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Vowel Harmony in Nez Perce and Korean

by

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Thesis submitted to
the School of Graduate Studies and Research
in partial fulfillment of the requirements for
the M.A. degree in Linguistics

University of Ottawa

ISBN 0-315-62336-5

UNIVERSITÉ D'OTTAWA
UNIVERSITY OF OTTAWA

Dedicated to my parents

ACKNOWLEDGEMENTS

I wish to thank my supervisor Prof. Douglas Pulleyblank for his guidance and encouragement. I would also like to thank Prof. Douglas Walker and Prof. John Jensen for their guidance and kindness. Special thanks are also extended to Janet Benger and Michele Foley.

ABSTRACT

In this study, I will try to show that vowel harmony in Nez Perce and Korean can be described as a [-ATR] spreading rule. The assumption that the harmonizing feature is [-ATR] is based on Hall and Hall (1980) in the case of Nez Perce, and on Hwang's formant analysis (1983) in the case of Korean. By using radical underspecification and a hierarchical theory of feature structure as the framework of analysis, vowel harmony will be described as a feature spreading rule: spread [-ATR], and the transparency of neutral vowels in the harmonizing process will be accounted for. On the other hand, I will show that in Korean there was a historical change in the type and nature of vowel harmony.

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Chapter One. Introduction

1.1. Introduction

In this study, I will show that Nez Perce vowel harmony and Korean vowel harmony can be described by the feature [ATR] (Advanced Tongue Root).

In a language with vowel harmony, vowels are divided into two sets and only vowels belonging to the same set occur within a domain. Vowel harmony is phonetically motivated, thus, it is characterized in terms of some distinctive feature. Vowel harmony which cannot be defined by a distinctive feature has been considered an exceptional phenomenon which does not belong to any harmony type. Nez Perce vowel harmony and Korean vowel harmony are typical examples (Tohsaku 1983). C.-W. Kim (1978) and Ultan (1973) suggested another harmony type to which Nez Perce and Korean belong, diagonal harmony (the term of C.-W. Kim), skewed horizontal harmony (the term of Ultan). However, neither C-W Kim nor Ultan described Nez Perce vowel harmony and Korean vowel harmony in terms of some distinctive feature.

In this study, I will show that Nez Perce vowel harmony and Korean vowel harmony can be described as ATR harmony, and how

vowel harmony operates within radical underspecification theory (Archangeli 1984, 1988, D. Pulleyblank 1988, etc.) and hierarchical feature theory (Archangeli and D. Pulleyblank 1989, Clements 1985, McCarthy 1988, Sagey 1986, etc.). The assumption that Nez Perce has ATR harmony is based on Hall and Hall (1980). I will describe vowel harmony in present-day Korean as ATR harmony, basing my claim on the formant analysis of Hwang (1983). On the other hand, through studying Later Middle Korean and Old Korean, I will show that between Old Korean and Later Middle Korean there was a change of harmony type: Old Korean with palatal harmony changed to Later Middle Korean with ATR harmony,[1] and between Later Middle Korean and present-day Korean there was a change in the nature of harmony from a phonological phenomenon to a morphological phenomenon.

1.2. Background

1.2.1. Radical underspecification

In this theory (Archangeli 1984, 1988, Archangeli and D. Pulleyblank 1987, 1989, D. Pulleyblank 1988), all redundant feature values which can be derived by redundancy rules are eliminated underlyingly, and only unpredictable feature values

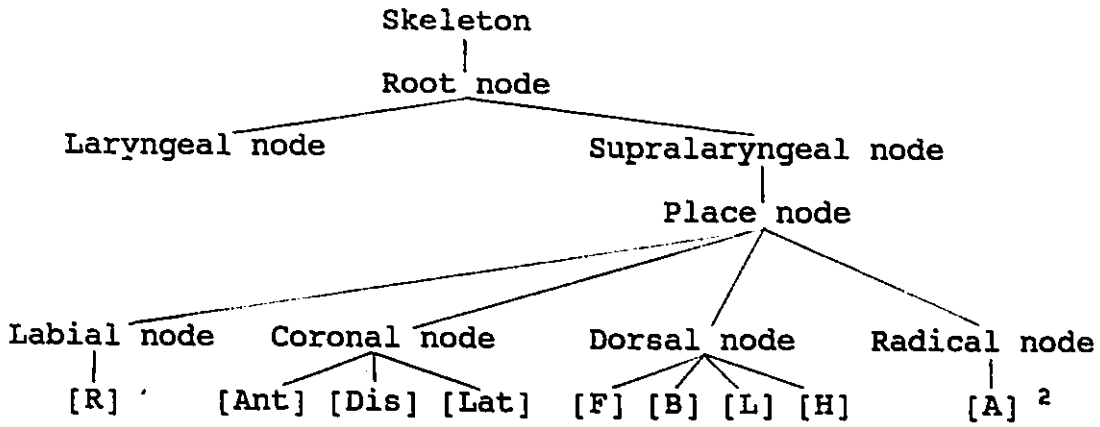
are present in underlying representation. Every language has one and only one totally underspecified vowel in underlying representation. The asymmetric character of any vowel in a given language (e.g., as seen with respect to epenthesis, transparency, vulnerability with respect to segmental processes, etc.) can be described by this total underspecification.

1.2.2. Hierarchical feature structure

In hierarchical approaches to feature structure (Archangeli and D. Pulleyblank 1987, 1989, Clements 1985, Maddieson and Ladefoged 1989, McCarthy 1988, Sagey 1986, Vago 1988, etc.), the distinctive features are not simply a set of phonetic categories which determine physical properties of a phoneme, but rather, they constitute a set with internal structure which consists of class nodes and terminal nodes (the terms of Clements 1985). Relations among distinctive features (terminal nodes) are achieved by the mediation of abstract autosegments, called "class nodes". Each node represents a distinct autosegmental tier, and can play a role in phonological operations. The detailed internal structure of feature hierarchy varies according to phonologists (Archangeli and D. Pulleyblank 1988, 1989, Goad 1989, Maddieson and Ladefoged 1989, McCarthy 1988, E.G. Pulleyblank 1989, Sagey 1986, Vago 1988). Since this study is not a study of the internal

structure of the feature hierarchy, without justification of the appropriateness of the model, for the purposes of this study, I will use the following abbreviated hierarchical feature structure based chiefly on Archangeli and D. Pulleyblank (1989) except for the presence of the feature [front].

(1)



With regard to the definitions of the features [round], [anterior], [distributed], [lateral], [low] and [high], I will use those of Chomsky and Halle (1968) without justification, because these features do not directly concern this study. With regard to horizontal tongue body movement, in Chomsky and Halle, there is only one feature, [back]: back sounds are articulated by tongue body retraction from the neutral position, and nonback sounds are articulated without such a retraction. Both back vowels and central vowels are characterized by the feature value [+back]. Generally, the distinction between vowels concerning the

degree of horizontal tongue body movement is adequately described by the feature [back] (with [round]). However, in Later Middle Korean where the low central unrounded vowel /a/ and the low back unrounded vowel /ʌ/ are distinct, three degrees of horizontal tongue body movement appear to be required to express the attested contrast. Hence, for the purpose of this study, on one hand, I redefine the feature [back] as follows: back sounds are articulated with tongue body retraction, resulting in a bunching up of the part of the tongue that is relatively back in the mouth; nonback sounds are articulated without such a retraction. On the other hand, I use the feature [front] as well as the feature [back], defined as follows: front sounds are articulated by advancing the tongue body, resulting in a bunching up of the part of the tongue that is relatively forward in the mouth; nonfront sounds are articulated without such an advancement. It might be possible to distinguish the feature [RTR] (Retracted Tongue Root) from the feature [ATR] as Goad (1989) suggested, because there are three types of articulatory gesture concerning the tongue root movement as will be seen in (53). However leaving aside the possibility of a separate feature [RTR], I assume in this study that [+ATR] sounds are articulated by advancing the tongue root, and [-ATR] sounds are articulated without such an advancement. Hence, both the retraction of the tongue root and a neutral tongue root position are characterized by [-ATR].

Chapter Two. Nez Perce vowel harmony

2.1. Nez Perce

The American Indian language Nez Perce is spoken in parts of Oregon, Washington and Idaho. Nez Perce has five underlying vowels: /i æ a o u/.[3]

(2)

i		u
		o
æ	a	

These vowels consist of two harmonizing sets, as shown in (3) below.

(3)

set 1		set 2	
i	u	i	
			o
æ		a	

/æ/ alternates with /a/ and /u/ alternates with /o/ while /i/ does not have any alternating counterpart. Words consist only of

vowels of set 1 or vowels of set 2. The examples in (4) illustrate these alternations:

(4)[4]

(a) næ? + tó·t => na?tó·t [5]
my - father 'my father'

(b) tó·t + æ? => tó·ta?
father - vocative suffix
'father!'

(c) næ? + mǽq => næ?mǽq [6]
my - paternal uncle 'my paternal uncle'

(d) mǽq + æ? => mǽqæ?
paternal uncle - vocative suffix
'paternal uncle!'

(e) tísqæ? + laykin => tísqa?laykin
skunk - near
'near a skunk'

(f) cǽ·qæt + ?áyn => caqá·ƛayn
raspberry - for
'for a raspberry'

(g) ?á·t + s + æ => ?á·tsa
go out - stem formant (s.f.) - 1st person
'(I) am going out'

(h) ?á·t + s + æ + næ => ?á·tsana
go out - s.f. - 1st person -long ago
'(I) went out long ago'

(i) ?á·t + s + æ + qa => ?á·tsaqa
go out - s.f. - 1st person - recently
'(I) went out recently'

(j) wǽ·yik + s + æ => wǽ·yiksæ
go across - s.f. - 1st person
'(I) am going across'

(k) wǽ·yik + s + æ + næ => wǽ·yiksænæ
go across - s.f. - 1st person - long ago
'(I) went across long ago'

(l) wǽ·yik + s + æ + qa => wá·yiksaqa
go across- s.f.-1st person-recently
'(I) went across recently'

(m) wæyæ + wǽ·yik + s + æ => wæyæwǽ·yiksæ
hurry-go across-s.f.-1st person
'(I) am hurrying across'

(n) wæyæ + wǽ·yik + s + æ + næ => wæyæwǽ·yiksænæ
hurry-go across-s.f.-1st person-long ago
'(I) hurried long ago'

(o) wæyæ + wǽ·yik + s + æ + qa => wayawá·yiksaqa
hurry-go across-s.f.-1st person-recently
'(I) hurried across recently'

(p) wat + wǽ·yik + s + æ => watwá·yiksa
wade-go across-s.f.-1st person
'(I) am wading across'

(q) wat + wǽ·yik + s + æ + næ => watwá·yiksana
wade-go across-s.f.-1st person-long ago
'(I) waded across long ago'

(r) wat + wǽ·yik + s + æ + qa => watwá·yiksaqa
wade-go across-s.f.-1st person-recently
'(I) waded across recently'

(Aoki 1966)

It was considered that the contrast between vowel set 1 and vowel set 2 could not be described by any single distinctive feature,

therefore, Nez Perce vowel harmony was considered an exceptional phenomenon which could not belong to any harmony type (Aoki 1968, Chomsky and Halle 1968, Kiparsky 1973, Rigsby and Silverstein 1969, Tohsaku 1983, etc.).

One of the characteristics of Nez Perce vowel harmony is that the neutral vowel /i/ triggers vowel harmony in some cases as seen in (5c, 5d and 5f). That is, there are morphemes composed of only neutral vowel /i/'s, which change other morphemes with vowels of set 1 into a form with vowels of set 2.

(5)

(a) næ? + í·c => næ?í·c
my - mother 'my mother'

(b) í·c + æ? => í·cæ?
mother-vocative suffix
'mother!'

(c) næ? + cí·c => na?cí·c
my - paternal aunt 'my paternal aunt'

(d) cí·c + æ? => cí·ca?
paternal aunt-vocative suffix
'paternal aunt!'

(e) tulé́· + qitti + s + æ => tulé́·qittisæ
with foot-place firmly-s.f.-1st person
'(I) am putting my foot down firmly'

(f) tulé́· + cḱil + k + s + æ => tolá·cḱilksa [7]
with foot-destroy-uncertain-s.f.-1st person
'(I) am destroying with my foot'

(Aoki 1966)

Because of this characteristic of the neutral vowel /i/ as well as the asymmetric surface form [i æ a o u], an abstract underlying vowel system was set up in previous studies. The underlying vowel system was set up as /i a u/ with the diacritic feature [αH] which governs harmony by Chomsky and Halle (1968), as /i a u/ with tongue root position, that is, with [αATR] by Hall and Hall (1980), as /i e a o u/ with the diacritic features 'A' (dominant) and 'E' (recessive) by Aoki (1966), as /i e ∂ a o u/ in which /∂/ is the counterpart of /i/ by Jacobsen (1968), and as /i e æ a o u/ in which /e/ is the counterpart of /i/ by Rigsby and Silverstein (1969). Hence, in all these studies, the neutral vowel /i/ has two underlying forms.

The stem-affix distinction does not play a role in determining vowel harmony in Nez Perce as shown in (4). Vowel harmony is determined by the stem in (4a), (4b), (4g) and (4h), by the suffix in (4e), (4f), (4l) and (4o), by the prefix in (4p) and (4q), by both the stem and the suffix in (4i), and by both the prefix and the suffix in (4r).[8] According to Aoki (1968), there are two types of vowel harmony: a symmetric system and an asymmetric system.[9] In a symmetric system, any vowel in a certain position can determine the set of vowels within a domain. That is, vowel harmony is determined morphologically: e.g., vowel harmony may be stem-determined. But, in an asymmetric system, vowel harmony is determined phonologically.[10] That is, one vowel set dominates the other. Aoki called the set of vowels that

triggers vowel harmony the dominant set, and the other set of vowels the recessive set. While the position of the vowel determines vowel harmony in a symmetric system, the nature of the vowel itself regardless of its position determines vowel harmony in an asymmetric system. Nez Perce vowel harmony belongs to the latter type. Aoki called /i a o/ the dominant set and /i æ u/ the recessive set. A morpheme containing dominant vowels is called a dominant morpheme, and a morpheme containing recessive vowels is called a recessive morpheme. Examples of dominant morphemes seen in (4) are as follows.

(6) stem : /tó·t/ 'father', /?á·t/ 'go out'
prefix : /wat/ 'wade'
suffix : /laykin/ 'near', /?áyn/ 'for', /qa/ 'recently'

Examples of recessive morphemes seen in (4) are as follows.

(7) stem : /mǽq/ 'paternal uncle', /tísqæ?/ 'skunk',
/cǽ·qæt/ 'raspberry', /wǽ·yik/ 'go across',
prefix : /næ?/ 'my', /wæyæ/ 'hurry'
suffix : /æ?/ 'vocative', /æ/ '1st person', /næ/ 'long ago'

When a dominant morpheme is present in a word, with a few exceptions as will be shown in (27), the whole word has dominant vowels as seen in (4). Dominant morphemes can occur either as roots or as affixes. Therefore, the stem-affix distinction does not play any part in determining vowel harmony in Nez Perce.

2.1.1. Hall and Hall's analysis

Hall and Hall (1980) suggested the following underlying vowels.

(8)

	i_1	i_2	u_1	u_2	a_1	a_2 [11]
high	+	+	+	+	-	-
back	-	-	+	+		
ATR	+	-	+	-	+	-

Hence, the contrast between vowels was described by the feature [ATR]. Hall and Hall insisted on the relevance of the feature [ATR] by showing that depending on the tongue root position, the phonetic realizations of underlying vowels /i a u/ are different:

> 'As the tongue root is moved forward, the tongue body is raised, conversely, as the tongue root is retracted, the tongue body is lowered. Hence, [+high, +back, +ATR] is realized as [u], and [+high, +back, -ATR] as [o]. But, in the case of low vowels, it is possible that as the tongue root is moved forward, the tongue body is moved forward, maintaining low position, as in Somali. Hence, [-high, +ATR] is realized as [æ], and [-high, -ATR] as [a]. In the case of high front vowels, the less forward position of the tongue root results in somewhat lowering of tongue body, but the lowering is not the same degree as in back vowels, and neutralization takes place. Hence, both [+high, -back, +ATR] and [+high, -back, -ATR] are realized as [i]. '
>
> (Hall and Hall 1980; 213ff; 215)

According to Hall and Hall, since Nez Perce vowel harmony is phonologically determined and there are words which consist only of recessive vowels, every recessive vowel must be fully

specified in the underlying forms. Hence, vowel harmony was described as the following feature changing rule:

(9) [+ATR] -> [-ATR] / [-ATR].

However, since they set up the abstract underlying vowel system (8), the following adjustment rules were required in order to have the correct surface forms.

(10)

(a) $\begin{bmatrix} -\text{high} \\ \alpha\text{ATR} \end{bmatrix}$ ---> [-αback]

(b) $\begin{bmatrix} +\text{high} \\ +\text{back} \\ -\text{ATR} \end{bmatrix}$ ---> $\begin{bmatrix} -\text{high} \\ -\text{low} \end{bmatrix}$

(c) $\begin{bmatrix} +\text{high} \\ -\text{back} \\ \alpha\text{ATR} \\ \beta\text{long} \end{bmatrix}$ ---> [βATR]

The realization of [æ] was described by rule (10a): the low vowel is realized as [a] if [-ATR] while [æ] if [+ATR]. The realization of [o] was described by rule (10b): a [-ATR] high back vowel is lowered, and realized as [o]. The realization of the vowel /i/ was accounted for by rule (10c). Rule (10c) neutralizes the [ATR] as an independent variable for the high front vowels, making it dependent on vowel length. Thus, the long

vowel [i·] is expected as the realization of the [+ATR] high front vowel and the short vowel [i] is expected as the realization of the [-ATR] high front vowel. However, vowel length is phonemic in Nez Perce as shown in (11) and vowel length is independent of vowel harmony as shown in (12).

(11)	a.	sí·s	'broth'	sís	'navel'
	b.	mǽ·qæ?	'snow'	mǽqæ?	'paternal uncle!'
	c.	?a·tó?sa	'I go out to see somebody else's'		
		?ató?sa	'I go out to see mine'		
	d.	mú·	'cow'	mú	'call'

(Aoki 1970)

(12)	a.	?ímæs	'deer'	tu·sti	'high'
	b.	waqí·pa	'one time'	watí·sx	'tomorrow'
	c.	?iní·t	'house'	?isqí·ki	'pitch'

(Aoki 1979)

In (12a), the short high front vowel /i/ cooccurs with vowels that are [+ATR], and the long high front vowel /i·/ cooccurs with vowels that are [-ATR] in (12b). As well, in (12c), the short high front vowel /i/ cooccurs with the long high front vowel /i·/. Since two distinct underlying vowels were set up for the neutral vowel /i/, the neutralization rule (10c) which wrongly related the feature [ATR] to the vowel length was required.

2.1.2. Non-linear analysis

Following Hall and Hall (1980), we assume in this study that Nez Perce vowel harmony sets are characterized by a distinctive feature, [ATR], as below.

(13)

set 1 (recessive vowels)		set 2 (dominant vowels)	
i	u	i	
			o
æ		a	
[+ATR]		[-ATR]	

However, the analysis differs crucially from that of Hall and Hall (1980). In this study, we will describe Nez Perce vowel harmony by means of a [-ATR] spreading rule within the framework of radical underspecification theory (Archangeli 1984, 1988, Archangeli and D. Pulleyblank 1987, 1989, etc.) and account for the characteristics of the neutral vowel /i/ in the harmonizing process by a Locality Condition based on hierarchical feature structure theory (Archangeli and D. Pulleyblank 1987, 1989, Clements 1985, McCarthy 1988, Sagey 1986, etc.).

In Nez Perce, /i/ can be considered a totally underspecified vowel since /i/ is neutral. Therefore, we can have the following underspecified feature matrix:

(14)

	i	æ	a	o	u
low		+	+		
round				+	+
ATR			(-)	(-)	

(Parentheses indicate that [-ATR] is not specified segmentally; there is a floating harmonizing feature [-ATR].)

Underspecified feature values are derived by the following redundancy rules.

(15) Redundancy rules [12]

(a) [+low] -> [-high]
(b) [+round, -ATR] -> [-high]
(c) [ ] -> [+high]
(d) [ ] -> [-low]
(e) [+back] -> [-front]
(f) [-round, -ATR] -> [-front]
(g) [ ] -> [+front]
(h) [+round] -> [+back]
(i) [ ] -> [-back]
(j) [ ] -> [-round]
(k) [ ] -> [+ATR]

Following radical underspecification theory, only one value of a distinctive feature is specified in underlying representation. The other value is derived by a redundancy rule. In Nez Perce, which value of the feature [ATR] is specified in underlying representation? Since the presence of at least one dominant vowel with [-ATR] in a word causes all vowels within the word to become

dominant vowels, it may be possible to assume that the harmonizing feature is [-ATR] rather than [+ATR], thus, [-ATR] is a specified value. However, even [-ATR] is not specified in segmental representations according to radical underspecification. The harmonizing feature [-ATR] is considered morphemic, not linked to any segment; that is, the harmonizing feature [-ATR] is floating in underlying representation.[13] Because the value of the feature [ATR] of each segment of a dominant morpheme can be derived from the morphemic harmonizing feature [-ATR] by association and spreading (i.e. vowel harmony), the [-ATR] value of individual segments is redundant. I distinguish association from spreading according to Archangeli and D. Pulleyblank (1989). The association which operates between a free autosegment and a free anchor takes place by the Universal Association Conventions stated below while spreading occurs by a language-specific rule after the association.

> "Universal Association Conventions
>
> Wherever possible, associate autosegments to anchors in a manner that is
> a. directional (left-to-right/ right-to-left)
> b. of a one-to-one nature."
>
> (Archangeli and D. Pulleyblank 1989; 181)

The assumption of a morpheme-sized feature value is consistent with the distinction between dominant morphemes and recessive morphemes in Nez Perce. The [+ATR] value of each segment inside a

recessive morpheme is given by the redundancy rule (15k). Hence, by radical underspecification, one can consider vowel harmony as a feature spreading rule rather than a feature changing rule (cf. Vago 1988).

We cannot find any evidence that shows whether the direction of the association is left-to-right, or right-to-left, because monomorphemes consist only of dominant vowels or recessive vowels as seen in (16) below, with a few exceptions as will be seen in (26). However, in terms of markedness, we assume the left-to-right direction because the left-to-right direction is the default direction while the right-to-left direction is the marked one (Archangeli and D. Pulleyblank 1989).

(16)

(a)	síl̓æm	'horse'	símuχ	'charcoal'
	hé·cu	'firewood'	wæyí·lætpu·	'Cayuse'
	tú·skæx	'upward'	qæpsí?s	'evil'
	?ilú·t	'belly'		
(b)	mitá·t	'three'	χá?wic	'sharp (of points)'
	tá·lo	'testes'	pí·ckatyo	'brook trout'
	pí·tamyalon	'chicken hawk'	q̓áχno	'prairie chicken'
	ní·ckaw	'basket-cap'	yoq̓opí	'that'

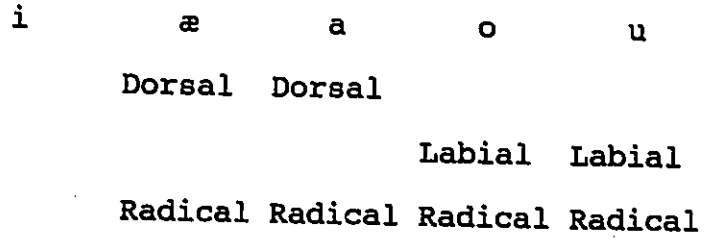
(Aoki 1970)

As shown in (4), spreading is bidirectional because the affix as well as the stem can condition vowel harmony, and it is iterative.

When we represent underspecified segments in terms of

hierarchical feature structure, we run into the problem of whether class nodes to which underspecified distinctive features belong are also absent in the feature structure. In this study, I assume that the contrast between segments is expressed not by a distinctive feature but by a class node (Avery and Rice 1988). That is, if a segment α contrasts with a segment β with regard to the feature F, the contrast is expressed not by the presence of different feature values, [-F] vs. [+F], but by the presence of the class node G to which the feature F belongs in both segments. Hence, the class node which expresses the contrast between segments is present in underlying representations regardless of the underspecification of features. Based on this specification of the class node, I assume that alternating counterparts are structurally identical except for the terminal nodes. Hence, we can represent Nez Perce underlying vowels by the class node matrix as in (17).

(17)



The vowels /æ/ and /a/ include both a Dorsal node and a Radical node, while /u/ and /o/ include a Labial node and a Radical node.

Since /i/ has no alternating counterpart, and no terminal feature, no further class node is required other than the Root node.

If we formalize the characteristics of Nez Perce vowel harmony seen above, it is as follows:

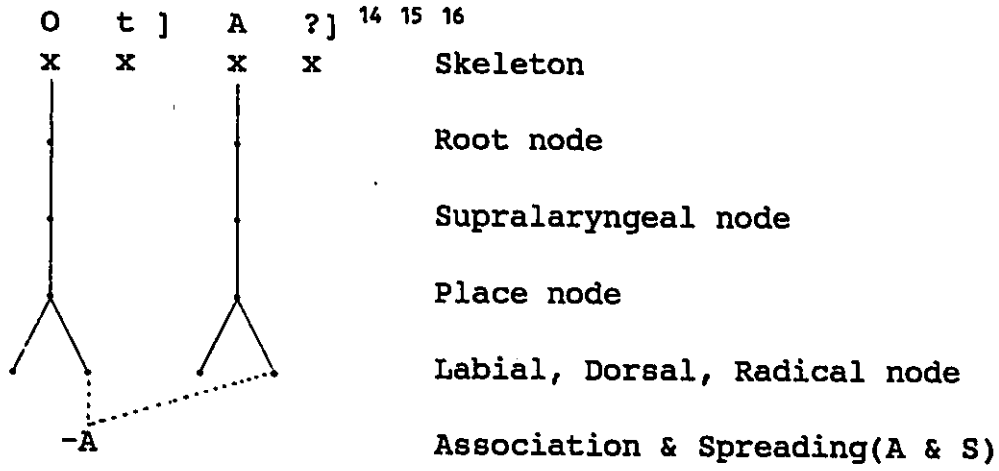
(18)

Harmonizing feature	: [-ATR]
Target	: Radical node
Association	: left-to-right
Spreading	: bidirectional iterative
Domain	: word

The application of vowel harmony is illustrated as in (19).

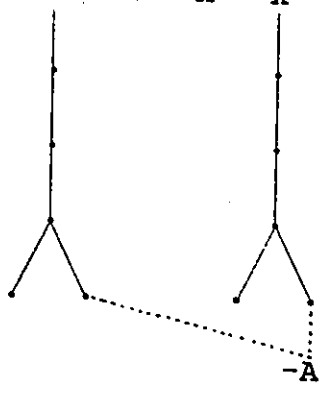
(19)

(a)



/tó·t æ?/ -> /tó·ta?/ 'father!'

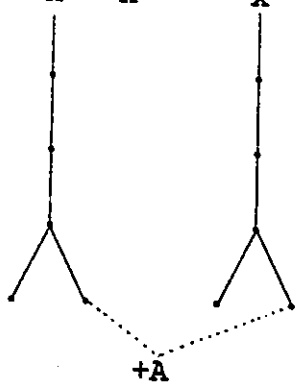
(b) [n A ? [t O t]]
x x x x x x



Skeleton
Root node
Supralaryngeal node
Place node
Labial, Dorsal, Radical node
A & S

/næ? tó·t/ -> /na?tó·t/ 'my father'

(c) m A q] A ?]
x x x x x



Skeleton
Root node
Supralaryngeal node
Place node
Dorsal, Radical node
Redundancy rule (R.R.)

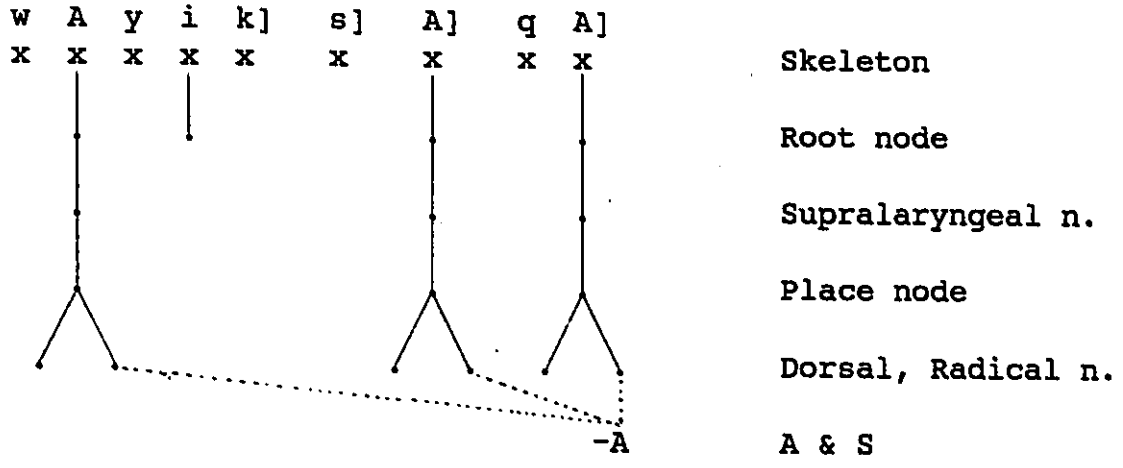
/mǽq æ?/ -> /mǽqæ?/ 'paternal uncle!'

In (19a and 19b), the stem /tó t/ has the harmonizing feature [-ATR]. The floating harmonizing feature [-ATR] is first linked to the leftmost vowel with a Radical node, the stem vowel /O/, associating within the stem by the Association Conventions; subsequently, spreading takes place to each affix vowel bidirectionally. In (19c), because there is no harmonizing

feature, vowel harmony does not occur, and each vowel gets [+ATR] by the redundancy rule (15k). After the application of the redundancy rule (15k), fusion takes place, an effect of the Obligatory Contour Principle (OCP) of McCarthy (1986), which prohibits the appearance of adjacent identical elements at a melodic level.[17] [18]

The fact that the intervening neutral vowel /i/ does not affect vowel harmony as seen in (20) can be accounted for by the Locality Condition, which I define as in (21), without the parameter of minimal and maximal scansion suggested by Archangeli and D. Pulleyblank (1987).

(20)



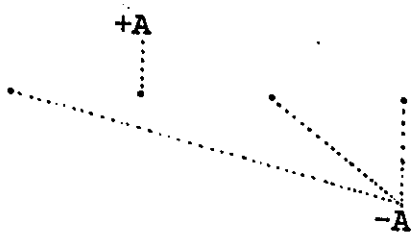
(21) Locality Condition

> If a rule propagating F applies to a string, then any segment intervening between trigger and target does not have F or G immediately dominating F if F is a terminal node.

That is, locality is dependent on the node actively involved in a

rule (Steriade 1987). Since Nez Perce vowel harmony is the spreading of the feature [-ATR], the target is the Radical node. Therefore, the neutral vowel /i/ without a Radical node does not affect vowel harmony. However, the neutral vowel /i/ gets [+ATR] by the redundancy rule (15k) after vowel harmony. Following Sagey's (1986) hypothesis that a terminal node can not be specified unless a corresponding articulator node is also specified, we assume that if the rule (15k) applies to the /i/ without a Radical node, the Radical node is automatically generated. On the other hand, in this study, we assume that the harmonizing feature value and the redundant feature value are present on different planes as seen in (22a) below in order to avoid a violation of the Line Crossing Prohibition of Goldsmith (1976). When Plane Conflation takes place, multiply linked [-ATR] is rewritten and there is no violation of the Line Crossing Prohibition as seen in (22b), as Mester (1986) pointed out.

(22) (a)



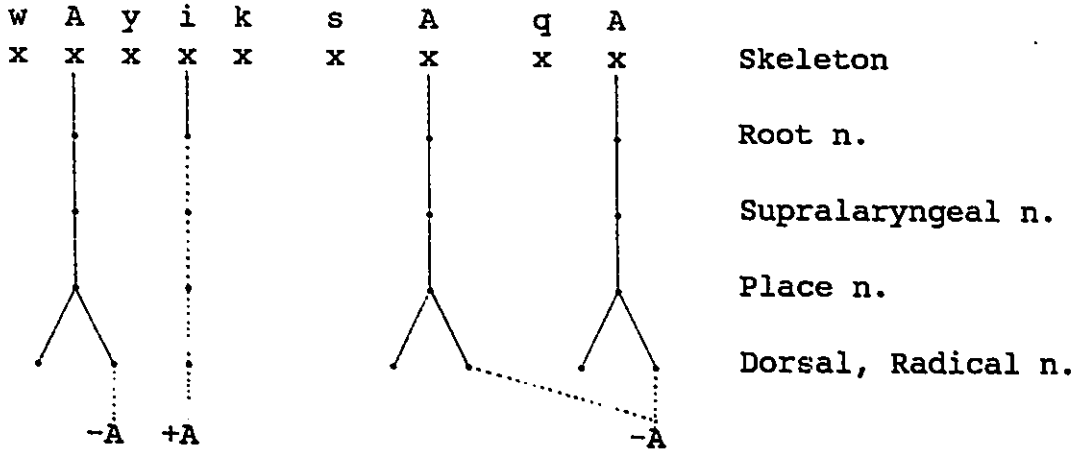
Radical node

(b) Plane Conflation

Radical node

After the application of the redundancy rule (15k), the lexical representation of (20) is as follows:

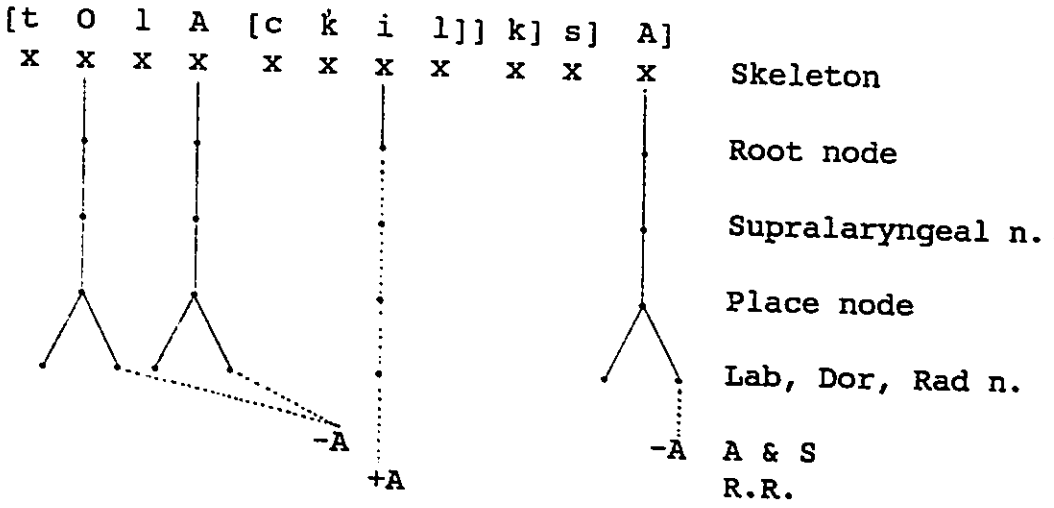
(20')



/wǽ·yik s æ qa/ -> /wá·yiksaqa/
'(I) went across recently'

Let us now examine a case in which a dominant morpheme contains only neutral vowels as illustrated in (23).

(23)



/tulæ· ck̓il k s æ/ -> /tolá·ck̓ilksa/
'(I) am destroying with my foot'

The stem /ckil/ has the harmonizing feature [-ATR] which is a phonological feature not a diacritic feature. Because the harmonizing feature was considered floating in underlying representation, we can say that the harmonizing feature remained regardless of the merger of a [-ATR] high front vowel into [+ATR] high front vowel /i/, like the case in which a tone remains after the loss of a tone bearing unit.

The association does not take place within the stem boundary because the stem vowel /i/ does not have a Radical node which is the target of the vowel harmony rule. Along with the word formation process, the floating harmonizing feature [-ATR] is linked to the leftmost vowel with a Radical node, the prefix vowel /O/. After association, spreading occurs. The stem vowel /i/ is not affected by this spreading process because it does not

have a Radical node. That is, by the Locality Condition, /i/ is skipped. After vowel harrony, /i/ gets [+ATR] by the redundancy rule (15K). By Plane Conflation, the multiply linked [-ATR] is rewritten and split as seen in (23).

There are words which consist of more than one dominant morpheme as was seen in (4i) and (4r). In these cases, if we assume that vowel harmony applies only on the final cycle and the representation is on a monoplane, the association (left-to-right, one-to-one) violates the OCP as shown in (24).

(24) [[[?A t] s] A] q A] => ?A t s A q A [19]

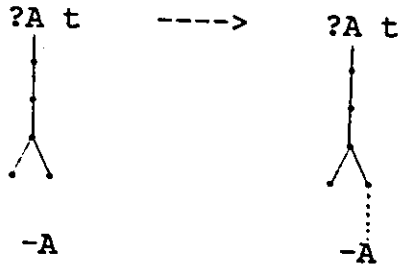
-A -A -A -A

However, if we assume that vowel harmony is cyclic and that there is planar segregation of morphemes, then we can account for this case without a violation of the OCP.[20] [21] In this study, planar segregation of morphemes is used simply in the sense that in the lexical representation, morphemes are demarcated by assignment to different planes, functioning in the same way as brackets, without any morphological identity.[22] At every lexical level, Plane Conflation takes place as Bracket Erasure (see McCarthy 1986, 1989). This process is illustrated in (25).

(25)

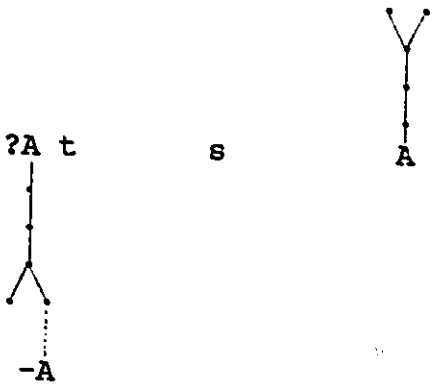
(a) stem

association

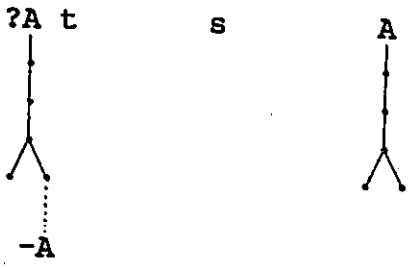


(b) stem + suffix + suffix

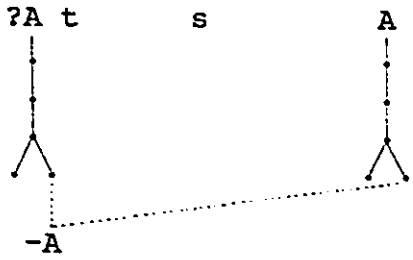
i)



ii) Plane Conflation

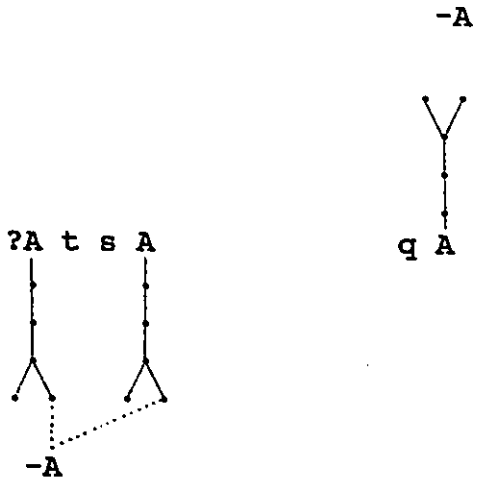


iii) spreading

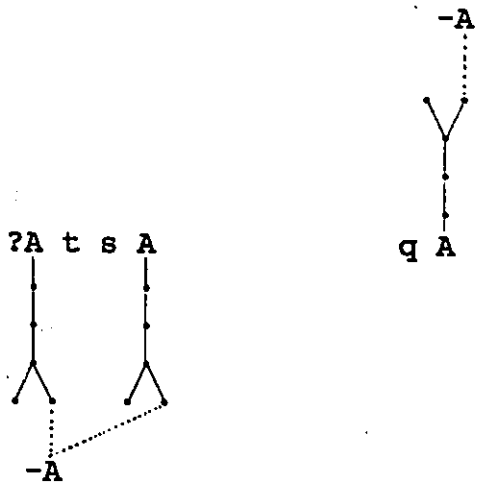


(c) (stem + suffixes) + suffix

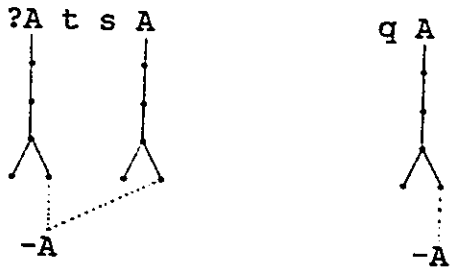
i)



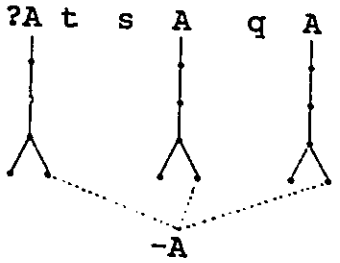
ii) association



iii) Plane Conflation



iv) fusion



v) output

/ʔá·tsaqa/ '(I) went out recently'

Vowel harmony in Nez Perce is a lexical rule. The domain of the rule is a word, and there are exceptions as seen in (26) and (27).

(26) páyus 'snake'
kúʔxmac 'several' lámha·y 'the Lemhi River'
pikunʔmaʔyqá·l 'September'

(Aoki 1962, 1966, 1970)

(27) /cú·læmayn/ 'for a bull'
/wæχwæqtáyn/ 'for a frog'
/ʔá·læʔcayn/ 'for a paternal grandmother'

/næʔǽ·læ̀ayn/ 'for my paternal grandmother'
/cæpǽ·pyuxṭiʔsʔayn/ 'for a pie'

(Aoki 1966, 1970)

Disharmony within a morpheme such as seen in (26) can be accounted for by prelinking (refer to Archangeli and Pulleyblank 1989). [-ATR] specification is a property of individual vowels in such cases, not that of a morpheme as whole; hence, [-ATR] is specified segmentally in underlying representation as seen in (28).

(28)

a. p a y O s
   |
  [-A]

b. l A h a y [23]
       |
      [-A]

Since [-ATR] is prelinked, the vowel harmony rule: spread [-ATR] cannot apply because of the Strict Cycle Condition stated below:

"Strict Cycle Condition

a. Cyclic rules apply only to derived representations.
b. Definition: A representation ϕ is derived w.r.t. rule R in cycle j iff ϕ meets the structural analysis of R by virtue of a combination of morphemes introduced in cycle j or the application of a phonological rule in cycle j."

(Kiparsky 1982; 41)

That is, because the condition of derived environment is

satisfied neither morphologically nor phonologically, the vowel harmony rule does not occur. On the other hand, disharmony between morphemes such as seen in (27) can be described by a diacritic feature [-S], which indicates that [-ATR] does not spread across a morpheme boundary. Aoki (1970) used boundary marker '-', which is considered a morphophoneme, to describe disharmony : e.g., cú·læm - 'áyn. According to him, a morpheme has allomorph with the boundary marker or that without or both: e.g., 'áyn ~ -'áyn. However, his assumption that the boundary marker is a morphophoneme is not justifiable because a morphophoneme represents the class of phonemes which occurs within a particular set of grammatical environments (Crystal 1985). By replacing Aoki's boundary marker as a morphophoneme with the diacritic feature [-S], we can describe disharmony between morphemes.

I can not find any evidence that shows whether the redundancy rule (15k) is a lexical rule or a post-lexical rule, hence, I leave this issue open.

Chapter Three. Korean vowel harmony

3.1. Present-day Korean

In present-day Korean (hereafter PDK), there are 10 monophthongs which result from the loss of /ʌ/ and monophthongization after Later Middle Korean (hereafter LMK).[24] [25] These are shown in (29).

(29)

i	ü	ɨ	u
e	ö	ə	o
ɛ		a	

The hypothesis that the loss of /ʌ/, monophthongization and the large number of loan words borrowed from Chinese, without vowel harmony, have caused the decay of vowel harmony since the 15th century (Kim-Renaud 1986) is generally accepted. The loss of /ʌ/ is regarded as the major factor (Huh 1985, Hwang 1986, K.-M. Lee 1987): first, /ʌ/ merged into /ɨ/ in non-initial syllables, and later, into /a/ in initial syllables. Because of this decay of vowel harmony, unlike LMK vowel harmony which will be seen in the next section, vowel harmony in PDK is found only in sound

symbolic words and in the alternation of A-initial suffixes [26] following verb or adjective stems (Ahn 1985, Huh 1985, C.-W. Kim 1978, J.-M. Kim 1986, Kim-Renaud 1986, Sohn 1986, etc.). In this study, I will show that both vowel harmony in sound symbolic words and that in A-initial suffixes can be described as a [-ATR] spreading rule.[27]

3.1.1. Vowel harmony in sound symbolic words

Sound symbolic words, in which Korean is very rich, are words denoting sound, smell, taste, colour, mood, size, type of movement or other perceptual experiences (Kim-Renaud 1986). In sound symbolic words, vowels are divided into two sets. Vowels of set 1 are opposed to those of set 2: /i/ is opposed to /ɛ/, /e/ opposed to /ɛ/, /ü/ opposed to /ö/, /ɨ/ opposed to /a/, /ə/ opposed to /a/, and /u/ opposed to /o/.

(30)

set 1 (dark vowels)				set 2 (light vowels)	
i	ü	ɨ	u		
e		ə		ö	o
				ɛ	a

The division of vowel sets in sound symbolic words has been

explained by the traditional distinction: dark vowels vs. light vowels according to the Yin-Yang principle (C.-W. Kim 1978, Kim-Renaud 1986). The vowels of set 1, /i e ü ɨ ə u/, are called "dark" (Yin) vowels, and the vowels of set 2, /ɛ ö a o/, are called "light" (Yang) vowels. /i/ and /ɨ/ in non-initial syllables are considered Neutral. Sound symbolic words containing vowels of set 1 (dark vowels) are called 'dark' sound symbolic words, and sound symbolic words containing vowels of set 2 (light vowels) are called 'light' sound symbolic words. Dark sound symbolic words give an impression of bigness, darkness and depth, while light sound symbolic words give an impression of smallness, lightness and shallowness (Kim-Renaud 1986). Some examples are given in (31).

(31)

dark	light	
cik'ək	cɛk'ak	'chattering'
t'eñkɨləñ	t'ɛñkɨlañ	'clanging'
kücücü	köcöcö	'shabby'
tɨls'ək	tals'ak	'lifting'
p'əlkəh-	p'alkah-	'to be red'
k'ukicək	k'okicak	'crumpling'

(Kim-Renaud 1986)

Unlike /i/ and /ɨ/ in initial syllables, which are opposed to /ɛ/ and /a/ respectively as shown in (32), /i/ and /ɨ/ in non-initial syllables are neutral as shown in (33).

(32)

dark	light	
kilc'uk	kɛlc'ok	'tall'
k'icək	k'ɛcak	'scribbling'
pisil	pɛsil	'staggering'
kɨlkcək	kalkcak	'scratching'
sɨlc'ək	salc'ak	'stealthy'
hɨntɨl	hantɨl	'rocking'

(Sohn 1986)

(33)

dark	light	
pəñsil	pañsil	'smiling'
pusisi	posisi	'gently rising'
pəncil	pancil	'shining'
siñkɨl	sɛñkɨl	'smiling'
pusɨl	posɨl	'drizzling'
sɨlkɨm	salkɨm	'stealthy'

(Sohn 1986)

In previous studies, vowel harmony in sound symbolic words was described by semantic features based on the traditional dichotomy (Kim-Renaud 1986), or it was considered an exception like Nez Perce vowel harmony because vowel harmony in sound symbolic words was not considered to be characterized by any single distinctive feature (Tohsaku 1983). McCarthy (1983) suggested that vowel harmony in sound symbolic words could be characterized by one distinctive feature, the feature [low] (cf. also Sohn 1986). However, in this study, we will show that the assumption of the tongue root feature [ATR] as the harmonizing feature is more

appropriate than that of the tongue body feature [low].

3.1.1.1. McCarthy's analysis

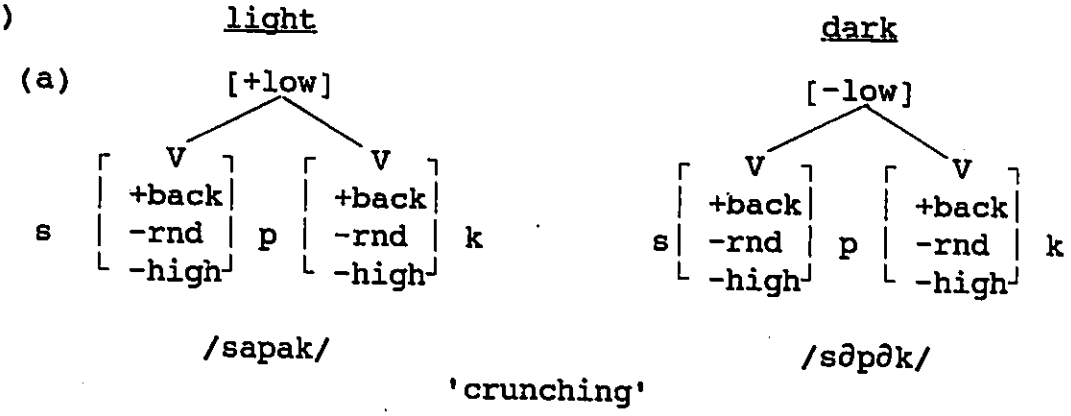
McCarthy (1983) described vowel harmony in sound symbolic words in PDK as a case of a feature-sized morpheme. According to him, Korean has formally systematic sound symbolic words.[28] That is, Korean displays a great deal of internal relation between a semantic function and a sound symbolic word. Vowels in sound symbolic words are divided into two classes, dark and light, as seen in (30). McCarthy proposed an abstract version of the Korean vowel system in order to make this dark/light distinction correspond to the values of [±low] in the following manner:

(30')	i	ü	ɨ	u	
	e		ə		dark = [-low]
	æ	ɐ	a	ɔ	light = [+low]

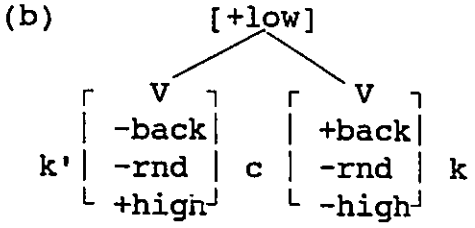
Vowels are divided into two groups according to the values of the feature [low], and the values of the feature [low] constitute morphemes, feature-sized morphemes (McCarthy 1981): [-low] is the 'dark' morpheme, [+low] is the 'light' morpheme. Vowels are unspecified with respect to this feature, except neutral vowels. The neutrality of /i/ and /ɨ/ in non-initial syllables is

accounted for by referring to specification. /i/ and /ɨ/ in non-initial syllables as seen in (34c) are fully specified in segmental representations, unlike those in initial syllables where the harmonizing feature values are unspecified as seen in (34b). The fully specified segments do not associate with the autosegmental feature value, and remain neutral. On the other hand, the autosegmental morpheme-sized feature [low] takes precedence over the segmental feature [high]. Hence, a lexical contrast in vowel height is neutralized in the light allomorphs as shown in (34b). Harmony phenomena are the result of autosegmental spreading. After vowel harmony, a context free rule: [+round] -> [-low] applies, hence, /ɐ/ changes to /ö/, /ɔ/ changes to /o/.

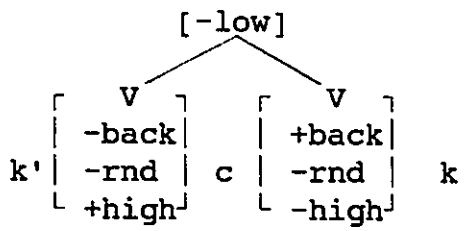
(34)



(b)



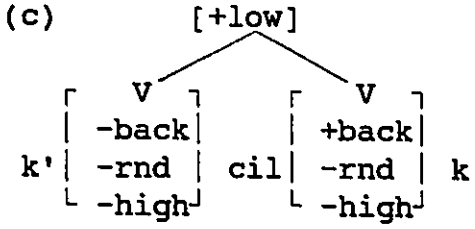
/k'æcak/



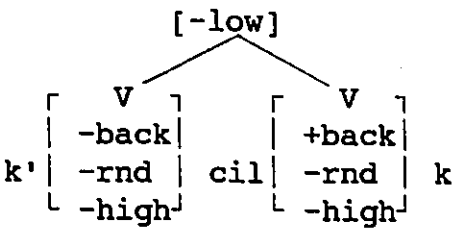
/k'icək/

'scribbling'

(c)



/k'æcilak/



/k'ecilək/

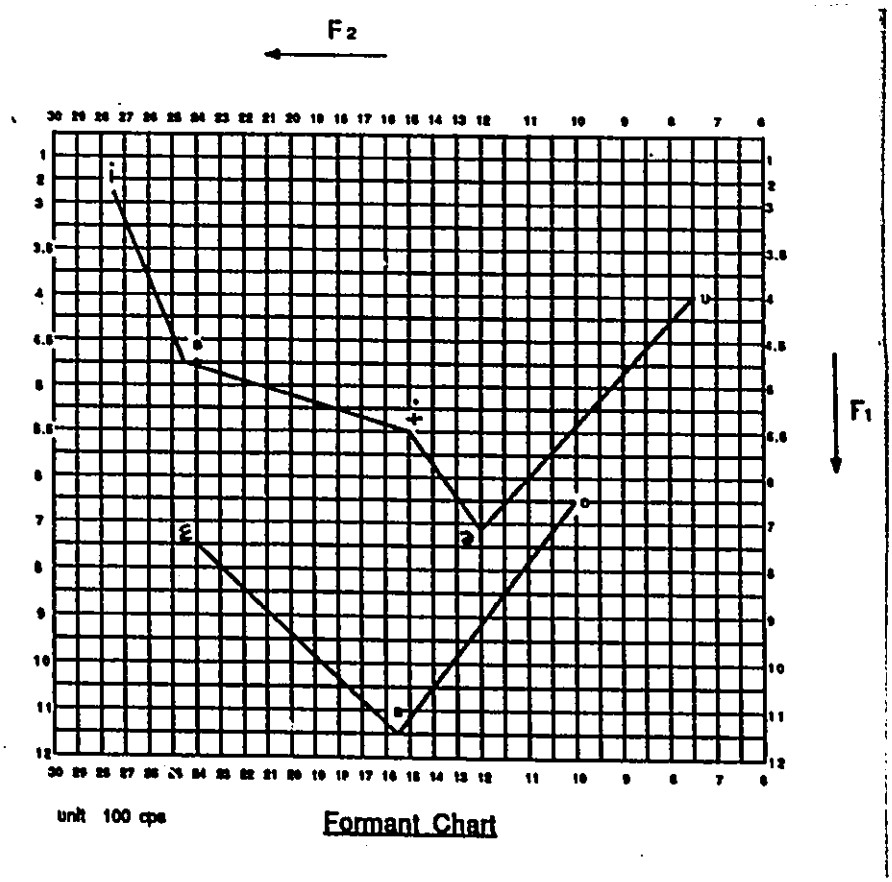
'halfheartedly'

As seen above, since McCarthy considered the harmonizing feature as a feature-sized morpheme, he described very well the characteristics of sound symbolic words. But since McCarthy considered the tongue body feature [low] as the harmonizing feature, it was necessary to assume the neutralization of contrast in vowel height in light sound symbolic words and the context free rule. However, if we consider [ATR] as the harmonizing feature, these assumptions are not required and a more elegant solution results.

3.1.1.2. [ATR] as a feature-sized morpheme

Based on Hwang's (1986) formant analysis, we have the following formant chart:[29]

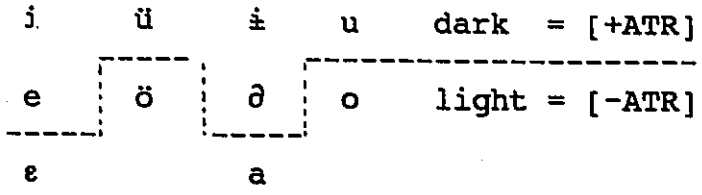
(35)



The major acoustic characteristic of [+ATR] is a lowering of F1 and concomitantly a downward shift of F2 for back vowels and an upward shift of F2 for front vowels (Hall and Hall 1980, Halle and Stevens 1969, Jacobson 1980, Lindau, Jacobson and Ladefoged

1972, Rialland and Djamouri 1984, etc.). In the formant analysis of PDK, the frequencies of F1 for /ɛ a o/ are higher than those of /i e ɨ ə u/. The frequencies of F2 for /i/ and /e/ are higher than that of /ɛ/, and the frequencies of F2 for /ɨ/ and /ə/, and /u/ are lower than those of /a/ and /o/, respectively. Based on this formant analysis, hence, we can say that vowel harmony in sound symbolic words is characterized by the feature [ATR]. That is, vowels in sound symbolic words can be divided into two sets by the feature [ATR] as below.

(30")



There is a dependence of light sound symbolic words on dark sound symbolic words. There are 'dark' sound symbolic words without 'light' counterparts, but there are no 'light' sound symbolic words without 'dark' counterparts, as shown in (36) below. Hence, 'light' sound symbolic words are generally regarded as subsets of 'dark' sound symbolic words.

(36)

	dark	light	
(a)	ulkəñ-ulkəñ	*olkañ-olkañ	'chewing'
(b)	pinduñ-pinduñ	*pɛndoñ-pɛndoñ	'idling'
(c)	ɨsisi	*asisi	'chilly'

(d) tɔñsil-tɔñsil *tañsil-tañsil 'merrily (dancing)'
(A hyphen indicates that sound symbolic words are derived by reduplication of the root morpheme.)

(Sohn 1986)

Based on this dependence of light sound symbolic words on dark sound symbolic words, we can assume the following word-formation process, considering the dark sound symbolic words as underlying forms.[30]

(37)

i. underlying sound symbolic word (SS) : darkness
ii. [-ATR] : 'lightness' morpheme of SS
subcategorization: [ ]ss

in word-formation process, (i) and (ii) are combined.

underlying SS
|
[-ATR] => light SS

Whereas by setting up both light and dark morphemes in the lexicon, McCarthy (1983) failed to notice the relation between dark sound symbolic words and light sound symbolic words, in this study, only [-ATR] is considered a morpheme since the dark sound symbolic words are considered underlying forms according to Sohn (1986). After the morphological operation (37), vowels receive phonological specifications for the feature [ATR] by association

and spreading, that is, vowel harmony.

In PDK /ɨ/ is considered a totally underspecified vowel because of the presence of /ɨ/-deletion and /ɨ/-epenthesis (Ahn 1985, Sohn 1986). Hence, the feature matrix of the underlying vowels in PDK can be described as follows:

(38)

	i	e	ɛ	ü	ö	ɨ	ə	a	u	o
high		-					-			
front	+	+	+	+	+					
back									+	+
round				+	+				+	+
ATR			(-)		(-)			(-)		(-)

Parentheses indicate that [-ATR] is not specified segmentally if there is a floating harmonizing feature [-ATR]. The underspecified feature values in (38) are derived by the following redundancy rules.

(39) Redundancy rules

(a) [+low] -> [-high]
(b) [+round, -ATR] -> [-high]
(c) [ ] -> [+high]
(d) [-round, -ATR] -> [+low]
(e) [ ] -> [-low]
(f) [ ] -> [-front]
(g) [ ] -> [-back]
(h) [ ] -> [-round]
(i) [ ] -> [+ATR]

Because vowel harmony in sound symbolic words is the residue of

LMK vowel harmony, I will account for vowel harmony in sound symbolic words in the same manner as that of LMK vowel harmony which will be seen in (57): the association is left-to-right, and spreading is left-to-right and iterative.

Vowel harmony in sound symbolic words is a lexical rule because there are exceptions as seen in (40) and the domain is a word.

(40) sɛlcuk 'twitching'
napul 'flapping roughly'
omul 'mumbling'

Ahn (1985) said that vowel harmony in sound symbolic words is a post-lexical rule because it applies to non-derived root form, violating the Strict Cycle Condition. However, even though vowel harmony in sound symbolic words applies to morphologically non-derived forms, it applies to phonologically derived forms. According to Archangeli and D. Pulleyblank (1989; 183), "the application of the Association Conventions on a given cycle creates the derived environment necessary to facilitate application on the same cycle of a rule". Since we distinguished association from spreading, we can describe vowel harmony in sound symbolic words without violation of the Strict Cycle Condition. On the other hand, exceptions such as in (40) can be accounted for by prelinking as in Nez Perce. Since [-ATR] is prelinked, the condition of derived environment is not satisfied, and therefore, the vowel harmony rule does not apply.

We can not have any evidence for the status of the redundancy rule (39i), hence, this issue will be left open.

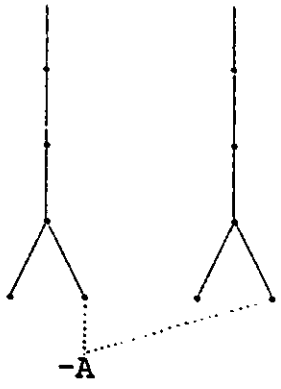
The operation of vowel harmony is illustrated in (41) below.

(41)

(a) /sapak/ ~/səpək/ 'crunching'

i. s A p A k] [31]

x x x x x Skeleton



Root n.

Supralaryngeal n.

Place n.

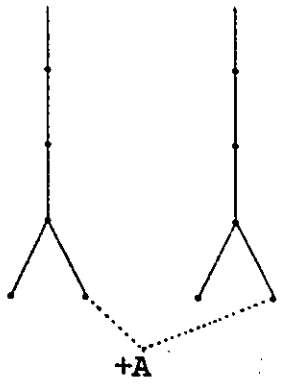
Dor, Rad n.

-A A & S

/sapak/

ii. s A p A k]

x x x x x Skeleton



Root n.

Supralaryngeal n.

Place n.

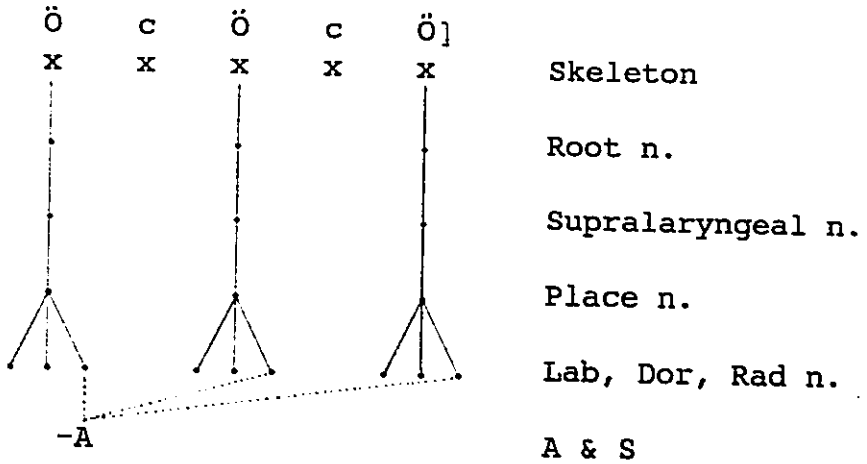
Dor, Rad n.

+A R.R.

/səpək/

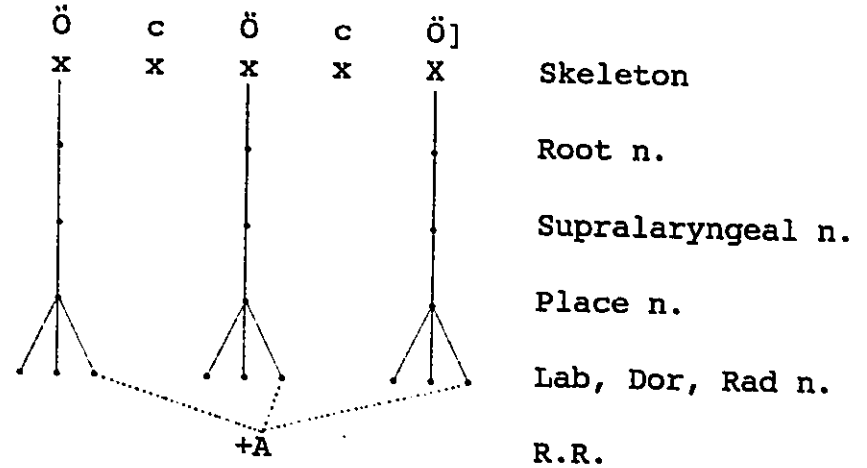
(b) /köcöcö/ ~ /kücücü/ 'shabby'

i.



/köcöcö/

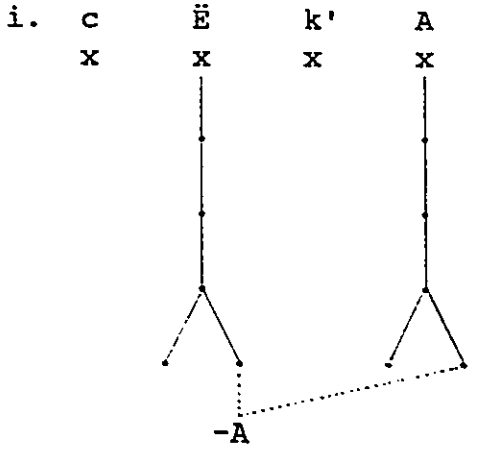
ii.



/kücücü/

(c) /cɛk'ak/ ~ /cik'ə̈k/ 'chattering'

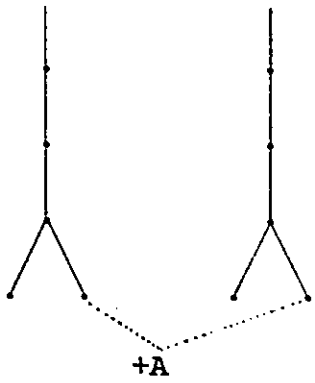
i.



Skeleton
Root n.
Supralaryngeal n.
Place n.
Dor, Rad n.
A & S

/cɛk'ak/

ii.

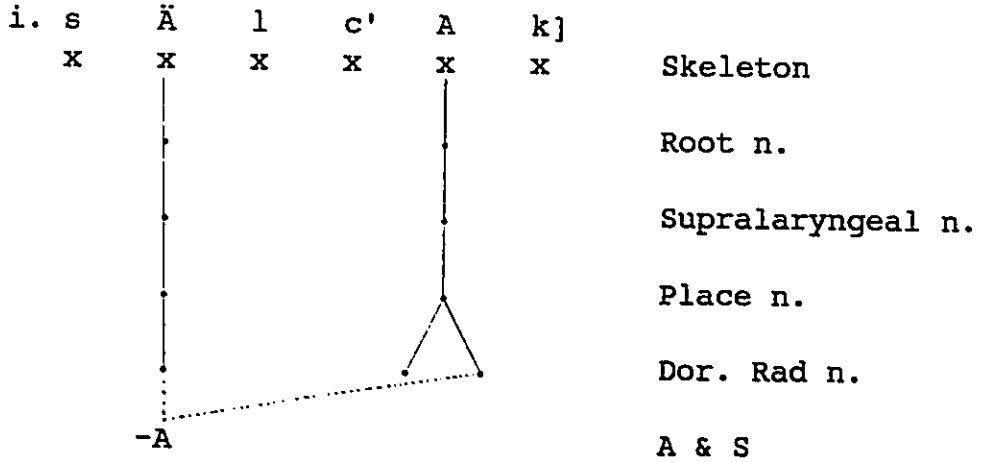


Skeleton
Root n.
Supralaryngeal n.
Place n.
Dor, Rad n.
R.R.

/cik'ə̈k/

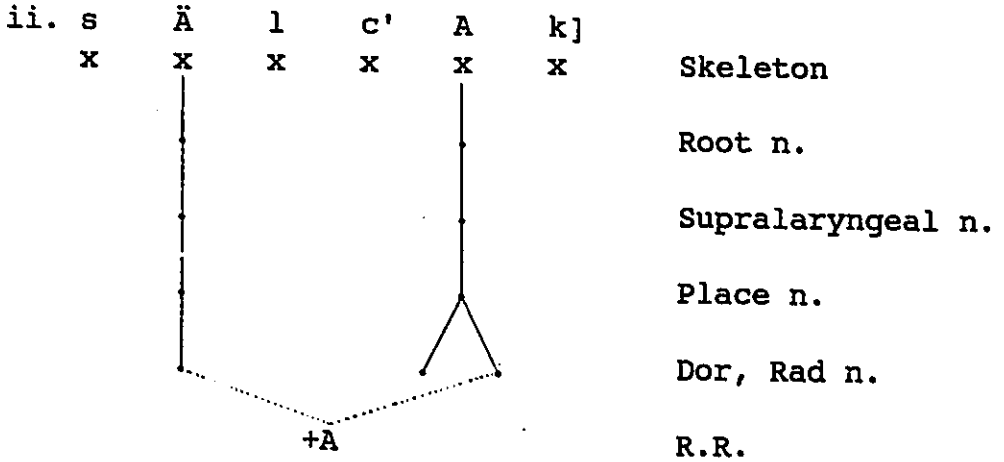
(d) /salc'ak/ ~ /sɨlc'ɘk/ 'stealthy'

i.



/salc'ak/

ii.



/sɨlc'ɘk/

As seen in (41 ai, bi, ci, and di), a light sound symbolic word has the harmonizing feature [-ATR] and vowel harmony takes place. But since a dark sound symbolic word has no harmonizing feature, there is no vowel harmony, and each vowel of a dark sound symbolic word gets the value of [ATR] by the redundancy rule

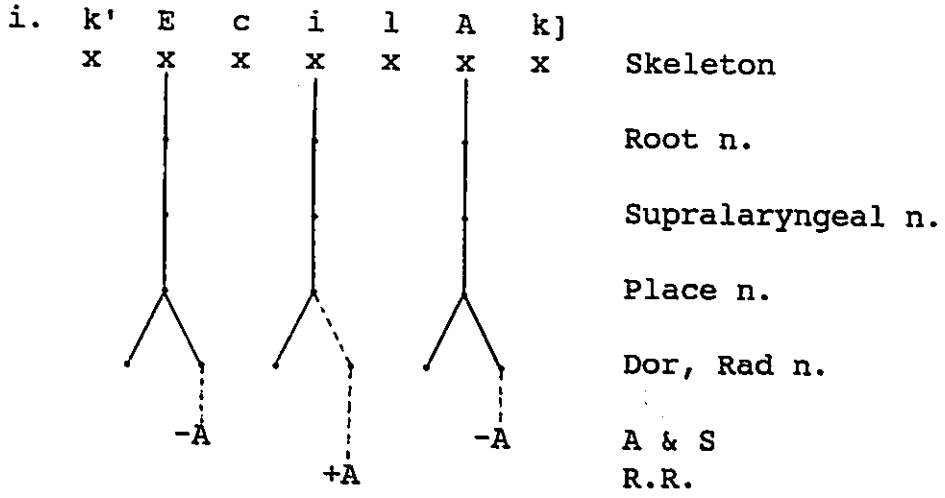
(39i) followed by fusion motivated by the OCP as seen in (41 aii, bii, cii, and dii).

The neutrality of /i/ and /ɨ/ in non-initial syllables can be accounted for by the Locality Condition. In this study, we assume that the feature structure of a segment is based on phonological properties according to Clements (1985) but not on phonetic properties as Sagey (1986) said. Hence, we can say that the feature structures of /i/ and /ɨ/ are different according to whether these are neutral vowels or harmonic vowels. In the case of /i/, it in initial syllables has Dorsal node and Radical node as seen in (41 cii) because /i/ is a harmonic vowel which alternates with /ɛ/. /i/ in non-initial syllables is a neutral vowel which has no alternating counterpart, but since /i/ has the terminal feature [+front], the Dorsal node is present as seen in (42a). In the case of /ɨ/, since /ɨ/ in initial syllables is a harmonic vowel which alternates with /a/, the Radical node is present as seen in (41 dii). But /ɨ/ in non-initial syllables is a neutral vowel, and no terminal node, hence, no further class node is needed to express /ɨ/ other than the Root node as will be seen in (42b). Since /i/ and /ɨ/ in non-initial syllables do not have a Radical node, /i/ and /ɨ/ are skipped by the Locality Condition as in (42).

(42)

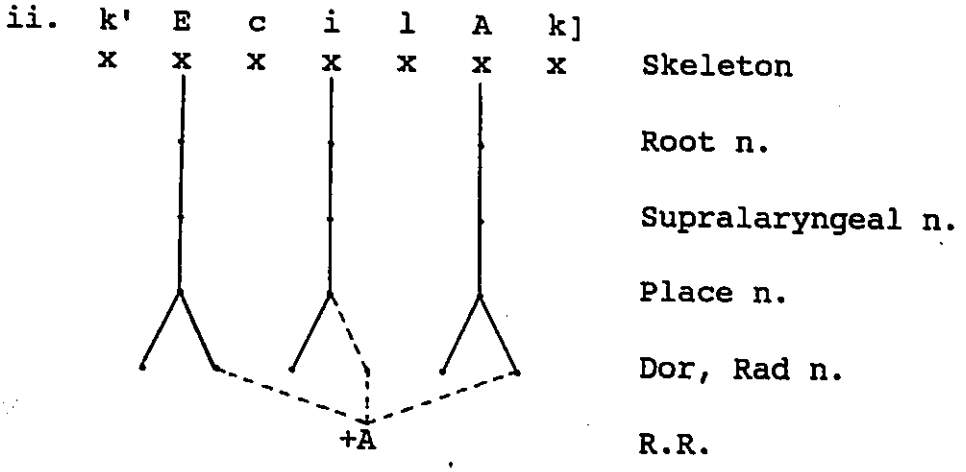
(a) /k'ɛcilak/ ~ /k'ecilɔ̃k/ 'halfheartedly'

i.



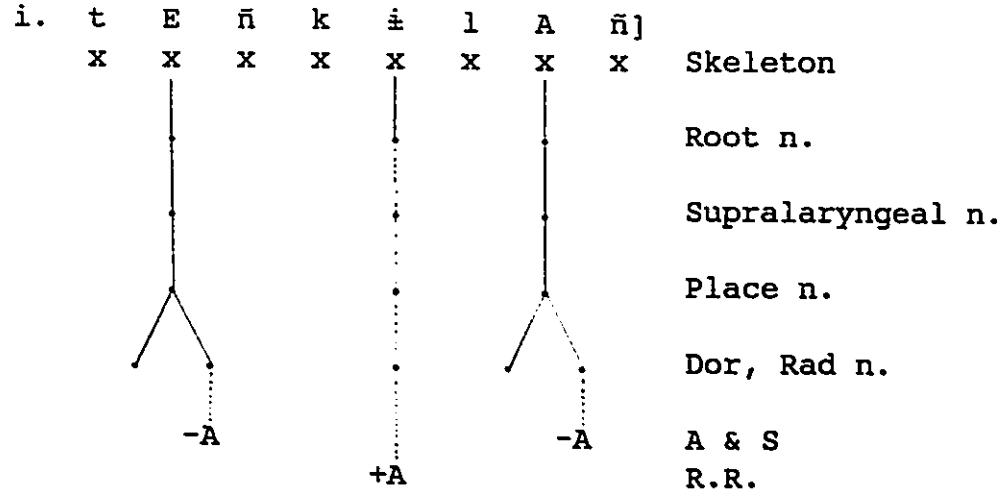
/k'ɛcilak/

ii.

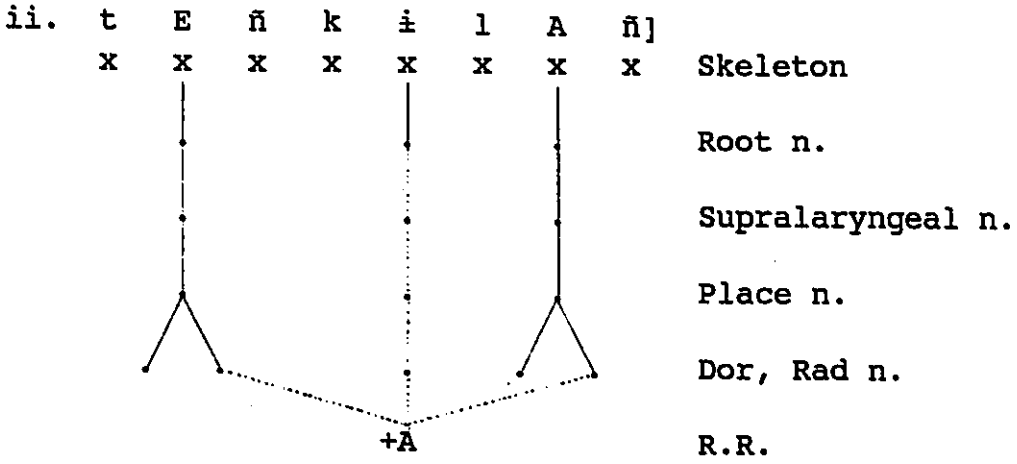


/k'ecilɛk/

(b) /tɛñkɨlañ/ ~ /teñkɨlðñ/ 'clanging'



/tɛñkɨlañ/



/teñkɨlðñ/

In this study, we assumed that the harmonizing feature value [-ATR] and the redundant feature value [+ATR] are present on different planes in order to avoid a violation of the Line Crossing Prohibition (see (22)). When Plane Conflation takes

place, Plane Conflation rewrites multiply linked [-ATR] and the harmonizing feature [-ATR] is split in (42 ai and 42 bi).

3.1.2. Vowel harmony in A-initial suffixes [32]

In the initial syllable position of A-initial suffixes, /∂/ alternates with /a/. /a/ appears after a verb or an adjective stem whose last vowel is /o/ or /a/, /∂/ elsewhere, as shown in (43).

(43) (a)	po + ala	'Look!'
	k + ala (<ka - ala)	'Go!'
	ko + a	'beautiful'
	malk + a	'clean'
(b)	cip + ∂la	'Pick (it) up!'
	pe + ∂la	'Cut (it)!'
	mɛ + ∂la	'Tie (it)!'
	cü + ∂la	'Hold (it)!'
	k'ö + ∂la	'Tempt (him)!'
	k' + ∂la (<k'ɨ - ∂la)	'Blow (it) out!'
	mul + ∂la	'Bite!'
	s + ∂la (<s∂ - ∂la)	'Stop!'
	nɨc + ∂	'late'
	kiph + ∂	'deep'

(Kim-Renaud 1986, B.-G. Lee 1985)

In previous studies (J.-M. Kim 1986, B.-G. Lee 1985), /∂/ is considered the underlying form for simplicity because vowel

harmony in A-initial suffixes was described as a feature changing rule. But in this study, we describe vowel harmony in A-initial suffixes as a feature spreading rule like vowel harmony in sound symbolic words, hence, we regard /A/ lacking a value for the feature [ATR], as the underlying form of both /ə/ and /a/. /A/ is realized as /a/ by the spreading rule, and /A/ is realized as /ə/ by the redundancy rule (39i). However, unlike vowel harmony in sound symbolic words, the harmonizing feature is a property of the stem-final vowel of a verb or adjective, hence the feature [-ATR] is specified segmentally. The underspecified feature matrix is as follows:

(38')

	i	e	ɛ	ü	ö	ɨ	ə	a	u	o
high		-					-			
front	+	+	+	+	+					
back									+	+
round				+	+				+	+
ATR			-		-			-		-

Since the harmonizing feature is specified segmentally, association does not play a role. The direction of spreading is left to right since the stem-final vowel determines vowel harmony. Vowel harmony in A-initial suffixes takes place only between the stem final vowel of a verb or adjective and the initial vowel of the A-initial suffixes. Vowel harmony is determined by the stem-final vowel not by the stem-initial vowel: e.g., /nanu + əs' + ta/ '(he) divided (it)'. Vowel harmony occurs

neither within the same A-initial suffix as seen in (43b), nor in A-initial suffixes when they follow another A-initial suffix: e.g., /mak + as' + ∂s' + ∂/ (* /mak + as' + as' + a/) '(he) had blocked (it)' (Kim-Renaud 1986). Hence, we can formalize vowel harmony in A-initial suffixes as follows.

(44) Trigger : [-ATR]
specification: [-ATR] of the stem final vowel of a verb or adjective which is not specified with regard to [front]
Target : Radical node
specification: Radical node of the initial vowel of A-initial suffixes
Spreading: left-to-right
non-iterative
Domain : between the stem final vowel of verb or adjective and the initial vowel of A-initial suffixes

Vowel harmony in A-initial suffixes is a lexical rule since it needs morphological information (that is, vowel harmony occurs only after the stem final vowel of a verb or adjective), does not cross word boundaries, and has exceptions as seen in (45) below. With regard to the redundancy rule (39i), I will leave aside the issue of the identity of it as in sound symbolic words.

(45) (a) cap - ala ~ cap - ∂la 'to take (it)'
(b) anc - ala ~ anc - ∂la 'to sit down'
(c) kolm - ala ~ kolm - ∂la 'to be stale'
(d) olm - ala ~ olm - ∂la 'to be infected'

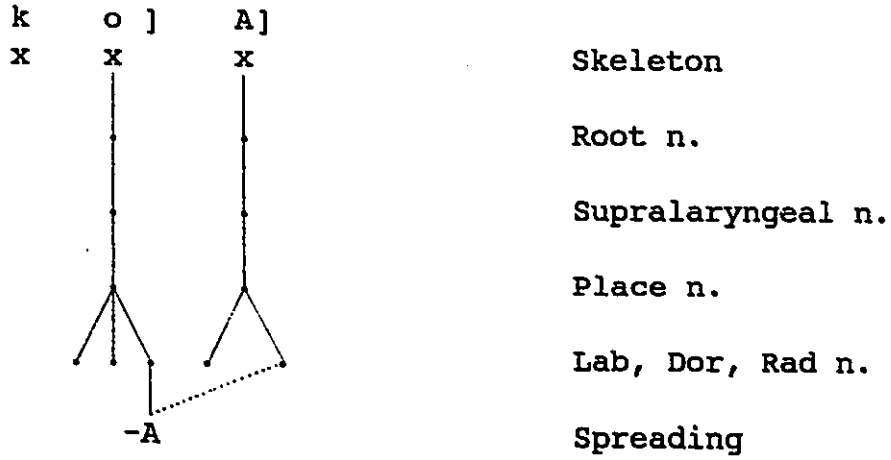
(Kim-Renaud 1986, Sohn 1986)

Exceptions such as shown in (45) can be accounted for by the assumption that the vowel harmony rule applies optionaliy after stem final vowel /a/ if one or two consonants intervene as Kim-Renaud (1986) suggested.

The application of vowel harmony in A-initial suffixes is illustrated in (46) below.

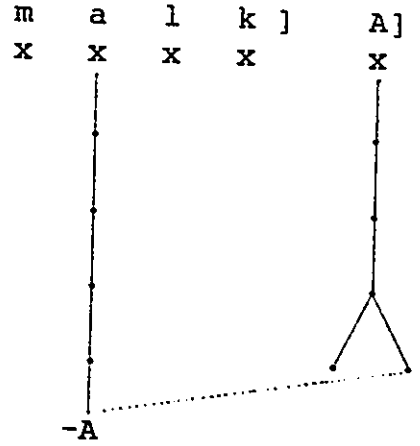
(46)

(a)



/koa/ 'beautiful'

(b)



Skeleton

Root n.

Supralaryngeal n.

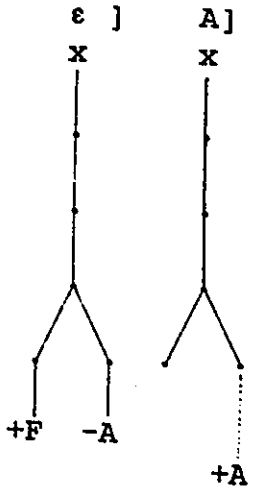
Place n.

Dor, Rad n.

Spreading

/malka/ 'clean'

(c)



Skeleton

Root n.

Supralaryngeal n.

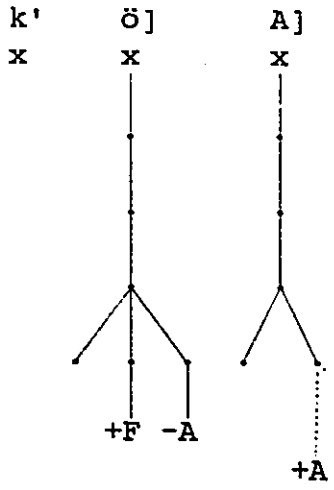
Place n.

Dor, Rad n.

R.R.

/mɛð/ 'to tie (it)'

(d)



Skeleton

Root n.

Supralaryngeal n.

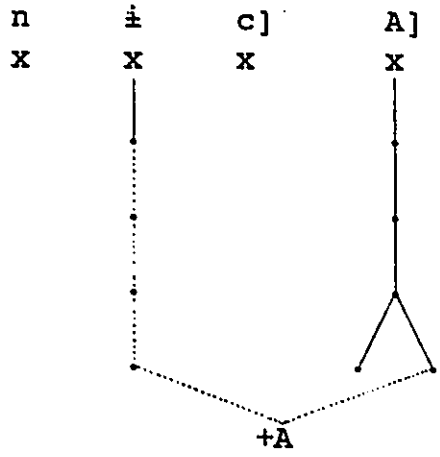
Place n.

Lab, Dor, Rad n.

R.R.

/k'öə/ 'to tempt (it)'

(e)



Skeleton

Root n.

Supralaryngeal n.

Place n.

Dor, Rad n.

R.R.

/nɨcə/ 'late'

The trigger of the vowel harmony rule is a [-ATR] specification on a vowel with no specification for the feature [front], hence, the [-ATR] of the front vowels, /ɛ/ and /ö/, does not affect vowel harmony as shown in (46c) and (46d) while the [-ATR] of /a/ and /o/ affects vowel harmony as in (46a) and (46b). If vowel

harmony does not take place, the redundancy rule (39i) applies, hence, /A/ gets [+ATR] as seen in (46c, 46d and 46e).

3.2. Later Middle Korean vowel harmony

In previous studies, LMK vowel harmony was characterized by the feature [back] (Ledyard 1966, Park 1982) or the feature [low] (B.-G. Lee 1985). But in this study, I will show that LMK vowel harmony is characterized by the tongue root feature [ATR]. LMK had seven underlying vowels as follows:

(47)

i	ɨ	u
	ə	o
	a	ʌ

These vowels were divided into two harmonizing sets:

(48)

set 1			set 2	
i	ɨ	u	i	
	ə			o
			a	ʌ

/i/ was neutral. /ɨ/ alternated with /ʌ/, /ə/ alternated with /a/, and /u/ alternated with /o/. Unlike PDK vowel harmony, LMK vowel harmony involved almost all words. Some examples are given in (49). There were only minor exceptions as will be seen in (58) and (59).

(49)

(a) stem + the adverbializing suffix /ə/ ~ /a/
/mə1 + ə/ 'far'
/mʌ1 + a/ 'ignorantly'

(b) stem + the locative suffix /əy/ ~ /ay/
/tuyh + əy/ 'behind'
/kulum + əy/ 'in the cloud'
/pʌ1ʌm + ay/ 'in the wind'
/namo + ay/ 'in the tree'
/kaci + ay/ 'in the branch'

(c) stem + the suffix of topicalization /(n)ɨn/ ~ /(n)ʌn/
/nə + nɨn/ 'you'
/na + nʌn/ 'I'

(d) stem + the accusative suffix /(l)ɨl/ ~ /(l)ʌl/
/kɨ + lɨl/ 'him'
/kɨypyə1 + ɨl/ 'news'
/halmi + lʌl/ 'grand-mother'

(e) stem + the genitive suffix /ɨy/ ~ /ʌy/
/cip + ɨy/ 'of a house'
/kot + ʌy/ 'of a flower'

(f) stem + the suffix of nominalization /um/ ~ /om/
/mək + um/ 'eating'
/cap + om/ 'holding'

(g) stem + more than one suffix
/tuy + əy + nɨn/ 'behind'
/alp + ay + nʌn/ 'before'

(Huh 1985, Hwang 1986, B.-G. Lee 1985)

Stems containing only neutral vowels also trigger vowel harmony as seen in (50).

(50)

(a) min + ɨl 'people (object)' kilh + ∂y 'in the street'
cip + ɨy 'of house'

(b) sin + ʌlo 'with shoe' cip + ʌlo 'with straw'

(Huh 1985, B.-G. Lee 1985)

In the 15th century, vowel harmony was explained by oriental philosophy, the Yin-Yang principle. In 'Hunmin-chongum-haerye' (HCH) (Explanations and examples of the correct sounds for the instruction of the people) written in 1446, according to the philosophical principle, /a ʌ o/ were categorized as Yang, /ɨ ∂ u/ as Yin, and /i/ as Neutral. Thus it was said that only Yang+Yang or Yang+Neutral, Yin+Yin or Yin+Neutral combinations were possible, but neither Yang+Yin nor Yin+Yang (Huh 1985, Hwang 1986, Kim-Renaud 1986, Ledyard 1966). In previous studies of LMK (Ledyard 1966, B.-G. Lee 1985, Park 1982), the harmonizing feature of LMK vowel harmony was assumed to be the tongue body feature [back] or [low]. The adoption of the feature [back] as the harmonizing feature (Ledyard 1966, Park 1982) presumes that the LMK vowel system was different from that of PDK as shown below (Ledyard 1966).[33] [34]

(51)

front	central	back
i	u	o
	ɨ	ʌ
	ə	a

However, because it is generally accepted that the vowel system of LMK is similar to that of PDK except for the loss of /ʌ/ (Huh 1985, Hwang 1986, K.-M. Lee 1987), this hypothesis may seem suspicious. On the other hand, the hypothesis that the harmonizing feature is [low] (B.-G. Lee 1985) is also doubtful since it presumes the LMK vowel system was different from that of PDK as follows:[35]

(52)

	i	ɨ	ə	a	u	o	ʌ
high	+	+	+	-	+	-	-
low	-	-	-	+	-	+	+
front	+	-	-	-	-	-	-
back	-	+	-	-	+	+	+
round	-	-	-	-	+	+	-

(B.-G. Lee 1985; 40)

In this hypothesis, /ə/ is regarded as a high vowel, /o/ is regarded as a low vowel.

If the harmonizing feature of LMK vowel harmony can be specified neither as [back] nor [high], what about [ATR]? The contrast between /ɨ/ vs. /ʌ/, /ə/ vs. /a/, and /u/ vs. /o/ can be described by referring to tongue root movement from an

articulatory point of view: as the tongue root is moved forward, the tongue body is compressed and therefore raised, conversely, as the tongue root is retracted, the tongue body is pulled down and therefore lowered (Hall and Hall 1980; 207). Therefore, we can assume that /ɨ/, /ə/ and /u/ had [+ATR], and /ʌ/, /a/ and /o/ had [-ATR]. As well, this hypothesis of ATR harmony is borne out by the explanation of vocalic articulation written in HCH (translated by Ledyard (1966)):

> ' With /ʌ/, the tongue retracts and the enunciation is deep.
> With /ɨ/, the tongue retracts a little and the enunciations neither deep nor shallow.
> With /i/, the tongue does not retract and the enunciation is shallow.
> /o/ is the same as /ʌ/, only the mouth is contracted.
> /a/ is the same as /ʌ/, only the mouth is spread.
> /u/ is the same as /ɨ/, only the mouth is contracted.
> /ə/ is the same as /ɨ/, only the mouth is spread.'

Vowels were divided into three groups according to the degree of tongue retraction in HCH. The neutral vowel /i/ was specified by non-retraction. The vowel set 1 was specified by a little retraction while the vowel set 2 by more retraction. But the feature [ATR] is not an n-ary feature but a binary feature. If there is movement of the tongue root, it means that the tongue root moves forward from the neutral position or that the tongue root moves backward from the neutral position (Lindau 1978). The opposition concerning tongue root movement can be characterized by three types of phonetic gestures as shown in (53) (Hall and

Hall 1980).

(53)

set 1	vs.	set 2
(a) advanced tongue root	vs.	retracted tongue root
(b) advanced tongue root	vs.	neutral tongue root
(c) neutral tongue root	vs.	retracted tongue root

If the tongue root movements are characterized by one of the above three types, how can we interpret the tongue movement described in HCH? To interpret correctly the explanation of the tongue movement in HCH, we should notice that /i/, /ɨ/ and /ʌ/ were considered basic elements following oriental philosophy and that other vowels were described by referring to these vowels.[36] The explanation of tongue movement in HCH is not that between two alternating vowels but among three basic vowels, /i/, /ɨ/ and /ʌ/. That is, the degree of tongue retraction in HCH is not relative. Because the most forward /i/ was considered in zero position, all other vowels were specified by retraction of tongue. But since tongue movement is needed in order to express a contrast between vowels, we should deal with the degree of tongue movement between /ɨ/ and /ʌ/, /ə/ and /a/, and /u/ and /o/. Hence, we can infer that /ʌ/, /a/ and /o/ are in zero position with regard to tongue movement while /ɨ/, /ə/ and /u/ result from the advancement of tongue root. That is, we can infer that LMK vowel harmony is characterized by the type (53b). As seen so far, according to the explanation of tongue movement in HCH, we can

describe LMK vowel harmony as ATR harmony.

3.2.1. Non-linear analysis

/i/ can be considered a totally underspecified vowel because of the neutrality of /i/ in vowel harmony, hence, the underspecified feature matrix of underlying vowels in LMK is proposed to be as follows:

(54)

	i	ɨ	ə	a	u	o	ʌ
high			-				
front		-					
back							+
round					+	+	
ATR				(-)		(-)	(-)

Parentheses indicate that [-ATR] is not specified segmentally if there is a floating harmonizing feature [-ATR]. The underspecified feature values in (54) are derived by the following redundancy rules.

(55) Redundancy rules [37]

(a) [+low] -> [-high]
(b) [+round, -ATR] -> [-high]
(c) [ ] -> [+high]
(d) [-round, -ATR] -> [+low]
(e) [ ] -> [-low]
(f) [+back] -> [-front]

(g) [-high, +ATR] -> [-front]
(h) [-round, -ATR] -> [-front]
(i) [ ] -> [+front]
(j) [+round] -> [+back]
(k) [ ] -> [-back]
(l) [ ] -> [-round]
(m) [ ] -> [+ATR]

Within a stem, vowel harmony applied almost completely as shown in (56) below, and there was almost no occurrence of [-ATR]..[+ATR] or [+ATR]..[-ATR] except for the neutral vowel /i/ (with very minor exceptions as seen in (58)).

(56)				
	/namo/	'tree'	/kulum/	'cloud'
	/sarʌm/	'man'	/pɔnkɔy/	'lightning'
	/kaci/	'branch'	/sɨmɨl/	'twenty'
	/kamakoj/	'crow'	/mɨcikɔy/	'rainbow'
	/kilʌma/	'saddle'	/nilkup/	'seven'
	/mili/	'in advance'	/kɨypyɔl/	'news'

(Huh 1985, Hwang 1986, B.-G. Lee 1985)

Hence, we can not find any evidence for the directionality of the association. But we can assume left-to-right directionality for two reasons. One is concerned with markedness: the left-to-right direction is the default one while the right-to-left direction is the marked one (Archangeli and D. Pulleyblank 1989). The other is due to the fact that in Korean there is no prefix and vowel harmony is determined by a stem. If we assume the left-to-right directionality of the association, we can describe this

characteristic by left-to-right spreading, while given the right-to-left association, spreading is bidirectional, and we fail to describe the morphological character of Korean vowel harmony. Hence, left-to-right association is assumed in this study. If we formalize the characteristics of LMK vowel harmony seen above, it is as follows:

(57)

Harmonizing feature	: [-ATR]
Target	: Radical node
Association	: left-to-right
Spreading	: left-to-right iterative
Domain	: word

Vowel harmony in LMK is a lexical rule because the domain of the rule is the word and there are exceptions as shown in (58) and (59).

(58)

moncjə	'first'
sjənpʌy	'gentleman'
ʌmanim	'mother'
cjəcay	'market'

(Huh 1985)

(59)

əps + a	'is not'
jənc + ʌni	'put on'
kip + ɨsay	'deep'

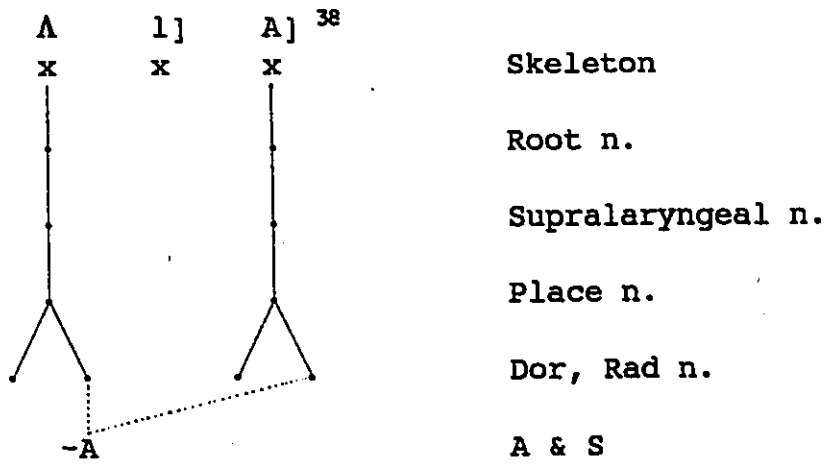
(Huh 1985)

Disharmony within a morpheme such as seen in (58) can be described by prelinking: since [-ATR] is prelinked, the vowel harmony rule does not apply due to the Strict Cycle Condition. Disharmony between morphemes as seen in (59) can also be described by prelinking. [-ATR] is a property of individual vowels. In the case of disharmony between morphemes, [-ATR] can not spread to other vowels because of its left-to-right directionality; because the condition of derived environment is satisfied morphologically, the Strict Cycle Condition is not relevant in such case.

We can not have evidence that shows whether the redundancy rule (55m) is a lexical rule or a post-lexical rule, hence, we will leave the issue of identity of the redundancy rule (55m) open. The application of vowel harmony is illustrated in (60) below.

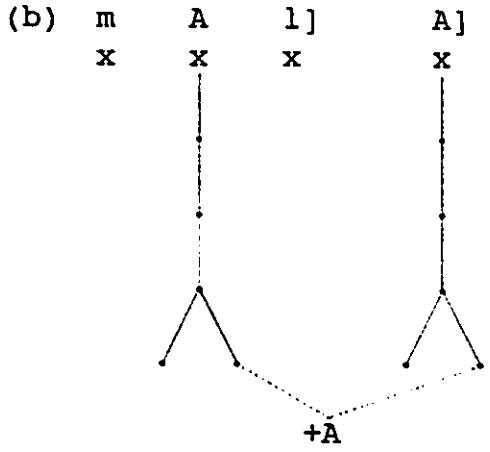
(60)

(a)



/mΛla/ 'ignorantly'

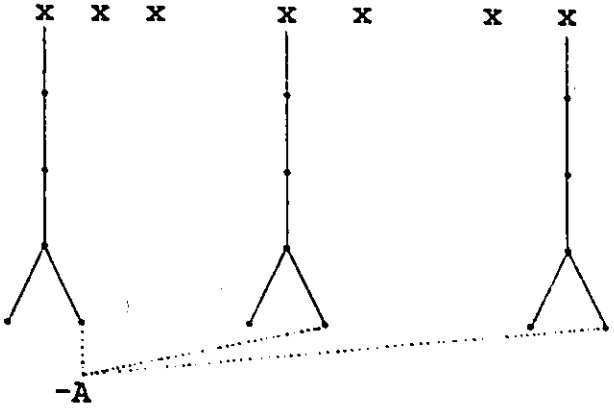
(b)



Skeleton
Root n.
Supralaryngeal n.
Place n.
Dor, Rad n.
R.R.

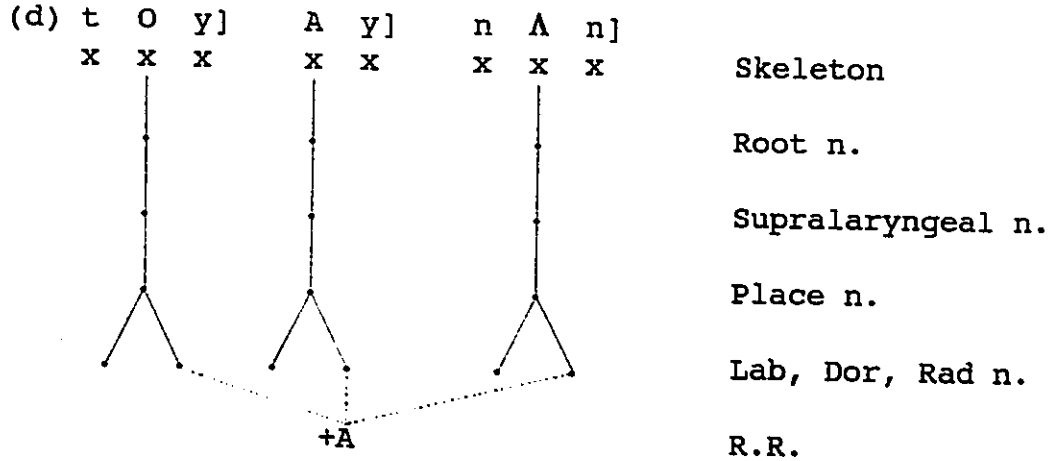
/mɔlɔ/ 'far'

(c)



Skeleton
Root n.
Supralaryngeal n.
Place n.
Dor, Rad n.
A & S

/alphaynΛn/ 'before'

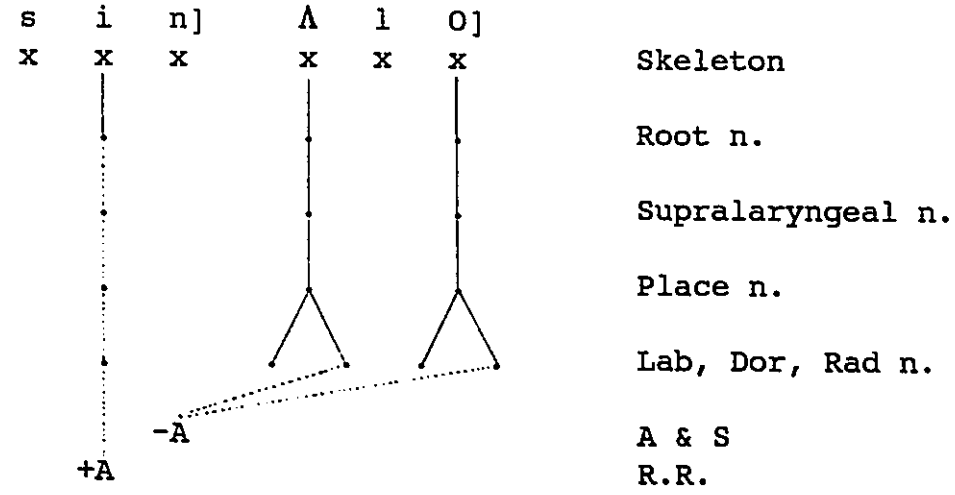


/tuyðynɨn/ 'behind'

If a stem has the harmonizing feature [-ATR], the floating harmonizing feature [-ATR] is first linked to the leftmost vowel with a Radical node, and then, it spreads rightwards as seen in (60a and 60c). If a stem does not have the harmonizing feature, vowel harmony does not take place, and therefore, each vowel gets the value of [+ATR] by the redundancy rule (55m) followed by fusion induced by the effect of the OCP, as seen in (60b and 60d).

Now let us consider a stem with only neutral vowels, as in (61).

(61)



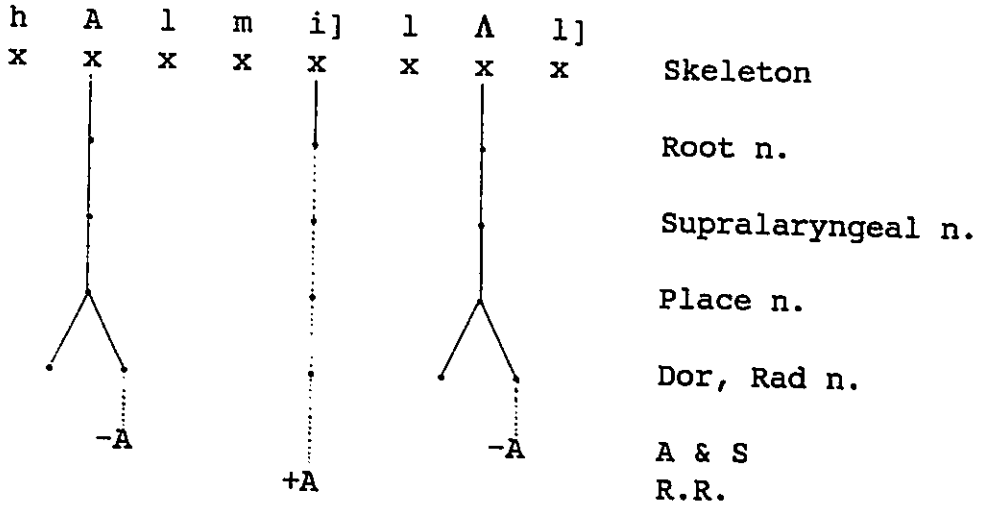
/sinΛlo/ 'with shoe'

In (61), the stem /sin/ has the harmonizing feature [-ATR], but the stem vowel /i/ does not have a Radical node to be the target of the vowel harmony rule, hence, association does not take place within the stem. Along with the word formation process, association takes place between the leftmost vowel with the Radical node, the suffix initial vowel /Λ/, and the floating harmonizing feature [-ATR], following spreading to the /O/. After vowel harmony, the stem vowel /i/ gets [+ATR] by the redundancy rule (55m).

The neutral vowel /i/ in non-initial syllables can be accounted for by the Locality Condition. Spreading skips the neutral vowel /i/ since it does not have a Radical node as shown in (62). After vowel harmony, the neutral vowel /i/ gets its value for the feature [ATR] by the redundancy rule (55m). This type of case is

illustrated in (62).

(62)



/halmilΛl/ 'grand-mother (accusative)'

We assumed that the harmonizing feature value [-ATR] and the redundant feature value [+ATR] are present on separate planes in order to avoid a violation of the Line Crossing Prohibition (see (22)). Plane Conflation rewrites multiply linked [-ATR], hence, the harmonizing feature [-ATR] is split in (62).

3.3. Old Korean with palatal harmony

One of the characteristics of the Altaic language family is palatal harmony (Aoki 1968, C.-W. Kim 1978, Poppe 1965, Tohsaku 1983, Ultan 1973, Vago 1980). Because Korean belongs to the Altaic language family, the hypothesis that Old Korean (hereafter OK) had palatal harmony was suggested by several phonologists (e.g., C.-W. Kim 1978, Kim-Renaud 1986, K.-M. Lee 1987, 1988, Park 1982, Ultan 1973, etc.). In this section, we will examine the earlier stage of Korean principally based on K.-M. Lee's historical studies of Korean (1987, 1988). The reconstruction of the earlier stage of Korean has generally been made by retroactive deduction from the LMK vowel system through comparison of Sino-Korean, Mongolian loan words and LMK words written in Hangul (Korean letters) in the 15th century, with Chinese, Mongolian, and OK words (written in Idu, Hyangchal, or Chinese letters which were used as writing systems in the OK period).[39]

K.-M. Lee (1987, 1988) reconstructed the vowel system of Earlier Middle Korean (hereafter EMK) in the following manner: Mongolian loan words were introduced into Korean in the 13th century, but these were not recorded in Hangul until in the 15th century, hence, we can infer the vowels of the 13th century corresponding to those of the 15th century through the comparison of Middle Mongolian with Mongolian loan words written in Hangul.

(63)

	a	b	c	d	e	f	g
Mongolian	a	o	u	e	ö	ü	i
loan words	a	o	o	ə	wə	u	i

For example,

	Middle Mongolian		loan words
(a)	aǰirγa 'foal'	-	acilkai
	qara 'black horse'	-	kara
(b)	šongqor 'blue'	-	sjoñkol
	bora 'autumn hawk'	-	pora
(c)	qula 'brown horse'	-	kora
	sa'uri 'couch'	-	saori
(d)	ǰe'erde 'red horse'	-	cjəlta
	terlig 'clothes of a military officer'	-	tjərlik
(e)	kögsin 'white hawk'	-	kwəcin
(f)	küreng 'nut-brown horse'	-	kurəñ
(g)	način 'black duck hawk'	-	nacin

As seen in (a) and (g), Mongolian /a/ was transcribed as LMK /a/, and Mongolian /i/ as LMK /i/, hence, we can assume that the phonological values in the EMK period of LMK /a/ and /i/ were the same as those in the LMK period. As seen in (b) and (c), both Mongolian vowels /o/ and /u/ were transcribed as LMK /o/, and, we can assume that there was only one nonlow back round vowel in the 13th century. As seen in (f), Mongolian /ü/ was transcribed as LMK /u/, and Mongolian /e/ was transcribed as LMK /ə/ as seen in (d), hence, it is assumed that LMK /u/ and /ə/ were reflexes of EMK /ü/ and /e/. The phonological values in EMK of LMK /ʌ/ and

/ɨ/ can be inferred by examining Mongolian loan words and Sino-Korean. Mongolian onu 'wrap' was transcribed as /onoj/ or as /onʌj/ in the LMK period (K.-M. Lee 1987). As well, /o/ and /a/ of Middle Chinese were transcribed as /ʌ/ as seen in (64). Hence, it is assumed that LMK /ʌ/ is a reflex of EMK /ɔ/.

(64)

Middle Chinese		Sino-Korean
xo 'water'	-	hʌ
ko 'inferior kind of jade'	-	kʌ
paj 'spread'	-	pʌi
kaj 'repair'	-	kʌi

('xo' and 'ko' are quoted from K.-M. Lee 1987 and 'paj' and 'kaj' from E.G. Pulleyblank 1984)

Middle Chinese /ə/ was transcribed as /ɨ/ as shown in (65), and it is assumed that LMK /ɨ/ was a reflex of EMK /ə/.

(65)

Middle Chinese			Sino-Korean	
/kən/	'root'	-	/kɨn/	(K.-M. Lee 1988)
/tək/	'gain'	-	/tɨk/	(Ledyard 1966)

Therefore, the vowel system of EMK can be reconstructed as follows (K.-M. Lee 1988; 99):

(66)

i(i)	ü(u)	u(o)
e(ə)	ə(ɨ)	ɔ(ʌ)
	a(a)	

(Parentheses indicate the phonological reflexes in LMK)

The OK vowel system has generally been deduced by the comparison of Ancient Chinese and Sino-Korean. /u/ and /ɨu/ of Ancient Chinese were transcribed as LMK /o/ and /u/, and /ä/ and /ïə/ of Ancient Chinese were transcribed as LMK /ə/ and /ɨ/ .

(67)

Ancient Chinese			Sino-Korean	
kuŋ	'public'	-	kong	(Ledyard 1966)
kɨuŋ	'bow'	-	kung	(Ledyard 1966)
iäp	'leaf'	-	iəp [40]	
ïəm	'deep'	-	ɨm	(Park 1982)

OK /ɔ/ was transcribed as LMK /ʌ/ as shown in (68).[41]

(68)

OK			LMK	
patɔr	'sea'	-	parʌr	(K.-M. Lee 1987)
tɔr	'moon'	-	tʌr	(Ledyard 1966)

Ancient Chinese /a/ was transcribed as LMK /a/. For example, Sino-Korean /s<u>a</u>n/ 'mountain' and /h<u>a</u>n/ 'cold' had the same rime vowel as Ancient Chinese /-<u>a</u>n/ and /-<u>a</u>n/ (Park 1982). The phonological value of LMK /i/ in the OK period was the same as that in the LMK period (K.-M. Lee 1987, 1988, Park 1982) and /i/ was a neutral vowel (K.-M. Lee 1987, 1988).[42] Therefore, the vowel system of OK can be reconstructed as (69) (K.-M. Lee 1988; 72).

(69) i(i) ü(u) u(o)

ɪə(ɨ) ɔ(ʌ)

ä(ə) a(a)

(Parentheses indicate the phonological reflexes in LMK)

This vowel system allows for a characterization of OK vowel harmony as palatal harmony. The division of vowels into the harmonizing sets is given as in (70).

(70)

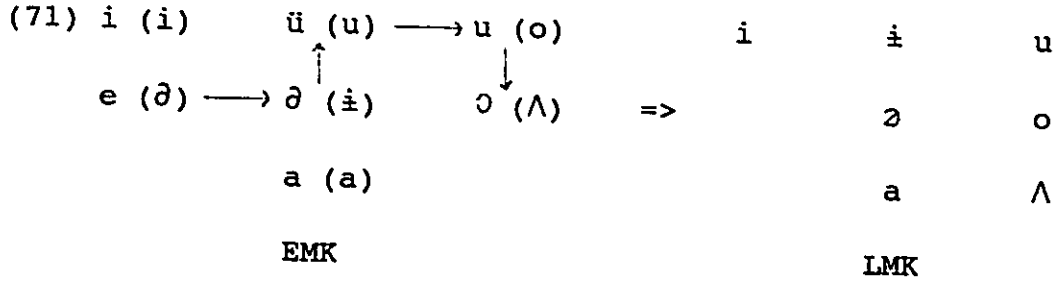
+front	ü(u)	ɪə(ɨ)	ä(ə)
-front	u(o)	ɔ(ʌ)	a(a)

There was a vowel shift following the OK period (K.-M. Lee 1987). By this vowel shift, Korean lost the palatal harmony characteristic of the Altaic language family (K.-M. Lee 1987). The change of the vowel system from OK to EMK was caused by a vowel shift. A vowel shift occurred between EMK and LMK also, hence, the vowel system of EMK changed to that of LMK (K.-M. Lee 1987; 117):

> " e(ə) started a push-chain reaction by retracting to the mid-central area occupied by ə(ɨ), which was then raised to ü(u), which was then pushed back to u(o), which then went to push ɔ(ʌ) down, which was later lost."

This series of changes is illustrated in (71).

(71)



3.4. Diachronic change of vowel harmony

In previous sections, PDK vowel harmony and LMK vowel harmony were described as ATR harmony while OK vowel harmony was described as palatal harmony. Why does the same language have different harmony types diachronically? This is because the tendency towards vowel harmony remained regardless of changes in the vowel system. That is, after OK, there was a change in the vowel system, but, the tendency towards vowel harmony remained, and therefore, there was a shift in the phonetic basis of vowel harmony from tongue body movement in OK to tongue root movement in LMK. This diachronic change of harmony type from palatal harmony to ATR harmony can be accounted for by markedness.[43] According to Ultan (1973), labial harmony is most marked, then palatal harmony, followed by the least marked ATR harmony.[44] That is, ATR harmony is most common, then palatal harmony, followed by the least common labial harmony. Historical changes are from a marked to an unmarked system (Aoki 1966, Ultan 1973). Hence, the hypothesis that OK, with more marked palatal harmony, changed to LMK, with less marked ATR harmony, is justifiable. On the other hand, the change from LMK vowel harmony to PDK vowel harmony, which is morphologically very restricted, can be accounted for by Dressler's (1985) semiotic model. Unlike LMK vowel harmony which applied to almost all words, PDK vowel harmony applies only to sound symbolic words and A-initial

suffixes following verb or adjective stems. Dressler (1982) showed an example of the diachronic change of vowel harmony through the history of Turkish vowel harmony. In Turkish vowel harmony, whereas stem harmony has degeneralized and decreased its productivity, suffix harmony has been generalized and has increased its productivity. However in Korean, since the merger of /ʌ/ to /ɨ/ in non-initial syllables in LMK caused first the unification of allomorphs of suffixes, suffix vowel harmony also has degeneralized unlike in Turkish. In PDK, suffix vowel harmony occurs only in A-initial suffixes following a verb or an adjective stem. The suffix initial vowel /a/ appears only following the final vowel /a/ or /o/ of a verb or an adjective stem, otherwise, /ə/ appears. That is, unlike LMK suffix harmony, PDK suffix harmony needs morphological information. As well, unlike LMK suffix harmony, PDK suffix harmony does not apply morpheme-internally, but only across morpheme boundaries: e.g., compare (50b) with (43b). Hence, in the sense of Dressler (1985), we can say that PDK suffix harmony is a morphonological rule whereas LMK suffix harmony is a phonological rule. On the other hand, whereas in LMK the difference of sound meaning was the secondary effect of vowel harmony resulting from the Yin-Yang principle, vowel alternations in sound symbolic words in PDK consist of feature-sized morphemes. Whereas in LMK [-ATR] is simply a morphemic feature which plays a role as a kind of Morpheme Structure Constraint as Mohanan (1989) has pointed out,

[-ATR] in PDK vowel harmony in sound symbolic words is not only phonologically a morphemic feature but also morphologically a morpheme itself. Therefore, we can say that Korean vowel harmony has changed from a phonological phenomenon to a morphological phenomenon, according to Dressler's (1985) hypothesis that diachronically, phonological rules unidirectionally develop to morphonological rules, and later to morphological rules.

Chapter Four. Conclusion

Nez Perce vowel harmony and (present-day) Korean vowel harmony were considered exceptions which could not belong to any harmony type because Nez Perce and Korean were not considered to be describable in terms of distinctive features (Tohsaku 1983). However, in this study, I have shown that vowel harmony in Nez Perce and Korean can be described as ATR harmony.

The assumption that Nez Perce has ATR harmony was based on Hall and Hall's (1980) study. In the case of Korean, the assumption that present-day Korean has ATR harmony was based on Hwang's (1986) formant analysis. The analysis proposed here was based on radical underspecification (Archangeli 1984, 1988, D. Pulleyblank 1988, etc.) and hierarchical feature structure (Archangeli and D. Pulleyblank 1987, 1989, Clements 1985, McCarthy 1988, Sagey 1986, Vago 1988, etc.). Couched within the radical underspecification theory framework, vowel harmony was treated as a feature spreading rule: Spread [-ATR]. The adoption of a hierarchical feature structure model allowed the characteristics of the neutral vowel in the harmonizing process to be accounted for by referring to the Locality Condition: the neutral vowel has no Radical node to be the target of the vowel harmony rule, hence, is skipped due to the Locality Condition.

In the case of Korean, through examining previous stages, I have shown that there was a diachronic change of the type and nature of vowel harmony. There was a change of vowel harmony type from palatal harmony in Old Korean to ATR harmony in Later Middle Korean. The direction of this diachronic change was accounted for by markedness (Ultan 1973): because historical changes are from a marked to an unmarked system, more marked palatal harmony changed to less marked ATR harmony diachronically. On the other hand, there was a change in the nature of vowel harmony from a phonological phenomenon in Later Middle Korean to a morphological phenomenon in present-day Korean. This change was accounted for within Dressler's (1985) semiotic model.

NOTES

1. C.-W. Kim (1978) and Ultan (1973) also noticed a diachronic change of the vowel harmony type in Korean.

2. [R] = [round], [Ant] = [anterior], [Dis] = [distributed], [Lat] = [lateral], [F] = [front], [B] = [back], [L] = [low], [H] = [high], [A] = [ATR].

3. Even though the surface form of Nez Perce vowels is [i æ a o u] (Aoki 1968), because this form which contains a high front vowel and a low front vowel but no mid front vowel is asymmetric, previous studies set up an abstract underlying vowel system (see page 10). However, in this study, /i æ a o u/ is regarded as the underlying vowel system without any abstract version.

4. Examples are cited from Aoki, but I replace /e/ with /æ/. This is because in this study /æ/ is considered an underlying vowel while Aoki considered /e/ as an underlying vowel.

5. /?/ indicates the glottal stop /ʔ/.

6. In Aoki (1966), this was written as /ne?méx̣/. According to Aoki, the q/x phoneme is /q/ before a vowel, /x̣/ elsewhere. Because in other examples /ne?méq/ was presented instead of /ne?méx̣/, I assume the correct form has /q/.

7. This form is /cik̓il/ after a word juncture or a consonant, /ck̓il/ elsewhere (Aoki 1966; 763).

8. According to Hall and Hall (1980), there seem to be no true cases of dominant grammatical prefixes which cause vowel harmony. Rather, one can consider a dominant prefix as part of a compound stem. For example, 'wat+ wǽ·yik' /watwá·yik/ is not the combination of a dominant prefix and a stem but a compound verb stem.

9. Vago (1980) used the terms 'root control harmony' and 'dominant harmony'. Halle and Vergnaud (1982) used the terms 'directional harmony' and 'dominant harmony'.

10. Vowel harmony is motivated phonetically. However, I use the terms 'morphologically' and 'phonologically' only in order to distinguish a harmony system in which a trigger vowel is determined according to the position within a domain as well as the possession of a harmonizing feature from that in which a trigger vowel is determined only by the possession

of a harmonizing feature.

11. For the underlying vowels which are differentiated only by tongue root position, Hall and Hall used numbers but not specific phonetic symbols because according to them, any further specification would be misleading.

12. Nez Perce is a marked language which has /i æ a o u/ not /i e a o u/ as underlying vowels. It can be accounted for by the fact that the universal redundancy rule: [+low] -> [-ATR], can not apply in Nez Perce because of the existence of /æ/. (refer to Archangeli 1988).

13. I extracted this concept of morpheme-sized feature from Archangeli and D. Pulleyblank (1989). Mohanan (1989) said that this morpheme-sized feature plays a role as a kind of Morpheme Structure Constraint (MSC). Kiparsky (1983) included MSCs in the lexical phonological rule (PR) as PR applying on the first cycle (underlying representations) (D. Pulleyblank 1986b). However I will sometimes use the term 'MSCs' for the clear explanation of my analysis.

14. A= /æ/ or /a/, O = /u/ or /o/, without an underlying specification for [ATR].

15. For simplicity, I will leave out the feature structure of consonants, and in the case of vowels, the terminal nodes except the feature [ATR].

16. Morpheme boundaries disappear by Bracket Erasure: remove morpheme boundaries as they become inaccessible to subsequent phonological rules (McCarthy 1986).

17. According to Yip (1988), the OCP plays a role as a MSC, and as a derivational constraint.

18. Following Mester (1986), we say in this study that fusion takes place as an effect of the OCP while McCarthy (1986) said that fusion takes place as a result of Plane Conflation but not of the OCP.

19. For simplicity, I omit the hierarchical feature structure.

20. The idea of the usage of planar segregation of morphemes as a manner to avoid a violation of the OCP was suggested by D. Pulleyblank in personal communication.

21. For planar segregation, see Archangeli (1985), McCarthy (1981, 1986, 1989), Mester (1986), Steriade (1987).

22. Hence, for simplicity, brackets are used in other cases.

23. For simplicity, hierarchical feature structure is omitted.

24. Korean is divided chronologically as follows according to K.-M. Lee (1988).

> Old Korean: before the 10th century
> Earlier Middle Korean: from the 10th century to the earlier 14th century.
> Later Middle Korean: from the late 14th century to the 16th century. Generally, one says the 15th century.
> Modern Korean: from the 17th century to the 19th century.
> Present-day Korean: after the 19th century.

25. After the loss of /ʌ/, there were five [-front] vowels and only one [+front] vowel, and therefore, the monophthongization of [-front] vowels + /y/ (< /i/) took place for the symmetry of the vowel system: /əy/ -> /e/, /ay/ -> /ɛ/, /oy/ -> /ö/, /uy/ -> /ü/ (Huh 1985, B.-G. Lee 1985).

26. 'A' indicates /ə/ or /a/.

27. In the sense of E.G. Pulleyblank (1989), the harmonizing feature of Korean vowel harmony is defined as [low]. While in my study [low] is a tongue body feature following Chomsky and Halle's definition, in Pulleyblank's study, [low] is a tongue root feature: [+low] is equivalent to [+Constricted Pharynx], [-low] equivalent to [+ATR]. The [low] expresses relative height between contrasting segments but not vowel height in the IPA vowel chart. The relative lowering/raising of the tongue body between contrasting segments is a secondary gesture which results from the tongue root movement (Hall and Hall 1980).

28. McCarthy (1983) used the term 'ideophone'; however, for the sake of consistency, I replace 'ideophone' by 'sound symbolic word'.

29. Because Hwang (1986) considered /ü/ a diphthong while he considered /ö/ a monophthong, he dealt with only /ö/ but not /ü/. For the purpose of this study, I omit the value of /ö/ in the formant chart and deduce the contrast of [ATR] value between /ü/ and /ö/ from that between /u/ and /o/.

30. This morphological operation in sound symbolic words is cited from Sohn (1986). However, she considered [+low] as the harmonizing feature, hence, the phonetic implementation rule: [+low] -> [-low] / [+round, _____] was required like that of McCarthy, while in this study in which [-ATR] is considered as the harmonizing feature, no phonetic implementation rule is required.

31. Ë = /i/ or /ɛ/, E = /e/ or /ɛ/, Ö = /ü/ or /ö/, Ä = /ɨ/ or /a/, A= /ə/ or /a/, O = /u/ or /o/, without an underlying specification for [ATR].

32. Suffix distribution after verb/adjective stem in present-day Korean (Ahn 1985; 22 ; 26)

Group	1	2	3	4	5	6	7*
Usage	Transitive	Voice	Honorific	Tense	Style	Aspect	Ending
Type	Derivational		Inflectional				
Item	-t'ɨli -thɨli -chi	-i -hi -li -ki -u -hu -chu -(i)khi	-(i)si	-As' -kes'	-(i)p -sip	-ni -ti -ci -si -(i)ni -nɨn -(n)ɨn -Ato -(i)l -(i)m -ki	-ta -ni -ka -k'a -o -A -i -Ala -Ayo -ca -nya

Note : (ɨ) does not occur after a vowel.
(n) occurs after a vowel.

*

Declarative	-ta, -ne, -Ayo, -ma
Interrogative	-k'a, -ka, -o, -A, -ni, -nɨnya, -Ayo
Propositive	-ca, -o, -A, -Ayo
Imperative	-Ala, -ke, -so, -Ayo, -sosə

33. Ledyard did not give specific phonetic descriptions to LMK vowels corresponding to PDK vowels. Only through showing the position in the vowel chart, he described LMK vowels corresponding to PDK vowels. For example, the LMK vowel corresponding to PDK /u/ is a high central vowel.

34. Whereas we assume that vowel shift took place before the LMK period, Ledyard assumed that vowel shift took place around the LMK period.

35. If B-G Lee had used the feature [low] in the sense of E.G. Pulleyblank (see note 27) as the harmonizing feature, not in the sense of Chomsky and Halle (1968), his analysis of LMK vowel harmony might be similar to our analysis: LMK vowel harmony is characterized by tongue root movement. However, I can not find any evidence that he did so.

36. /i/ implies the man, /ɨ/ implies the earth and /ʌ/ implies the heaven.

37. That many redundancy rules are required appears to explain the fact that the LMK vowel system is a marked one: there are three central vowels and three back vowels but only one front vowel.

38. /Λ/ = /ɨ/ or /ʌ/, A = /ə/ or /a/, O = /u/ or /o/, without an underlying specification for [ATR].

39. It seems to me that it was based on the hypothesis that there was no other phonological change in loan words.

40. 'iäp' is cited from Karlgren (1922) (from E.G. Pulleyblank 1984).

41. Examples of OK were written in Idu, which was a writing system before Hangul.

42. Park (1982) said that /i/ was a harmonic vowel which had a counterpart /ï/, unlike K.-M. Lee (1987, 1988). However, since this study is principally based on K.-M. Lee, I follow K.-M. Lee's hypothesis.

43. Cf. Svantesson (1985) showed that in Mongolian there was a change of the vowel harmony type from palatal harmony in Classical Mongolian to ATR harmony in Modern East Mongolian, and described this vowel harmony shift as a rule simplification based on Wood's feature system.

44. Ultan (1973) used the term 'horizontal harmony' because he assumed that ATR harmony is a subcategory of horizontal harmony following Jakobson (1942). But because all varieties of horizontal harmony that he considered (e.g., open-close, lax-tense, retracted-advanced tongue root, creaky-hollow, etc.) are due to tongue root movement (Hall and Hall 1980, Vago 1980), I replace the term 'horizontal harmony' by the term 'ATR harmony'.

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