
<td>(to inform)</td>
</tr>
</tbody>
</table>

As illustrated in (4), it seems to be the coronal consonants that block the umlaut process. Traditionally, it has been assumed that all coronal consonants block umlaut and [-coronal] or the equivalent, [+grave], should be specified in the environment of umlaut rule according to C-W. Kim (1973a) and B-G. Lee (1976) This may present a serious challenge to the feature geometry model presented in Chapter Three, since coronals are supposed to be underspecified in their place features, which in turn predicts that coronals cannot block the vowel fronting rule. Precisely for this reason Y-S. Kang (1991) abandons feature geometry and adopts the Dependency Phonology model as developed by Anderson and Jones (1974) and Anderson and Ewen (1987) in his explanation of vowel fronting in Korean.

However, we have to note that there are coronal consonants which show transparency effects as seen by the data in (5):
(5) Transparency of Coronals

tali  \[ tari, \ [tæri] \quad \text{(to iron)}
p\text{oli}  \ [p\text{ɔri}, \ [peri] \quad \text{(to discard)}
tani  \ [tani, \ [tæni] \quad \text{(to go to and from)}
mati  \ [madi, \ [mædi] \quad \text{(knot)}

The examples in (5) are simply noted as exceptions if we stick to the observation that all the coronal consonants block umlaut. In this chapter, I will show that coronals are actually transparent and the apparent opaque nature observed in the examples given in (4) can be explained systematically without abandoning the present feature geometry model presented in section 3.2.4.

Another interesting observation is that some back vowels in specific environments resist fronting as shown in (6):

(6) Resisting Umlaut

a. Identical Vowels
\[ \text{odynamii} \ [\text{dyno}\text{ni}, \ *[\text{dynen}] \quad \text{(mother)}
\text{kamani}  \ [\text{kamani}, \ *[\text{kamæni}] \quad \text{(straw bag)}

b. Long vowels
\[ \text{pa:l+hi} \ [\text{pa(\text{\text{\text{-}}}lphi}, \ *[\text{pæ(\text{\text{-}}}phi} \quad \text{(to be trodden)}
\text{sa:l + i} \ [\text{sa(\text{\text{-}}}ri}, \ *[\text{sæ(\text{\text{-}}}ri} \quad \text{(life)}

Notice that in all these examples a coronal intervenes between the possible target and trigger of vowel fronting. Thus these examples might be simply explained in the traditional framework. However with the present model of feature geometry, these examples add to the
complexity of vowel fronting phenomena in Korean.

Further, sometimes umlaut unexpectedly fails to apply as the following examples show:

(7) Additional Data on Umlaut blocking

\[
\begin{array}{lll}
\text{napi} & \text{[nɔbi]}, & *[\text{næbi}] & \text{width} \\
\text{napi} & \text{[nabi]}, & *[\text{næbi}] & \text{butterfly} \\
\text{cɔki} & \text{[cɔgi]}, & *[\text{cegi}] & \text{that place}
\end{array}
\]

We may understand these data once we know the history of the high front vowel in these examples. W-J. Kim (1963: 221) explains that /i/’s in the above examples are derived by a historical merger of /ʌyl/ or /iyl/. Thus he explains that these /i/’s are not "pure /i/’s" and argues that umlaut is triggered only by "pure" or underived /i/’s. W-J. Kim (1963) also takes these examples as strong evidence that umlaut is a historical rule which ceased to operate before the historical monophthongization.

Given all these exceptions, we see that it may not be an easy task to explain all these examples in a consistent way. However, it will be shown in this chapter that in spite of the complexity of the data, they do not argue against any of the theoretical assumptions laid out in Part I. On the contrary, the frameworks set in Chapters 2, 3 and 4 can explain these complicated data and apparent exceptions in a relatively straightforward way.

Particularly, I will show that coronal underspecification does not have to be abandoned to explain vowel fronting. In spite of the underspecification of [coronal], it has to be specified when it serves as an anchor for linking a coronal dependent feature such as [palatal] to the root node. I will also argue that not only [palatal] but also [continuant] is coronal dependent. I will follow the line of argument presented by Levin (1988) in her claim for the coronal nature of [lateral] and show that [continuant] in Korean can be understood as a coronal feature.
Vowel fronting is analyzed as spreading of [coronal] from a high front vowel /i/ to a preceding vowel which is adjacent to the triggering vowel on the moraic tier. This simple description of vowel fronting along with the interaction of other important principles in phonology that include Line Crossing Prohibition, Linking Convention and Geminate Inalterability can explain all the data presented so far.\(^4\)

In the next section, I will briefly discuss the previous studies on umlaut, but the major emphasis will be given to the non-linear analyses. Specifically I will discuss Hume (1990) and Y-S. Kang (1991) to show some problematic aspects of their analyses. One common problematic point both in Hume and Y-S. Kang is that umlaut has to work in close connection with secondary palatalization in Korean. However the secondary palatalization is clearly post-lexical in nature, therefore umlaut, the lexical rule, cannot be ordered after the secondary palatalization rule in Korean. Truly, primary palatalization is lexical and it shows an interaction with umlaut. However, both Hume and Y-S. Kang crucially rely on the ordering of umlaut after secondary palatalization and this results in an insoluble ordering problem.

I will analyze umlaut as [coronal] spreading with a moraic tier adjacency condition while explaining [palatal] and [continuant] blocking of umlaut phenomenon. Since these two features are coronal dependent, coronal should be specified, and the specified [coronal] will block [coronal] spreading due to the Line Crossing Prohibition discussed in 3.2.2.1.

\(^4\) I will not go into the debates on the historical nature of the umlaut rule in Korean. S-G. Kim (1978) and M-O. Choi (1988) argue that umlaut in Korean is a historical rule, no longer witnessed in contemporary Korean. I will simply present an analysis to show that regardless whether it is historical or not, the present framework can offer a consistent account of vowel fronting.
Further, I will show how the adjacency condition explains some of the apparent exceptions of umlaut. I will argue that a linked structure and a geminate structure resist umlaut because of Geminate Inalterability which prohibits changing half of a doubly linked segment. Other apparent problems, the historical monophthongization, the status of glides in umlaut and the instability of round front vowels will also be dealt with in wrapping up the discussion in this chapter.

7.1 Previous Studies

As briefly noted in the introduction, it has been generally considered that coronal sounds have a blocking effect on umlaut in Korean as illustrated in W-J. Kim (1963), C-W. Kim (1973), Shim (1986) M-O. Choi (1988) and many others. Thus within the generative framework we may posit the following umlaut rule:

\[
V \rightarrow [-\text{back}] / _____ C \begin{bmatrix} +\text{syl}\l \l \mathrm{+high} \mathrm{-back} \end{bmatrix} \] 

Unround back vowels become [-back] by the influence of a [-back, +high] vowel /i/. However this rule has many problematic aspects. Firstly, as noted in (5), umlaut takes place even across some coronal sounds. Secondly, the rule does not tell us about the number of intervening consonants. Umlaut can take place across two consonants as the following examples show:
(9) Umlaut Across Two Consonants

\[
\begin{align*}
\text{an} + \text{ki} & \quad [\text{aŋki}], \ [\text{æŋki}] & \quad \text{(to be hugged)} \\
\text{æŋ} + \text{ki} & \quad [\text{æŋgi}], \ [\text{eŋgi}] & \quad \text{(to be curdled)} \\
\text{nampi} & \quad [\text{nambi}], \ [\text{næmbi}] & \quad \text{(kettle)}
\end{align*}
\]

The rule also does not tell us the relationship between [+coronal] and [-back]. We cannot see why the intervening coronal consonant blocks the assimilation process. Especially, the feature [-back] should be changed to [+coronal] as discussed in Chapter 3. These problems are partly dealt with in the non-linear framework. I will introduce Hume's (1990) and Y-S. Kang's (1991) analyses in this section to show how umlaut and the blocking effects are dealt with in these analyses along with their potential problems.

7.1.1. Hume's Analysis

Hume (1990) limits her discussion to umlaut in Kyungsang (=KS) dialect. However, we may safely assume that the same rules are applicable to standard dialects with minor change in her rule descriptions. To be more specific, the KS dialect differs from the Standard dialect in two respects. First the KS dialect does not allow front round vowels even on the surface level. (See 5.1.3.) Therefore Hume assumes that if a back round vowel is a target of umlaut, the round vowel is affected by the umlaut but loses its [+round] feature as the result of umlaut. Second unlike in the standard dialect, there is no surface alternation between umlauted and unumlauted forms. Thus umlaut is an obligatory rule in KS dialect.

Hume bases her argument on Clements' (1989) Feature Geometry of C-place and V-place. As discussed in 3.2.2.2, Clements (1989) suggests the following internal structure of the Place node:
(10) Clements’ Two Place Node Geometry

![Diagram of Place Node](image)

It should be noted that under the geometry given in (10), front vowels have [coronal] under V-pl and coronal consonants are underspecified for [coronal] under the C-pl node. Therefore umlaut can be analyzed as the spreading of [coronal] under the V-pl node as schematically shown in (11):

(11) Hume’s Umlaut Rule

![Diagram of Umlaut Rule](image)

The umlaut operation spreads [+coronal] from one V-pl node to another V-pl node. Thus it is predicted that any intervening consonant that does not have a V-pl node is transparent to the spreading rule. Hume (1990: 236) suggests that /t/ and /c/ are different in their geometrical representation as shown in (12):
Notice that a palatal consonant, unlike an alveolar consonant, has [+coronal] under the V-pl node. Thus it is predicted that alveolar sounds are transparent while palatal consonants are opaque, because as shown in (13) spreading [+coronal] through a palatal consonant will result in a violation of the Line Crossing Prohibition:

Thus Hume can explain the opacity of /c/ and the transparency of /t/ and /l/ under her analysis. However there are other coronals such as /s/ and a geminate /l/ that also block umlaut spreading. Hume suggests that umlaut works in connection with consonant palatalization. She poses two different rules, palatalization and dissimilation, to explain the interaction of palatalization and umlaut, as shown in (14):
(14) Rules that Interact with Umlaut

a. Palatalization

\[
\begin{array}{c}
\text{C} \\
\text{PL} \\
\text{C-pl} \\
(V-pl) \\
(V-pl)
\end{array}
\quad
\begin{array}{c}
\text{V} \\
\text{PL}
\end{array}
\quad
\begin{array}{c}
\text{[+coronal]}
\end{array}
\]

b. Dissimilation

\[
\begin{array}{c}
\text{V} \\
\text{[+coronal]}
\end{array}
\quad
\begin{array}{c}
\text{C}
\end{array}
\]

In this analysis, the umlaut rule is general, but then the umlauted vowel dissimilates when it is next to [+coronal]. The gist of her analysis is that palatalization in (14a) applies before the umlaut rule.\(^5\) Then the application of both the umlaut and palatalization will result in the following structure:

(15) Outcome of Palatalization and Umlaut

\[
\begin{array}{c}
\text{V} \\
\text{place}
\end{array}
\quad
\begin{array}{c}
\text{C} \\
\text{place}
\end{array}
\quad
\begin{array}{c}
\text{V} \\
\text{place}
\end{array}
\quad
\begin{array}{c}
\text{C-pl} \\
\text{V-pl} \\
\text{V-pl}
\end{array}
\quad
\begin{array}{c}
\text{[+cor]}
\end{array}
\]

\(^5\) To be more specific, Hume (1990: 239) proposes that palatalization applies twice. Once in the lexical derivation where it applies before umlaut, and then later on at the post-lexical level, palatalization is also applicable.
One problematic aspect of this analysis is that the spreading of [+coronal] violates the Linking Constraint proposed by Hayes (1986a: 331) as given in (16):

(16) Linking Constraint

Association lines in structural descriptions are interpreted as exhaustive.

The umlaut rule given in (14a) shows a single association line to [+coronal]. But in (15) we find that [+coronal] is doubly linked to both a C and a V. Therefore, if we interpret the single association given in (14a) as exhaustive, following the Linking Constraint, the double association of [+coronal] does not meet the environment of rule application. Therefore the spreading might be blocked by the Linking Constraint. However Hume (1990: 239) simply abandons the Linking Constraint in her analysis. Now, we can see that the first V and the following C share the [+coronal] feature, thus meeting the structural description of the Dissimilation rule given in (14b). Thus the dissimilation applies which has the effect of undoing the umlaut as shown in (17)⁶:

(17) Application of Dissimilation Rule

---

⁶Notice again that there is another violation of the Linking Constraint in the application of the dissimilation rule.
Here are some of the exemplary derivations:

(18) Exemplary Derivations

<table>
<thead>
<tr>
<th>Gloss</th>
<th>baby</th>
<th>thorn</th>
<th>to be hung</th>
<th>sister</th>
</tr>
</thead>
<tbody>
<tr>
<td>UR</td>
<td>/aki/</td>
<td>/kasi/</td>
<td>/kəl +li/</td>
<td>/ənni/</td>
</tr>
<tr>
<td>a. palatalization ----</td>
<td>kaši</td>
<td>kələli</td>
<td>ənəni</td>
<td></td>
</tr>
<tr>
<td>b. umlaut æki</td>
<td>kæši</td>
<td>ke ləli</td>
<td>eŋni</td>
<td></td>
</tr>
<tr>
<td>c. diss ---</td>
<td>kaši</td>
<td>kələli</td>
<td>ənəni</td>
<td></td>
</tr>
<tr>
<td>d. others [ægi]</td>
<td>[kaši]</td>
<td>[kələli]</td>
<td>[ənəni]</td>
<td></td>
</tr>
</tbody>
</table>

As discussed earlier, the application of umlaut and dissimilation renders the output identical to what was before the application of both rules if the intervening segment is coronal. I think it would have been much simpler to adopt the Linking Constraint and prevent the spreading of doubly linked [+coronal] to the first vowel than to posit the ill-motivated Dissimilation rule in (14b) to undo the effect of umlaut.

Hume’s analysis as it stands has two serious problematic aspects. Hume differentiates /l/ from /c/ to explain the transparency of /l/. And later she suggests the palatalization rule given in (14a), which applies to the coronal consonants. In her formulation of the palatalization rule, it should be noted that not only /s/ or /ll/ but also /l/ and /l/ can be the target of palatalization. If palatalization applies to /l/, then the whole argument for /l/ transparency is lost and this predicts that /l/, /n/ and /l/ will also block the umlaut, contrary to her first observation. Under her geometry it is not possible to subcategorize two different coronal consonants: /l/, /n/, and /l/ on the one hand and /s/ and geminate /ll/ on the other. Thus Hume’s
palatalization rule eventually makes all the coronal consonants opaque to the umlaut rule resulting in the loss of the earlier account of alveolar consonant transparency.

Another problem comes from the lexical status of the palatalization rule. It should be noted that the umlaut rule is lexical thus the rule that applies before the umlaut, the palatalization rule in Hume's analysis, is also a lexical rule. Hume (1990: 238) claims that palatalization which is applied before umlaut is a lexical rule. If palatalization is a lexical rule, then the output should conform to Structure Preservation discussed in 2.3.3. In essence, Structural Preservation does not allow a lexical rule to produce a segment not in the underlying representation. However given the fact that [š] (palatalized [s]), [ł] (palatalized [l]), and [ń] (palatalized [n]) are not in the phonemic inventory of KS dialect, and of the Korean language in general for that matter, the palatalization rule creates segments which are not underlyingly present thus violating Structure Preservation.

7.1.2. Kang's Analysis.

Y-S. Kang (1991) totally abandons the feature geometry model noting the inability of explaining the opacity effect of coronal sounds in the feature geometry model. He adopts Dependency Phonology developed by Anderson (1980), Anderson and Jones (1974) and Anderson and Ewen (1987). Though the discussion on the Dependency Phonology is not crucial in the present analysis, I will briefly introduce the articulatory gesture components needed to follow Kang's argument. In Dependency Phonology (=DP), segments are represented by the combination of categorial gestures and articulatory gestures which are dependent on categorial gestures. In articulatory gestures, there are four components: {i}, {a}, {u}, and {l}. The interpretation of these components is given in (19):

---
7 See S-C. Ahn (1988a) for specific argumentation that s-palatalization, n-palatalization and l-palatalization are post-lexical rules.
Interpretation of the Articulatory Gesture Components

<table>
<thead>
<tr>
<th>Vowel</th>
<th>Consonant</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. {i}</td>
<td>front</td>
</tr>
<tr>
<td>b. {a}</td>
<td>low (open)</td>
</tr>
<tr>
<td>c. {u}</td>
<td>round</td>
</tr>
<tr>
<td>d. {l}</td>
<td>_____</td>
</tr>
</tbody>
</table>

With these components, Kang (1991: 84) formulates the following umlaut rule:

Kang's Umlaut Rule under DP.

Categorial Gesture  | {V} | {V} |
|--------------------|-----|-----|
Articulatory Gesture | {a} | {i} |

Kang's explanation of the palatal blocking is due to the OCP and Linking Constraint. In DP a palatal sound has both {l} and {i}. Therefore the usual representation of an intervening palatal will look like (21a). However the OCP does not allow two adjacent identical components, two {i}'s in this particular case. Therefore the intervening palatal should be represented as in (21b) according to Kang's argument:

---

8I will not go into the categorial gesture components, since it is not directly relevant to the present discussion. I will use [V] for vowels and "X" for consonant instead of the actual categorial gesture components for the sake of simplicity. (See Anderson (1987:33-37) or Anderson and Ewen (1987: 151-184) for explanation of different combinations of components for categorial gestures of consonants.)
(21) Representation of Intervening Palatal Consonant.

<table>
<thead>
<tr>
<th>a. /k/</th>
<th>/a/</th>
<th>/c/</th>
<th>/i/</th>
<th>b. /k/</th>
<th>/a/</th>
<th>/c/</th>
<th>/i/</th>
</tr>
</thead>
<tbody>
<tr>
<td>{X}</td>
<td>{V}</td>
<td>{X}</td>
<td>{V}</td>
<td>{X}</td>
<td>{V}</td>
<td>{X}</td>
<td>{V}</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>/</td>
<td></td>
<td></td>
<td></td>
<td>/</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>/</td>
<td></td>
<td></td>
<td></td>
<td>/</td>
</tr>
</tbody>
</table>

Now since the gesture component {/i/} is doubly linked, it cannot spread to the preceding vowel due to the Linking Constraint. One interesting observation is that the structure in (21b) can also be derived by primary palatalization across a word boundary as illustrated in (22):

(22) Palatalization of Alveolar Sounds (from Kang (1991: 86))

| a. /katʰ + i/ | → | [kaːtʰi], *[kætʰi] (together) |
| b. /patʰ + i/ | → | [paːtʰi], *[paːtʰi] (field + Nom.) |
| c. /mat + i/  | → | [maːti], *[maːti] (the eldest son) |

Though (22a) and (22b) are not relevant to our discussion of umlaut since adverb derivation as in (22a) and Nominative suffixation as in (22b) are not the domain of umlaut since there are morphological constraints on umlaut as discussed in 7.0, we see that the derived palatals in (22c) can also block umlaut since the structural representation is quite similar to that of (21b). This palatalization is lexical and truly it does not violate Structure Preservation since /ch/ is an underlying segment in the inventory of Korean phonemes.

However, expanding the same analysis to the secondary palatalization can result in the violation of Structure Preservation as discussed in 7.1.1. In Kang’s analysis of /l/ blocking, he argues that the same palatalization converts the second /l/ into /L/ (palatal lateral), then the
doubly linked [i] cannot trigger umlaut. Consider the representation given in (23):

(23) Representation of /ll/ and Palatalization

\[
\begin{array}{cccc}
/a/ & /l/ & /l/ & /i/ \\
\{[V]\} & \{X\} & \{X\} & \{[V]\} \\
\{[a]\} & \{[l]\} & \{[i]\} \\
\end{array}
\]

The application of palatalization to the second /l/ results in the double linking and because of the double linking, [i] cannot spread to the first vowel. There are two related problems in this analysis. First, the analysis abandons the notion of Geminate Inalterability as proposed by Hayes (1986a). I slightly extend Hayes’ Geminate Inalterability and use it with the following interpretation:

(24) Geminate Inalterability

A phonological operation cannot change half of a doubly linked segment.

With the interpretation of Geminate Inalterability given in (24), we see that only the latter half of the geminate structure undergoes palatalization by the palatalization rule in (23).

This problem is further aggravated by Kang’s explanation that only the geminate /l/ undergoes palatalization. Non-geminate /l/ does not undergo palatalization thus remains

---

9In spite of Kang’s representation in (23), it may be argued that since two /l/’s are separated by a morpheme boundary, Geminate Inalterability may not hold.
transparent to the umlaut rule. (Y-S. Kang (1991: 88)) While the observation that /l/ is transparent in the umlaut process is correct, Kang's explanation is in contradiction to the Geminate Inalterability. Second, we cannot disregard the fact that a palatal lateral is not in the underlying phoneme inventory of Korean. This, according to Structure Preservation, means that /l/-palatalization is not a lexical rule. Thus in this analysis, a post-lexical rule is applied before umlaut which should be a lexical rule considering the morphological constraints it has.

A similar problem can be found with Kang's Adjacency Condition. Kang (1991: 89) argues that if two or more articulator gestures (two or more segments which differ in their places of articulation) intervene between the possible target and trigger, umlaut fails to apply. His definition of Adjacency Condition is given in (25):

(25) Adjacency Condition

Spreading of a component cannot cross over two articulatory gestures.

This Adjacency Condition accounts for the blocking of the umlaut process in such words as /paľpʰi/ (to be trodden) or /caňti/ (grass), since in these examples, there are two consonants between the two vowels. In order to see some of Kang's problems, consider the following data:

(26) Additional Data Concerning Adjacency Condition

a. /n'amki/ [naŋgi], [næŋgi] (to leave (ST) behind)  
   /aŋki/ [aŋgi], [æŋgi] (to be embraced)

b. /caňti/ [caŋdi], *[caændi] (grass)  
   /paňtis práŋul/ [paŋdíp'ul], *[paændíp'ul] (firefly)

c. /n'ampli/ [næmbi], [næmbi] (kettle)  
   /oŋki/ [oŋgi], [eŋgi] (to be curdled)
Words in (26a) undergo umlaut in spite of the fact that there are two consonants between two vowels. However, Kang (1991: 90) argues that place assimilation applies before the application of umlaut. After the application of Place assimilation, the structure will be like in (27) for words in (26a):

(27) Place Assimilation

Now since there is just one articulatory gesture, spreading |i| is not a violation of the Adjacency Condition given in (25). Again just like the palatalization, we will have to think about the status of the place assimilation rule. As previously discussed, umlaut is a lexical rule. On the other hand place assimilation is postlexical in nature, because it applies within a word as well as across phonological words as the examples in (28) show:

(28) Place Assimilation

a. Within a word

[pokmyɔŋ]_{N} [poŋmyɔŋ] (mask)
[tanpake]_{Adv} [tambage] (at once)

b. Across word boundary

[ɪlɛˈik]_{Adv} [mannala]_{V} [ɪlɛˈɪŋmɔŋnara] (meet soon!)
[kʰin]_{Adj} [pawi]_{N} [kʰɪm bawi] (big rock)
Thus a post-lexical rule (place assimilation) should be applied before a lexical rule (umlaut) in order to defend the Adjacency Condition. It may be argued that place assimilation applies at more than one level. However, even if we argue that somehow place assimilation takes place before umlaut, the data in (26b) still presents a problem. Notice that the intervening consonants are of the same place of articulation, but umlaut is blocked. Kang (1991: 90) argues that examples in (26b) are different from those in (26a) in that they are not derived by place assimilation. Kang (1991: 90) assumes that the underlying representation of the words in (26b) does not have doubly linked articulatory gesture as shown in (29):

(29) Underlying Representation of /cantí/

\[
\begin{array}{cccc}
/a/ & /n/ & /t/ & /i/ \\
{[V]} & {X} & {X} & {[V]} \\
{[a]} & {[l]} & {[l]} & {[i]} \\
\end{array}
\]

Now by putting two identical articulatory gesture components adjacent to one another, Kang can explain the opacity in the examples in (26b). However, there is a contradiction in the explanation of palatal consonant blocking as shown in (21). In (21), Kang says that the OCP does not allow two identical gesture components in two adjacent segments and invoked the OCP fusion to make a linked structure. It is curious why the same OCP does not fuse two identical articulatory gesture components in (29). It is crucial for Kang's analysis that the OCP should not be involved in the examples of (26b).

Even if we admit that underived consonant articulatory gesture components are not subject to the OCP, another serious problem of the Adjacent Condition occurs in the examples given in (26c). Notice that the words in (26c) are just like the words in (26b) in that they have
underlyingly identical articulatory gesture components as illustrated in (30) showing the first
word in (26c):

(30) Underlying Representation of /nampi/

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>/a/</td>
<td>/m/</td>
<td>/p/</td>
<td>/i/</td>
</tr>
<tr>
<td>{V}</td>
<td>X</td>
<td>X</td>
<td>{V}</td>
</tr>
<tr>
<td>[a]</td>
<td>[u]</td>
<td>[u]</td>
<td>[i]</td>
</tr>
</tbody>
</table>

Now given the underlying representation as in (30), Kang's Adjacency Condition
predicts that umlaut will be blocked just like the cases in (26b). However, (26c) can undergo
umlaut and both the umlauted and unumlauted forms exist in the standard dialect of Korean.
Therefore Kang's Adjacency Condition cannot explain both the data in (26b) and (26c).

In the following sections, I will present an analysis which does not rely on the
problematic ordering of palatalization before umlaut or on the unmotivated Adjacency
Condition proposed by Y-S. Kang (1991). It will be shown that the analysis crucially relies on
syllable structure of the input form of umlaut.

7.2. Vowel Fronting in Korean

In this section, I will briefly sketch out the basic umlaut operation. I will show that
under the present feature geometry model, umlaut can be analyzed as the spreading of the
[coronal] node to a preceding vowel which is adjacent to the trigger of the umlaut on the moraic
tier. I will also explain palatal consonant blocking and continuant consonant blocking in the
process of umlaut. Specifically I will argue that the features [palatal] and [continuant] in
Korean are coronal dependent. Therefore [coronal] should be specified in order to link [palatal] or [continuant] to the root node as explained by Inherent Redundancy in 3.3.3.

7.2.1. Vowel Fronting as [coronal] Spreading

Given the feature geometry and underspecification model, we may formulate the following vowel fronting rule as a first approximation:

(31) Coronal Spreading

\[
\begin{array}{c}
\text{\[coronal\]} \\
\text{\[palatal\]}
\end{array}
\]

The high front vowel /i/ is represented as [coronal] that dominates [palatal]. Thus the umlaut process can be analyzed as spreading [coronal]. However [coronal] spreading is not enough to characterize umlaut since there is another rule, primary palatalization, which retracts alveolar sounds to make them alveo-palatal sounds. Therefore we have to define the target so that it is a vowel. Hence it is necessary to specify that the target is another vowel which is moraically adjacent.

Also we will have to limit the trigger to /i/ since two other front vowels /e/ and /æ/ in Korean do not trigger vowel fronting, though they are specified for [coronal].
Compare the geometric representations of front vowels in Korean as given in (32):

(32) Three Front Vowels

<table>
<thead>
<tr>
<th>a. /i/</th>
<th>b. /e/</th>
<th>c. /æ/</th>
</tr>
</thead>
<tbody>
<tr>
<td>[voc]</td>
<td>[voc]</td>
<td>[voc]</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>[coronal]</td>
<td>[coronal]</td>
<td>[coronal]</td>
</tr>
<tr>
<td>[palatal]</td>
<td>[palatal]</td>
<td>[palatal]</td>
</tr>
<tr>
<td></td>
<td>TP</td>
<td>TP</td>
</tr>
<tr>
<td></td>
<td>[open]</td>
<td>[RTR]</td>
</tr>
</tbody>
</table>

In (32), we can immediately see that /i/ is different from other front vowels in that it does not have a branching place node. I argue that the rule given (31) does not predict that umlaut is triggered by all the three front vowels in Korean. We do not need any extra condition to exclude open front vowels from the trigger. The Linking Constraint given in (16) can successfully limit the trigger to /i/. Notice that the structural description of (31) does not show branching in the place node. Therefore if we interpret the single association line between the Place node and the Articulation node as exhaustive, we can see that the two other front vowels have another line coming out of the Place node and so would not be a trigger for the rule.  

10

7.2.2. Palatal Blocking

Korean vowel fronting is analyzed in the previous subsection as the spreading of [coronal] to the preceding vowel which is adjacent to the trigger on the moraic tier. Now I

10In the DP framework, {[x]} means a segment that has only "x", while {x} means a segment which has "x" and possibly other components. Therefore by saying that umlaut is {[i]} spreading instead of {[i]} spreading, the DP framework can limit the trigger to /i/.
will explain the blocking effect of [palatal] consonants. As shown in the examples in (33), umlaut does not take place if a palatal consonant intervenes between two vowels:

(33) Palatal Consonant Blocking

/kachʰi/ [kacʰi], *[kæcʰi] (value)
/taci/ [taji], *[tæaji] (to mince)
/pʰəci/ [pʰəji], *[pʰəji] (to spread out)
/kəci/ [kəji], *[keji] (beggar)

We have already shown that in spite of [coronal] underspecification, [coronal] should be specified if any of the coronal dependent features is to be specified. As discussed in Chapter 3, [palatal] is a feature that is located under a coronal node. Therefore it is only natural that the umlaut rule is blocked if there is a [coronal] consonant intervening between the trigger and the target, since spreading of [coronal] through a consonant specified for [coronal] will result in a line crossing violation as schematically shown in (34):

(34) Ill-formed Spreading

As shown in (34) spreading across a palatal consonant results in the violation of the line crossing prohibition. Therefore the present analysis can explain palatal blocking in a straight-forward way.
7.2.3. Continuant Blocking

Now, let’s consider the blocking effect of other coronal consonants. Consider the following data:

(35) Intervening Coronals\(^{11}\)

\begin{itemize}
\item a. Non-continuant
  \begin{itemize}
  \item /mati/ [madi], [mædi] (knot)
  \item /pəli/ [pəri], [peri] (to be spoiled)
  \item /tali/ [tari], [tæri] (to iron)
  \item /tani/ [tani], [tæni] (to go to and from)
  \end{itemize}
\item b. Continuant
  \begin{itemize}
  \item /psiny̚ki/ [pšiny̚gi], *[epšiny̚gi] (to despise)
  \item /kasina/ [kašina], *[kæšina] (girl)
  \item /masi/ [maši], *[mæši] (to drink)
  \item /ka + si/ [kaši], *[kæši] (go- honorific)
  \end{itemize}
\end{itemize}

We see that the data in (35a) strongly argues that [coronal] should not be specified for alveolar coronals in Korean, contrary to Y-S. Kang’s (1991: 79) claim. However, we are still left with the examples in (35b). We find that all the intervening consonants are /s/ in (35b). For these examples I will claim that [continuant] is a coronal dependent feature in Korean.

\(^{11}\) As observed by S-C. Ahn (1989: 170), /l/ is transparent in verbs but not in nouns as the following examples show:

<table>
<thead>
<tr>
<th></th>
<th>[məri], *[meri]</th>
<th>[tari], *[tæri]</th>
</tr>
</thead>
<tbody>
<tr>
<td>mali</td>
<td>(head)</td>
<td>(bridge)</td>
</tr>
<tr>
<td>tali</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As discussed in 3.3.4, there are two different types of parameterization in Feature Geometry: place feature parameterization, and independent feature parameterization. We have talked about place feature parameterization in 3.3.4, while the discussion on independent feature parameterization has been postponed up to this point. What I mean by "independent feature" is a feature which is not dominated by any organizational node, i.e. a feature directly under root node; features such as [sonorant], [lateral], [nasal] and [continuant] can be considered independent features.

Before discussing the location of [continuant] in the feature geometry of Korean, I will briefly introduce Levin's (1988) argument for the place of [lateral] in Feature Geometry. Levin argues that the feature [lateral] may be specified under coronal following Steriade (1986). Levin introduces two interesting arguments for her justification that [lateral] is a coronal feature: a representational argument and a rule-based phonological argument.12

Levin (1988:1) says that the representational argument claims that "if non-coronal laterals exist, then lateral cannot be a feature exclusively associated with coronal segments". In other words, if segments with the feature [lateral] are always coronal, then we may argue that placing [lateral] under [coronal] is representationally motivated. The second argument, the rule-based phonological argument, is that if a rule involving [coronal] also affects [lateral], then we might say that [lateral] is geometrically related to [coronal].

I argue that placing [continuant] under coronal in Korean is supported by both types of the arguments that Levin presents. We find that coronal continuants, /s/ and /s'/, are the only segments specified for [continuant] in Korean. There is no other continuant segment that has a different place of articulation. One might say that /h/ is another continuant. However, I

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12It should be noted that Levin does not present the argument for [lateral] as part of a parametric approach. However, I think the same argument can be employed as a basis for language particular parametrization.
argue that /h/ should not be specified for [continuant] on the basis of the consonant coalescence data given in (36):

\[(36) \text{ Consonant Coalescence} \]
\[
\begin{align*}
\text{cap} + \text{hi} & \rightarrow \text{cap}^h\text{i} & \text{(to be caught)} \\
\text{mək} + \text{hi} & \rightarrow \text{mək}^h\text{i} & \text{(to be eaten)} \\
\text{coh} + \text{ciman} & \rightarrow \text{co}^h\text{iman} & \text{(though it is good)} \\
\text{nah} + \text{ko} & \rightarrow \text{nak}^h\text{o} & \text{(give birth and)}
\end{align*}
\]

If we assume that /h/ does not have [continuant] the consonant coalescence can be explained simply by the combination of features of the two adjacent sounds as illustrated in (37) with the first word in (36):

\[(37) \text{ Coalescence Process} \]
\[
\begin{array}{ccc}
p & \hfill \hfill h\hfill \hfill p^b\hfill \\
\text{R[con]} & + & \text{R[con]} \\
\text{PL} & | & \text{LG} \\
\text{A} & | & \text{[SG]} \\
[\text{peripheral}] & | & \text{[peripheral]}
\end{array}
\]

However, if we specify [continuant] for /h/, we cannot explain why the coalescence of stop and /h/ becomes a stop sound instead of a fricative consonant. This indicates that /h/ should not be specified for [continuant]. Therefore we can say that /s/ is the only segment
specified for [continuant] in Korean. Since there is no non-coronal continuant segment in Korean, putting [continuant] under [coronal] is representationally supported.\textsuperscript{13}

For the rule-based phonological argument for the place of [continuant] in the feature geometry, there is at least one rule that affects [coronal] as well as [continuant] in Korean. Consider the following place neutralization:

\begin{equation}
\text{(38) Korean Place Neutralization Data}^{14}
\end{equation}

\text{a.} \begin{array}{lll}
\text{pap} & [\text{pap}] & \text{(meal)} \\
\text{kak} & [\text{kak}] & \text{(angle)} \\
\end{array}
\text{b.} \begin{array}{lll}
\text{nac} & [\text{nat}] & \text{(day)} \\
\text{mac} & [\text{mat}] & \text{(opposite)} \\
\end{array}
\text{c.} \begin{array}{lll}
\text{pus} & [\text{put}] & \text{(brush)} \\
\text{nas} & [\text{nat}] & \text{(sickle)} \\
\end{array}

The data in (38a) and (38b) show that the place neutralization affects only the coronal sounds. Given the fact that /t/ is the least specified consonant in Korean, the data in (38b) can be explained by delinking the [coronal] node as shown in (39):

\textsuperscript{13}S-H. Kim (1989) also argues that /s/ is the only continuant in Korean.

\textsuperscript{14}There is another process of neutralization in Korean, which involves delinking of laryngeal features as the following examples illustrate:

\begin{array}{lll}
ap^b & [\text{ap}] & \text{(front)} \\
nac^b & [\text{nat}] & \text{(face)} \\
k'ak' & [k'ak] & \text{(to cut)} \\
\end{array}
The coronal delinking at the end of a syllable will result in getting rid of the place features and the resulting underspecified consonant will be correctly interpreted as /t/ in the phonetic component.

Now consider the data given in (38c). We see that syllable final /s/ is also realized as /t/ losing its [continuant] feature just like the palatal consonants in (38b). This is a clear case that delinking coronal also affects [continuant]. If we place [continuant] under [coronal] for Korean, we can easily understand why alveopalatals and continuants are realized as /t/. If not we have to say that place neutralization involves two distinct rules: [continuant] delinking and [coronal] delinking. Thus the rule-based argument also supports placing [continuant] under [coronal].

Once this argument is accepted, we can explain why not only palatal consonants but also continuant consonants block the umlaut process in Korean. The ill-formed nature of [coronal] spreading through a continuant consonant is shown in (40):
As illustrated in (40), [coronal] spreading through a continuant consonant results in the Line Crossing Violation. Therefore it is predicted in this paper that all other alveolar

15There are systematic exceptions to this generalization, where /s/ seems to be transparent as the following example shows:

\[ p\overline{as} + ki \rightarrow [p\overline{ak}'i], [pek'i] \] (to undress)

In this example /s/ seems to be transparent. However we have to note that here /s/ is in the coda position, where neutralization applies. Therefore at the stage when the umlaut applies, [coronal] and [continuant] is delinked and erased as shown below:
consonant /t, th, t', n, l/ and all the non-coronal consonants are transparent in Korean vowel fronting. However two groups of coronal consonants, alveopalatal consonants /c, ch, c'/ and continuant consonants /s, s'/ block the application of umlaut due to their geometrical representation.

7.3. Moraic Adjacency Condition

In the previous section, we have sketched out the outline of vowel fronting in Korean. It is shown that coronals are transparent except alveopalatals and continuants. And the opaque nature of these sounds is explained by their geometrical representations. In this section, I will take up the rest of the exceptional cases discussed in (4), (6) and (7) and I will show that these apparent exceptions can be explained systematically within the present framework.

7.3.1. Geminate Structure

We have shown that alveolar consonants, /t, n, l/ are transparent with respect to the umlaut operation in Korean. However in some cases a coronal sonorant may look opaque to vowel fronting as the examples in (41) show:

\[
\begin{array}{c}
\sigma \\
\mu \\
p \\
\mu \\
et \\
\mu \\
\mu \\
ki \\
\mu \\
\mu \\
dashed line \rightarrow [\text{cor}] \\
dashed line \rightarrow [\text{palatal}]
\end{array}
\quad \text{other rules} \quad \begin{array}{c}
\sigma \\
\mu \\
p \\
\mu \\
pe \\
\mu \\
\mu \\
\mu \\
ke \\
\mu \\
\mu \\
dashed line \rightarrow [\text{cor}] \\
dashed line \rightarrow [\text{palatal}]
\end{array}
\]
The examples in (41) clearly show that the intervening coronal sonorants block the umlaut process. However, with a closer look, we find that the intervening coronal consonants are geminates. This is a very significant observation in that as discussed in 4.2.3 and 4.3.2, a geminate sonorant consonant is moraic in Korean syllable representation. Consider the syllable structure in (42) illustrated with the first word in (41):

Given the moraic syllable representation in (42), we can see that the words in (41) do not meet the environment for vowel fronting. Notice that umlaut operates on the moraic adjacency condition as shown in (31). In (42), we find that the vowel /a/ in the first syllable is not moraically adjacent to the triggering vowel /i/ in the second syllable. There is another moraic segment between them. The mora that dominates /l/ is adjacent to vowel /i/. But since /l/ is specified for [consonantal] in the root node, it also does not satisfy the structural
description of umlaut. Thus it is shown that the apparent coronal blocking given in (41) is reanalyzed as geminate blocking.\textsuperscript{16} We see that geminate blocking correctly predicts that all the intervening geminates, regardless whether they are coronal or not, block the umlaut process.

\textbf{7.3.2. Linked Structure}

In this subsection, I will offer an account for the exceptional cases given in (6a).

Consider the data given in (43):

\begin{verbatim}
(43) Two Identical Vowels
\begin{tabular}{lcc}
\textbf{w1} & \textbf{w2} & \textbf{w1} \\
\text{秫} & \text{秫} & *[秫ni] (mother) \\
\text{倀} & \text{倀} & *[倀ni] (a clumsy person) \\
\text{s} & \text{s} & *[s\text{\textacuteni}] (ape) \\
\text{k} & \text{k} & *[k\text{\textacuteni}] (leech) \\
\text{s} & \text{s} & *[s\text{\textacuteni}] (ladder) \\
\text{k} & \text{k} & *[k\text{\textacuteni}] (straw bag) \\
\end{tabular}
\end{verbatim}

Some of the data in (43) are cited in the literature as examples of coronal blocking. However as the second and third examples show, umlaut can be blocked even with a non-coronal consonant. One common characteristic of all the examples given in (43) is that the vowels in the first and the second syllables are identical. I assume that these two vowels have the linked structure illustrated in (44) with the first word in (43):

\textsuperscript{16}Note that the explanation given here predicts that even a non-coronal geminate will also block vowel fronting. Thus it correctly predicts that /kammi/ (sweetness) does not undergo vowel fronting because of the intervening geminate consonant.
The second mora comes without subsegmental features and this empty mora is filled by rightward spreading from the preceding syllable as in the case of ideophones discussed in 6.2.2. Notice that the representation in (44) shows a linked structure which can be treated as a long-distance geminate. Under this assumption, we see that spreading [coronal] from the triggering vowel to the second mora will result in changing half of the linked structure or geminate, which is not allowed by the Geminate Inalterability given in (24). Thus I argue that all the examples given in (43) fail to show the umlauted forms because of the Geminate Inalterability condition.

However, I am not saying that all the identical vowels in two consecutive syllables show the linked structure. It is only when an unassociated mora is underlyingly present that the root spreading takes place to derive a linked structure. If two identical vowels are independently associated to the subsegmental structure, then they cannot be treated as a long distance geminate. When all the moras are independently linked, umlaut applies regardless whether the two vowels preceding /i/ are identical or not. Consider the examples in (45):

(45) Non-linked Structure

<table>
<thead>
<tr>
<th>Word</th>
<th>Pronunciation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>kalanji</td>
<td>[karaŋi], [karæŋi]</td>
<td>(crotch)</td>
</tr>
<tr>
<td>kacami</td>
<td>[kajami], [kajæmi]</td>
<td>(flat fish)</td>
</tr>
</tbody>
</table>
The examples in (45), in spite of the fact that the first two vowels are identical, undergo umlaut. I attribute the difference to the difference of the underlying representations as shown in (46):

(46) Different Underlying Representation

\[
\begin{array}{cccc}
\mu & \mu & \mu & \\
\sigma & m & n & i \\
\end{array}
\quad
\begin{array}{cccc}
\mu & \mu & \mu & \\
\kappa & a & l & a & \eta & i \\
\end{array}
\]

The crucial difference between (46a) and (46b) is the status of the second mora. In (46a), the second mora is underlyingly without segmental association. However in (46b), the second mora is associated to a vowel. Thus root spreading applies only in (46a) to form a long distance geminate, which will resist the umlaut application. In (46b), on the other hand, the second mora is not doubly linked. It is not a part of a linked structure, and it is adjacent to /i/ on the moraic tier. Therefore the representation in (46b) satisfies the structural description of the umlaut rule in Korean.

An additional interesting point follows from the preceding discussion. If the two identical vowels are separated by a geminate consonant, these two vowels can never form a long distance geminate as the schematic representation in (47) shows:

(47) Ill-formed Linked Structure

\[
\begin{array}{ccc}
\mu & \mu & \\
V & C \\
\end{array}
\]
In (47) we see that the third mora cannot form the latter half of a long distance geminate across a moraic consonant due to the Line Crossing Prohibition. If such structure is followed by the trigger of umlaut, the prediction is that the third mora will always undergo umlaut, if it is not a round vowel. Consider the following data:

(48) \text{Words with Identical Unlinked Vowels}

\begin{align*}
\text{holl} & \quad [\text{holl}], \quad [\text{holl}] \quad \text{(a loose person)} \\
\text{toll} & \quad [\text{toll}], \quad [\text{toll}] \quad \text{(a careless person)} \\
\text{t'all} & \quad [\text{t'all}], \quad [\text{t'all}] \quad \text{(tinkler)}
\end{align*}

The examples in (48) show that though the first two vowels are identical, these vowels cannot form a linked structure because of the intervening geminate consonant. This, in turn, means that the second vowel undergoes umlaut by the influence of the following /i/.

7.3.3. \textbf{Long Vowels}

Another interesting case of geminate structure comes from a long vowel in the target position of umlaut. Long vowels, or geminate vowels, resist umlaut like the linked structure that was just discussed in the previous subsection. Consider the following examples:

(49) \text{Words with Long Vowels}\textsuperscript{17}

\textsuperscript{17}The long vowels are shortened in casual or fast speech, which is indicated by the parentheses in the phonetic forms. It should be also noted that there are controversies on vowel length in Korean, which may weaken the argument given here. However there is sound evidence for the vowel length of the examples cited here and it must be noted that I consistently follow H-S. Lee's \textit{Kukeo Taeajeon} (A Comprehensive Dictionary of Korean), one of the most widely accepted of the Korean dictionaries, to represent the vowel length.
Y.-S. Kang (1991: 89) proposes the Adjacency Condition to explain the blocking of umlaut in (49a). However as discussed in 7.1.2., his Adjacency Condition does not accommodate major observations of the Korean vowel fronting as well as the examples in (49b). I assume that it is not the number of intervening consonant but the nature of the stem vowel that blocks the application of umlaut.\(^\text{18}\) Thus I shift focus from the intervening consonant to vowel length. A long vowel is represented as a geminate, a vowel linked to two moras. Consider the representation of the first word in (49a):

\[\begin{array}{c}
\mu \\
p\
\bigg| \bigg| \bigg| \\
a \\
l \\
\mu \\
ph \\
i
\end{array}\]

\(^{18}\)Surely there are tendencies that the number of intervening consonants can influence the use of an umlauted form as noted by W-J. Kim (1963: 221) and also by S-C. Ahn (1989: 169). However the relationship between the number of intervening consonants and the process of umlaut are observed as a tendency. The intervening two or more consonants do not absolutely forbid the application of umlaut. For example, as S-C. Ahn (1989: 169) points out, /palk + hi/ (to brighten) undergoes umlaut to become *[pæk̚hi]*, though this form is less frequently used than other forms with one intervening consonant such as /pak + hi/*([pæk̚hi]).
As shown in (50), applying umlaut in this representation results in changing half of a geminate. Therefore just like in the cases of linked structures discussed in 7.3.2, Geminate Inalterability is responsible for the lack of umlaut in the examples given in (49).

7.4. Further Problems

We have shown that the umlaut rule given in (31) can explain the major facts found in Korean umlaut. However, in spite of the analyses presented so far, there are residual problems which defy a simple explanation. I will discuss these residual problems in this section. Specifically, I will focus on three aspects: umlaut blocking by a derived /i/, glide as a possible trigger of umlaut and the instability of front round vowels in Korean.

7.4.1. Umlaut Blocking by a Derived /i/.

The data shown in (7) is left unexplained in the present analysis. They remain as counter-examples. Consider the data given in (51) which are of the same class as the data in (7):

(51) Historical Effect of Vowel Change

<table>
<thead>
<tr>
<th>Word (Old)</th>
<th>[New], *[New]</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>canti (&lt;canti)</td>
<td>[canti], *[cændi]</td>
<td>grass</td>
</tr>
<tr>
<td>napi (&lt;napí)</td>
<td>[nabi], *[næbi]</td>
<td>butterfly</td>
</tr>
<tr>
<td>kɔki (&lt;kɔki)</td>
<td>[kɔgi], *[kegi]</td>
<td>that place</td>
</tr>
<tr>
<td>nɔpi (&lt;nɔpi)</td>
<td>[nɔbi], *[nebi]</td>
<td>width</td>
</tr>
</tbody>
</table>
The historical forms are given in the parentheses. These examples illustrate that umlaut takes place before the monophthongization of /ı/y/ into /i/. W-J. Kim (1963: 221) takes these examples as evidence for the historical nature of umlaut.19 If we suppose that umlaut ceased to apply before the historical monophthongization of /ı/y/, then we can nicely explain why these forms do not undergo umlaut. However I would like to note that the monophthongization is not only historical but also an ongoing synchronic change as witnessed in the following examples.

19 In certain Cholla dialects, the derived /ı/ can trigger umlaut in some words as observed by Kee (1983: 14):

<table>
<thead>
<tr>
<th>Word</th>
<th>Monophthongization</th>
<th>End Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>kyŏnti</td>
<td>kyŏnte</td>
<td>[cendi]</td>
</tr>
<tr>
<td>titiŏ</td>
<td>titiŏe</td>
<td>[tidıe]</td>
</tr>
</tbody>
</table>
Now, we see that monophthongization is realized by fusing two adjacent vocalic roots. This operation exactly duplicates the umlaut operation. With this observation, I propose that the examples given in (51) have the off-glide, /ɨi/, in the underlying representation in the second syllable. The underlying /ɨi/ forms also match with the archaic forms of these words. B-G. Lee (1973: 150) further observes that "the morpheme internal abstract underlying sequence /ɨy(=ɨi)/, which shows up nowhere on the surface ... should be allowed in the phonological grammar of Korean, if the problems of palatalization and umlaut are to be solved in a general and natural way".

Now consider the underlying moraic representation of the first word in (51):

(54) Underlying Representation of /canti/

Notice that the first vowel /a/ and the possible trigger /ɨ/ are not moraically adjacent because of

---

20 There is another option of the monophthongization operation for the genitive marker /ɨi/. We find that the genitive marker /ɨi/ is monophthongized into /i/ rather than /ɨi/. The genitive marker often surfaces as /e/, too.
the intervening /i/, which is also moraic. Thus it does not satisfy the structural description of umlaut. Note also that the second moraic segment is adjacent to /i/ on the root tier. As will be discussed in Chapter 8, the two vocalic roots adjacent on the root tier are fused into one if the features are not incompatible. Application of vowel coalescence will result in the long vowel /i/. However since this long vowel is linked to two moras, [coronal] cannot spread to the first syllable. Thus in this stage the Linking Constraint blocks the application of umlaut.\footnote{Finally in the post-lexical level, all long vowels in non-initial syllables of a word are shortened by a vowel shortening rule. (cf. Kim-Renaud (1982))}

As a result, the derived /i/ by monophthongization of /iy/ will always have the effect of blocking the umlaut process, either because of not meeting the moraic tier adjacency condition or because of the Linking Constraint.

### 7.4.2. Glides as Triggers?

The analysis of Korean vowel fronting given so far crucially relies on the fact that both the trigger and target are moraic segments. Glides as discussed in Chapter 5, on the other hand, are not moraic. Therefore it is clearly predicted in this chapter that front glides are not possible triggers. However, there seems to be counter-examples to this strong claim. The data given in (55) apparently show that a front glide [y] triggers vowel fronting:

(55) Umlaut Apparently Triggered by Glides

\begin{itemize}
\item[a.] capʰyọ [capʰyọ], [caepʰyọ] (to be caught)
\item[b.] mọkyọ [mọgyọ], [megyọ] (to feed)
\item[b.] əlyọp [əryọp], [eryọp] (difficult)
\end{itemize}
kalyəp   [karyəp],   [kæryəp]   (itchy)
kapyəp   [kabyəp],   [kæbyəp]   (light)
malyəp   [maryəp],   [mæryəp]   (to be about to (urinate))

In all the examples given in (55) there is no high front vowel /i/ in the representations, but they show umlauted forms. However, I argue that the examples in (55a) can be explained with the correct understanding of affixation processes. Note that forms in (55a) have two different suffixes. The causative/passive suffix /hi/ is added to the stem and then the infinitive suffix /ə/ is added. Umlaut applies in the suffixation of the causative/passive marker, and glide formation applies only after infinitive suffixation. The derivational process is shown in (56):

\[(56)\] Derivation of /cæpʰya/  
a. Underlying Representation   cap  
b. Passive Suffixation   cap + hi  
c. Umlaut and Consonant Merger   cæpʰi  
d. Infinitive Suffixation   cæpʰi + ə  
e. Glide Formation   cæpʰya  
f. Vowel Shortening   cæpʰya

Therefore if we follow the step by step derivation of the words in (55a), we find that when umlaut applies, both the trigger and the target of umlaut are adjacent on the moraic tier. Glide formation applies only after umlaut. Therefore, in spite of the surface representation, the trigger of umlaut is moraic when the umlaut rule applies.
The examples in (55b) cannot be incorporated into the present analysis. However we will have to note that all the examples are underived adjectives and these four constitute an exhaustive list of exceptions of this kind to the best of my knowledge. Recall that all the examples discussed in this chapter are either nouns or verbs. In adjectives we do not usually find the umlaut process as illustrated in (57):

(57) Non-application of Umlaut in Adjectives

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ali</td>
<td>[ɔrɪ], *[ɛrɪ] (young)</td>
</tr>
<tr>
<td>ali'tap</td>
<td>[aɾɪ'tap], *[æɾɪ'tap] (pretty)</td>
</tr>
<tr>
<td>kiliŋ</td>
<td>[kɪɾɪŋ], *[kɪɾɪŋ] (beloved)</td>
</tr>
</tbody>
</table>

Thus I think that the examples in (55b) should be treated differently from the regular umlaut process found in nouns and verbs. Thus I claim that the existence of the forms in (55b) do not argue against the analysis presented in this chapter.

One possible explanation may be presented in connection with the KS dialect forms. The umlauted words in (55b) are regularly found in the KS dialect in slightly different forms. The KS dialect forms are given in (58):

(58) KS Dialect Forms

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>əlyəp</td>
</tr>
<tr>
<td>kalyəp</td>
</tr>
<tr>
<td>kapyəp</td>
</tr>
<tr>
<td>malyəp</td>
</tr>
</tbody>
</table>

---

22It should be noted that there is virtually no phonetic distinction between /æ/ and /e/ in the colloquial KS dialect.
As discussed in 5.1.3, the KS dialect does not allow a glide vowel sequence when there is an onset element in the same syllable. Therefore there is a predicted difference in the KS dialect in that the second syllable has the mid-front vowel /e/ in the KS dialect. As a matter of fact, the forms in (58) are more frequently found than the umlauted forms in (55b) among the standard dialect speakers in very casual speech.

In any case, it is clearly shown that we do not have to abandon the moraic adjacency condition simply because of the presence of examples like (55b), since they are exceptional in many respects. These four constitute an exhaustive list of this kind of exception, all these forms have a /yap/ sequence in the second syllable, and they are not nouns or verbs.

7.4.3. Umlaut of Round Vowels

So far, we have not discussed the umlaut of back round vowels. In this subsection, I will briefly discuss the status of round vowels in the Korean vowel fronting process. We have argued that umlaut is a lexical rule, which is not applicable at the post-lexical level. Therefore the umlaut rule is subject to Structure Preservation, which does not allow the creation of novel segments in the lexical derivation. Recall also that the eight vowel system is adopted in this dissertation, excluding two round front vowels /ü/ and /ö/. The corollary of these observations is that umlaut should not be applied to round vowels. Truly as illustrated in (59), round vowels resist vowel fronting:

(59) Umlaut Resistance of Round Vowels

    a. /u/
    muk + hi [mukhi], *[mükhi] (to keep idle)
    kup + hi [kuphi], *[küphi] (to bend)
culi [curi], *[cüri] (to starve)
uli [uri], *[üri] (cage)

b. /o/

nok + i [nogi], *[nögi] (to melt)
k’op + hi [kophi], *[köphi] (to be selected)
noli [nori], *[nöri] (to aim)
kopi [kobi], *[köbi] (crisis)

The examples in (59) clearly show that round vowels resist the application of vowel fronting. This is the predicted behavior given the lexical status of the vowel fronting rule, the underlying eight vowel system and Structure Preservation.

However there are exceptions to the observation. Round vowels can be affected by the umlaut rule as the following additional examples show:

(60) Umlaut of Round Vowels

a. /u/

nup + hi [nupʰi], [nüpʰi] (to lay)
cuk + i [cugi], [cügi] (to kill)

b. /o/

p’op + hi [p’opʰi], [p’öpʰi] (to be selected)
tomi [tomi], [tömi] (porgy)
koki [kogi], [kögi] (meat)
kop’i [kop’i], [köp’i] (bridle)

In general there are fewer examples of /u/ umlaut than /o/ umlaut. If we adopt ten vowel system as in B-G. Lee (1973), we may explain the data in (60). However, this is at the
cost of losing accountability of the data in (59). Thus we see that neither the eight vowel system nor the ten vowel system can successfully incorporate the data in (59) and (60). There are no systematic differences in the data (59) and (60)\(^{23}\) as can be seen when we compare the last words of (59b) and (60b). I suggest that the words in (60) should be marked in the lexicon as undergoing umlaut, following Shim's (1986) rule formulation of Korean umlaut.

However such underlying information does not help to account for the data in (60), since whether they are marked for umlaut or not, umlauting the round vowel violates Structure Preservation given the eight vowel system. I claim, though, that umlaut in the exceptional cases in (60) does not contradict Structure Preservation. What I suggest is to relate the data in (60) to the umlaut phenomenon found in the KS dialect. In the KS dialect, a round vowel loses its round value in the course of umlaut as the following examples show:

\[(61) \text{ Umlaut in KS Dialect} \]

- nup + hi → \([\text{nip}^\text{hi}]\) (to lay)
- cuk + i → \([\text{cigi}]\) (to kill)
- koki → \([\text{kegi}]\) (meat)

The data in (61) shows that the [round] feature is delinked in the process of umlaut. In order to explain the KS dialect umlaut, we will have to posit the following umlaut rule (cf. Hume (1990: 235)):

\[\text{Though it is true that if the intervening consonants are coronal, the preceding round vowel seems to show stronger resistance to vowel fronting as observed by S-C. Ahn (1989: 169), we can easily see that it is not a sufficient condition for umlaut blockage, as the first two words in (59a) and (60b) show.}\]
A round vowel loses its [labial] feature as a result of the application of the vowel fronting rule. In the KS dialect, the delinked [labial] cannot surface as a glide if the vowel from which [labial] is delinked is preceded by a consonant due to the Single Onset Consonant Constraint (=SOCC) discussed in 5.1.3. However, in the standard dialect, I assume that the delinked [labial] will be relinked to a syllable node and surfaces as a round glide since the SOCC does not hold in the standard dialect. Therefore the exceptional application of umlaut to round vowels in (60) will result in the glide plus vowel sequence as shown in (63):
Thus the round vowel fronting process will produce the following outputs:

(64) Round Vowel Umlaut Outputs

<table>
<thead>
<tr>
<th>Word</th>
<th>Umlaut Form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>cuki</td>
<td>[cwiki]</td>
<td>(to kill)</td>
</tr>
<tr>
<td>nup + hi</td>
<td>[nwiphi]</td>
<td>(to lay)</td>
</tr>
<tr>
<td>koki</td>
<td>[kweki]</td>
<td>(meat)</td>
</tr>
</tbody>
</table>

Then in the post-lexical level the round glide and the following vowel merge into a front round vowel (cf. the discussion in 5.1.3. and 8.2.3.) Consequently, the umlauted forms in (60) are produced. Therefore the application of umlaut to the handful of exceptional cases can be explained within the eight vowel system. One piece of supporting evidence for such an analysis is that not only front round vowels but also glide-vowel sequence can be found in the umlauted forms of the standard dialect due to the optional nature of the post-lexical merger.

Hence it is shown that some sporadic existence of round vowel fronting can be reanalyzed without abandoning the eight vowel system, the lexical status of umlaut and Structure Preservation. Finally it should be mentioned that though there are lexically marked exceptions as given in (60), there is no violation of any of the previously discussed conditions on umlaut. Even the round vowel fronting obeys all the constraints as shown in (65):

(65) Non-application of Round Vowel Fronting

a. Coronal Blocking

<table>
<thead>
<tr>
<th>Word</th>
<th>Umlaut Form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>k'ucic</td>
<td>[k'ujit], *[küjit]</td>
<td>(to scold)</td>
</tr>
<tr>
<td>toci</td>
<td>[toji], *[tōji]</td>
<td>(to worsen)</td>
</tr>
</tbody>
</table>
b. Geminate Blocking

mul + li  [mulli],  *[mülli]  (to be bitten)
tol + li  [tollı],  *[tölli]  (to turn)

c. Linked Structure Blocking

tulumi  [turumi],  *[turümi]  (crane)
osoli  [osori],  *[osöri]  (racoon)

d. Long Vowel Blocking

ku:lm + ki  [ku(:)ŋgi],  *[kü(:)ŋgi]  (to let go hungry)
no:l + i  [no(:)ri],  *[nö(:)ri]  (game)

e. Derived /i/ Blocking

coki (<coki y)  [cogi],  *[cögi]  (yellow corbina)
nophi (<nop h i y)  [nop h i],  *[nöp h i]  (height)

As the examples in (65) show, we find that even round vowel fronting, which is extremely rare in Korean is subject to all the blocking effects discussed in this chapter.

7.5. Conclusion

In this chapter, we have discussed the vowel fronting phenomena in Korean. Umlaut, in its essence, can be simply described as back vowel fronting by the regressive influence of the following high front vowel. However, we find that there are phonological and morphological constraints on umlaut.

Morphologically umlaut application is limited to nouns and verbs. It is shown that in the derived position not all /u/’s trigger umlaut. Only two suffixes, nominalizer /i/ for noun
formation and passive/causative suffixes, /i/, /hi/, /li/, /ki/ can trigger umlaut for verbs while all
other suffixes that may have high front vowels such as nominative marker /i/, adverbial marker
/i/, /hi/ and /li/, gerundive marker /ki/ or copula /ita/, fail to trigger umlaut.

In its phonological constraints, the coronal blocking has been one of the major
controversies in the non-linear analysis of umlaut. Hume (1990) proposed an ordering of the
secondary palatalization before umlaut and Kang (1991) also resorted to the same ordering to
make the best use of his proposal of an adjacency condition. However given the fact that
umlaut is a lexical rule and the secondary palatalization and place assimilation are post-lexical
rules, we find that there is an insoluble ordering problem in both of the analyses.

I have shown that the feature geometry model does not have to be abandoned in light of
the data from Korean umlaut. On the contrary, I argued that the spreading of [coronal] from a
high front vowel to the preceding vowel which is adjacent on the moraic tier can explain the
major observations in Korean umlaut. Since umlaut is analyzed as [coronal] spreading, we
may predict that an intervening consonant specified for [coronal] will block the umlaut process.
Truly, there are two kinds of coronal segments specified for [coronal] under the present
geometrical analysis: palatal coronals, /c/, /ch/, and /c'/, and continuant coronals, /s/ and /s'/. I
argued that Levin’s (1988) representational and rule based arguments for the location of lateral
under coronal can be used as support for the parameterization of [continuant] under the coronal
node in Korean. Therefore, it is correctly predicted that other intervening coronals, which are
underspecified for [coronal], such as /t/, /n/, and /l/ will be transparent in the umlaut process.

The apparent effect of other coronal blocking is attributed to the Moraic Adjacency
Condition, the Linking Constraints and Geminate Inalterability. First we note that intervening
geminate consonants can block umlaut. Since the intervening geminate is linked to a mora,
the possible trigger cannot be adjacent to the preceding vowel across another moraic segment.
Therefore, intervening moraic segments, whether they are coronal or not, block umlaut.
Second, we see that some of the stems that unexpectedly fail to undergo umlaut have identical vowels in two consecutive syllables. I proposed that the second syllable in such stems has an unassociated mora in the underlying representation and root spreading from the first vowel results in two identical vowels. Then we see that the first and the second vowels are linked to form a long distance geminate. If umlaut applies to such structure, it will change the latter half of the long distance geminate, which is a violation of Geminate Inalterability. With the same reasoning, we can see that long vowels are also represented by double association of a root to two moras. Hence Geminate Inalterability also does not allow application of umlaut to long vowels.

Again, if the possible trigger is long, then umlaut does not occur because of the Linking Constraint. The rule description of umlaut clearly shows that the triggering segment that has [coronal] does not have double association lines between the root and moras. Thus the Linking Constraint does not allow spreading from a doubly linked structure. We find cases where there is a long /i/ derived from /äi/. Such derived long /i/ does not trigger umlaut as correctly predicted by the Linking Constraint. I have strongly argued in this chapter that it is not only the intervening coronals but also general principles and the structural description of the umlaut rule that explain the various kinds of blocking effects.

There are observations that glides can sometimes trigger umlaut. But this claim is reanalyzed in this chapter. It was shown that in spite of the surface appearance, the triggering glide was actually moraic /i/ when umlaut applied and then later the triggering /i/ became a glide by a later rule of glide formation.

We also find that there are some exceptional cases of round vowel fronting. I suggest that the round vowel fronting follows a slightly different pattern of the umlaut rule, an umlaut rule found in the KS dialect. However the existence of round vowel fronting does not necessarily mean that we have to abandon the underlying eight vowel system for contemporary
Korean. I analyzed round vowel fronting as vowel fronting with the delinking of [labial] and subsequent relinking of [labial] to the syllable node to make it a surface round glide. In the post-lexical level, the round glide and front vowel sequence can optionally merge into a round front vowel. It is also noted that even such highly marked round vowel fronting strictly obeys all the blocking effects of various kinds discussed in this chapter.

As clearly shown in this chapter, we do not have to abandon the feature geometry proposal or the underlying eight vowel system in order to explain Korean vowel fronting. On the contrary, I have shown that the feature geometry proposed in Chapter three and the moraic syllable structure in Chapter four, and general principles in phonology such as Line Crossing Prohibition, Geminate Inalterability, Linking Constraint, and Structure Preservation closely interact with one another in the umlaut process in Korean.
Chapter 8

Vowel Coalescence

8.0. Introduction

Discussion on Korean vowels cannot be complete without considering the vowel coalescence phenomena. In this final main chapter, I will concentrate on the vowel coalescence phenomena and how they can be analyzed in the present framework. As discussed in Chapter 5, several different changes take place when two vowels are adjacent. These include glide formation, glide insertion, vowel deletion and vowel coalescence. Following Choi (1971), Huh (1965), C-W. Kim (1971), and Kim-Renaud (1982), I assume that these changes take place in order to avoid a vowel clash. We have already discussed glide formation and glide insertion in Chapter 5, thus the main focus of this chapter will be on vowel coalescence (henceforth VC) and vowel deletion.

I include vowel deletion triggered by the presence of another adjacent vowel as a subpart of vowel coalescence. Consider the coalescence process proposed by de Hass (1988: 84):

\[ \text{For the purpose of discussion in this chapter I will not differentiate the terms, "coalescence", "fusion" and "merger". I will use them interchangeably.} \]
(1) De Hass’ Vowel Coalescence Rule

\[
\begin{align*}
\text{V} & \quad \text{V} \quad \rightarrow \quad \text{V} \quad \text{V} \\
[\alpha F] & \quad [\beta G] \quad \rightarrow \quad [\alpha F, \beta G]
\end{align*}
\]

De Hass views VC as feature node coalescence here. Thus the (specified) features associated to different V-tiers are combined together with resultant lengthening of the merged segment. However the process is blocked if the resultant feature combination cannot be interpreted in a given language. Now suppose that either of the two vowels is featureless. The coalescence rule in (1), in its broad sense, will predict that the coalescence rule still applies, but the result of VC is a long vowel with specified features of one vowel as schematically shown in (2):

(2) VC with Unspecified Vowel

\[
\begin{align*}
\text{V} & \quad \text{V} \quad \rightarrow \quad \text{V} \quad \text{V} \\
[\alpha F] & \quad [\emptyset] \quad \rightarrow \quad [\alpha F]
\end{align*}
\]

( [ ] represents an empty feature matrix.)

Further if the specified features of a vowel are a subpart of the specified features of another vowel, VC will produce the following output:

(3) VC of Complex Feature Combination

\[
\begin{align*}
\text{V} & \quad \text{V} \quad \rightarrow \quad \text{V} \quad \text{V} \\
\left[ \alpha F \right] & \quad [\beta G] \quad \rightarrow \quad [\alpha F] \quad [\beta G]
\end{align*}
\]
If we compare the outputs with the inputs of VC in (2) and (3), we find that the result of VC looks just like deletion of one vowel with subsequent lengthening. Therefore the apparent deletion in these environments can be explained without positing another rule of vowel deletion.\(^2\) Thus the deletion of a vowel when it is adjacent to another vowel can be viewed as a subpart of the VC process.

In Korean, we may find three major types of vowel coalescence process as illustrated in (4):

\[(4) \text{ Korean VC Data} \]

a. Merger

\[
\begin{align*}
\text{ai} & \quad [\text{ai}], [\text{æː}] & \text{(baby)} \\
\text{ai} & \quad [\text{æːu}], [\text{æːgu}] & \text{(Oh!)} \\
\text{t'e} + \circ & \quad [\text{t'æə}], [\text{t'æː}] & \text{(to detach)}
\end{align*}
\]

b. /i/ Deletion

\[
\begin{align*}
\text{mai} & \quad [\text{maːi}], [\text{maːm}] & \text{(mind)} \\
\text{yo + taim} & \quad [\text{yodaːim}], [\text{yodam}] & \text{(right next time)} \\
\text{choi} & \quad [\text{chɔːim}], [\text{chɔːm}] & \text{(first time)}
\end{align*}
\]

\(^2\)There are deletion phenomena that may need a special rule of vowel deletion if the deletion process would result in the elimination of features of a vowel, which cannot be explained by VC alone as schematically shown under:

\[
\begin{align*}
V & \quad V & \quad V & \quad V \\
[\alpha F] & \quad [\beta G] & \quad [\alpha F]
\end{align*}
\]

In such a situation we clearly see that there is a need to posit a separate rule of vowel deletion or feature delinking. However, no such case is witnessed in Korean. The presence of independent vowel deletion in fast speech forms as discussed in 4.3.1, does not pose a problem to the present assumption since it is not triggered by the presence of another vowel.
c. VC without Lengthening

\begin{align*}
\text{ka + a} & \quad [\text{ka}], \quad *[\text{ka}:] \quad \text{(to go)} \\
\text{kh y} & \quad [\text{kh} y], \quad *[\text{kh}:] \quad \text{(to light)} \\
\text{ca + i o} & \quad [\text{caro}], \quad *[\text{ca}:\text{ro}] \quad \text{(with a ruler)} \\
\text{ka + im y} & \quad [\text{kamy}], \quad *[\text{kai m}] \quad \text{(if . . . go)}
\end{align*}

It should be mentioned that the VC in (4) is limited to pure Korean words. They do not apply to Sino-Korean words or loan words, just like umlaut in Korean discussed in Chapter 7, as exemplified in (5)\(^3\):

\begin{align*}
\text{(5) Sino-Koreans and Loan Words} \\
\text{k o + in} & \quad [\text{kain}], \quad *[\text{ke}:\text{n}] \quad \text{(giant)} \\
\text{ky e + o m} & \quad [\text{kyeom}], \quad *[\text{kye}:\text{m}] \quad \text{(martial law)} \\
\text{s'ain} & \quad [\text{sain}], \quad *[\text{sa}:\text{n}] \quad \text{('sign')} \\
\text{boi} & \quad [\text{boi}], \quad *[\text{bo}:] \quad \text{('boy')} 
\end{align*}

Returning to the examples in (4), we observe that the VC in (4a) and (4b) seems to be optional, since the coalesced forms and noncoalesced forms coexist on the surface. Further we see that the VC is accompanied by vowel lengthening as de Hass' VC rule given in (1) predicts. I have to make note of the second example in (4b), since it does not show a long vowel in the coalesced form. However, the appearance of a short vowel is due to another independent

\(^3\)However the /i/ deletion in (4b) can take place even with Sino Korean words in fast speech or casual speech forms as shown below:

\begin{align*}
\text{a} & \quad [\text{a}:\text{m}] \quad \text{(IOU note)} \\
\text{hoi} & \quad [\text{ho}:\text{n}] \quad \text{(good response)}
\end{align*}
process found in Korean. Vowel length is retained only in initial syllables. In noninitial syllables, long vowels surface as short vowels. This is captured by Kim-Renaud's (1974) vowel shortening rule as given in (6):

\[
V \rightarrow [-\text{long}] \# [C_o V_o C_o]_1
\]

(Every vowel becomes [-long] non-initially.)

In moraic theory, vowel length is captured by the number of mora that a vowel is associated with. Thus the rule given in (6) can be translated into moraic theory as shown in (7):

\[
\sigma \quad \sigma
\]

\[
\sigma \sigma \quad \mu \quad \mu
\]

\[
v
\]

(A long vowel is shortened in non-initial position.)

With this independent vowel shortening process, we can generalize that the examples in (4a) and (4b) always have long vowels after VC, and the long vowels in non-initial syllables are shortened by the application of the shortening rule given in (7); thus they surface as short vowels.

Another interesting observation in connection with the data in (4a) is that sometimes the vowel clash just remains unresolved, i.e. not all the vowel clashes trigger VC. Consider the following examples:
(8) Unresolved Vowel Clashes

\[ s\dddot{o} + o \] \[ s\dddot{o}, *[so:] \] (please stop)

\[ me + o \] \[ meo], *[mö:] (carry on the shoulder!)

\[ ki + o \] \[ ki\ddot{o}, [ky\ddot{e}:], *[ke:] \] (to crawl)

The examples in (8) clearly show that not all adjacent vowels are subject to VC, in spite of the fact that the possible output of the coalescence does not create uninterpretable feature combination in Korean. I propose that there are certain constraints on VC.

Turning to the examples in (4c), we find that the data in (4c) are different from those in (4a) or (4b) in many respects. First, there is no lengthening effect. As the monosyllabic stems in (4c) show, the initial vowels are not lengthened. If they are long, then they are ruled out as ill-formed. Second, we see that the coalescence is not optional. If the VC does take place, the resultant vowel sequence is tolerated. Third we see that there are no examples of this kind in underived words. Thus we can generalize that the obligatory VC as shown in (4c) is applicable only in the lexical derivation and that there is no lengthening effect.

The obligatory nature of vowel deletion in coalescence as in (4b) has been one of the major controversies in the study of this phenomenon in Korean. Excluding the first two examples of (4c), we find that the deleted vowel is /i/. And /i/ deletion in this environment has been extensively studied by many phonologists including, Kim-Renaud (1974, 1982), S-C. Ahn (1985), H-S. Sohn (1987b) and D-J. Lee (1989) among others. However, the rules that have been posited are either too complicated so as to lose any naturalness or they are not complete in dealing with the exceptional cases.

On the other hand, scholars such as H-B. Choi (1971), W. Huh (1965), C-W. Kim (1971) and Y-S. Kim (1984) try to explain the alternation by means of the /i/ insertion analysis instead of an /i/ deletion analysis. However such an approach has proven to be even less satisfactory because of the problem in delimiting the domain of the application of insertion and
in dealing with exceptions.

Against this backdrop, I will make a new proposal that some underlying high vowels are introduced without associated moras and that the /i/ deletion effect can be accounted for by means of the syllabification process with Stray Syllabification or Stray Erasure. To be more specific, I will argue that if /i/ appears on the surface in these examples, its appearance is due to Stray Syllabification, and if /i/ does not surface, its lack of appearance is the natural result of Stray Erasure Convention as discussed in 4.2.5.2.

In the following section, I will make a survey of VC phenomena and distinguish two different processes: optional VC and obligatory VC. I will show that there are possible and impossible types of vowel coalescences. Afterwards, I will discuss optional VC, and argue that one general rule can cover all the optional mergers with resultant lengthening. I will also discuss that there are constraints on the general rule of vowel merger. To be more specific, I will propose that there is a [round] constraint and an [RTR] constraint in optional VC. The [round] constraint disallows VC if the first vowel is not round and the second vowel is round. However if the second one is not round then the first one may be either round or unround. Further if the second vowel is [RTR] and the first vowel is not [RTR], the optional VC does not take place.

In 8.3, I will turn to the cases of obligatory VC. I will argue that the obligatory nature of a high vowel deletion comes from the underlying moraic status of these vowels. As discussed in 4.2.5.1. moras are assumed to be underlyingly present and some vowels are not moraic. In these contexts, I will propose that the stem final /i/ and affix initial high vowels in verbal morphology such as /i/, /i’, /u/ are underlyingly nonmoraic. Therefore they may not appear on the surface level unless they acquire moraic status by either Stray Syllabification or by a (morphological) Minimality Condition.
As such I will separate two different aspects of vowel fusion and explain that the cases in (4a) and (4b) truly reflect the merger process and the examples in (4c), though they look like VC follows an entirely different path of derivation.

8.1. Survey

Before going into the discussion of VC in Korean, I will present the facts about Korean VC and how they have been analyzed in previous research. The optional VC illustrated in (4a) and (4b) are assumed to be post-lexical rules since it applies both to derived and non-derived forms regardless of their morphological content. However there seem to be certain restrictions. VC does not readily take place in co-compounding and across phrasal boundaries as illustrated in (9):

(9) Lack of VC

a. Co-compounding
   tæku + ṣnyaŋ  [tæguŋnyaŋ], *[tægonyaŋ]  (Tague and Eonyang)
   namu + ili m  [namuirim], *[naũririm]  (tree name)

b. Across Phrasal Boundary
   cipesɔpp [onta]v  [cibesɔnda], *[cibesonda]  (come from a house)
   Minki\NXp [anta]v  [miŋgianda], *[miŋgænda]  (knows Minkı)

Thus I will assume that the co-compounding boundary and the phrasal boundary are strong enough to separate two vowels thus the motivation for VC, i.e. vowel clash avoidance is absent
in these environments.\(^4\)

Now consider the following coalescence chart:

(10) Vowel Coalescence Chart

\(V_1:\) first vowel

\(V_2:\) second vowel

<table>
<thead>
<tr>
<th>(V_1)</th>
<th>i</th>
<th>i</th>
<th>u</th>
<th>o</th>
<th>ə</th>
<th>e</th>
<th>æ</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>i</td>
<td>i</td>
<td>u</td>
<td>o</td>
<td>ə</td>
<td>e</td>
<td>æ</td>
<td>a</td>
</tr>
<tr>
<td>i</td>
<td>i</td>
<td>i</td>
<td>ü</td>
<td>ö</td>
<td>e</td>
<td>e</td>
<td>æ</td>
<td>æ</td>
</tr>
<tr>
<td>u</td>
<td>u</td>
<td>*</td>
<td>u</td>
<td>o</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>o</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>o</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>ə</td>
<td>ə</td>
<td>e</td>
<td>o</td>
<td>*</td>
<td>ə</td>
<td>e</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>e</td>
<td>e</td>
<td>e</td>
<td>e</td>
<td>e</td>
<td>*</td>
<td>*</td>
<td>e</td>
<td>*</td>
</tr>
<tr>
<td>æ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>æ</td>
<td>*</td>
</tr>
<tr>
<td>a</td>
<td>*</td>
<td>æ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>a</td>
</tr>
</tbody>
</table>

* : Coalescence does not take place.

O: Does not surface as a long vowel.

In the VC chart given in (10), we can immediately see that not all the vowel sequence triggers vowel coalescence. The absence of coalesced forms in some cases can be attributed to surface constraints found in Korean. In Korean a front low round vowel [œ] and a back low round vowel [ə] are not allowed even on the surface level. Therefore the sequences like /oa/,
/œ/, /œ/, or /ua/ cannot fuse into one vowel because the resultant low round vowels are phonetically uninterpretable in Korean. In addition to such surface constraints, we might need some restrictions so as to eliminate other unattested surface forms in the coalescence process.

Any account for VC in Korean has to deal with the optionality and obligatory nature of the vowel coalescence. Consider the following examples:

(11) /i/ deletion

a. Optional

maim   [maim], [maːm]    (mind)
kail   [kaɪl], [kaːl]    (fall)
naili   [naiɾi], [naːri]    (sir)

b. Obligatory

kɔnni + ɔ   [kɔnɾi], *[kɔnɾiɔ]    (to cross)
chili + ɔ   [chɪɾi], *[chɪɾiɔ]    (to pay)
so + ɾo   [sɔɾo], *[sɔɾo], *[sɔɾɔ]    (with a cow)

In (11a), the merger is optional, while in (11b), we find that the surface form without merger is rendered ill-formed. Therefore we can say that the two different examples in (11a) and (11b) should be treated differently. Another dimension that we have to think about is the output forms of the merger. We see that the output of the merger can either be long vowels or short vowels. Consider the following data:

(12) Long and Short Outputs.

a. Long Vowels

t'e + ɨ   [t'eɪ], [t'eː]    (to be detached)
k' æ + ɔ   [k'æɾ], [k'æː]    (to break)
b. Short vowels

mønilimøniliritmønilirimønilirimeniři (daughter in law)

namu + ílo [namuro] (with a tree)

Notice that the first word in (12b) is optional and the second one is obligatory. Thus here we see that the surface vowel length is another distinction. Though it may be true that all the obligatory VC results in short vowels, we see that sometimes the apparent VC is optional but the merged vowel surfaces short. Therefore we may summarize the different types of vowel coalescence as in (13):

(13) Different VC Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Optional</th>
<th>Obligatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Vowel</td>
<td>A</td>
<td>Unattested</td>
</tr>
<tr>
<td>Short Vowel</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

This diagram provides comprehensive information about VC in Korean. Firstly, we find that obligatory application of VC with a resultant long vowel is not attested in Korean. However the result of the optional application of VC can be either long or short. Area (A) in (13) is the typical case of vowel coalescence which can be neatly captured by the VC rule given in (1). I assume that the appearance of short vowels in areas (B) and (C) is due to the lack of a mora of one of the fused vowels. Specifically, area (B) can be explained by onset simplification (cf. 5.1.3). For example the underlying /piæ/ (rice) is realized as [pyæ] or [pe] but it does not show up as [pe:]. In such cases the fusion takes place between an onset element,
i.e. a glide, and a following vowel. Since onset elements do not have moras, the merger does not have two moras, thus there cannot be any lengthening effect.

In area (C), I offer a similar explanation. If one of the vowels in a two vowel sequence is not moraic, then the result of the merger is always a short vowel. Besides, the fusion process may involve delinking of a mora. For example there may be a strong segmental OCP effect that one of two identical vowels deletes in the process of lexical derivation, if the OCP induced deletion also deletes moras, then again such deletion will result in short vowels.

In the following sections, I will divide two VC phenomena on the basis of the optionality of application. Thus in 8.2, I will concentrate on optional vowel coalescence and in 8.3, I will discuss obligatory VC by positing nonmoraic vowels in the underlying representation.

8.2. Optional Vowel Coalescence

In this section, I will first consider Sohn's (1987b) rules for the optional VC, the area (A) in (13). I will show that Sohn's rules, though very comprehensive, have some undesirable aspects. Then I will combine two of Sohn's rules to propose one general rule of optional VC. It will be shown that we need some constraints on this general rule, so as to prevent wrong outputs. In 8.2.3, I will discuss the optional VC which is not accompanied by vowel lengthening. I will argue that the optional VC without vowel lengthening is different from VC and propose that the apparent VC is actually an onset simplification process. Thus since the onset element does not have moraic status in the underlying representation, the fused vowel cannot be long.
8.2.1. Sohn’s Analysis

Sohn (1987b) presents a comprehensive analysis of optional vowel coalescence with Levin’s (1985) style of syllable structure. She proposes two rules for VC, which she calls Nucleus Gemination and Merger as given in (14):\(^5\)

\[(14)\quad \text{Two Processes of VC}\]

\(\text{a. Nucleus Gemination (post-lexical)}\)

\[\begin{array}{c}
N \\
\hline \\
\end{array}
\begin{array}{c}
x \\
\hline \\
x \\
\hline \\
\% \\
\end{array}
\]

\(\text{b. Merger (optional)}\)

\[\begin{array}{c}
N \\
\hline \\
N \\
\hline \\
N \\
\hline \\
x \\
\hline \\
x \\
\rightarrow \\
\end{array}
\begin{array}{c}
\text{[αF]} \\
\hline \\
\text{[βG]} \\
\hline \\
\text{[αF, βG]} \\
\end{array}
\]

(14a) subsumes Kim-Renaud’s (1982) Casual /i/ Deletion\(^6\) as well as identical vowel fusion. Thus Sohn argues that (14a) can explain two different sets of data as given in (15):

\[^{5}\text{There is much previous research on vowel coalescence. However, such research focused on /i/-deletion, disregarding other types of merger. In some cases, the research is limited to certain combinations such as /V + i/ coalescence as in Ahn (1989: 172).}\]

\[^{6}\text{Kim-Renaud (1982: 476) formulate the casual /i/ deletion rule as shown below:}\]

\[\begin{array}{cccc}
X & V & i & Y \\
1 & 2 & 3 & 4 \\
1 & 2 & \emptyset & 4 \\
\hline \\
\text{+long} \\
\end{array}\]

([i] is truncated when following another vowel and the remaining vowel is lengthened.)
(15) Examples of Nucleus Gemination

a. /i/ deletion

\[ \text{ch\text{\textcompwordmark}im} \rightarrow [\text{ch\textcompwordmark}im], [\text{ch\textcompwordmark:m}] \] (first time)

\[ \text{kai\text{\textcompwordmark}l} \rightarrow [\text{kai\textcompwordmark}l], [\text{ka:l}] \] (fall)

\[ \text{iikk\text{\textcompwordmark}o} \rightarrow [\text{iikk\textcompwordmark'o}], [\text{i:kk\textcompwordmark'o}] \] (finally)

\[ \text{ki\text{\textcompwordmark}s + o} \rightarrow [\text{ki\textcompwordmark}s], [\text{k\textcompwordmark:o}] \] (to draw)

b. Identical Vowel Fusion

\[ \text{nah + o} \rightarrow [\text{na\textcompwordmark}s], [\text{n\textcompwordmark:o}] \] (to put)

\[ \text{tah + a} \rightarrow [\text{taa}], [\text{ta:}] \] (to reach)

\[ \text{cas + a} \rightarrow [\text{caa}], [\text{ca:}] \] (to spin)

\[ \text{c\text{\textcompwordmark}s + o} \rightarrow [\text{c\textcompwordmark}s], [\text{c\textcompwordmark:o}] \] (to stir)

It is curious however, how Merger in (14b) is different from (14a). Ignoring the mirror image environment in (14a) for the moment, we can see that the rule given in (14a) can subsume (14b) too. Without further constraining the Nucleus Gemination, we can see that the rule in (14a) is not just restricted to /i/ deletion or identical vowel deletion. The structural description argues that any two vowel sequence is subject to Nucleus Gemination. Consider /AB/ and /BA/ sequences, where both /A/ and /B/ are vowels. The mirror image environment in (14a) predicts that both /AB/ and /BA/ sequences are subject to the same Nucleus Gemination rule. Consider the following examples:
(16) Absence of Mirror Image Effect.

a. s’a + i  [s’ai], [s’æ:]  (to be piled up)

mian  [mian], [mya:n], *[mæ:n]  (sorry)

b. cu + ø  [cuø], [cwø:], [co:]  (to give)

soul  [soul], *[so:l]  (the city of Seoul)

The examples given in (16) clearly show that though the /AB/ sequence undergoes Nucleus Gemination, the /BA/ sequence fails to merge together.

(14b) is for verbal suffixation. As the rule refers to the morpheme boundary, the merger process is lexical but optional as the following examples show:

(17) Examples of Merger

pe + ø  [peø], [pe:]  (to cut)

pe + i  [pei], [pe:]  (to be cut)

kæ + ø  [kæø], [kæ:]  (to fold)

kæ + i  [kæi], [kæ:]  (to be folded)

Notice that Merger is optional. Therefore a vowel sequence, for example /æø/ that meets the environment of Merger may remain unaffected in the lexical derivation, then in the post-lexical level, this sequence again meets the structural description of Nucleus Gemination and may appear as [æ:] by the application of Nucleus Merger. What I am pointing out is that (14b) is totally redundant given the post-lexical Nucleus Gemination given in (14a). This gives us a hint that the rules given in (14a) and (14b) can be replaced by one general rule of vowel coalescence.
8.2.2. Coalescence as Root Deletion

We have shown that it is not unreasonable to combine Sohn's two rules into one. Thus following de Hass' (1988) formulation of VC, I propose following VC rule as a first approximation:

(18) Vowel Coalescence (post-lexical)

\[
\begin{array}{c|c}
\mu & \mu \\
R[/voc] & R[/voc] \\
\hline 
[F] & [G] \\
\end{array} 
\xrightarrow{\text{Root deletion}} 
\begin{array}{c|c|c}
\mu & \mu & \mu \\
R[/voc] & [F, G] \\
\hline 
\end{array}
\]

When two vowels are segmentally adjacent, these two vowels can optionally fuse into one vowel by forming a segment that shows the feature combination of the two vowels. However I think that this coalescence process is actually a result of two different rules. One of the vocalic roots deletes, then the features originally dominated by the deleted root node is floating unassociated. These unassociated features are then linked up to the remaining vocalic root thus changing the vowel quality of the linked vocalic segment; the empty mora is then filled by root spreading as shown in (19):

(19) VC as Two Separate Process

\[
\begin{array}{c|c}
\mu & \mu \\
R[/voc] & R[/voc] \\
\hline 
[F] & [G] \\
\end{array} 
\xrightarrow{\text{Root deletion}} 
\begin{array}{c|c}
\mu & \mu \\
R[/voc] & R[/voc] \\
\hline 
[F] & [G] \\
\end{array} 
\xrightarrow{\text{Association}} 
\begin{array}{c|c|c}
\mu & \mu & \mu \\
R[/voc] & [F, G] \\
\hline 
\end{array}
\]
Seen from this viewpoint, VC is essentially a process of eliminating one of two adjacent vowels, if both of them are moraic. The root spreading to the empty mora can be viewed as a process of compensatory lengthening due to the presence of an unassociated mora and the association of the delinked features comes from general principles. Thus I assume that association and spreading are mechanical processes that need not be included in the structural description of the VC rule. I propose the following Feature Association Convention, which is applicable to unassociated features:

(20) Feature Association Convention (=FAC)

Unassociated features are locally associated.

Here local association means the association to a root node which is nearest to the floating features. Consider the schematic representation of an unassociated feature.

(21) Local Association

```
  \[ \begin{array}{ccccc}
    R_1 & R_2 & R_3 & R_4 \\
  \end{array} \]
```

Suppose that [C] is an unassociated feature. FAC allows the association of the feature [C] to \( R_2 \) or \( R_3 \) but disallows the association of [C] to either \( R_1 \) or \( R_4 \), since \( R_1 \) and \( R_4 \) are not local to [C], since there are closer root nodes such as \( R_2 \) or \( R_3 \). It should be noted that a floating feature introduced as a part of a morphological process may not be subject to the FAC. These morphological features are usually specified for the linking target in the rule description. For example the introduction of the floating feature [RTR] in light ideophone derivation and of [back] in affixal harmony discussed in Chapter 6, are immune to FAC. In this sense, we may
say that FAC is purely phonological in nature.

With these observations, we can condense the VC rule into a simpler rule of Root Deletion as given in (22):

\[
(22) \text{VC as Root Deletion}
\]

\[
\begin{array}{c}
\text{µ} \\
\text{µ} \\
\text{R[voc]} \quad \text{R[voc]} \\
\text{[F]} \quad \text{[G]}
\end{array}
\]

This rule can subsume Sohn’s two rules, Nucleus Gemination and Merger. I assume that the second vocalic root deletes, for reasons that will be clear in our discussion of constraining the Root Deletion (=RD) rule in order to filter out ill-formed outputs. Let’s first consider some exemplary derivations assuming the vowel specification discussed in Chapter Five:

\[
(23) \text{Examples of VC}
\]

a. a + i → a:

\[
\begin{array}{c}
\text{µ} \\
\text{µ} \\
\text{R} \quad \text{R} \\
\text{[RTR]} \quad \text{[RTR]}
\end{array} \quad \text{RD} \quad \begin{array}{c}
\text{µ} \\
\text{µ} \\
\text{R} \quad \text{FAC} \\
\text{[RTR]} \quad \text{[RTR]} \quad \text{Spreading} \quad \text{R} \quad \text{[RTR]}
\end{array}
\]
b.  ø + i → ø:

\[ \begin{array}{c|c|c}
& RD & FAC \\
\hline
\mu & R & R \\
\mu & [open] & [front] \\
\end{array} \quad \begin{array}{c|c|c}
& \rightarrow & \\
\hline
\mu & R & R \\
\mu & [open] & [front] \\
\end{array} \]

(23a) and (23b) are self-explanatory. In (23c), we find that the VC process introduces the feature [open] which is redundant for /æ/. However since the addition of [open] to /æ/ can be phonetically interpretable, the presence of the redundant feature does not pose any problem.

In (23d), FAC adds the [round] feature which is already present in the preceding vowels. This may not be a problem given the Redundant Feature Interpretation proposed by Buckley (1991:13), as discussed in 3.3.4.\(^7\)

One more thing that should be mentioned here is the potential mirror image effect of

---

\(^7\)Notice also that the Twin Sister Convention (Clements (1986)) or the OCP fusion analysis (Mester (1986)) can achieve the same effect.
the vowel deletion rule as in the analysis of Sohn (1987b) as shown in (14). I assumed that it is the second vowel that deletes and the second vowel deletion has proven to be quite effective as shown by the sample derivations in (23). However, if we reverse the order of the vowel sequence in (23), we find that vowel coalescence does not take place. Thus /iu/, /ia/, /ia/ and /uo/ sequences do not undergo VC. Surely the second sequence can be fused into /e/ but such fusion is not accompanied by a vowel lengthening effect, thus they should be treated differently from the optional VC discussed in this subsection. There really is no mirror-image effect.

Now, as I mentioned earlier, not all the vowel clashes are resolved in Korean. We will have to constrain the general rule given in (22) in order to eliminate the over-generation. First, notice how round vowels in the second position behave differently as shown in the partial reproduction of the VC chart (cf. (10)) as given in (24):

(24) Round Vowels in Coalescence

<table>
<thead>
<tr>
<th>V1</th>
<th>i</th>
<th>i</th>
<th>u</th>
<th>o</th>
<th>e</th>
<th>æ</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>u</td>
<td>u</td>
<td>*</td>
<td>u</td>
<td>o</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>o</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>o</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

(* represents non-occurrence of VC.)

We find that there is a generalizable tendency in this chart. If the second vowel is [round], then it refuses to merge with the preceding vowel unless the preceding vowel is also [round].\(^8\) Thus we may postulate the following [round] condition on VC:

---

\(^8\)Notice that the /iu/ sequence can be fused into /u/ in spite of the generalization. This merger is witnessed in the Kyonggi and Chungcheong dialects as well as in the casual speech forms of the standard dialect, where /u/ is a question marker as shown below:

<table>
<thead>
<tr>
<th>tamk + u</th>
<th>[tamg], [tamu]</th>
<th>(dipping?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>s'i + u</td>
<td>[s'iu], [s'u:]</td>
<td>(writing?)</td>
</tr>
</tbody>
</table>
(25) Round Condition

If the second vowel is [round] then the first vowel should be round, too.

Also a similar pattern can be witnessed in the RTR vowels. Observe the possible and impossible VC when the second vowel is \([\text{RTR}]\) in (26):

(26) RTR Vowels in Coalescence\(^9\)

<table>
<thead>
<tr>
<th>V1</th>
<th>i</th>
<th>i</th>
<th>u</th>
<th>o</th>
<th>ə</th>
<th>e</th>
<th>æ</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>o</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>o</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>æ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>æ</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>a</td>
<td>*</td>
<td>æ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>a</td>
</tr>
</tbody>
</table>

○ represents that the vowel is short.

*represents non-occurrence of VC.

We see that if the second vowel is [RTR] then the first vowel should also be [RTR]. With the exception of the circled \([æ]\) example, we find no example of VC in Korean where the

---

\(^9\)In the Kyeongsang dialect, the standard form [tao] is realized as [to:]. However this is not an exception to the coalescence chart given here, since the KS dialect forms do not show [a] in the stem as shown in the following contrasts:

<table>
<thead>
<tr>
<th>Standard</th>
<th>KS</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>[tao]</td>
<td>[to:]</td>
<td>please give.</td>
</tr>
<tr>
<td>[tallago]</td>
<td>[tollak'o]</td>
<td>give + complementizer</td>
</tr>
<tr>
<td>[tallani]</td>
<td>[tollani]</td>
<td>give? (surprise question)</td>
</tr>
</tbody>
</table>

This suggest that the underlying forms for the standard and KS dialects are different from each other. We can safely assume that the underlying forms in the KS dialect contain /o/ not /a/. Thus these are not counterexamples to the VC chart.
first vowel is not [RTR] and the second vowel is [RTR]. The circled part indicates that the surface vowel is short. This form can be explained by onset simplification. I will return to these in the following subsection. For the moment, I will concentrate on surface long vowels. This constitutes another condition on VC:

(27) RTR Condition

If the second vowel is [RTR, x], then the first vowel should be [RTR, x].

(where x represents any feature or null.)

Putting these two conditions, the round condition and the RTR condition, we come up with the final version of VC as Root Deletion given in (28):

(28) Root Deletion

The VC as root deletion equipped with two additional conditions can effectively explain all the possible optional VC found in Korean. These conditions can be bypassed in casual or fast speech. Consequently in fast speech the /uo/ sequence, though it violates the RTR condition, can be pronounced as [o(:)]. However how to incorporate the fast speech and casual speech phenomena in optional merger is beyond the scope of this chapter and is left open for further research.

8.2.3. Onset Simplification

In the previous subsection, I argue that one general rule of vowel coalescence with two
additional conditions can cover all the cases of optional vowel merger with subsequent lengthening. However there are some apparently exceptional cases where the apparent vowel merger does not trigger vowel lengthening as the following examples show.

(29) VC without Lengthening

<table>
<thead>
<tr>
<th>VC</th>
<th>Lengthening</th>
</tr>
</thead>
<tbody>
<tr>
<td>p'iam</td>
<td>[p'yam], [pæm] (cheek)</td>
</tr>
<tr>
<td>kiøul</td>
<td>[kyøul], [keul] (winter)</td>
</tr>
<tr>
<td>kiesan</td>
<td>[kyesan], [kesan] (calculation)</td>
</tr>
<tr>
<td>kuemul</td>
<td>[kwemul], [kömul] (monster)</td>
</tr>
</tbody>
</table>

In order to explain such phenomena, Sohn (1987b: 157) proposed the following Nucleus Degemination rule:

(30) Nucleus Degemination

\[
\begin{array}{c}
\text{N} \\
\text{X} \quad \text{X} \quad \rightarrow \quad \text{N} \\
\text{[αF] [βG]} \quad \text{[αF] [βG]}
\end{array}
\]

Notice that Nucleus Degemination given in (30) does not refer to onset structure. Thus it predicts that the rule given in (30) is insensitive to the onset structure. However I have already shown in 5.1.2. that the fusion takes place only when there is an onset element. Therefore the fusion is not found when the sequence is not preceded by an onset consonant as the following examples show:
In Sohn’s Nucleus Degemination, we do not understand why the fusion process deletes features as well as a slot on the x-tier. However, with the onset Simplification analysis of vowel merger posited here, we can clearly show that there will not be vowel lengthening since the vowel in the onset, i.e. a glide, is underlyingly nonmoraic. Consider the following onset simplification rule:

(32) Onset Simplification (=OS)

In the OS analysis, the glide can optionally delink from the syllable node, if there is another onset within the syllable. Features of the delinked glide, [round] or [front], are associated to the following vowel by FAC. Therefore by virtue of being nonmoraic, the glide delinked from the syllable node does not leave behind any unassociated mora. Consider the following derivation.
(33) Sample Derivations.

a. Underlying Representation

\[
\begin{array}{cccccc}
\mu & \mu & \mu & \mu & \mu & \mu \\
| & | & | & | & | & | \\
\kappa & \iota & \sigma & \upsilon & \lambda & \kappa & \upsilon & \epsilon & \mu & \lambda
\end{array}
\]

b. Syllabification

\[
\begin{array}{cccccc}
\sigma & \sigma & \sigma & \sigma & \sigma & \sigma \\
\mu & \mu & \mu & \mu & \mu & \mu \\
\kappa & \iota & \sigma & \upsilon & \lambda & \kappa & \upsilon & \epsilon & \mu & \lambda
\end{array}
\]

c. Onset Simplification

\[
\begin{array}{cccccc}
\sigma & \sigma & \sigma & \sigma & \sigma & \sigma \\
\mu & \mu & \mu & \mu & \mu & \mu \\
\kappa & \iota & \sigma & \upsilon & \lambda & \kappa & \upsilon & \epsilon & \mu & \lambda
\end{array}
\]

d. Feature Association

\[
\begin{array}{cccccc}
\sigma & \sigma & \sigma & \sigma & \sigma & \sigma \\
\mu & \mu & \mu & \mu & \mu & \mu \\
\kappa & \iota & \sigma & \upsilon & \lambda & \kappa & \upsilon & \epsilon & \mu & \lambda
\end{array}
\]

This analysis explains two aspects that the Nucleus Degemination fails to explain: why the surface vowel is short and why it takes place only when the glide follows a consonant. We do not need an arbitrary x-tier deletion rule as in Sohn's Nucleus Degemination. Vowel length can be directly captured by a moraic analysis. Vowel length is always manifested on the moraic tier and since an onset is not moraic, the fusion between the onset and the following vowel cannot be long. Secondly, the onset simplification analysis successfully limits the occurrence to a complex onset thus establishing a more clear relationship between the merger
and onset structure.

Finally consider the following cases of three way variation:

(34) Additional Data

\[
\begin{align*}
\text{cu} + \varepsilon & \quad [\text{cu}\varepsilon], [\text{cw}:], [\text{co}:] \quad \text{(to give)} \\
\text{tu} + \varepsilon & \quad [\text{tu}\varepsilon], [\text{tw}:], [\text{to}:] \quad \text{(to put)} \\
\text{nanu} + \varepsilon & \quad [\text{nanu}\varepsilon], [\text{nanw}:], [\text{nano}] \quad \text{(to divide)}
\end{align*}
\]

In (34), the vowels are all moraic in the underlyingly representation. Therefore they do not meet the environment of onset simplification. However they can undergo glide formation resulting in a long vowel. Now the glide can be optionally delinked in the complex onset. Then the floating feature will be re-associated to the following vowel resulting in the long vowel [o:], as shown in the following derivation.

(35) Sample Derivation

\[
\begin{align*}
\text{Syll} & \quad \rightarrow \quad \text{GF} \quad \rightarrow \quad \text{FAC}
\end{align*}
\]

As the sample derivation in (35) shows, the three way contrasts in the examples in (34) are due to the optional nature of the merger rules discussed in this section. Since both of the vowels are moraic, the derived environment meets the environment of the optional VC rule or of glide
formation. Therefore application of either of the processes can show the surface difference. Notice that the surface form /co:/ can be derived in two different ways, one by directly applying the optional VC rule discussed in the previous subsection or by OS after glide formation. Here the interesting thing is that the vowel after the application of OS is long if it is long before the application of the OS rule. Thus it is clearly shown that vowel length can be represented only on the moraic tier.

8.3. Obligatory Vowel Coalescence

In this section, I will turn to obligatory vowel fusion found only in the lexical derivation. The discussion in this section pertains to the area (C) in the figure given in (13). Consider the following examples:

(36) Obligatory Vowel Coalescence

a. Stem Final /i/

kɔnni + ə  [kɔnnə], *[kɔnnə]  (to cross)
papɔ + ə  [papɔ], *[papɔ]  (to be busy)
kipɔ + ə  [kipɔ], *[kipɔ]  (to be happy)

b. Suffix Initial /i/

no + əlo  [noro], *[noiro]  (with an oar)
cu + ini  [cuni], *[cuni]  (to give - effective)
pata + əlo  [padaro], *[padairo]  (to the sea)

c. Identical Vowels

sɔ + ə  [sɔ], *[sɔ], *[sɔ:]  (to stand)
ca + a  [ca], *[caa], *[ca:]  (to sleep)
I will argue that the examples in (36a) and (36b) can be explained by positing underlying non-moraic vowel /i/ in stem-final position or in suffix-initial position. Thus this non-moraic vowel cannot surface when another vowel, which has a mora, is segmentally adjacent to it. However, I will assume that when they are located immediately after an unsyllabified consonant, the stray syllabification process takes the CV sequence and incorporates them into a syllable. Then we can see that /i/ shows up in the surface forms.

For the data in (36c), I propose that there is a strong OCP induced delinking rule that does not allow for two identical vowels separated by a morpheme boundary.

8.3.1. Previous Analyses.

There are two types of /i/ deletion as exemplified by (36a) and (36b). In (36a) we find that the stem final /i/ in verbs or adjectives is deleted if it is followed by a vowel initial suffix. In (36b), the suffix initial /i/ is deleted if it is added to a vowel final stem. Kim-Renaud (1974: 61) thus proposes a mirror image /i/ deletion rule to cover both of the deletion phenomena as given in (37):

(37)  Affix - Boundary /i/ Deletion

\[
i \rightarrow \emptyset \ % \ V + _____
\]

(\(i\) is deleted when preceded or followed by a vowel across an affix boundary.)

However, Kim-Renaud (1982) notes that the mirror image /i/ deletion rule in (37) is not tenable because of the following examples:
(38) Exceptions to Rule (37)

ki + eke
[kiege], *[ke:ge] (to him)

milk + e
[milkie], *[milk:e] (in the milk)

simisi + e
[simise], *[simise] (Smith’s)

Thus Kim-Renaud (1982: 475) replaces (37) with two separate /i/ deletion rules: Stem final /i/ deletion and Affix initial /i/ deletion as shown in (39):

(39) Two Rules for /i/ Deletion

a. Verb Stem Final /i/ Deletion

i → Ø / _____ & V

(& is a verb stem boundary)

The final /i/ of a verb stem is deleted when followed by an affix beginning with a vowel.

b. Affixal /i/ Deletion

i → Ø / V + _____

The initial /i/ of an affix is deleted when following a stem ending in a vowel.

However, Kim-Renaud also finds that there are exceptions to the rule given in (39a), in monosyllabic verbs and adjectives as shown in (40):

(40) Monosyllable Stems

s’i + i
[s’ii], [s’iː], *[si] (to be used)
Thus Kim-Renaud (1982: 475) proposes that monosyllabic verbs should be marked in the lexicon that they have the rule feature [- Verb Stem Final /i/ Deletion], which prevents the stems given in (40) from undergoing the rule in (39a). However not all the monosyllabic stems that end in /i/ belong to this category. If the suffix /iu/ is added to monosyllabic stems, we find that they undergo stem final /i/ deletion as shown in (41):

(41) /iu/ Suffixation

\[ \text{t'i} + i + u \rightarrow [\text{t'iu}], *[\text{t'iu}] \quad \text{(let . . . be worn)} \]
\[ \text{thi} + i + u \rightarrow [\text{thiu}], *[\text{thiu}] \quad \text{(let . . . be opened)} \]
\[ \text{t'i} + i + u \rightarrow [\text{t'iu}], *[\text{t'iu}] \quad \text{(let . . . float)} \]

Thus only a small number of /i/ final monosyllables carry the rule feature [- Verb Stem Final /i/ Deletion]. Sohn (1987b: 128) noting that the three words in (40) along with the first word in (38) are the only exceptions to the general rule of /i/ deletion suggests one rule of /i/ deletion, ignoring the exceptional nature of these words. Thus Sohn (1987b: 129) propose the following Empty Nucleus Deletion rule:

(42) Empty Node Deletion (=END)

\[
\begin{array}{c}
N \\
\mid \quad \mid \\
x \quad \rightarrow \quad \emptyset \quad x \quad \mid \\
\mid \quad \mid \\
\end{array}
\]
Though this might be a significant generalization of /i/ deletion phenomena, I do not see any improvement from the Affix-boundary /i/ deletion rule in (37) proposed by Kim-Renaud (1974) except that the rule is written in a syllabic framework. The exceptions to (37) are still exceptions to (42). Another theory internal observation we can make is that END given in (42) is in conflict with another similar rule given for the optional vowel merger. Compare the following two rules:

(43) Comparison of END and Merger

<p>| | | | |</p>
<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>X</td>
<td>x</td>
<td>%</td>
<td>→  x</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

<p>| | | | |</p>
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<tbody>
<tr>
<td>N</td>
<td>N</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td>→  x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I have slightly changed Sohn's END rule to show the similarity of the structural description of these two rules. (see (42)) Now in the absence of a further restriction on (43b) to the effect that the features should not be null, we see that these two rules can be applicable to the same string of words. Thus these two rules predict that Merger, which is lexical according to Sohn, can be applicable instead of END. However, as the ill-formedness of long vowels in /i/ deletion shows, the prediction is not born out. We will have to make reference to the absence of feature in order to differentiate (43a) from (43b). This certainly is not a desirable move.10

One radically different approach to /i/ deletion is to propose an /i/ epenthesis analysis so

---

10There are other /i/ deletion analyses. The complicated rule of /i/ deletion proposed by B-G. Lee (1979b) is discussed and criticized in S-C. Ahn (1985) and Ahn's proposal is criticized in H-S. Sohn (1987b). Please refer to these three papers for other previous analyses on obligatory /i/ deletion.
as to stay away from the problems caused by the /i/ deletion analysis. Researchers such as H-B. Choi (1971), Huh (1965), C-W. Kim (1973a) and Y-S. Kim (1984) proposed the /i/ insertion hypotheses. However, as pointed out by S-C. Ahn (1985: 203), the /i/-epenthesis analysis is untenable given the fact that there are two different suffixes, aspect suffix, /ını/ and interrogative suffix /ni/ in Korean. Consider the following examples:

(44) Aspects and Interrogatives

<table>
<thead>
<tr>
<th>Stem</th>
<th>Aspect</th>
<th>Interrogative</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>po</td>
<td>poni</td>
<td>poni</td>
<td>see</td>
</tr>
<tr>
<td>ka</td>
<td>kani</td>
<td>kani</td>
<td>go</td>
</tr>
<tr>
<td>cap</td>
<td>capini</td>
<td>capni</td>
<td>catch</td>
</tr>
<tr>
<td>cuk</td>
<td>cukini</td>
<td>cukni</td>
<td>die</td>
</tr>
</tbody>
</table>

Notice that the aspect suffix surfaces as /ni/ after vowel final stems and /ını/ after consonant final stems, while the interrogative suffix always surfaces as /ni/ regardless whether the stem final segment is a vowel or a consonant. If we take the /i/ insertion approach, the two suffixes are thought to have the same underlying form, /ni/. Then /i/ is inserted between two consonants. That will neatly explain all the variation found with the aspectual suffix. However, we also find that /i/ is not inserted between two consonants, if /ni/ is the interrogative suffix. Therefore we are faced with the problem of delimiting the application of /i/ insertion.

However we cannot decide the application domain of /i/ insertion solely on the bases of phonological information.

Further, we find that /i/ epenthesis might be too strong, since it might wrongly insert /i/ in between two consonants as in some of the following words:
We see that the examples given in (45), focusing on the last two examples, are not affected by the /i/ insertion rule. Therefore it would make it extremely complicated to add phonological and morphological restrictions on /i/ epenthesis. As such, /i/ epenthesis seems to create more problems than it solves.

8.3.2. Nonmoraic Vowels

Given the complexity of /i/ deletion and the untenability of the /i/ insertion analysis, we find that neither of the approaches captures the /i/ deletion phenomena found in Korean. I will make another proposal in this subsection that the deletion phenomena can be captured more neatly not by rules but by representation. Specifically I will argue that stem final /i/ and affix initial high vowels /i/, /i/, and /u/ are underlyingly not associated to moras, i.e. they are nonmoraic. And the syllabification process may or may not take the nonmoraic vowels as a head of a syllable.

If these nonmoraic vowels are not linked to the head of a syllable, they will either appear as glides or they will be erased by the Stray Erasure Convention. However, if these nonmoraic vowels are preceded by an unsyllabified consonant than such a CV sequence meets the structural description of Stray Syllabification. Thus they may gain moraic status by
undergoing Stray Syllabification. They then can appear on the surface as full-fledged vowels:

Consider the following examples:

(46) Surfacing /i/

\[
\text{camki} + \text{ko} \quad [\text{camgigo}] \quad \text{(lock and)} \\
\text{silp}^\text{h}i + \text{ni} \quad [\text{silp}^\text{h}ini] \quad \text{(sad?)} \\
\text{tamki} + \text{ke} \quad [\text{tamgige}] \quad \text{(in order to dip)}
\]

In these examples we see that /i/ shows up on the surface. I attribute these to Stray Syllabification. Consider the sample derivation of the first word in (46):

(47) Sample Derivation of /camki + ko/

\[
\text{\begin{align*}
\text{c} & \text{a} \text{m} \text{k} \text{i} & \text{k} \text{o} \\
\text{\sigma} & \text{\sigma} & \text{\sigma} & \text{\sigma} & \text{\sigma} \\
\text{\mu} & \text{\mu} & \text{\mu} & \text{\mu} & \text{\mu} \\
\text{SS} & \text{SI} & \text{SI}
\end{align*}}
\]

The stem final vowel /i/ is underlyingly nonmoraic. Then the suffix /ko/ is added to form a connective. The syllabification takes a moraic segment and the preceding consonant to form a syllable.\textsuperscript{11} Now after the syllabification, we find that three segments /mk/ are left

\textsuperscript{11}I assume that the coda elements are linked to the syllable in the process of Syllable Incorporation. However as will be discussed in 8.4, I assume that one consonant /l/, which is the most sonorous consonant in Korean is syllabified to the coda in the syllabification process.
unsyllabified. Since there are unsyllabified segments, the Stray Syllabification process will be invoked. Notice that not all the consonants are subject to SS. There is another phonological change of coda simplification in Korean. When two consonants are left unsyllabified, one of them is deleted by the coda simplification process. The inputs to Cluster Simplification are in (48):

(48) Inputs of Cluster Simplification

   a. ps ls ks nc lth lh nh
   b. lk lp lph (lm)

The result of the cluster simplification in (48a) is the loss of the second consonant, but the realization of the clusters in (48b) varies from dialect to dialect.\(^\text{12}\) These sequences are not subject to Stray Syllabification though they may be left unsyllabified in the process of syllabification. Looking closely at the data of coda simplification given in (48), ignoring the sonority difference between stops and fricatives, we find that all the clusters have decreasing sonority.\(^\text{13}\) There is no example of cluster simplification when the second one is more sonorous than the first member. Thus we find that coda simplification and Stray Syllabification operates in mutually exclusive environments. Stray Syllabification is restricted to apply to a sequence of unsyllabified segments where the second one is more sonorous. Otherwise cluster simplification will apply.

Therefore I add a sonority condition to the stray syllabification process as in (49):

\(^{12}\)It is not the purpose of the discussion here to formulate the cluster simplification process. Please refer to B-G. Lee (1976), Whitman (1985), and Y. Y. Cho (1988) for data and analyses. Roughly, the second consonant surfaces in the standard dialect, but the first one survives in the KS dialect.

\(^{13}\)I will not be concerned with the /ps/ cluster which shows increasing sonority. I assume that the relevant sonority distinction is as follows:

obstruents < nasals < liquids < vocalic
Now with the Stray Syllabification process given in (49), we return back to the derivation given in (47). There are three unsyllabified segments /m/, /k/, and /i/. Notice that the first two segments /mk/ does not satisfy the structural description of Stray Syllabification due to the fact that the second segment /k/ is not more sonorous than the first segment /m/. However the next two segments /ki/ meet the environment of Stray Syllabification and a mora is projected from the syllable to make the syllable well-formed. Then finally, the unsyllabified segment /m/ appears as a coda segment by Syllable Incorporation.

The surfacing of /i/, therefore, is due to the presence of another unsyllabified segment, which meets the environment of Stray Syllabification. Now consider how such a nonmoraic analysis of affix final /i/ can explain the non-appearance of /i/ or the obligatory nature of /i/ deletion. Consider the following derivations:

(50)  Derivation of /i/ Deletion Phenomena

a. /camki +ɔ/  [camgɔ], *[camgiɔ] (to lock)
b. no + ilo [noro], *[noiro] (with an oar)

In (48a), the stem final vowel /i/ is nonmoraic, but the affix initial vowel is moraic. Thus the syllabification process for the second mora will take the preceding consonant /k/ as the onset, since the back unround high vowel is not a candidate for the onset segment. Then Syllable Incorporation will take the unsyllabified consonant /m/ to the coda of the first syllable. Therefore /i/ is left unsyllabified. However since /i/ here is not the target of Stray Syllabification, it will eventually be erased by the Stray Erasure Convention.

I further extend the nonmoraic analysis to suffix initial high vowels. Thus as shown in (50b), my argument for affix initial /i/ deletion is exactly same as the stem-final /i/ deletion. Affix initial high vowels are considered to be nonmoraic. Thus /i/, /i/, and /u/ in affix initial position will be introduced in the underlying representation without moras. Consider the following additional data:

(51) Affix Initial High Vowels

a. cip + ilo [cibiɣo], *[ciplo] (to the house)
   pata + ilo [padaro], *[patairo] (to the sea)

b. cuk + i + ø [cugyɔ], *[cugiɔ] (to kill)
   t'ε + i + ø [t'eyɔ], *[t'eiɔ] (to be cheated)

c. k'æ + u + ø [k'æwɔ], *[k'æuɔ] (to awaken)\(^\text{15}\)

\(^{14}\)Korean do not have an unround back glide.

\(^{15}\)There is no example of the /u/ suffix on a consonant final stem. H-B. Choi (1971: 413) cites two
As predicted if /i/ is placed after a consonant, Stray Syllabification will take the two to form a syllable. However if /i/ is placed after a stem final vowel, then /i/ alone cannot trigger Stray Syllabification and thus will not show up on the surface. Again if /i/ or /u/ is added to a stem and they are followed by a moraic segment, they never appear as full-fledged vowels. They surface as glides as the examples in (51b) and (51c) shows. Consider the derivation of the first words of (51b) and (51c):

(52) Exemplary Derivations

a. / cuk + i + o / → [cugyo], *[cugiə]

b. / kæ + u + o / → [kæw], *[kæuə]

As the derivations given in (52) show, the high vowel /i/ or /u/ can never appear as a full vowel when they are followed by moraic segments. They will be incorporated to onsets of the following moraic segments. Examples /kil + u/ (to grow) and /il + u/ (to prosper). However the stems of the word cited are no longer in the vocabulary of present speakers of Korean. They are regarded as underived words with underlying forms /kil/ and /ilu/ respectively.
Therefore the nonmoraic analysis of stem final /i/ and affix initial high vowels are motivated. Now I will return to the exceptions of END rule and how they may be explained. Consider the following three examples:

(53) Comparison of Different /i/’s

a. pap’i + ə [pap’i], *[pap’iə] (to be busy)
b. ki + eke [kiege], [ke:ge] (to him)
c. simisi + e [simisei], *[simisei] (Smith’s)

In (53), we see that /i/ in (53a) and (53b) and (53c) behave differently. In (53a), /i/ is deleted obligatorily and there is no lengthening effect. In (53b), /i/ can optionally delete with subsequent lengthening. And (53c) shows neither the obligatory deletion nor the optional deletion. In other words, these three /i/’s show mutually exclusive behaviors. My explanation is that /i/ in (53a) is nonmoraic, but /i/ in (53b) is moraic. Notice that the stem /ki/ (him) is introduced with a mora in the underlying representation, since the distribution of nonmoraic segment is restricted to the stem final vowels of verbs and adjectives as well as to affix initial high vowels. Finally in (53c), we find that /i/ is the interpretation of an unassociated mora which is introduced by Stray Syllabification. Therefore we can make a three way contrast of /i/ as shown in (54):

(54) Underlying Contrasts

It is only the nonmoraic vowel in (54a) that fails to surface before or after a vowel. In (53b), /i/ is represented as in (54b). This time /i/ is moraic and therefore /i/ does not obligatorily delete and the optional VC will result in vowel lengthening. In (53c), there is no melodic representation at all. This representation arises epenthetically through the syllabification process and it will be interpreted as the least specified segment [i] in Korean. Consider the following derivation:

\begin{center}
\begin{tabular}{c}
\textbf{(55) Derivation of [simisi]} \\
\end{tabular}
\end{center}

\begin{center}
\begin{tabular}{c|c|c|c}
& & & \\
\hline
s & m & i & s \\
\hline
\end{tabular}
\end{center}

\begin{center}
\begin{tabular}{c|c|c|c}
& & & \\
\hline
\hline
\end{tabular}
\end{center}

\begin{center}
\begin{tabular}{c|c|c|c}
& & & \\
\hline
\hline
\end{tabular}
\end{center}

Now in (55) we see that the moras in the first and the third syllables are introduced in the process of Stray Syllabification.\textsuperscript{16} They are not initially linked to any element on the segmental tier. Consequently, such sequences do not satisfy the structural description of the optional VC, which crucially refers to two adjacent vocalic roots. Thus the /i/ in (53c) shows different behavior than the /i/’s in (53a) or (53b).

Notice that we can predict which /i/ will have which representation given in (54). The representation in (54a) is found only in verb stem final syllables or suffix initial vowels. The unassociated mora in (54c) is found only in the Stray Syllabification process in loan words.

Finally consider the following surface vowel alternations:

\textsuperscript{16}Stray Syllabification given in (55) applies only to loan words. It does not apply to pure Korean or Sino-Korean words.
(56) Surface Vowel Length Contrasts

a. Vowel final stem + vowel initial suffix

na + iynyən  [namyən], *[naïmyən]  (if ... be born)
s'a + iynyən  [s'amyən], *[s'aïmyən]  (if ... wrap)
i + iynyən  [imyən], *[iïmyən]  (if ... carry (on the head))
ca + iynyən  [camyən], *[caïmyən]  (if ... sleep)

b. Consonant final stem + vowel initial suffix

nah + iynyən  [naïmyən], [na:myən]  (if ... deliver a baby)
s'ah + iynyən  [s'aïmyən], [s'a:myən]  (if ... pile up)
is + iynyən  [iïmyən], [i:myən]  (if ... connect)
cas + iynyən  [caïmyən], [ca:myən]  (if ... spin)

We observe that in (56a), the suffix initial /i/ obligatorily deletes without lengthening. However the suffix initial vowels can optionally surface or delete with subsequent lengthening of stem vowels in (56b). Notice that the examples in (56b) are either h-irregular or s-irregular verbs. In these irregular verbs the stem final segments are deleted, but only in the onset position. For these consonants to be deleted, syllabification should precede consonant deletion. However since the verbs in (56b) are consonant final, the consonant and the following nonmoraic /i/ undergo Stray Syllabification. Consider the derivation of the first words in (56a) and (56b):

(57) Comparison of Derivation

a.

\[ \text{syll} \rightarrow \text{SS} \]
As shown in (57b), the Stray Syllabification process takes /h/ and the following nonmoraic vowel into a syllable and /i/ acquires moraic status in the process of Stray Syllabification. Therefore we can explain how the words in (56a) are different from those in (56b).

In this subsection, I argued that we do not need any deletion rule at all. As already noted in 5.3, the high vowels /i/, /i/, /u/ (and even /o/)\textsuperscript{17} can be underlyingly nonmoraic. These nonmoraic vowels cannot surface as heads of syllables, though they may show up as glides. However, if the nonmoraic vowel is preceded by another unsyllabified consonant, the CV sequence is subject to Stray Syllabification and a mora is projected to meet the syllable well-formedness condition. Thus /i/ deletion is the result of Stray Erasure and /i/ appearance is due to Stray Syllabification.

8.3.3. Minimality Condition

In the previous subsection, I have argued that obligatory /i/ deletion can be best explained by positing nonmoraic vowels in the underlying representation. In this subsection, I will discuss how the present approach can deal with the exceptional cases. As we have already observed, monosyllable stems that end with /i/ show different behavior, which have
remained exceptional to all previous analyses. This subsection will introduce another way that a nonmoraic vowel gets moraic status. Consider the following data again:

(58) Mono-syllable Stems

a. /i/ Suffixation

\[
\begin{align*}
\text{s'í} + i & \quad [s'íi], [s'i:], \quad *[si] \quad \text{(to be used)} \\
\text{t'í} + i & \quad [t'íi], [t'i:], \quad *[t'i] \quad \text{(to be found)} \\
\end{align*}
\]

b. /iu/ Suffixation

\[
\begin{align*}
\text{s'í} + i + u & \quad [s'íu], \quad *[s'íu] \quad \text{(let . . . be worn)} \\
\text{t'hí} + i + u & \quad [t'híu], \quad *[t'híu] \quad \text{(let . . . be opened)} \\
\text{t'i} + i + u & \quad [t'íu], \quad *[t'íu] \quad \text{(let . . . float)}
\end{align*}
\]

As shown in (58), /i/ undergoes obligatory deletion in the examples of (58b) but it remains undeleted in the examples of (58a). Sohn (1987b: 133) notes that since these are the only exceptions their presence as exceptions does not harm the general rule of END. However, from a slightly different perspective, we see that /i/ suffixation to /i/ final monosyllabic stems all show uniformed behavior that should not be ignored. We can deduce a very strong generalization from the fact that they always fail to undergo the /i/ deletion rule.

Note also that the examples in (58a) cannot be explained simply by positing a nonmoraic vowel in the stem final position and the suffix initial position. However I argue that the examples in (58) illustrate an independent morphological constraint. McCarthy and Prince (1986, 1990, 1991) argue that there is a minimal word length condition which is definable by morphological templates in languages. The minimal word length, if there is such

---

17See the discussion in 5.3 for non-moraic /o/.
a morphological constraint, should be at least of a foot. And a foot is binary under moraic and sylla\nble analysis. The corollary of these observations is that a minimal word should be at least bimoraic or disyllabic. The minimality condition can be imposed on such morphological category as roots or derived words.

The minimality condition once operative in a given language can either block certain rules or augment the base by insertion. For example in Estonian (see Prince (1980) for data), the final vowel deletion rule does not apply to disyllabic words. McCarthy and Prince (1991) attribute the blocking effect of the apocope rule to the minimality condition that the output should be a prosodic word (=PrWd), and minimality is imposed on the PrWr so that it should at least be of two moras. Again in Shona (see Myers (1987: 128-130) for data), unaffixed monosyllabic bases are augmented to bimoraic words by inserting prothetic /i/. Such an insertion rule is triggered by the minimality condition.

Returning to Korean, we find that though there are monomoraic roots such as /so/ (cow) or /kam/ (persimon), there are no monomoraic derived words. Thus, following McCarthy and Prince (1991), I propose that there is a morphological condition, Morphological Category Minimality Condition, on derived words in Korean:

(59) (Morphological Category) Minimality Condition (=MC)

Derived words are PrWd (=prosodic words).

PrWd is minimally bimoraic.

The Minimality Condition given in (59) is assumed to strongly interact with the morphological derivation. Now I argue that the Minimality Condition is directly responsible for the surface forms of the examples given in (58). Consider the derivation of the first word in (58):
In morpheme concatenation, we find that both the stem final /i/ and the suffix vowel /i/ are moraless. Therefore the string cannot be syllabified. The morphological derivation violates the MC. Thus the minimality condition adds two moras, or a bimoraic foot, to remedy the violation. Then the floating moras are associated to melodic tiers. I assume the following association convention:

\[(61) \quad \text{Association of Mora}\]

\[
\begin{align*}
\text{Association} & : \text{mora driven.} \\
\text{Direction} & : \text{right to left.}
\end{align*}
\]

Thus the two moras are associated to two moraless vowels and the subsequent syllabification gives the correct output [s\'i\i] on the surface. The sequence of two vowels, by virtue of being moraic, can undergo the optional VC, discussed in 8.2.2, and produce [s\'i:].
Here we see that the exceptional behavior of a monosyllabic stem in Sohn's framework is not exceptional at all. The appearance of [i] on the surface, even before another vowel, is due to the fact that it becomes moraic in the course of morphological derivation by the minimality condition. Thus both of the nonmoraic vowels are associated to moras and therefore they can surface as full-fledged vowels. Consider more examples of morphological derivation:

(62) More examples of Morphological Derivation

a. Passive/Causative

\[
\begin{align*}
\text{mæ} + i & \quad [\text{mæi}, \text{mæ:}] \quad \text{(to be tied)} \\
\text{camki} + i & \quad [\text{camgi}], *[\text{camgii}] \quad \text{(to be locked)} \\
\text{k'æ} + u & \quad [\text{k'æu}] \quad \text{(to let ... wake up)}
\end{align*}
\]

b. Passive/Causative + Infinitive

\[
\begin{align*}
\text{t's} + i + u + o & \quad [\text{t'iwə}], *[\text{t'iuə}] \quad \text{(to let ... float)} \\
\text{s'i} + i + u + o & \quad [\text{s'iwə}], *[\text{s'iwə}] \quad \text{(to let ... worn)} \\
\text{sə+ i} + u + o & \quad [\text{sewə}], *[\text{seuə}] \quad \text{(to let ... stand)}
\end{align*}
\]

One thing we can notice immediately from the examples given in (62) is that the outputs are all bi-moraic, regardless how many nonmoraic vowels may appear in the underlying representation. This generality offers relative strong support that MC is at work in the morphological derivation. Observe also that in the first two examples of (62b), /i/ does not surface though it can optionally surface in the examples given in (58). Here we can clearly see that simply saying that the stems are exceptional as in Kim-Renaud (1982) and H-S. Sohn (1987b) does not explain the /i/ deletion effect in these examples. Consider the derivation of the first two examples in (62a):
(63) Sample Derivations of (62a)

a. /mæ + i/ → [mæi], [mæ:]  

As shown in the exemplary derivation in (63), we see that the syllabification and the MC can produce the right output, without assuming a rule-based approach for the /i/ deletion phenomena. The same is also true for words in (62b). Consider the derivation of the last two examples in (62b):

(64) Samples Derivations of (62b)

a. sʻi + i + u + ə → [sʻiwa], *[sʻiwa], * [sʻiuə], *[sʻiuə]
In (64a), the infinitive suffix /ɨ/ is moraic, since it is not one of the high vowels. Therefore MC introduces only one additional mora and the right to left association links the mora to the vowel /ɨ/. The syllabification process then will skip the featureless vowel /ɨ/ in selecting an onset. Thus the stem final /ɨ/ cannot surface. In (64b), we find that the result of the derivation already has two moras, since the stem final vowel is moraic and the final infinitive suffix is moraic. Therefore it satisfies the minimality condition and no additional moras are introduced. The syllabification process leaves /ɨ/, the passive suffix, unassociated. Thus the feature [front] under the unassociated root will be locally re-associated to the preceding vowel by the Feature Association Convention given in (20).

Notice that the rule based approach to /ɨ/ deletion fails to explain why the causative suffix /u/ before /ə/ cannot surface as a head of a syllable. This makes it imperative to posit another rule of obligatory glide formation for the suffix /u/. Further in the exemplary derivation in (64b), the obligatory nature of /ə/ and /ɨ/ fusion, as witnessed in the ill-formedness of such forms as *[səıwə], *[səyua] or *[səiuə] cannot be explained without another obligatory fusion rule. As such, the rule based approach of vowel deletion phenomena should be patched up with at least two more obligatory rules, which lack independent motivation, and it would still
be unable to explain the monosyllabic stems ending in /i/.

Thus in this section, I have shown that the obligatory nature of /i/ deletion is neither the result of obligatory vowel coalescence nor of obligatory /i/ deletion. The peculiarity of stem final /i/ and the affix initial high vowels are captured not by rules but by their representational characteristics, i.e. they are not associated to moras in the underlying representation.

8.3.4. **Vowel Contraction**

In addition to the data presented in the previous subsection, we find that there is another type of vowel deletion as shown in the following examples:

(65) **Obligatory Vowel Deletion**

<table>
<thead>
<tr>
<th>Vowel</th>
<th>contracted</th>
<th>(to)</th>
<th>(to)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ka + a</td>
<td>[ka], *[kaa], *[ka:]</td>
<td>(to go)</td>
<td></td>
</tr>
<tr>
<td>na + a</td>
<td>[na], *[naa], *[na:]</td>
<td>(to be born)</td>
<td></td>
</tr>
<tr>
<td>s'a + a</td>
<td>[s'a], *[s'a], *[s'a:]</td>
<td>(to wrap)</td>
<td></td>
</tr>
<tr>
<td>b. phy + o</td>
<td>[phyo], *[phyo], *[phyo:]</td>
<td>(to unfold)</td>
<td></td>
</tr>
<tr>
<td>s' + o</td>
<td>[s'o], *[s'o], *[s'o:]</td>
<td>(to stop)</td>
<td></td>
</tr>
<tr>
<td>khy + o</td>
<td>[khyo], *[khyo], *[khyo:]</td>
<td>(to light)</td>
<td></td>
</tr>
</tbody>
</table>

These examples show the obligatory fusion of two identical vowels separated by a morpheme boundary. Given the fact that the output of such fusion, or contraction, is a monomoraic syllable, I posit that the rule is applicable after syllabification in the lexical derivation. Following Sohn (1987b: 148), I propose the vowel contraction rule given in (66):

18 Since MC interacts with syllabification and Vowel Contraction applies after syllabification, I assume that the MC does not interfere with the Vowel Contraction.
(66) Vowel Contraction

\[ R[\text{voc}] \quad R[\text{voc}] \]

Notice that the rule environment is very similar to the vowel coalescence rule except that there is a morpheme boundary and that the dependent features are identical. This vowel contraction rule seems to indicate that there is a strong tendency to avoid two identical vowels in the lexical derivation. The vowel contraction interacts with other rules to show different surface forms. Consider the following data:

(67) Contrast of Surfacing Vowels

<table>
<thead>
<tr>
<th>Verb</th>
<th>Surface Forms</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>nah + a</td>
<td>[naa], [naː], *[na]</td>
<td>(to deliver a baby)</td>
</tr>
<tr>
<td>tah + a</td>
<td>[taa], [taː], *[ta]</td>
<td>(to reach)</td>
</tr>
<tr>
<td>nəh + ē</td>
<td>[nəʔ], [nəː], *[nə]</td>
<td>(to put in)</td>
</tr>
<tr>
<td>cəs + ē</td>
<td>[cəʔ], [cəː], *[cə]</td>
<td>(to stir)</td>
</tr>
</tbody>
</table>

In the examples given in (67), we find that the Vowel Contraction in (66) does not apply. Notice that at the derivational stage before the deletion of the final consonant /s/ or /h/ in the irregular verbs, the input does not satisfy the structural description in (66) because of the presence of the intervening stem final consonants. Thus the words in (67) have long vowels on the surface. Here we see that the Vowel Contraction, just like Stray Syllabification as discussed in the examples of (56) and their derivation in (57), is ordered before the stem final consonant deletion in irregular verbs.
One problematic aspect of this approach is the apparent /i/ deletion, observable in the following examples:

(68) Apparent Exceptions

\[
\begin{align*}
\text{s'i + ə} & \quad [s'i\,ə], \text{*}[s'i\,ə], \text{*}[s'i:\,] \quad (\text{to write}) \\
\text{k'i + ə} & \quad [k'i\,ə], \text{*}[k'i\,ə], \text{*}[k'i:\,] \quad (\text{to extinguish}) \\
\text{t'i + ə} & \quad [t'i\,ə], \text{*}[t'i\,ə], \text{*}[t'i:\,] \quad (\text{to float})
\end{align*}
\]

We may expect that the surface forms of the examples in (68) are the asterisk-marked ones, since the nonmoraic high vowel /i/ should acquire moraic status due to MC. However, the surface forms are monomoraic and such deletion of /i/ may be explained by Sohn's (1987b) END rule (given in (42)).

I tentatively propose an obligatory [open] spreading rule as in (69):

(69) [open] Spreading

This rule specifically says that the feature [open], if it is the only feature, obligatorily spread to the preceding vowel which is adjacent to the trigger on the root tier, if the preceding vowel is the least specified vowel.

\[\text{This rule specifically says that the feature [open], if it is the only feature, obligatorily spread to the preceding vowel which is adjacent to the trigger on the root tier, if the preceding vowel is the least specified vowel.}\]

\[\text{I am aware that the rule proposed here is quite ad hoc in nature. However I do not have any other explanation for the examples given in (68).}\]
Therefore this rule applies only between /i/ and /a/, if they are separated by a morpheme boundary. Notice that the rule results in two identical vowels which are separated by a morpheme boundary. However the sequence of two identical vowels separated only by a morpheme boundary is not tolerated in Korean. Therefore the examples given in (68) first undergo spreading and the result is subject to the Vowel Contraction rule. This explains why only short vowels appear in the examples in (68).

8.4. Interconsonantal /i/ Deletion

Now I will briefly discuss another case of /i/ deletion found in Korean, which Kim-Renaud (1982) named Interconsonantal /i/ Deletion. It is not the manifestation of vowel coalescence, it is therefore not the main concern of this chapter. However, since the interconsonantal /i/ deletion might pose problems in the analysis given in this chapter I will deal with it so as to show that the nonmoraic analysis proposed in this chapter also holds for interconsonantal /i/ deletion. Consider the examples of interconsonantal deletion given in (70):

(70) Interconsonantal /i/ Deletion

u:l + ɨmyən [u:lm myən], ʔ[urimyən] (if ... cry)

u:l + ɨlə [ullə], ʔ[urɨə] (in order to cry)

pul + ɨmyən [pulmyən], ʔ[purimyən] (if ... blow)

20The second forms in each of the words given here is rarely found among native speakers of Korean. They are more readily witnessed in the language of children or those who learned Korean in non-native environments. In this sense the variations given here is different from other variants in the examples given in this chapter. That is why I put question marks in each of these forms, though Kim-Renaud (1982) assumes that they are fully acceptable.
Kim-Renaud (1982: 481) proposed the following /i/ deletion rule to account for the data given in (70):

\[
\text{Interconsonantal } /i/ \text{ Deletion (optional)}^{21}
\]

\[
i \rightarrow \emptyset / l & \{ m \}
\]

An important generalization we can make from the examples in (70) is that the Interconsonantal /i/ Deletion applies when a verb stem ends in /l/ and the suffix starts with a nonmoraic vowel. Then the best way to capture the generalization is to say that /l/ is already in the coda of the stem final syllable, thus it blocks the environment for resyllabification. This assumption is reasonable given that /l/ is the most sonorous segment among the Korean consonants. Actually scholars such as B-G. Lee (1979b) and D-J. Lee (1989) even suggest that /l/ should be considered as a [+voc] segment. I will propose that the most sonorant consonant /l/ can be syllabified as a coda in the process of syllabification in the lexical derivation. Accordingly I propose the following stem-final coda well-formedness condition:

---

\[^{21}\text{D-J. Lee (1989) proposes to include } /u/ \text{ in the conditioning environments. But Kim-Renaud (1982) has pointed out problems of including } /u/.\]
(72) Coda Well-formedness Condition (=CWC)

\[
\sigma \\
\text{R[cons]}
\]

Notice that the CWC allows /l/ to be syllabified as a coda of a syllable in the syllabification process. If the stem final consonant is not /l/, then it will remain unsyllabified in the lexical derivation and may show up on the surface as an onset by Stray Syllabification or as a coda by Syllable Incorporation in the post-lexical domain, where the CWC in (72) is no longer operative. With the CWC, we can see that /l/ deletion phenomena in (70) are due to Stray Erasure. Consider the derivation of the first word in (70):

(73) Derivation of /u:l + imyɔn/ and /u:l + ɪlɔ/

a. u:l + imyɔn → [u:lmyn]

b. u:l + ɪlɔ
In (73a), we find that stem final /l/ is syllabified as a coda, and the featureless vowel /ɨ/ is left unsyllabified. However, since the featureless vowel /ɨ/ alone does not meet the environments for Stray Syllabification, it will eventually be erased. In (73b), just like in (73a), the stem final /l/ is syllabified as a coda and /ɨ/ is erased. Then the two identical sonorant consonants are combined to form a geminate. Since geminate consonants are moraic and a tri-moraic syllable is not allowed, the gemination of sonorants results in shortening the stem vowel.

I have explained when /l/ is syllabified into the coda of the stem final syllable. The CWC is a language particular condition that should be learned by a language learner. Thus I assume that in the initial stage of language learning, the CWC is not readily reflected in the phonological process. Thus often we find that the variant forms [urini] or [uriri] appears. These variants reflect that the CWC is not operative, and predictably these forms occur more readily among the younger speakers and those who learned Korean in non-native environments.

The brief discussion in this section shows that all the vowel deletion phenomena can be explained without resorting to specific rules for each of the deletion phenomena. The proposal for underlying nonmoraic vowels is shown to have a consistent effect on the deletion phenomena in Korean. It is once again shown that the representation-based approach is more explanatory than the rule-based approach in explaining the vowel phonology of Korean.
8.5. Conclusion

In this chapter, we have seen that there is optional vowel coalescence and obligatory vowel coalescence in Korean. In optional VC, we observe two different results: the resultant vowel can be either long or short.

I have proposed one general rule of vowel coalescence for optional VC with vowel lengthening. Optional Root Deletion with Feature Association Convention (=FAC) explains all the subcases of optional VC in Korean. However it is also shown that such a VC rule should be constrained. We find that if FAC results in an uninterpretable combination of features, then such a form is filtered out and it does not surface. Further the VC chart shows that if the second vowel is round, it is fused into the preceding vowel only when the first vowel is also round. And if the second vowel is [RTR], then it should be identical to the preceding vowel to meet the structural description of VC. Thus this one general rule with two conditions can replace the previous proposals on optional VC.

The second type of VC, an optional VC without lengthening, is analyzed as the result of the onset simplification process. If a glide is preceded by another onset consonant, the glide is optionally delinked to simplify the onset. Then the delinked feature is linked up to the following vowel by FAC. Thus we find that the result is very similar to the optional VC discussed above. But since onset segments are not moraic, it does not lengthen the following vowel.

In obligatory VC, I made two different proposals: a nonmoraic vowel analysis and an OCP induced vowel contraction rule. I have proposed that high vowels can be moraless in the underlying representation. Specifically, I have proposed that the stem final /i/ in verbs and adjectives are not moraic and that the affix initial high vowels /i/, /i/ and /u/ are all nonmoraic, i.e. they are not associated to moras in the underlying representation. Thus they can appear
only as a glide in the process of syllabification unless there are other mechanisms which hook up these vowels to moras. I proposed that there are two such mechanisms: Stray Syllabification and the Minimality Condition.

Stray Syllabification is invoked when two segments are left unsyllabified if the second one is more sonorous. Two unsyllabified segments can also be subject to the cluster simplification process in Korean. Thus we see that the presence of two unsyllabified segments is not a sufficient and necessary condition for Stray Syllabification. We see that there is a clear difference between the input to cluster simplification and that to Stray Syllabification with respect to their sonority sequencing. No input to Cluster Simplification shows a rising sonority contour between the two segments. Thus the sonority relation between the two unsyllabified segments decides whether they will be subject to Cluster Simplification or Stray Syllabification.

If the moraless high vowel is preceded by a consonant, these two segments are subject to Stray Syllabification with a mora being projected to a vowel to satisfy the Syllable Well-formedness Condition.

Another way for a nonmoraic vowel to acquire moraic status is by the Minimality Condition on derived words. All the derived words in Korean should be bimoraic. Therefore if there are less than two moras in a derived word, one or two additional moras are introduced to satisfy the Minimality Condition. Then the association of the introduced moras to the melodic tier can give moraic status to underlying nonmoraic vowels. It is shown that such an approach can cover all the examples covered by a rule-based approach of /i/ deletion along with their exceptions.

Finally we find that there is another very specific obligatory VC without lengthening. Such VC is only witnessed when two identical vowels are adjacent on the root tier separated by a morpheme boundary. I simply suggest that the VC can be explained by an obligatory vowel contraction rule.

Thus in this chapter, I have argued that all the optional cases of VC are triggered to
break vowel clash and that the obligatory nature of \( /i/ \) deletion is the natural result of syllabification. The appearance of stem final \( /i/ \) and suffix initial high vowels are attributed to Stray Syllabification or the Minimality Condition. Here again I have shown that the peculiarity of high vowels can be better-captured by considering the nature of the representations rather than by implementing a series of unmotivated rules for Korean vowel coalescence.
Chapter 9

Conclusion

This study has dealt with phonological modes of representation and their application to the vowel phonology of Korean. In the first part, I investigated feature specification, feature geometry and syllable structure.

I proposed a monovalent feature system, which allows only the phonologically active features to be specified in underlying representations. As Sanders (1974) points out, the simplex feature system, or the monovalent feature system, imposes restrictions on possible natural classes, simplification of the representation and of the related rules.

In the analysis of the vowel phonology of Korean, it was shown that the proposed monovalent feature system greatly reduces the redundancy rules, thus achieving a high simplification in representation and rule description. The four underlying features [front], [open], [round] and [RTR] proposed for Korean vowels can consistently explain various aspects of Korean vowel phonology without assuming that these features are binary.

The feature geometry adopted in this study includes a branching Place Node that dominates the Articulator Node and the TP Node. The Articulator Node contains the place of articulation features such as [labial], [coronal] and [dorsal]. The features that involve tongue movement in phonetic realization such as the tongue height features [high] and [low] as well as the tongue root feature [RTR] and [ATR] are grouped together under the TP Node which is
assumed to be independent of the Articulator Node. Such a branching Place Node can subsume the majority of proposals made on the internal structure of the Place Node such as those made by Archangeli and Pulleyblank (1987), Clements (1989) and Goad (1991) as shown in Chapter 3.

McCarthy and Prince's (1986) moraic theory of syllable structure is adopted in Chapter 4. Moraic theory is motivated on the basis of such non-segmental phenomena as language particular syllable weight assignment in accounting for such phenomena as quantity sensitive stress (Hyman (1984, 1985)), compensatory lengthening (Hayes (1989)) and prosodic morphology (McCarthy and Prince (1986)). However it was also shown that the moraic theory of syllable structure also plays an important role in explaining subsegmental phonological changes in Korean such as vowel fronting and vowel coalescence as shown in Chapter 7 and Chapter 8, respectively.

In Chapter 5, we observe the interaction of syllable structure and feature specification in the onset analysis of Korean on-glides and glide formation. The non-moraic status of glides was captured directly by locating them in nonmoraic position, i.e. in an onset position rather than adjoining them to moraic segments. A variety of phonological data from Korean was presented to argue for the hypothesis that Korean on-glides are located in the onset position in syllable structure.

In Korean glide formation, we saw that vowel length can be represented only on the moraic tier. Thus long vowels are not represented by a feature [+long]. Rather they are represented as bimoraic segments, i.e. segments associated to two moras. Therefore if the input of glide formation is moraic, it is detached from its mora and this mora is filled by spreading from the following vowel. Therefore glide formation results in lengthening of the following vowel. However if the input is not moraic, glide formation does not create any unassociated mora thus there is no lengthening effect. At the same time such non-moraic vowels can appear only as glides. This explains why the obligatory glide formation does not
result in compensatory lengthening.

Chapter 6 dealt with vowel harmony. Here we observed the interaction of feature geometry and the monovalent feature system. In Korean vowel harmony, the harmonic feature [RTR] spreads from a trigger to the following vowel which is adjacent to the trigger on the TP tier. This simple mechanism can explain the harmony process as well as high vowel transparency without creating theory internal discrepancies. Any theory that does not recognize the TP Node has to resort to abstract underlying representations (McCarthy (1983)), phonetic or phonological readjustment rules (C-W. Kim (1973b), H-S. Sohn (1987b)) or ideophone-specific repair strategies (J-S. Lee (1992)). Further, it was shown that vowel harmony in ideophones and in verbal suffixation can be related by identifying the similarity and difference of these two harmony processes. It was shown that the vowel harmony in verbal suffixation has one additional condition on the trigger that it should be a [back] segment. Then the following spreading process is exactly the same as the harmony spreading in the ideophone vowel harmony process.

Umlaut in Korean discussed in Chapter 7 provides an opportunity to observe the active interaction among feature specification, feature geometry, and syllable structure. Umlaut is described as [coronal] spreading from a trigger to the preceding vowel which is adjacent on the moraic tier. Since it is [coronal] spreading, the intervening consonant with specified coronal dependent features such as [palatal] or [continuant] blocks the umlaut process because of the line crossing prohibition (Goldsmith (1976), McCarthy (1988)). An intervening moraic segment can also block umlaut since the target and the possible trigger do not satisfy the adjacency condition because of the intervening moraic segment. If the target is a bimoraic or long vowel, Geminate Inalterability (Hayes (1986a)) does not allow umlaut, since the application of umlaut to a geminate segment would result in changing only half of a doubly linked segment.
Thus the interaction of underspecification, feature geometry, and syllable structure along with the general principles in phonology can neatly explain the complicated data on Korean umlaut. It was shown that the previous rule-based approaches cannot deal with all the umlaut data presented in Chapter 7 without enormously complicating the rules and their conditions.

Vowel coalescence and vowel deletion have been discussed in Chapter 8. I proposed one general rule of vowel coalescence for optional vowel coalescence with resultant lengthening found in Korean. Another type of optional vowel coalescence which is not accompanied by the lengthening effect is explained by the onset simplification process proposed in Chapter 5.

As for obligatory vowel coalescence or /i/ deletion, I argued that the deletion phenomena cannot be explained by coalescence rules and that any rule based approach may not satisfactorily deal with /i/ deletion. If we are to explain it with rules, we have to resort to various boundaries including a verb stem boundary, a noun stem boundary, an affix boundary and so on.

It is shown that the feature specification and syllabification interact with each other to present the surface phenomena of obligatory /i/ deletion. High vowels in suffix initial positions and verb stem final positions are represented without moras in the underlying representation. These non-moraic vowels cannot appear as heads of syllables, though they may appear as glides. But since /i/ cannot be realized as a glide, it cannot appear on the surface if it fails to obtain moraic status in the course of a derivation.

In this study I have presented a comprehensive and consistent analysis of Korean vowel phonology based on a representation-oriented approach. It was shown that it is not a combination of complicated rules, their conditions and their ordering that is responsible for phonological alternations. On the contrary, the rules are very general and they comply with
universal conditions and principles. Phonological alternations can be accounted for by characterizing underlying representations with general rules operating on those representations.

It was shown in this study that the phonological representation is not just a linear arrangement of features. I have recognized three important subcomponents in representation: feature underspecification, feature geometry, and syllable structure. These are among the distinct but interacting modes of representation. Throughout this study it was shown that reference to just one of these alone cannot explain the phonological phenomena. We have observed the active interaction among these in conditioning rules and constraining rule application. A change in one of these aspects can influence another. For example, the coalescence operation of root deletion brings about changes in the association lines in syllable structure and geometrical representation. The subsegmental operation of [coronal] spreading in umlaut is controlled by the moraic structure and is blocked by certain geometrical configurations. As such, a phonological change that makes reference to one aspect of the representations can be constrained by, and bring about changes to other aspects as well. In this sense, this study shows that not only the phonological representation, but also phonological processes are in a sense multi-linear and multi-directional.

This study employs a monovalent feature system. It has proven to be effective in simplifying underlying representations and rules as well as in defining natural classes. Thus a segment is characterized not by an exhaustive list of binary values of features but by a small number of underlyingly active features. The complexity of the binary feature system has lead some researchers to find non-feature analyses of phonological representation such as seen in Dependency Phonology (Anderson and Jones (1974), Anderson and Ewen (1987)), Particle Phonology (Schane (1984)) and the Theory of Charm and Government (=TCG). In these non-feature approaches, particles, components or elements are introduced that can replace the SPE type of features. These basic units are fundamentally monovalent and combinations of these basic units are assumed to produce segments.
However with the minimal monovalent specification of phonologically relevant features, the present framework can also characterize segments with a small number of phonologically active features. The articulatory components in Dependency Phonology, particles in Particle phonology, or elements in TCG are translatable to the monovalent feature system. The analogy is so striking that using a monovalent feature system along with Feature Geometry can be compatible with these non-feature approaches at least in subsegmental representation. This study emphasizes that features just like elements or particles, are basic and segments are derivative in the sense that the feature combinations can be "interpreted" as traditional segments.


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