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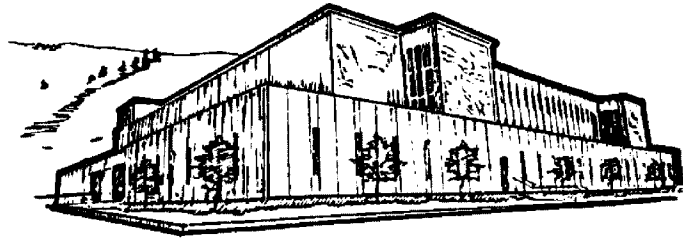
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AN ANALYSIS OF VOWEL HARMONY  
IN LATVIAN

by

Guna Kupcs Chaberek

B.A., University of Connecticut, Storrs, 1982

Presented in partial fulfillment of the requirements

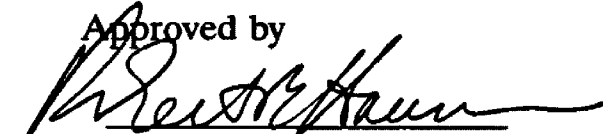
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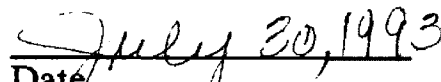
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Chaberek, Guna Kupcs, M.A., July 1993 English/Linguistics

An Analysis of Vowel Harmony in Latvian

Committee Chair: Robert B. Hausmann *RA*

This thesis explores the phenomenon of vowel harmony in Latvian--how it operates, and what features are involved. Three possible analyses are examined: 1) the two alternative vowels ([e] and [æ]) are underlyingly separate phonemes; 2) /æ/ underlies [e]; and 3) /e/ underlines [æ]. The first analysis has been rejected because there may not be enough justification for the claim of separate phonemes, while the second analysis is based on a few very rare underived instances of underlying /æ/. The preferred analysis of this thesis, the third alternative, uses diacritics assigned to suffixal morphemes, along with a spreading rule and an autosegmental framework. Diacritics have been set up because the two sets of harmonic vowels in Latvian (/i, e/ and /a, o, u, æ/) cannot be assigned to cohesive natural classes.

## TABLE OF CONTENTS

Abstract	ii
Table of Contents	iii
0. Introduction	1
<b>Chapter 1 The General Phenomenon of Vowel Harmony</b>	<b>5</b>
1.1. Assimilation	5
1.1.1. Assimilation of Adjacent Consonants	5
1.1.2. Assimilation of Non-Adjacent Consonants	6
1.1.3. Assimilation of Distant Vowels	7
1.1.3.1. Vowel Harmony	7
1.1.3.2. Umlaut	8
1.1.3.3. Types of Vowel Harmony Rules	10
<b>Chapter 2 Historical Survey</b>	<b>12</b>
2.1. Classificatory Criteria	12
2.2. Representations	16
2.2.1. Linear Representations	17
2.2.1.1. Phonemic Representations	19
2.2.1.1.1. Lyon's Analysis of Turkish	20
2.2.1.1.2. Boas' Analyses of American Indian Languages	21
2.2.1.2. Abstract Representations	21
2.2.1.2.1. Prosodic Representations	22
2.2.1.2.1.1. Sprigg's Analysis of Lhasa Tibetan	23
2.2.1.2.1.2. Aoki's Analysis of Nez Perce	25
2.2.1.2.2. Diacritic Representations	27
2.2.1.2.2.1. Lightner's Analysis of Classical Mongolian	27
2.2.1.2.2.2. Ringen's Analysis of Hungarian	29
2.2.1.2.2.3. Rule-based Representations--Vago's and Ringen's Analyses of Hungarian	30
2.2.2. Non-linear Representations	34
2.2.2.1. Autosegmental Representations	35
2.2.2.1.1. Clements' Analysis of Akan	36
2.2.2.1.2. Lieber's Analysis of Khalka Mongolian	39
2.2.2.1.3. Archangeli and Pulleyblank's Analysis of Yoruba	42
2.2.2.1.4. Halle and Vergnaud's Analysis of Kalenjin	43
2.2.2.2. Metrical Representations	45
2.2.2.2.1. Zubizarreta's Analysis of Andalusian Spanish	46
2.2.2.2.2. Haman's Contribution of Umlaut (Roermond Dutch)	49

2.2.2.2.3. A Synthesis of Autosegmental and Metrical Representations	50
2.2.2.2.4. The Merits of Two Separate Methods of Analysis	51
2.2.3. The Preservation of Vowel Harmony	51
<b>Chapter 3 Latvian Vowel Harmony</b>	<b>53</b>
3.1. Phonological Facts	53
3.1.1. Vowels	53
3.1.2. Consonants	54
3.1.3. Syllable Types	55
3.1.4. Syllable Structure Rules	58
3.1.5. Harmony	61
3.1.5.1. Harmony Facts	61
3.1.5.1.1. Distribution	61
3.1.5.1.2. Examples	62
3.1.5.1.3. Domain	64
3.2. Previous Literature	65
3.2.1. Strautina's phonetics	65
3.2.2. Halle and Zeps--Latvian Morphophonemics	68
3.2.3. Zeps' study of Latvian folk-songs	71
3.3. Possible Analyses	73
3.3.1. The Problem	73
3.3.2. Harmonic Distinction	73
3.3.3. Analytic Approaches	74
3.3.3.1. Two Phonemes	75
3.3.3.2. Underlying Phoneme	76
3.3.3.2.1. Underlying /æ/	76
3.3.3.2.2. Underlying /e/	83
3.3.3.3. Evaluation of the Three Analytic Approaches	89
<b>Chapter 4 Conclusion</b>	<b>93</b>
<b>Bibliography</b>	<b>97</b>



## **Introduction**

In this thesis, I will examine the systematic alternation of two front vowels, [æ] and [e], in the Central Dialect of Latvian. The Central, or Mid Dialect, as it is sometimes called, has become accepted as the standard form of the language, and is the basis for the literary language.

Latvian is classified as belonging to the Balto-Slavic branch of the Indo-European family of languages. Only two Baltic languages remain extant: Latvian and Lithuanian. Both, but especially Lithuanian, retain many ancient characteristics of proto-Indo-European (Stevenson: 1983). A third Baltic language, now extinct, is Old Prussian.

During the course of my linguistic studies, I noticed that, in many languages, the way a particular alternating vowel was treated within the context of a word had been analyzed at some length. A professor encouraged me, as a native Latvian speaker, to examine Latvian vowels, and to attempt to describe the ways in which they pattern. I became aware of an anomaly (of the vowels, only [æ] and [e] alternate with each other) which has apparently gone unanalyzed. To the best of my ability, I sought literature by expert linguists who had made analyses of Latvian, and found this question has not adequately been addressed. Despite my limitations as to education and ability, I have therefore attempted to answer this question as well as others which have arisen since my first introduction to this problem.

Traditional Latvian grammars deal with the anomaly to which I refer as vowel harmony, stating that this system contains a great many exceptions (Berzina-Baltina: 1946). However, there is a possibility that this phenomenon (in Latvian) may actually not be vowel harmony. Steriade (1979:43) states that the 'definitory feature of such rules is that they operate on strings of vowels of indefinite length.' In Latvian, the alternation of [æ] and [e] seem to pattern with certain vowels in the next syllable only.

This phenomenon may also be termed 'umlaut.' I shall examine both phenomena, with particular emphasis on the way linguists have treated vowel harmony during the 20th century. My specific goal will be to try to understand how this process may operate in Latvian, my native language.

I shall demonstrate that the vowel alternations in Latvian are assimilatory in nature, and may be called vowel harmony. A distinct group of exceptions, where [æ] and [e] seem to have no phonological motivation, and thus appear to be morphological umlaut, can also be analyzed as vowel harmony. With the aid of synchronic as well as diachronic rules, the environments conditioning these vowel changes are recoverable.

The data for this paper are taken from my knowledge as a native speaker with the aid of dictionaries which differentiate [e] and [æ]. I have also randomly chosen various fictional and non-fictional works in Latvian, making lists of individual words which contain either [æ] or [e].

This thesis is organized in the following manner: Chapter 1 consists of a

discussion of the general phenomenon of vowel harmony: section 1.1. discusses assimilation--section 1.1.1., assimilation of adjacent consonants; section 1.1.2., assimilation of non-adjacent consonants; section 1.1.3., assimilation of distant vowels, section 1.1.3.1., vowel harmony; section 1.1.3.2., umlaut; and section 1.1.3.3., types of vowel harmony rules.

Chapter 2 comprises a historical survey of vowel harmony analyses--section 2.1 discusses classificatory criteria; section 2.2, representations: section 2.2.1. introduces linear representations--section 2.2.1.1., phonemic representations; section 2.2.1.1.1., Lyons' analysis of Turkish; and section 2.2.1.1.2., some comments on Boas' analyses of American Indian languages. Section 2.2.1.2. discusses abstract representations: section 2.2.1.2.1., prosodic representations--section 2.2.1.2.1.1., Sprigg's analysis of Lhasa Tibetan; and section 2.2.1.2.1.2., Aoki's analysis of Nez Perce. Section 2.2.1.2.2. discusses diacritic representations--section 2.2.1.2.2.1., Lightner's analysis of Classical Mongolian; and section 2.2.1.2.2.2., Ringen's analysis of Hungarian; section 2.2.1.2.3 discusses rule-based representations, citing Vago's and Ringen's analyses of Hungarian. Section 2.2.2. discusses non-linear representations--section 2.2.2.1., autosegmental representations; section 2.2.2.1.1., Clements' analysis of Akan; section 2.2.2.1.2., Lieber's analysis of Khalka Mongolian; section 2.2.2.1.3., Archangeli and Pulleyblank's analysis of Yoruba; and section 2.2.2.1.4., Halle and Vergnaud's analysis of Kalenjin. Section 2.2.2.2. discusses metrical representations; section 2.2.2.2.1., Zubizarreta's analysis of Andalusian Spanish; section 2.2.2.2.2., Hamans' analysis of umlaut in Roermond

Dutch; section 2.2.2.2.3., a suggestion for the synthesis of autosegmental and metrical models; and section 2.2.2.2.4. discusses the merits of two separate methods of analysis. Section 2.2.3. contains a brief discussion of the preservation of vowel harmony..

Chapter 3 deals with Latvian vowel harmony in particular. Section 3.1. lays out some phonological facts of the language--section 3.1.1. discusses vowels; section 3.1.2., consonants; section 3.1.3., syllable types; and section 3.1.4., syllable structure rules. Section 3.1.5. discusses the harmony process in Latvian--section 3.1.5.1., the facts: section 3.1.5.1.1., the distribution; section 3.1.5.1.2., examples of alternations; and section 3.1.5.1.3., the domain. Section 3.2. discusses the existing literature--section 3.2.1., Strautina's phonetic contribution (1984); section 3.2.2., Halle and Zeps' survey of Latvian morphophonemics (1966); and section 3.2.3., Zeps' study of Latvian folk-songs (1963). Section 3.3. contains possible analyses--section 3.3.1. states the problem, and section 3.3.2., the harmonic distinction. Section 3.3.3. discusses several different approaches of analysis--section 3.3.3.1., one positing two separate phonemes; section 3.3.3.2., one positing setting up an underlying phoneme--section. 3.3.3.2.1., /æ/ as underlying; and section 3.3.3.2.2., /e/ as underlying. Section 3.3.3.3. contains an evaluation of these three approaches.

Chapter 4 is the conclusion, what I have demonstrated, what remains to be demonstrated, and some predictions as to what vowel harmony in Latvian may look like in the future.

## Chapter 1

### The General Phenomenon of Vowel Harmony

#### 1.1. Assimilation

All languages studied by linguists incorporate some form of phonetic agreement between certain segments (either vowels or consonants) of words. The phenomenon of assimilation takes several forms: it may be total, where one segment becomes identical with another, taking on all the other's features, or it may be partial, where one segment takes on one or more, but not all, of the other's features.

##### 1.1.1. Assimilation of adjacent consonants

For instance, the following examples exemplify total assimilation of (adjacent) consonants. In the Akan example, we see that underlyingly, a labial stop [b] follows the labial nasal [m]. All the features of [m] are spread onto this [b] which, as a result, becomes [m]. The Proto-Germanic example shows a similar phenomenon--the alveolar nasal [n] of the original form assimilates totally to the preceding alveolar liquid [l], thereby itself becoming an [l]:

(1) Akan /ɔ m bá/ [ɔmmá] 'he doesn't come'

PGmc \*wulnō > \*wullō > OE wull 'wool'

These examples show what linguists call "progressive assimilation"--that is, assimilation from left to right of the word.

In the following Latin and Sanskrit examples, we see a partial, regressive (or anticipatory) assimilation of adjacent consonants. That is, assimilation progresses

from the right to the left of a word:

- (2) Lat. in- + primere : imprimere 'impress'  
 Skt. yu-ṅ-g-+tha > yuṅktha 'yoke ye'

In the Latin example, the [n] (an alveolar nasal) partially assimilates (in place of articulation only) to the immediately following [p] (a labial stop), becoming [m] (a labial nasal); while in the Sanskrit example, the [g] (a voiced velar stop) partially assimilates (in voicing) to the following [t] (an unvoiced alveolar stop), becoming [k] (an unvoiced velar stop).

In this next example, we see a double, or two-step assimilation:

- (3) Skt ātman > ātpan > āppan 'self'

First, the [t] (alveolar stop) spreads its manner of articulation to the neighboring [m] (labial nasal), forming a [p] (labial stop) in a progressive assimilation. Next, the [t] itself assimilates totally to the newly formed [p] in a regressive assimilation.

### 1.1.2 Assimilation of non-adjacent consonants

While we might expect adjacent consonants or segments to influence each other, consonants separated by other segments may also assimilate. In adult speech, this happens rarely<sup>1</sup>. Below are some examples found in Hock (1991):

---

<sup>1</sup>Children, according to Smith (1973), in producing English, very often substitute some segments for others, in effect simplifying the articulation of words by making certain segments more alike. Smith gives the following examples:

- a) little > didi:  
 b) broken > bugu:

In a), the sequence is presumably [liTəl], with a medial flap sounding much like a [d]. This flap is changed to a [d], then the initial [l] is totally assimilated to it. In b), the [k] assimilates in voicing to the initial [b], becoming [g].

- (4) Lat. \*līrium > līium 'lily'  
 pre-Lat. penk<sup>w</sup>e > \*k<sup>w</sup>enk<sup>w</sup>e > Lat. quīnque 'five'

In the first example, the medial [r] assimilates totally to the initial [l], while in the second example, the initial [p] assimilates totally to the medial [k].

### 1.1.3 Assimilation of distant vowels

More commonly, distant vowels exert an influence on each other.

#### 1.1.3.1 Vowel Harmony

In these cases, vowels in successive syllables of a word may agree in some systematic, phonetic manner--often in backness (also called front harmony by Steriade (1979) or in advanced tongue root. Some examples of this process follow:

#### (5) Vowel Harmony

- |            |               |   |            |                    |
|------------|---------------|---|------------|--------------------|
| a) Finnish | /asema + lta/ | > | [asemalta] | 'from the station' |
|            | /järve + lta/ | > | [järveltä] | 'from the lake'    |
| b) Hung.   | /ház + nak/   | > | [háznak]   | 'to the house'     |
|            | /föld + nak/  | > | [földnek]  | 'to the earth'     |

(The Finnish examples are from Malmberg, 1963; the Hungarian examples from Ringen, 1978.) In all of them, the influencing vowel occurs to the left of the alternating vowel. The examples are arranged to make the alternations clear. In (5a), then, we see an alternation between [a] and [ä]. In the first Finnish example, the first morpheme contains only back vowels. Thus, the [a] of the second morpheme remains back. The second Finnish example shows that when [ä] occurs in the first morpheme, the [a] in the second morpheme becomes fronted ([ä]). In

the next set of examples (Hungarian), we see an alternation between back and front vowels. Again, the initial vowel ‘dominates’ the following vowel--that is, if the initial vowel is back, the next vowel is also back, while if the initial vowel is front, then so is the next vowel.

Rennison (1987) aptly describes this vowel ‘agreement’ as a ‘pull’ on the tongue body exerted by one vowel, thereby making a neighboring vowel more similar to it.

### 1.1.3.2 Umlaut

The differences between what is called ‘umlaut’ and what is called ‘vowel harmony’ are not always clear. Umlaut, also, can be described as a distant assimilation of vowels. Penzl (1949), in analyzing what he called umlaut in Old High German, gave the following forms:

(6)	OHG	helfan	hilfu	hilfis	‘help’
		berg	gebirgi		‘mountain’

If we look at the original forms, we see that the mid-vowel [e] became the high vowel [i] before a following high vowel ([u] or [i]).

If we describe vowel harmony as the assimilation of one vowel to a non-adjacent vowel, then umlaut is vowel harmony as long as the conditioning environment is present. I shall therefore call the data in (6) vowel harmony, as the conditioning environments are present, allowing the vowel changes to be clearly seen. However, there are other cases termed ‘umlaut’ where the vowel does not, on the surface, appear phonetically motivated, as the conditioning environments have been lost. These, to me, are no longer cases of phonological vowel harmony, but of morphological umlaut. The only way to learn such forms is



through memorization.<sup>2</sup> Some examples of ‘true’ umlaut, then, may be:

(7)	PGmc		OE	
	a) *fulljan [fullian]		fyllan [füllan]	‘fill’
	b) *gastiz		giest [yest]	‘guest’
	pre-ON		ON	
	c) *sakū		søk [søk]	‘thing’ <sup>3</sup>

In (7), then, we see that by the time of Old English and Old Norse, the vowel alternation had ceased to be vowel harmony, becoming morphological with the disappearance of the suffixal high, front vowel.

From the data in (6) and (7), we can see that the conditioning or triggering element is in the final syllable. This is so in all the cases of umlaut which I have encountered.

Another way of describing the two phenomena is that in vowel harmony, the alternating vowels may be considered allophones of one another, with distributional constraints. In umlaut, however, new sound units result (Penzl, 1949), which contrast with each other in all positions. One example of this is from Old High German, cited by Marchand (1956):

---

<sup>2</sup> An interesting question which arises is why the umlauted sound doesn’t revert back to the original once the conditioning environment is lost. Penzl (1949) argues that it is because the new sound has, over time, itself become a phoneme.

<sup>3</sup> The above examples (in 7a,b,c) represent fronting, raising and backing umlaut, respectively. Hock states that these, along with lowering, are the four usual processes of umlaut.

(8) [möh̥tə] from \*mohti  
3rd sg. pret. subj. of [mugan] ‘to be able’

[mohtə] from \*mohta  
3rd sg. pret. indicative of [mugan] ‘to be able’

The conditioning [i] and [a] (respectively) have merged into [ə]. The two allophones [o] and [ö] then split into two separate contrasting phonemes, occurring in the identical environment.

Hock states that umlaut is fairly unstable, and given enough time, alternations between umlauted and non-umlauted vowels disappear.<sup>4</sup> He also states that alternations within roots are more often eliminated than introduced. An example of a ‘live’ alternation resulting from umlaut in English may be ‘louse, lice’. Increasingly, the plural form ‘louses’ is heard. If this form becomes widespread and accepted, then the previous root alternation will be lost. I mention this characteristic of umlaut, because it may have some bearing on a possible future status of ‘umlaut’ in Latvian (see Conclusion, Chapter 4).

### 1.1.3.3. Types of Vowel Harmony Rules

Most linear analyses have considered vowel harmony as a process of assimilation. However, Zimmer (1967) suggests that assimilation rules are language-specific, and so cannot be the basic (universal) type of vowel harmony rule. A few diacritic, or root-marker, analyses have been attempted (see Lightner, section 2.2.1.2.2.1. and Ringen, section 2.2.1.2.2.2.).

---

<sup>4</sup>Hock does not say, however, that the umlauted vowel changes back to the original vowel.

These last two types of harmony (vowel harmony and umlaut) are the types which I shall examine in this thesis.

## **Chapter 2**

### **Historical Survey of Vowel Harmony Analyses**

Over time, systems of vowel harmony and umlaut have been described in various ways, with varying degrees of adequacy. In this chapter, I will attempt to review several of the main types of analyses (linear and non-linear) after a prefatory discussion of the different types of vowel harmony.

#### **2.1. Classificatory framework**

Different languages contain different degrees and types of vowel harmony. Before we can speak of exactly what vowel harmony may be, perhaps it would be helpful to survey these different types. Aoki (1968) has isolated three distinguishing classificatory criteria.

His first criterion deals with what (and how many) features are being spread or assimilated. What he calls Total Harmony occurs when all the features of a certain vowel are spread onto another vowel, making that vowel identical in quality (what I have termed Total Assimilation in Section 1.1). Another way to describe this is that all the vowels of a certain morpheme are specified solely as +V (plus vowel) or -C (minus consonantal), and phonological rules then map the correct vowel features onto the representation. Although I haven't been able to find any examples of this type of harmony, Aoki cites the illative in Finnish.

In Partial Harmony only certain vowels have particular features left unspecified. These features are then filled in through phonological rules. The

capital letters in the following representations symbolize these partially unspecified vowels:

(2) Partial harmony

Turkish	/köy+IEr/	[köyler]	nom. pl. 'village'
	/son+IEr/	[sonlar]	nom. pl. 'end'

(Examples from Matthews, 1974)

Basically, (still according to Aoki), Partial Harmony consists of three types.

In palatal harmony, certain vowels are left unspecified for backness. Examples:

(3) Palatal harmony

Finnish	/tuoli+lIA/	[tuoli-lla]	'on the chair'
	/pöyda+lIA/	[pöydä-llä]	'on the table'

(Examples from Hock, 1991)

Hung.	/varos+nAk/	[varos-nak]	'to the city'
	/tömeg+nAk/	[tömeg-nek]	'to the crowd'

(Examples from Ringen, 1978)

Mong.	/ger+UUd/	[ger-üüd]	'yurts'
	/nom+UUd/	[nom-uud]	'books'

(Examples from Steriade, 1979)

Horizontal harmony is based on the height, tenseness or advanced position of the tongue root (ATR):

(4) Horizontal harmony

Yoruba	/Obe/	[òbè]	'soup'
	/Èko/	[èkò]	'pap'

(Examples from Archangeli & Pulleyblank, 1989)

The last vowel of each example is [-ATR], and its effect spreads leftward, to the first vowel.

Labial harmony is based on rounding. This type of Partial Harmony often occurs in tandem with another type. For instance, Turkish exhibits both palatal and labial harmony:

(5) Palatal and labial harmony

Turkish	/k <sup>h</sup> öy+Un/	[k <sup>h</sup> öy <sup>h</sup> ün]	gen. sg. 'village'
	/son+Un/	[sonun]	gen. sg. 'end'

(Examples from Matthews, 1974)

In the first example, the [-back] quality of labial [ö] spreads to the suffixal vowel, causing it to surface as [-back], labial [ü]. In the second example, the [+back] quality of labial [o] spreads to the suffixal vowel, causing it to surface as labial [u].

The second of Aoki's criteria for vowel harmony classification is what he calls the 'quality of symmetry.' In a symmetrical system, whatever vowel occupies a certain position in a word (for example, the first vowel of the root) will determine the series of vowels for the word. For example, in the following Finnish examples, where a root with /ie/ is followed by a suffix with /A/, the /A/ surfaces as a fronted ([ä]). If the root vowel is /aa/, and a suffix with /A/ is added, the /A/ surfaces as a back [a].

In the Turkish examples, two suffixes are added to each root--the plural /Er/ and the ablative /dEn/. If the stem vowel is front vowel /<sup>h</sup>ö/, both suffix vowels surface as front [e], but if the stem vowel is back vowel /o/, the suffix vowels surface as back [a]:

## (6) Symmetrical harmony

Finnish	/tie+llA/ /maa+llA/	[tie-llä] [maa-lla]	'road' 'land'
---------	------------------------	------------------------	------------------

(Examples from Hock, 1991)

Turk.	/köy+lEr+dEn/ /son+lEr+dEn/	[köylerden] [sonlardan]	'village' 'end'
-------	--------------------------------	----------------------------	--------------------

(Examples from Matthews, 1974)

In an asymmetric system, however, one series of vowels will dominate the other--if a vowel of the dominant series appears in a word, all the other vowels are of the same dominant series:

## (7) Asymmetric harmony

Nez Perce	/ne?+tót/	>	/na?tót/	'my father'
	/ne?+mex/	>	/ne?mex/	'my uncle'
	/wat+we.yiksa/	>	/watwa.yiksa/	'(I) am wading across'
	/weye+we.yiksa/	>	/weyewe.yikse/	'(I) am hurrying across'

(Examples from Aoki, 1966)

Two sets of vowels appear in Nez Perce words: /i a o/ and /i e u/. A word may consist of either the vowels of the first (or dominant) set, or of vowels from both sets (a word cannot contain only the vowels of the second, or 'recessive' set). When the recessive morpheme /ne?/ 'my' is added to the dominant morpheme /tót/ 'father,' the /e/ changes to [a], a dominant vowel. When, however, /ne?/ is added to recessive /mex/ 'uncle,' [e] surfaces.

In the next two examples, the morpheme for 'go across,' /we.yik/, contains recessive vowels. When this is added to morphemes containing dominant vowels,

the /e/ changes to [a].

Aoki's third criterion is whether or not alternating forms are present. He states that alternating forms are dependent on the number of features left unspecified in the lexicon. In other words, if only backness is unspecified (such as in a language with only palatal harmony), then two alternating forms exist--front and back forms. For example, see the Finnish examples (in (3) and (6) above, the Turkish examples (in (5) and (6)) and the Mongolian examples (in (3) above). In languages with two kinds of harmony, two features are left unspecified, and so four alternating forms are found. For example, Turkish has both palatal and labial harmony (see examples (5) and (6)).

By collecting and classifying the above phenomena, Aoki offers a tentative framework by which we may more precisely capture the notion of 'vowel harmony.'

## **2.2 Representations**

Historically, vowel harmony in specific languages has been handled in two very different ways, using two basic types of representations: linear (segmental) and non-linear (non-segmental).

Bendor-Samuel (1960) explains these differences of segmentation, in a discussion of phonemic vs. prosodic analyses. While vertical segmentation (the kind appearing in phonemic analyses--see Section 2.2.1.1. below) is based on a linear, sequential approach, with one segment immediately following another in the stretch of the utterance, prosodic analyses contain this type of segment as well



as what he calls ‘horizontal segments.’ Prosodists recognize that many phonetic features extend over more than one linear segment, and that vertical segmentation alone cannot adequately handle this phenomenon. Horizontal segments, then, consist of ‘prosodies,’ extending over more than one linear segment (see section 2.2.1.2.1. below).

As prosodic analyses, then, contain both linear and non-linear segments, it is difficult to fit them into the above two classifications. They are an early type of representation, however, and address certain types of problems raised by phonemic analyses of the time. Therefore, I am including prosodic analyses in Section 2.2.1., Linear Representations, although they are not strictly linear.

Although most of the analyses up to this point have been language-specific or particular to one language, linguists are continually searching for a more universally applicable, non-arbitrary (that is, well-motivated) theory.

### **2.2.1. Linear Representations**

The relations between elements in an utterance, such as syllables, words and phrases, have often been described by generative phonologists through rules (Anderson, 1985). Generative phonology only began to be accepted in the late 1960’s; earlier analyses stemmed from a structuralist view, and did not include rules. Instead, they consisted of statements of forms and their distributions.

Most of the following analyses hold a common assumption: both speech and phonological representations can be represented as unilinear sequences.

Theories of vowel harmony within the existing generative frameworks, writes

Clements (1976b), have mostly been quickly falsified, often because of an analyst's reluctance to examine complex data. He suggests that although it is fairly simple to describe vowel harmony, it is more difficult to provide a well-motivated account of the data which are apparently exceptional.

Kaye (1989) asserts that whichever representation is chosen for an analysis implies that whatever cannot be expressed by a certain notation does not exist. A strength of the standard SPE representational model, he goes on to say, is that it is able to distinguish natural classes. A 'natural class' is designated as one in which the defining number of features is smaller than the number of distinguishing features. However, a great drawback of the theory (recognized by its originators, Chomsky and Halle), is that there is no apparent connection between the input (that which appears to the left side of the arrow in the formal notation) and the structural changes it undergoes.

Kaye cites the common phonological rule of velar palatalization before a front vowel. An example from Italian follows, along with the formal notation of the rule:

8) Italian [amiko] 'friend' [amiči] 'friends'

Velar palatalization:

$$\left[ \begin{array}{l} \text{-sonorant} \\ \text{-anterior} \end{array} \right] \rightarrow \left[ \begin{array}{l} \text{-back} \\ \text{+coronal} \\ \text{+delayed release} \\ \text{+strident} \end{array} \right] / \_ \left[ \begin{array}{l} \text{-consonantal} \\ \text{-back} \end{array} \right]$$

Eight features are used to express this rule. By SPE's own evaluation metric, this great number of features ranks the rule low on the scale of preference (the more

features a rule requires, the lower it ranks on this scale).

The two feature matrices linked by the arrow may be reversed, to express the inverse of this rule:

$$(9) \begin{bmatrix} -\text{back} \\ +\text{coronal} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{sonorant} \\ -\text{anterior} \end{bmatrix} / \_ \begin{bmatrix} -\text{consonantal} \\ -\text{back} \end{bmatrix}$$

or, in other words, palatal consonants become velars before [-back] vowels. There is no known example of such a rule.

This version has the same number of features, and so the SPE's evaluation metric cannot choose between them. Kaye argues that the general problem is that the theory predicts it is all right to take any rule and either change the value of a particular feature, or change that feature to another (resulting in the same number of features). Chomsky and Halle, reaching this same analysis, concluded that SPE was too formal a theory.

#### 2.2.1.1. Phonemic Representations

Before the mid-1960's, linguists were primarily concerned with the phonic features in each language and how they could distinguish one utterance from another (Sommerstein, 1977). This structuralist view led to phonemic analyses, with their importance of contrast.

Bendor-Samuels (1960) argues that the advantage of a phonemic analysis is its overall simplicity of statement--all the phonetic phenomena are assigned to one type of unit, i.e., the phoneme, and only one type of segmentation is utilized--vertical.

### 2.2.1.1.1. Lyons, Turkish

According to Lyons (1962), a phonemic analysis is one-dimensional, a unilinear sequence of phonological representations. The phonemicist first determines the inventory of phonological units, then describes their distribution. He confines himself to strict empirical induction, and is not concerned with questions of meaning. Lyons uses an analysis of Turkish vowel harmony to illustrate this type of approach.

He isolates eight contrasting vowels ( i, ü, ı, u, e, ö, o and a). Although these occur freely in monosyllabic words, certain restrictions apply in words of more than one syllable--in other words, front and back vowels do not co-occur within the same word, nor do round and non-round vowels. Some examples (repeated from (6) above--without, however, representing the underlying phonemes as underspecified):

(10)	/k <sup>h</sup> öy+ler+den/	[k <sup>h</sup> öylerden]	'village'
	/son+ler+den/	[sonlardan]	'end'

(Thus, some of the phonemic distinctions are neutralized within multi-syllabic words).

Lyons concludes that a phonemic description is highly redundant, as it lists all contrasting vowels, then adds statements of their distribution. Thus, it contains much unnecessary (non-distinctive) information.

Anderson (1985) states that in a phonemic description, all features are treated in the same manner, no matter what position they occupy in the utterance. (Compare this characteristic of feature treatment with the prosodic analysis

discussed in Section 2.2.1.2.1.below.) A set of rules must be added to specify the phonemic descriptions for additional, non-distinctive properties.

#### **2.2.1.1.2. Boas--American Indian Languages**

Most of the grammars in Boas' Handbook of American Indian Languages are described using a phonemic analysis. First, Boas presents an inventory of sounds, describes their possible combinations, and then adds what he calls 'euphonic laws.' These modify sounds when in combination with certain others (thus, these laws merge all assimilatory instances into one phenomenon). Anderson (1985) states that they express systematic relations between the shapes of surface forms, and do not extract underlying forms. Boas, with his 'laws,' asserts Anderson, simply states what different forms are possible.

#### **2.2.1.2. Abstract Representations**

Several different types of analyses use abstract representations: prosodic, diacritic, as well as rule-based analyses. Some linguists have found that these phonological representations may have been too abstract, that is, that they differed too greatly from the surface forms. Kiparsky (1973) argues against the use of diacritics, contending that with their use, no reference need be made to particular morphemes which undergo change. Kiparsky also opposes using diacritics to trigger phonological rules, arguing such usage goes against the general claim that phonological representations should be nonarbitrary in content.

Below are several examples of abstract analyses.

### 2.2.1.2.1. Prosodic Representations

In the early 1960's, prosodic treatments were attempted. Robins (1967) explains that this type of analysis contains two elements: segmental units (such as consonants and vowels), which are linear and successive, and prosodies, which are assigned to definite structures to handle relations between certain phonetic features.

While a phonemic description contains all the distinctive features of its phonemes, the segmental units of a prosodic analysis may incorporate non-distinctive features as well. All the regularities are included. A prosodic analysis may also treat a feature as prosodic in one position, and as phonemic in another. A number of different 'sub-systems' are thereby set up, each relevant to different phonological structures. For example, syllable initial consonants may be treated differently (forming a separate 'sub-system') than syllable final consonants, even though they may share many phonetic features.

A prosodic analysis can more explicitly link phonetic features to a grammatical analysis. A prosodic analysis of the Tereno word<sup>5</sup> [ãỹõ] 'my brother,' considers the phonetic features of nasalization as one phonological feature (not a sequence of features). Thus, nasal [ã] is considered as having two parts--the phonetic exponent of the phonematic unit a (with vertical segmentation), and a partial exponent of n-prosody (nasality--which is a horizontal segmentation). In Tereno, nasalization acts grammatically; in this case, denoting the first person.

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<sup>5</sup>Example taken from Bendor-Samuel (1960).



vowel, together with the particles pas or rog; and b) lists two harmonizing morphemes with a ‘half-close, backing, spreading’ vowel, with the same particles:

(11) a) 1st syllable, close

yin-pas [jumbe:] ‘are’ (?)  
zin-rog [sumio:] ‘catch’

b) 1st syllable ‘half-close + back + spread (ɣ)’

rgyab-pas [lɣbe:] ‘sweep’  
bslabs-rog [lɣbio:] ‘teach’

In the ‘Open Piece,’ however, the vowels of the second syllables (pas and rog) are more open (actually, half-open--ε, ɔ) while the harmonic features in the first syllables are non-close (open [ɔ, a, ʊ], half-open [e, ɔ], or half close and front [e, φ]):

(12)

gnang-ngas	[nɛ:ɛ:]	‘have’
ster-ras	[te:ɛ:]	‘give’
yong-ngas	[jʊɛ:]	‘come (on foot)’
phebs-pas	[phe:be:]	‘come’
bzos-pas	[sφ:be:]	‘make’
gnang-rog	[ñ:ɔ:]	‘give’
phye-rog	[tɕhe:ɔ:]	‘open’
nyo-rog	[nɔ:ɔ:]	‘buy’
phebs-rog	[phe:ɔ:]	‘come’
skyon-rog	[cō:ɔ:]	‘print’

In short, Sprigg’s analysis distinguishes two types of ‘piece’--close and open.

Such ‘pieces’ occur within the grammatical classification ‘Verb + Particle,’ in the following combinations:

1. one close, one open piece
2. only close pieces

Due to this type of analysis, certain identical particles (eg., Verbal--gi/gyi/kyi and



Nominal--gi/gyi/kyi/-i') are differentiated, although Sprigg writes that certain grammarians have tried to merge the two.

Thus, we see that a single phonological structure may be associated with two or more phonetic forms. Crucially, neither of the alternating forms is more 'basic,' or underlying, than the other, Sprigg argues, and each is realized under different prosodic conditions.

He concludes that a phonemic analysis of this phenomenon would lead to inconsistencies--for example, the data show that some pairs of alternating vowels can be assigned to one phoneme (as they are phonetically identical) and called allophones of that phoneme, while other pairs would be split between different phonemes. Sprigg also argues that his prosodic analysis is superior to an assimilatory one--he cannot accept the assumption of one member of an alternating pair of vowels to be 'basic' or 'the norm,' and in some contexts being replaced by the 'non-normal' member. Besides this notion of 'basicness,' Sprigg notes, as well, that the direction of assimilation is indefinite--which of the two segments would be assimilating to which is unclear.

#### **2.2.1.2.1.2. Aoki, Nez Perce**

In 1966, Aoki made a prosodic analysis of Nez Perce. Previously, Lyons (1962) had argued that morphemes in this language belong to two phonological classes, one containing the dominant series of vowels, the other, the recessive series. He assigned each of these classes a 'prosody'--'e' for the recessive series, and 'A' for the dominant series. These extracted entities were assigned to whole

morphemes, not to individual vocal segments (in Bendor-Samuel's terms, they became horizontal segments). However, Aoki claims that with this method, there is no way of identifying conditioning morphemes with the vowels of dominant morphemes. Thus, Lyons' analysis--although Aoki admits it is adequate for Turkish, in which the stem vowels govern suffix vowels--is inadequate for the facts of Nez Perce, where the stem vowel, the prefix vowel, or both may seem to determine harmony. A better description, he argues, would consist of four morphophonemic entities plus a harmonic sequence boundary marker: i, e, u, A and - (a three-way vocalic contrast, a prosodic notation, and a boundary marker). As /i/ belongs to both the dominant and recessive series, Aoki argues it is impossible to determine its membership from the phonemic shape of the morpheme. There seems to be a difference between /i/s, however, even though /i/ occurs in both the dominant (/i a o/) and the recessive (/i e u/) series of vowels.

In the following examples, each of the morphemes following the morpheme boundary symbol (+) contains an /i/, while the preceding morpheme alternates between a surfacing [e] or [a]:

(13) Nez Perce

/neʔ+i.c/	>	/neʔi.c/	'my mother'
/neʔ+ci.c/	>	/naʔci.c/	'my paternal aunt'
/tolá+qittise/	>	/tulé.qittise/	'(I) am putting my foot down firmly'
/tolá+ck'ilksa/	>	/tolá.ck'ilksa/	'(I) am destroying with my foot'

Aoki claims that the best way to analyze these is to abstract prosodies, and assign them to the morphemes. Each morpheme in Nez Perce, he contends, should

include such prosodic information.

#### **2.2.1.2.2. Diacritic Representations**

From the above, we can see that prosodic analyses of vowel harmony are complex and not very clear. Following is a discussion of abstract, segmental representations, using rules to adjust to the surface, phonetic form, beginning with Lightner's diacritic analysis (1963).

##### **2.2.1.2.2.1. Lightner, Classical Mongolian**

Preferring to view vowel harmony as a manifestation of a property inherent to root-morphemes, Lightner marks each root with a morpheme-sized diacritic. In his analysis, all underlying vowels are unspecified for backness, and the diacritic associated with each root distributes (by phonological rule) the proper vocalic quality throughout the word.

Lightner contends that a description as assimilation is inadequate, for it is not always clear which segment is to be considered basic, and the choice is often arbitrary (this objection is similar to Sprigg's, above 2.2.1.2.1.1.).

In his analysis of Classical Mongolian, Lightner notes that the vowels of each word are either all grave (back), or all acute (front), with the exception of acute /i/, which occurs in both contexts. He assigns each root with an abstract marker (or diacritic) [GRAVE], which represents an abstract root property. As a result, the segmental feature [grave] is not specified. A rule such as the following is posited:

.

- (14)
- |     |   |   |                       |   |
|-----|---|---|-----------------------|---|
| 1a. | $\left[ \begin{array}{l} +\text{vocalic} \\ -\text{consonantal} \end{array} \right]$  | } | [%grave] <sup>6</sup> | $\left\{ \begin{array}{l} \text{when root is} \\ \text{specified} \\ [\%GRAVE] \end{array} \right.$ |
| 1b. | $\left[ \begin{array}{l} -\text{vocalic} \\ +\text{consonantal} \\ +\text{compact} \\ -\text{strident} \end{array} \right]$ |   |                       |   |

Thus, we have these derivations:

- (15) [uɣuta]  
 /UGUta/ (root marked {+GRAVE})  
 1a uGuta  
 uɣuta
- [köbegün]  
 /KObAGUn/ (root marked {-GRAVE})  
 1a KöbeGün  
 1b köbegün

In the first example, the root is marked [+GRAVE]. Therefore, according to rule 1a, all the vowels must surface as [+grave], and according to rule 1b, the archiphoneme (or underspecified phoneme) /G/ must also surface as [+grave]. In the second example, the root is marked [-GRAVE]--in this case, all vowels as well as archiphonemes /K/ and /G/ must surface as [-grave].

Lightner accepts that there is a choice between two types of rules: root-marker rules (or diacritics) and assimilation rules, stating, however, that the description of harmony as an assimilation process is arbitrary, and that we need a way to capture the 'notion' of harmony. Lightner argues that using abstract

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<sup>6</sup> Throughout this paper, the symbol '% ' represents the alpha symbol.

markers is a way to formalize this intuitive ‘notion.’

Zimmer (1967), in addition, claims that assimilation rules, being language-specific, may not be the basic type of vowel harmony rules. This objection reminds us of the concern to find a universal theory of vowel harmony, one which would be applicable cross-linguistically.

#### **2.2.1.2.2.2. Ringen, Hungarian**

Ringen has also attempted a diacritic analysis (1980). She argues that both root and suffix harmony in Hungarian are related and predictable processes, and so must be handled with a single vowel harmony rule.<sup>7</sup> The irregular, unpredictable aspects can be assigned diacritics, which trigger optional rules of Disharmony.

The first harmonic vowel in the root is fully specified underlyingly, while any remaining vowels appear as only partially specified archisegments. A vowel harmony rule then fills in the missing specifications. Along with this she argues, a slightly modified form of Kiparsky’s revised Alternation Condition is needed:

#### (16) New Alternation Condition

Feature-changing applications are permitted only to derived forms.

This condition accounts for both root and suffix harmony in native derived forms

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<sup>7</sup> Using one rule to handle vowel harmony in both roots and suffixes was the most common method before the late 1960’s. Afterward, some linguists, such as Vago (see section 2.2.1.2.3) categorized morphemes differently. Kiparsky (1973) also argued for the need for two rules (a vowel harmony rule as well as a morpheme structure condition), asserting that roots and suffixes had different classes of exceptions, and so were affected by different processes. His Alternation Condition, forbidding feature changes in non-derived environments, also demanded a separate explanation for harmony within roots.

Ringen, then, is here reverting to an earlier conception.

(those formed through the addition of inflections or derivational morphemes). It predicts, Ringen explains, that the Hungarian rule of vowel harmony will not apply to disharmonic loanwords, as these are non-derived forms. No feature change is possible, and so no additional diacritic is necessary to mark their exceptional status.

#### **2.2.1.2.3. Rule-based; Vago, Ringen--Hungarian**

Other abstract analyses posit underlying features which do not appear on the surface of the word, with these features later adjusted by rules such as Absolute Neutralization. Kiparsky (1973), however, objects to recourse to a rule of Absolute Neutralization, arguing that it is not legitimate to set up underlying distinctions solely to structurally satisfy a rule, and then to eliminate that distinction completely.

Robert Vago prefers an abstract solution to account for Hungarian vowel harmony (1973, 1980). First of all, he considers four problems in the description of vowel harmony:

1. Are root and suffix harmony the same process, or are they actually two different processes?
2. Is the value of the harmonic feature underlyingly specified, or is it filled in by a vowel harmony rule?
3. Is vowel harmony a phonological assimilation rule, or does it operate via diacritic markers?
4. Is vowel harmony adjacent assimilation, assimilating to a nearby vowel, or does it skip over neutral vowels?

Vago argues there are differences between harmony in suffixes and harmony in roots. Roots are static, he writes, and the best way to describe lexical

generalizations is by morpheme structure conditions (MSCs), while alternating suffixes are best described by phonological rule. He also argues that suffixes and roots have distinctive exception classes.

There is some argumentation concerning whether MSCs should describe vowel harmony within roots (Vago 1976, Ringen 1978). Vago, however, argues that using MSCs in this manner does not miss any generalizations, and does not duplicate any vowel harmony rule.

He argues that, according to MSCs in Hungarian, both back vowels and round front vowels may not occur within the same morpheme. This is a negative condition, reinforced positively at the word level by vowel harmony rules. Ringen's mixed vowel roots (eg., /tib+i+nál > [Tibinel] dim. of Tibor, a personal name) and disharmonic roots (such as /sofför+nak/ > [sofför-nek] 'to the chauffeur') provide no positive evidence for allowing vowel harmony to apply within the root. Vago looks at these facts of non-cooccurrence as not simply being exceptions (as does Ringen) but as revealing generalizations.

Vago concludes that vowel harmony consists of two different processes, while vowels in Hungarian roots must be lexically specified. (Ringen however does not agree, claiming that Vago does not adequately motivate the splitting of vowel harmony into two processes.)

In Vago's analysis, the harmonic feature in the root is stated through an MSC, while suffixes are determined by two vowel harmony rules--one marked, the other unmarked.

The first vowel harmony rule should be marked. This rule skips over neutral vowels (i, í, and é)<sup>8</sup>:

(17) (m)VH

$$[+syllabic] > [+back] / \left[ \begin{array}{c} +syllabic \\ +back \end{array} \right] C \quad \left[ \begin{array}{c} +syllabic \\ -back \\ -round \end{array} \right] C \text{ —}$$

According to this rule, a suffixal vowel would become [+back] when the first root vowel is [+back], despite an intervening [-back, -round] vowel. This would account for the backness of suffixal vowels (such as [o] in the first example below, and [a] in the second example) in the so-called Hungarian ‘mixed roots’ (roots with both back vowels and neutral vowels):

(18) /ta:nye:r + tö:l/ > tányértól ‘from the plate’  
/radi:r + nek/ > radírnak ‘to the eraser’

The second vowel harmony rule should be unmarked, and accounts for regular cases of harmony:

(19) (u)VH

$$[+syllabic] > [%back] / \left[ \begin{array}{c} +syllabic \\ \%back \end{array} \right] C \text{ —}$$

This rule assimilates vowels for backness, accounting for suffixal harmony in forms such as:

(20) /ha:z + nek/ > háznak ‘to the house’

---

<sup>8</sup>Neutral vowels interrupt harmony; they are not affected by neighboring vowels, but they do institute their own harmonic domain.



Both the marked and unmarked vowel harmony rules apply disjunctively, or alternately.

In order to account for words such as [hidnal] ‘at the bridge,’ where the back vowel [a] follows a front [i], Vago posits underlying abstract back /i/. Because surface Hungarian contains no [-low], [-round] vowels which are back, Vago also posits a rule of Absolute Neutralization, to apply after both vowel harmony rules:

(21) Absolute Neutralization

$$\begin{matrix} \text{V} \\ \left[ \begin{array}{l} \text{-low} \\ \text{-round} \end{array} \right] > \text{[-back]} \end{matrix}$$

In his argument against diacritic solutions, Vago states that a theory in which diacritic features can condition phonological rules (such as in the analysis posited by Lightner above), cannot distinguish between predictable (or phonological) processes and unpredictable (or morphological) ones. He goes on to state that diacritics should be used only when one cannot posit a phonological rule. Using diacritics otherwise misses the generalization that vowel harmony is mostly a phonetically motivated assimilation phenomenon. Another point he makes is that in using diacritics, the fact that the last vowel of roots determines suffix harmony is made accidental.

Vago also questions whether vowel harmony is a case of adjacent or non-adjacent assimilation. Although he decides it is non-adjacent, skipping over neutral vowels, Jensen (1978) argues Vago does not adequately define what he means by ‘non-adjacent,’ and does not explain exactly which segments are

irrelevant to his vowel harmony rule. In his own Relevancy Condition (1974), Jensen states that only irrelevant segments may intervene between segments causing and undergoing a phonological rule. Jensen argues that in rejecting this condition, Vago suggests no replacement, and thereby has no non-arbitrary way of evaluating his two vowel harmony rules. Jensen goes on to state that Vago's 'two different exception classes' are an artifact of his analysis, for with Jensen's single vowel harmony rule, no different exception classes appear.

Ringen (1978) also objects to the way Vago treats exceptions. She says that in positing underlying abstract vowels, any exceptionality of forms is actually denied--they are claimed to be regular 'at some deeper level.' Ringen claims Vago uses a totally ad hoc exception mechanism--that although it may be possible to motivate it, Vago does not prove its necessity.

Ringen also refutes his arguments against diacritics, saying that even Lightner would not set up such a rigid use of them. Today, she asserts, it is no longer an issue whether the phonetically conditioned aspects of vowel harmony should be accounted for by a diacritic marker, but, instead, whether that part of vowel harmony which is not phonetically motivated is appropriately handled with such a marker.

### **2.2.2. Non-linear representations**

Representations can be divided into two main types: linear and non-linear. In the remainder of this section, I will discuss the latter type.

Kaye (1989) writes that during the past decade, linguists have become more

interested in non-linear models of analysis such as the autosegmental model. Such models may be able to explain data more completely, and any failures of descriptive power may, Kaye explains, be due to faulty assumptions or incomplete data. Unlike the linear theories, a non-linear theory drastically reduces the set of possible phonological processes. An autosegmental theory, then, can express exactly the processes observed, and nothing else, and explains the relation between the change and its context.

#### **2.2.2.1. Autosegmental Representations**

According to Lieber (1987), many variations of the autosegmental model exist. They all share some common assumptions: more than one tier or structural level is involved (with different autosegments found on different tiers); these tiers are not isolated from each other, but are associated either by a 'well-formedness condition' (stating which types of representations are not admissible) or by linking rules; and, lastly, some autosegmental tiers may represent entire morphemes. Individual analyses may differ, Lieber explains, according to exactly how these assumptions are realized. She also states that not all harmony processes are formally the same--different processes require different analyses. For example, some harmony systems may require underspecification of stems, others require delinking rules, but all harmony systems require an unbounded spreading of harmonizing features.

Segments are still represented as bundles of distinctive features, but now they are distributed among a number of tiers. Whether a particular feature may be

projected only on one tier, or onto more than one, is being argued. All analyses agree, however, that processes operating on one tier do not affect autosegments on another.

#### **2.2.2.1.1. Clements, Akan**

Clements (1981) analyzes vowel harmony in the Asante dialect of Akan. As usual in autosegmental analyses, Clements first decides on a set of parameters: 1) The class of segments represented on a separate tier; 2) the harmonic segments; and 3) the opaque segments (lexically linked in the underlying representation). Clements uses the term 'opaque' to refer to a certain type of invariant vowel which superficially violates harmony, and which can control a harmony domain of its own.

The minimal display is two tiers--one with the harmonic segments and one with the core. The segments on each tier are associated to segments on other tiers by a set of conventions. A process which occurs on one tier is independent of any process occurring on another tier.

The Association Convention (which is language-specific) states that association occurs from left to right in a one-to-one manner. (The autosegmental model developed from examinations of tonal systems (see Goldsmith, 1976). No languages have been found where contour tones appear only on initial syllables, while languages do have these tones only on final syllables. The expected direction of association is left to right, except when dealing with suffixal material, where association is from right to left (see Marantz, 1982). This may account for

left to right being the default direction of association.) A lexical pre-linking, or underlying association with a segment, interrupts this mapping, and begins a new process.

According to Clements, the system of vowel harmony in Akan consists of:

- (22) Harmonic segments: [advanced] (called ATR in other analyses)  
 Opaque segments: [+syllabic, +low]

The category [advanced] can apply only to vowels, so it is unnecessary, Clements states, to specify harmonic feature-bearing units as [+syllabic]. Any neutral vowels, those 'invisible' to the harmonic process, must be specifically excluded from this class of units.

Thus the features [+/- advanced] are not specified in the segmental matrices of the core, but are projected onto a separate tier. Low vowels are lexically associated with [-advanced].

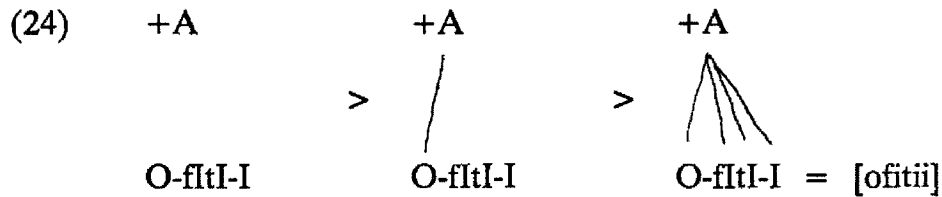
A word such as [fiti] 'pierce' may be represented in several different ways, but in accordance with the criterion of fewest elements consistent with phonological behavior, Clements chooses:

- (23) +A  
 ftI

In the case of a word such as [O-fiti-i] 'he pierced (it)', the autosegment associated with the root spreads to the prefix and the suffix. (In principle, vowel harmony is an unbounded phenomenon. However, there do seem to be some constraints in a majority of languages--the domain, different in each language, must be specified.

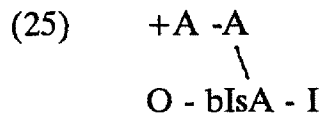
Akan vowel harmony is unusual in that the domain includes prefixes as well as roots and suffixes.)

Below is the derivation of /O-fltI-I/ [ofitii] 'he pierced it':

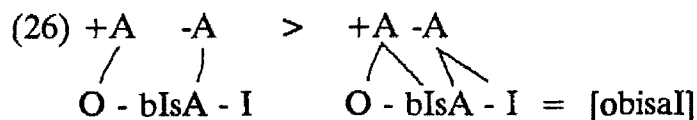


First a harmonic autosegment is assigned to each lexical root, then the autosegment is projected onto a separate tier, associated in accordance with the Association Convention mentioned above, and spread to all other non-linked segments which can accept it (here, non-low vowels).

Clements has stipulated that the opaque segments are the low vowels. These low vowels are lexically associated with [-A], and so the underlying representation of [o-bisa-I] 'he asked it' is:



Applying the Association Convention, we have:



[bIsA] is a mixed vowel root. This root is associated with the autosegment [+A], but it also contains a prespecified low vowel (that is, linked to [-A]). As association lines cannot cross, the [+A] can spread only to the vowel immediately in front of the prespecified vowel. [-A] then associates to its own right. It is now

clear why neither vowel will assimilate to the other.

Disharmonic roots, such as [ɲinsɛɲ], ‘to be pregnant,’ are clarified by the autosegmental representation, also. In these cases, the vowels are lexically prespecified:

$$(27) \quad \begin{array}{cc} +A & -A \\ | & | \\ \text{ɲInsEɲ} & \end{array}$$

and no harmonic spreading can take place.

Clements argues that linear analyses such as Lightner’s diacritic analysis cannot clearly account for the fact that a root may have two different harmonic domains. The autosegmental approach, he demonstrates, can easily handle such a case.

Also, under an autosegmental analysis, the alternating vowels have no ‘basic’ or underlying alternant. The vowels are not prespecified (or lexically linked) for the quality being autosegmentalized (or projected onto another tier--here, [ATR]).

#### 2.2.2.1.2. Lieber, Khalka Mongolian

In her study of autosegmentalism, Lieber describes the harmonic system of Khalka Mongolian as ordinary as well as feature-adding (1987, 134). Ordinary means that it includes both ‘+’ and ‘-’ values of the harmonizing features, both of which induce harmony (such as both [+back] as in [boogd-uul-ax] below, and [-back] as in [ünee] ‘cow’.) This is opposed to ‘dominant’ harmony, where only a ‘+’ value of the harmonizing feature induces harmony (such as [+ATR] in Kalenjin, see 2.2.2.1.4. below).

Khalka has two types of harmony: backing and rounding. Backing is triggered by the initial vowels of words while non-initial [i] neither undergoes nor blocks it. Rounding is triggered by initial non-high vowels as well as [i]. Along with non-initial [i], [u] and [ü] in any position will block rounding.

Following is a description of vowel harmony in Khalka:

- a) If a word contains only [-high] vowels, all the vowels agree in backness and roundness:

[ot-ox] ‘to keep a watch on’	[örg-öx] ‘to raise’
[avr-ax] ‘to save’	[nem-ex] ‘to add’

If the word has an initial [-high] vowel followed by an [i], roundness and backness spreads over the [i]:

[oril-ox] ‘to weep’

The initial [-high] [o] skips over the [i] and induces the suffixal vowel to be both round and back.

- b) If the initial vowel is high, [-back] [i], the succeeding [-high] vowel agrees with it in roundness and backness:

[ir-ex] ‘to come’

- c) If the initial vowel is high, back, round [u] or high, [-back, -round] [ü], the succeeding [-high] vowel agrees only in backness:

[ünee] ‘cow’ [sudar] ‘chronicle’

- d) Non-initial high [u] and [ü] undergo backness harmony, but block rounding harmony:

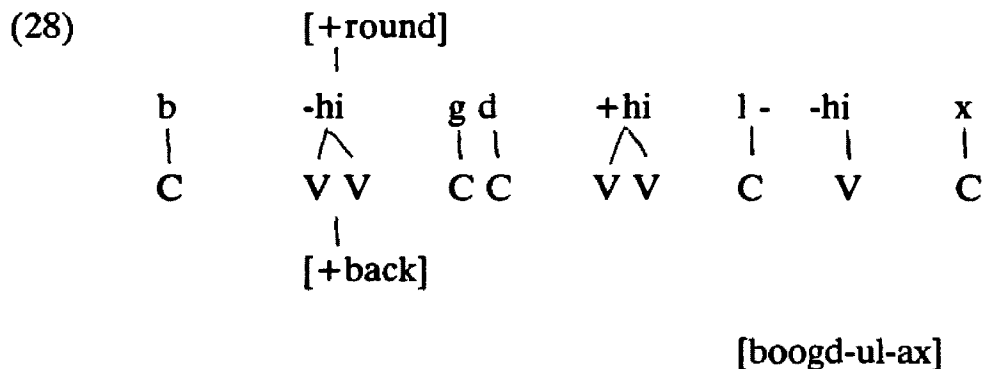
[boogd-uul-ax] ‘to hinder’	[nül-üülex] ‘to write’
----------------------------	------------------------

In her autosegmental analysis of the above phenomena, Lieber views initial vowels of all stems in Khalka as opaque (lexically linked in the core) for both harmonic features (both [+/-round] and [+/-back]). The first stem vowel, then, is



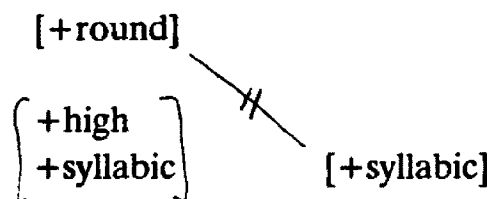
linked lexically. Non-initial [i], being neutral (or ‘invisible’ to spreading), is also lexically linked. ([u] and [ü]) are, like all initial vowels, opaque and lexically linked to both roundness and backness.. However, non-initial [u] and [ü] are opaque only for roundness. This allows them to agree with preceding vowels only in backness. In addition to this, all non-initial [-high] vowels are underspecified for both roundness and backness (allowing them to agree with preceding vowels in those features), while [+high] vowels (excluding non-initial [i], which is neutral and so specified [-back, -round]) are underspecified for backness.

An example of a lexical representation in Lieber’s analysis:



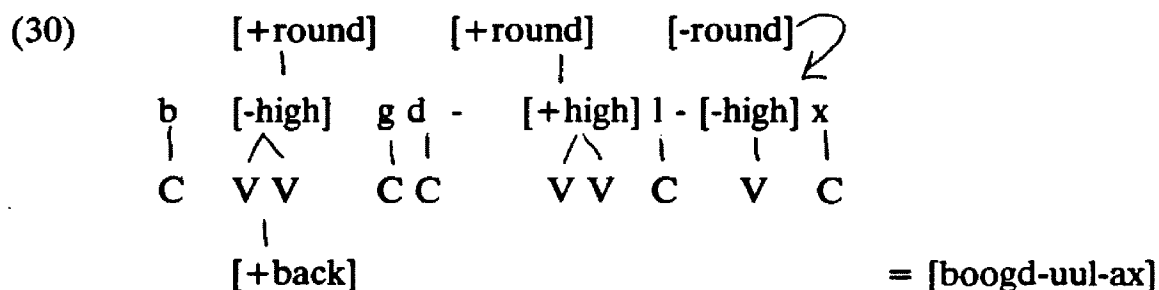
The first vowel is lexically linked to [+round] and [+back]. Spreading rules apply, spreading [back] and [round] to the right, attaching them to [+syllabic]. However, in the case of (28), this leads to an incorrect result (\*boogd-ul-ox). Khalka needs a rule to delink associations which have spread from a [+round], [+high] vowel:

(29) Khalka Delinking



With this rule, vowels following [u] and [ü] are unspecified for the feature round.

A default [-round] is assumed to apply to such vowels:



Lieber argues that the above analysis, even with its lexical linking, prespecification, and costly Delinking Rule, is still superior to a metrical analysis, as it accounts for all the complex facts of Khalka harmony.

### 2.2.2.1.3. Archangeli and Pulleyblank, Yoruba

Archangeli and Pulleyblank, in their analysis of Yoruba vowel harmony (1989), question whether certain types of predictable information should be included in underlying representations.

This questioning has led them to support a theory of radical underspecification, whereby the underlying representation contains no predictable information at all--no non-contrastive values<sup>9</sup> and no redundant contrastive values.<sup>10</sup> The data from Yoruba also indicate that only one value for a harmonic feature may be present underlyingly. (This value, whether '+' or '-', is language-

<sup>9</sup> If, for example, there is no contrast between a back and a round vowel, then both those features need not be included.

<sup>10</sup> A language may have a contrast between [+high] and [-low] vowels, but [-low] may be redundantly added to a [+high] segment.

specific).<sup>11</sup>

Although the Association Convention states that association of autosegments must proceed from left to right, Yoruba requires right to left association, as well as right to left spreading. Constraints on feature combinations govern initial associations and determine the possible cases of exceptional prelinking.

For example, Archangeli and Pulleyblank state that the underlying specification [-ATR] can only apply to non-high vowels. They capture this restriction with a feature combination restraint:<sup>12</sup>

(31) A [-ATR] specification can be linked only to a [-high] vowel.

High vowels neither trigger nor undergo [ATR] harmony in Yoruba. Any analysis must explain why this is so. Archangeli and Pulleyblank argue that it is a result of the lack of [-ATR, +high] vowels in Standard Yoruba, and that the constraint in (31) expresses this. Therefore, because [-ATR] cannot be associated to high vowels, high vowels can neither trigger nor undergo harmony.

#### 2.2.2.1.4. Halle and Vergnaud, Kalenjin

Halle and Vergnaud (1981) assert that bi-directional harmony systems are best represented by the autosegmental model. An example of such a system is Kalenjin, which has what they term 'dominant harmony'--that is, there are two sets

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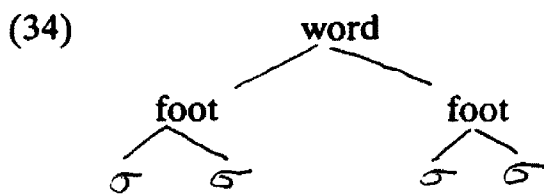
<sup>11</sup> Pulleyblank (1988) also uses Yoruba to argue for underspecification of vowels. He notes that [i] either is the only vowel to undergo certain rules, or it is the only vowel which does not. Individual stipulations will not explain its repeated appearances--Pulleyblank argues that the alternative is to look at the inherent structure of [i] and to derive its special properties from that. He concludes this special structural property must be an underspecified underlying representation.

<sup>12</sup> Archangeli and Pulleyblank state that this constraint is a necessary condition of the Yoruba vowels, and that it is needed independently of the harmony system.



### 2.2.2.2. Metrical Representations

Non-linearly, vowel harmony has been described in two ways--dominant, bi-directional harmony within an autosegmental framework, and uni-directional harmony within a metrical framework. In metrical phonology, representations are hierarchical. They are based on the notion of the 'foot,' a constituent lying between the syllable and the word:



Directional harmony has a terminal triggering element (either initial or final) which does not vary within a particular language. Within this type of analysis, all the triggering elements are considered opaque, with each element initiating a harmony of its own.

Metrical phonology arose from Liberman's work on English stress (1975, 1977). It has since been extended to cover other phenomena, including vowel harmony. According to Halle and Vergnaud (1981), this method best describes directional, local harmony (while autosegmental phonology best describes dominant harmony).

At base, metrical phonology consists of the idea that two adjacent elements are made into a single unit by building a branching structure over them:


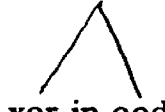


Halle and Vergnaud propose that a particular feature specification is copied by rule onto the root of the tree and percolates downward from there to all the tree's terminal nodes. This feature, they add, cannot be arbitrarily assigned--it must be copied from the core.

In their discussion of Khalka Mongolian, they consider the harmony domain to be the metrical foot, with this foot being derived by:

- (36) a. Assigning a left-dominant metrical foot from left to right such that no recessive node is a high rounded vowel  
 b. deleting branches whose terminal elements are high vowels.

Applying this process, we get:

- (37) a.  b.   
 xor in-ood                      xor in-ood

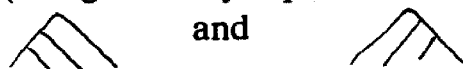
Each vowel in a word is considered a terminal node, while [+high], [+round] vowels are opaque (they block rounding harmony). Propagation is from left to right, and a 'pruning' rule deletes [+high] nodes from the tree. The feature [+round] is copied by rule onto the root of the tree. This rule must always copy a feature specification from a slot in the core--it cannot assign an arbitrary feature specification to the root. Halle and Vergnaud explain that this is an important limitation on the power of the directional harmony mechanism.

#### 2.2.2.2.1. Zubizaretta, Andalusian Spanish

Zubizaretta (1979) demonstrates, within a metrical framework, two different types of laxing harmony in Andalusian Spanish. One type is phonological, while

the other is phonetic. She states that according to Halle and Vergnaud (1978) three types of vowel harmony exist:

- (38) a) Left to right  
 b) Right to left (being formally represented as binary branching trees:



- c) Bidirectional harmony (represented as a multi-branched tree):



A rule of vowel harmony must include:

(39) The Projection

The set of segments sensitive to vowel harmony are isolated (the local nature of the phenomenon is thus made clear).

The Opaque Elements

These may be both triggers or blocks of the process of harmony.

The Direction of the harmony

The Harmonizing Features

These are copied onto the root of the tree and percolate to the nodes they dominate (by universal convention).

The projected elements are scanned, and the tree most compatible with the rules of the grammar is constructed.

Zubizarreta claims that a metrical treatment of Andalusian vowel harmony best captures the behavior of high vowels. She offers the following analysis:

- |      |                       |                      |
|------|-----------------------|----------------------|
| (40) | Projection:           | [-high] peaks        |
|      | Opaque segments:      | [+low] vowels        |
|      | Harmonizing Feature:  | [+lax]               |
|      | Direction of Harmony: | R-L (left-branching) |

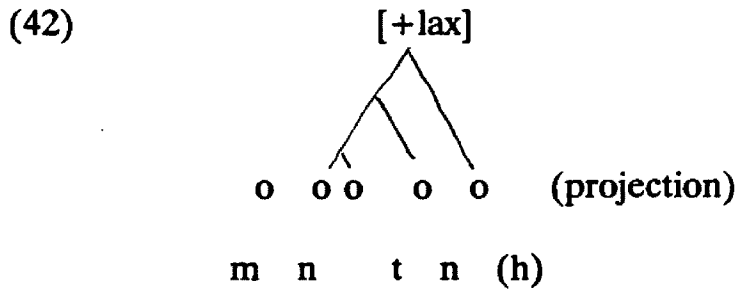
In the following data, the lax vowels are marked with a cedilla:

(41)	<u>Singular</u>	<u>Plural</u>
a)	kápa trása	kápǎ(h) trásǎ(h)
b)	vandéra mésa	vandérǎ(h) mésǎ(h)
c)	dɔ́ oídɔ́(h) dɔ́ níñɔ́(h)	dɔ́kúrǎ(h)

Laxness proceeds leftwards from a final lax vowel, and stops at the stressed vowel, unless this is [+high]. The examples in c) above show that the [+high] vowels [i] and [u] do not interrupt the harmony as other stressed vowels do--laxness proceeds past them to the preceding [o]'s. In other words, a [+high] stressed vowel is 'invisible,' and the process of laxing skips right over it.

Zubizarreta projects only the [-high] vowels. In this manner, [+high] vowels cannot undergo harmony, and a stressed [+high] vowel cannot block harmony (they do not appear on the autosegmental tier). The harmonizing element is [+lax], and the opaque element is [+low]. As harmony proceeds from right to left, it is represented by a branching tree--it is an empirical choice as to exactly which is ultimately chosen. Zubizarreta chooses a left-branching tree. Thus, she represents 'mɔ́nɔ́tɔ́nɔ́(h)' as follows (first, she projects the vowels onto a separate tier, representing the stressed vowel as two linked vowels, then builds a tree):





The harmonic feature,  $-[+lax]$ , is taken from the final [o] in the core, and copied onto the tree, from which it percolates down to the terminal nodes. (In this case, the first [o] is later laxed phonetically.) Thus, the behavior of stressed vowels as both undergoers and blockers of laxing harmony seems to follow from the metrical representation.

However, in contrast to other metrical analyses, the foregoing depends on the ability to stipulate the direction of branching.

#### 2.2.2.2. Hamans, Roermond Dutch

Camiel Hamans, considering umlaut a harmony process, analyzes it non-linearly (1985). For Hamans, umlaut is directional harmony, occurring either progressively (as in Sinhalese--[sevel] 'moss', cf. Pali [sevala]) or regressively (as in German). Besides occurring in adjacent syllables, it can also occur in non-adjacent syllables:

(43) computer - compüterke<sup>13</sup>

as well as in more than one syllable (this example, as the one in (43) is from Roermond Dutch):

(44) zahari - zeheren

---

<sup>13</sup> -ke is a diminutive suffix

Umlaut is usually considered a morphological phenomenon, but in Roermond diminutives, it is still phonologically productive. Such words are fronted, and, Hamans claims, the lexical representations need both [-suffix] and [-back] specifications.

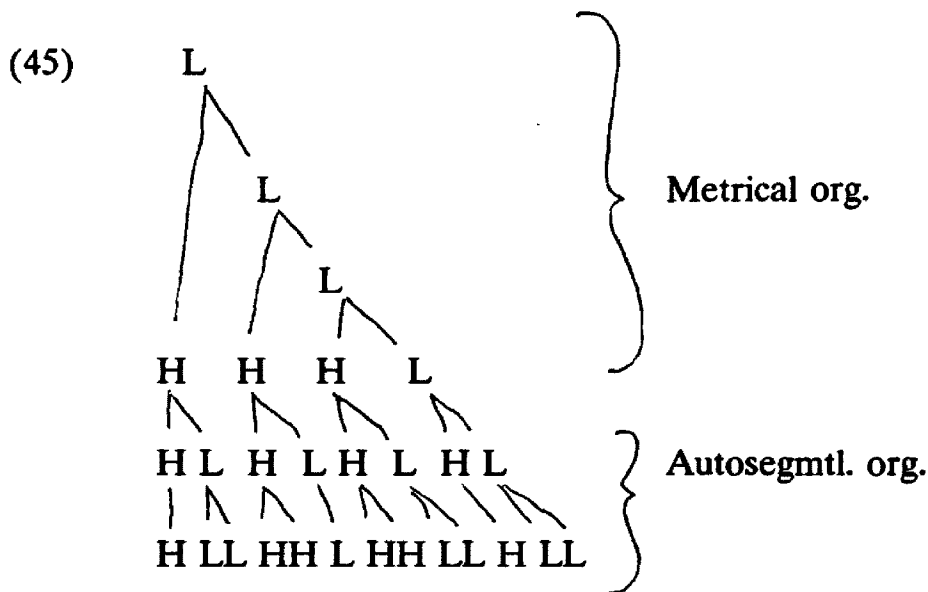
He goes on to state that the strength of metrical representations is that the notion of 'foot' provides a natural domain for vowel harmony.

#### **2.2.2.2.3. Synthesis of Autosegmental and Metrical Representations**

Hamans argues that a regular metrical account cannot adequately describe the need for both a [-suffix] and [-back] specification. As no designated terminal node has the specification [-back], this specification cannot be copied, and cannot percolate down the tree.

Although both metrical and autosegmental representations can stipulate opaque segments, there is no such natural class, Hamans argues. He suggests we either need to state that umlaut occurs in the foot adjacent to the suffix, or that a floating feature ([-back] exists).

An amalgam, he concludes, of the autosegmental and the metrical structures would be best, one similar to Hulst's suggestion for tonal phenomena (1982):



#### 2.2.2.2.4. Merits of two separate methods of vowel harmony analysis

Lieber (1987) argues there is no good reason to use two separate methods of analyzing vowel harmony. If, indeed, she asks, two methods for one process do exist, then how can a child, in producing the language, choose the correct method? She also argues that two different models imply two different types of harmony, and that there is no way to predict which type of harmony is liable to occur.

Therefore, she concludes, all harmony phenomena should be treated in the same manner. The autosegmental model provides the best description, and it is flexible enough to incorporate the different types of harmony processes.

#### 2.3.3. Preservation of vowel harmony

None of the systems examined here are completely predictable. The vowel in the root often serves as a trigger in vowel harmony systems, and in this position is usually stable (unchanging). In one case mentioned by Hock (1991), although the root vowel has remained largely unchanged in Norwegian, the system is no longer predictable due to a reduction of its final vowels (the contrast between high and

mid vowels was neutralized).

A system where final vowels have been lost after the root vowel has harmonized is no longer synchronically predictable. In such a system we often look to morphology for explanation, and the phenomenon is usually termed ‘umlaut.’

Looking at the linear, segmental analyses in section 2.2.1, we can see that these systems are largely predictable. Any exceptions may be incorporated through the use of underlying segments, at times concrete, at others abstract, as well as with additional rules. Other linguists often look at an analysis’ exceptions, try to determine regularity and incorporate them within some representational modification.

The more recent non-linear theories are still incomplete, but the processes of vowel harmony are assumed to be universal, and its principles are frequently used to develop the theories further. As within linear theories, apparent exceptions are carefully examined to uncover any heretofore hidden regularities.

In brief, then, vowel harmony may be phonetically apparent, or it may become clear through the use of phonological or morphological rules. In such cases, vowel harmony has persisted intact over time. If, however, the conditioning environments are lost, we must lexicalize the information, in which case, a learner must simply memorize the form.<sup>14</sup>

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<sup>14</sup>Faulty memorization may lead to new forms. For example, as mentioned in section 1.1.3.2. above, when ‘lice’ is not memorized as the plural for ‘louse,’ the umlauted vowel [i] may be lost, with the new form, ‘louses,’ exhibiting no harmony traces at all.

## Chapter 3

### Latvian Vowel Harmony

In the following sections, I will first describe the language, summarize the existing literature, then offer an analysis of the facts of vowel harmony in Latvian.

#### 3.1. Phonological Facts

##### 3.1.1. Vowels

Latvian has been analyzed as having the following six vowel phonemes:

(1)		front	back
	high	i (:)	u (:)
	mid	e (:)	o (:)
	low	æ (:)	a (:)

The symbol (:) signifies length--this does not seem to affect the alternation of [e] and [æ] (for ex., Latvian has both [ve:rmeles] 'wormwood' and [zemene] 'strawberry'; and [sæ:kla] 'seed' and [sækla] 'shallow' (fem. sg.)).

Strautina argues (see section 3.2.1.) that both [e] and [æ] are phonemes, due to the existence of minimal pairs such as [tsep] 'you bake' and [tæp] 'he bakes' as well as [næsu] 'I carry' and [nesu] 'I carried'.

Latvian also has nine diphthongs. In the following chart, the half-moon subscript indicates lack of syllabicity:

(2) [-back]	[+back]
i̯ɛ	u̯ɪ
i̯æ	u̯o
i̯u	o̯ɪ
e̯ɪ	a̯ɪ
	a̯u

### 3.1.2. Consonants

Below is a chart of phonemically distinctive consonants in Latvian:

#### (3) Consonant Chart

	labial	labio dent	dent	alveo	alveo pal	pal	velar	glottal
Stops	b p		ɖ t			ʃ ç	g k	
Fricatives		v f		z s	ž š	ç		h
Affricates				dz c	ʃ ç			
Nasal	m			n	ɲ			
Liquids				l	ʎ			
(Trill)				r	ɽ <sup>15</sup>			
Semi-vowel					y			

Alveolar consonants are [-back, -high], alveo-palatals are [-back, +high], palatals are [-back, +high], and velars are [+back, +high].

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<sup>15</sup>In contemporary speech, [ɽ] is no longer used. As its constraint is still seen in a preceding front, non-high vowel, in other words, as it patterns with the rest of the palatal and alveo-palatal consonants, I have left it in this chart.

### 3.1.3. Syllable Types

Following is a list of syllable types along with an example of each:

(4)	V	[je.ɒ.gra.fi.ya]	'geography'
	VC	[æ.l.pa]	'breath'
	VV	[a:.ra:]	'outside'
	VVC	[a:r.pra:ɫ]	'madness'
	VVCC	[æ:r.ɫ]	'comfortable'
	CV	[te]	'here'
	CVV	[dʒe:.re:ys]	'drinker'
	CVVC	[me:s]	'we'
	CVVCC	[tæ:fs]	'father'
	CVVCCC	[bæ:rns]	'child'
	CVC	[be:.res]	'funeral'
	CVCC	[dʒimt]	'to be born'
	CVCCC	[kaɪns]	'mountain'
	CVCCC	[sfe:.rɪks]	'spherical'
	CCV	[kli.buɔt]	'to limp'
	CCVV	[slæ:.puɔt]	'to ski'
	CCVCC	[snɪkt]	'to snow'
	CCVCCC	[svelpt]	'to whistle'
	CCVVC	[at.sta:t]	'to leave'

The notation VV here refers to a long V (V:).

The most common syllable forms are CV and CVC. Any of the consonants may be the sole consonant in an onset. The constraints in two-consonant onsets are as follows:

## (5) 2-C Onset Constraint

pl-	pʎ-	pr-	py-							
bl-	bʎ-	br-	by-							
		dr-								
		tr-								
gl-	gʎ-	gr-	gv-	kn-	kñ-	ks-				
kl-	kʎ-	kr-	kv-							
hl-		hr-								
fl-		fr-								
sl-			sv-	sn-	sk-	sm-	sp-	sf-	st-	sʎ-
	šʎ-	šr-	šv-	šñ-		šm-	šp-		št-	šʎ-
			zv-	zn-						
	žʎ-			žñ-						

The first of two consonants in an onset must either be [p], [b], [d], [t], [g], [k], [f], [h], [s], [š], [z] or [ž]. In other words, although the alveo-palatal [š] and [ž] can be the first member of a two-consonant onset, a palatal (either [j], [c] or [ç]) cannot. Other than these, all stops and fricatives (except [v] can occur in this position. In the second position, we can have no [+voi] stops (no [b], [d], [g] or [j]), no [+voi] fricatives except for [v] (no [z] or [ž]) and no [+voi] affricates (no [dʒ] or [tʃ]).

The alveo-palatal [-voi] affricate ([tʃ]) cannot occur in this position, either.

In a three consonant onset, the first C must be an [s], the second a [k], [p] or [t] ([-voi] stops--however, a palatal stop never occurs in this position), and the third is an [r] or [l] (liquids):

## (6) 3-C Onset Constraints

skr- skl- spr- str-

Any vowel (or diphthong) may fill the nucleus, but two immediately neighboring vowels (of different syllables--v.v) are constrained--we never hear a sequence of [æ,e] or [e,æ]. A sequence of [e,e] or [æ,æ] can, however, be found. This



distributional constraint is discussed below.

Most consonants may appear as the single member of the coda, but there are some constraints: of the palatals, only [ʎ], [ɹ] and [y] may appear as the single consonant, and of the alveo-palatals, only the fricatives [š,ž]. Also, [f] may not occupy this position.

The following chart indicates how consonants may occur within a two-consonant coda:

(7) 2-C Coda Constraints

					-by
-rt	-rɛ	-rš	-rs	-rp	
		-ɹš			
		-r̃š			
		-yš	-ys		
-lt	-lɛ	-lš	-ls		
-mt	-mɛ		-ms		-my
			-ns		
			-fs		
-kt	-kɛ		-ks		
-pt			-ps		-py
-st					
		-ʎš			

The first member of a two-consonant coda may be a labial, a nasal, a liquid, [y], or the [-voi] labio-dentals [f], the [-voi] dental [t], or the [-voi] alveolar fricative [s]. The second member of a two-consonant coda may be a [-voi] stop (but not [c] or [k]), a [-voi] alveolar, the palatal [y], or the alveo-palatal [š].

A three consonant coda must begin with [r], [l], [s], [k], [m] or [š]. The second consonant has to be [p], [n], [m], [k] [s] or [c] and the third consonant has to be [ɛ], [t] or [s]:

## (8) 3 C Coda Constraints

-lms	-lms	-lks	-lkt			
		-rks	-rkt			
-rns		-sks		-lpt	-ks̥	
						-lst
					-ls̥	-rst
					-rp̥	-kst
					-šcs	
						-rpt
						-mpt

The three members of a three-consonant coda must be liquids, nasals or [-voi].

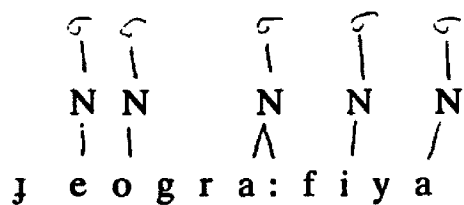
A four-consonant coda may begin with [r]: -rkst.

Liquids, normally consonantal, may, when they appear as the second element in a sequence of three consonants, may be syllabified. Thus, words such as [a:trs] 'fast', [ti:kls] 'web' may be composed of two syllables (i.e., /a:trs/ and /ti:kls/). An example with four consonants is [mæzɡls] 'knot'--here, the /l/ may be syllabified, thus making two syllables: /mæz.ɡls/.

### 3.1.4. Syllable Structure Rules

In building a properly constructed syllable, the nucleus is first isolated, then the onset is created and maximized (keeping in mind the phonotactic rules), and after that, the coda is created and maximized. Below are several examples of this process:

(9) a) Isolate nucleus:

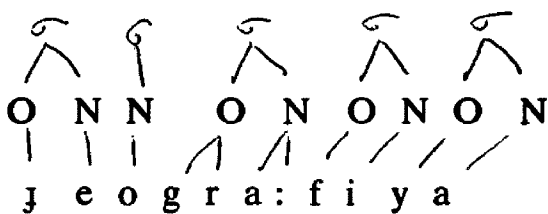


'geography'

b) Create onset:



Maximize onset:

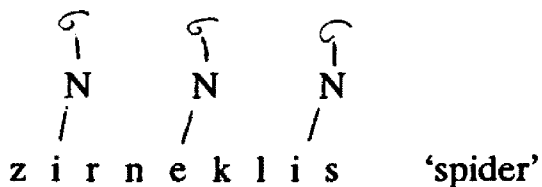


(/gr/ is a proper onset sequence)

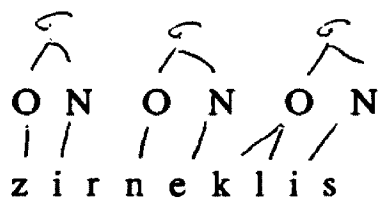
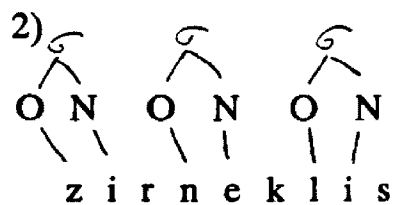
c) Create coda:

N/A = /je.o.gra.fi.ya/

B) 1)



'spider'

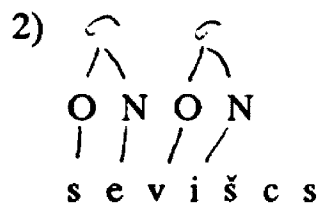
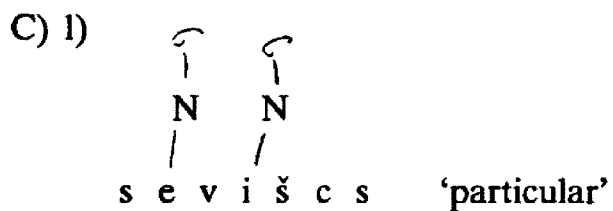


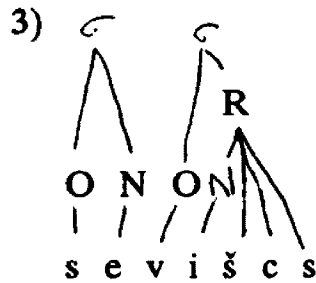
(/rn/ is not a proper onset sequence)

(/kl/ is a proper onset sequence)



= /zir.ne.klis/





= /se.višcs/

### 3.1.5. Harmony

#### 3.1.5.1. Facts

##### 3.1.5.1.1. Distribution

Every vowel, except [æ] and [e], may occur in any position in a word. [æ] and [e] do not occur freely, and some constraints seem to apply. Their distribution indicates that there may be a harmony process at work.

In some words, the surface final vowel is [æ]. This, however, is not the final vowel of the word. Historically, the vowel /a/ appeared as part of the suffix, but /a/ has since been deleted:

(11)	/vesel + as/	[væsæls]	'healthy'
	/be:rn + as/	[bæ:rns]	'child'
	/ret + as/	[ræϕ]	'rare'

The following chart summarizes the basic distributional facts of the vowels of Latvian, (excluding systematic exceptions in the present indicative and past indicative of verbs, as well as two-syllable adverbs--these exceptions are accounted for in section 3.3.3.2.1. below). To devise this chart, I have isolated the vowels in a word, considering them as overlapping pairs (that is, in a word such as [væ:stule]

'letter', [æ,u] and [u,e] have been extracted. The leftmost member of each pair may be referred to as V1 (read vertically on the chart below), while the rightmost member may be referred to as V2 (read horizontally on the chart):

(12) Vowel Distribution Chart (excluding the previously described verbs & adverbs)

		V2					
		i	e	æ	u	o	a
V1	i	+	+	+	+	+	+
	e	+	+	-	-	-	-
	æ	-	-	+	+	+	+
	u	+	+	+	+	+	+
	o	+	+	+	+	+	+
	a	+	+	+	+	+	+

A '+' represents sequences that do occur, a '-' those that do not. Clearly, the only irregularities concern [e] and [æ]--the very ones which alternate in vowel harmony. The generalization is that when V2 is æ, u, o or a, then V1 must be [æ], and when V2 is i or e, then V1 must be [e].

In other words, if the rightmost member of the set of two vowels is [u] ( as in \_Cu), the leftmost member cannot be [e] (\*eCu)--we find only such words as [væ:lu] 'late', [sæ:duot] 'sitting', and [væ:stule] 'letter', not \*ve:lu, \*se:duot, and \*ve:stule.

### 3.1.5.1.2. Examples

Following are some data exemplifying vowel harmony alternations. I have chosen [e] to represent the underlying form of the alternating vowel (see 3.3.3.2.2. below for reasons):

## (13) a) Nouns

/te:v + a/	[tæ:va]	'father's'
/te:v + i + ya/	[te:vija]	'fatherland'
/se:t + a/	[sæ:ta]	'fence'
/se:t + iñ + a/	[se:tiña]	'fence' (dim.)
/ve:st + ul + e/	[væ:stule]	'letter'
/ve:st + i:t/	[ve:sti:t]	'to herald'

## b) Adjectives

/ve:l + u/	[væ:lu]	'late'
/d <sup>2</sup> elten + a/	[d <sup>2</sup> æltæna]	'yellow'
/veʔ + a/	[væʔa]	'old'

## c) Verbs

/red <sup>2</sup> + e:t/	[red <sup>2</sup> e:t]	'to see'
/red <sup>2</sup> + uot/	[ræd <sup>2</sup> uot]	'seeing'
/se:d + i/	[se:di]	'you sit'
/se:d + e: + dams/	[sæ:dæ:dams]	'sitting'
/mel + uot/	[mæluot]	'lying'
consider /mel + is/ >	[melis]	'liar'

The next set shows that when a palatal consonant occurs in a word, the preceding vowel is always [e], never [æ], regardless of the vowel that follows the palatal consonant:

(14) /ʔeʎ + u/	[ʔeʎu]	roads (gen.pl.)
/ʔe:l + u/	[ʔæ:lu]	noble (adj-acc.sg.)
/ey + u/	[eyu]	I go
/esm + u/	[æsmu]	I am
/be:ɣ + a/	[be:ɣa]	bay-horse (gen.sg.)
/be:r + as/	[bæ:rs]	birch

/se:ñ + u/	[se:ñu]	mushrooms (gen.pl.)
/sen + u/	[sænu]	old (gen.pl.)
/več + a/	[veča]	old man (gen.sg.)
/več + a/	[væča]	old (gen.sg.)
/reǰ + u/	[reǰu]	sights (gen.pl.)
/redʒ + u/	[rædʒu]	I see
/mež + u/	[mežu]	forests (gen.pl.)
/med + u/	[mædu]	honey (gen.pl.)
/me:neš + u/	[me:nešu]	moons (gen.pl.)
/debes + u/	[dæbæsu]	skies (gen.pl.)
/dec + u/	[decu]	blankets (gen.pl.)
/sek + u/	[sæku]	consequences (gen.pl.)
/tečnoloǰi + a/	[tečnoloǰiya]	technology <sup>16</sup>

The above includes all the palatal and alveo-palatal consonants (except for /j/, which I could not find).

The following pair shows that [e] and [æ] themselves may induce harmony on a preceding vowel (both these words are adjectives). In other words, in the first example, the suffixal /a/ changes the preceding /e/ to /æ/. Then the newly formed /æ/ changes the preceding /e/ to [æ]:

- (15) /vesel + as/      [væsæls]      'healthy'  
       /vesel + i:k + s/      [veseli:ks]      'healthy'

### 3.1.5.1.3. Domain

All the words cited above consist of stems with or without suffixes. Consider

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<sup>16</sup> This word doesn't indicate much, as all (but a few special exceptions--see Halle & Zeps, section 3.2.2.) borrowed words contain [e], not [æ]. However, this was the only example with palatal ç that I could find.



the following compounds, however:

- (16) a) /pret + stat + s/ 'against + standing'  
           [pretstaɕ]       'opposite'  
       b) /ne + varu/       'not + able to'  
           [nevaru]       'I can't'  
       c) /veča + pilsæ:ta/ 'old + town'  
           [væɕpilsæ:ta] 'old town'

In the first two examples, a particle is added to a noun, while in the last one, an adjective is added to a noun. While appearing to violate vowel harmony, there are no exceptions to the fact that compounds never exhibit harmony between roots. (Each section of a compound, however, contains its own harmony domain.) Therefore, we can state that Latvian vowel harmony progresses from the extreme right of a word to the beginning of the stem and no further--it does not affect prefixes.

### 3.2. Previous Literature

I have not been able to find much research on the Latvian language which has relevance to an analysis of vowel harmony; however, three analyses are summarized below.

#### 3.2.1 Strautina

Strautina based her study, The Phonetics of the Latvian Literary Language (1984), on the Central Dialect. In a consideration of vowels, she found that the operation of the tongue and the lips form the shape and size of the resonating chamber of the mouth, which determines the quality of vowels. Latvian vowels differentiate between three tongue heights: high, mid, and low. There is also a length distinction.

She states the vowel chart is divided into three rows, and that the position of an individual vowel is determined by which part of the tongue rises to the palate.

The front vowels are formed by raising the body of the tongue. The high front vowels are [i] and [i:], which have a narrow resonating chamber. The vowels [e] and [e:] have a mid tongue height, while [æ] and [æ:] are low. These last two vowels have a greatly lowered jaw, and a wide open mouth. There is no rounding in any of these front vowels.

In the back vowels, the back of the tongue is raised to the soft palate, with the jaw moving backward ([u], [u:], [o] and [o:]). The resonating chamber is large in front, small in back. In [u] and [u:] the general tongue height is high, and in [o] and [o:] it is mid. These back vowels are rounded.

What she calls central vowels ([a] and [a:]) are formed by a slight rise in the section of the tongue between the middle and the back, toward the boundary between the hard and soft palates. The lower jaw slides very low, and the mouth is opened widely. The resonating chamber is trumpet-shaped.

Thus, a vowel chart (leaving out diphthongs) would look like this<sup>17</sup> :

(17)	Front	Back
	non-round	round
	high	[i], [i:]      [u], [u:]
	mid	[e], [e:]      [o], [o:]
	low	[æ], [æ:]      [a], [a:]

The phonemes [e] and [æ] are not always distributionally distinguished:

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<sup>17</sup> Strautina uses the symbol [e] instead of [æ] for the low, front, non-round phoneme.

(18)	[næssu]	'I carry'	[nessu]	'I carried'
	[næs]	'you carry'	[nes]	'you carried'
	[t̥æ:la]	'he raised'	[t̥æ:la]	'noble' (acc.sg.)

Thus, Strautina analyzes them as separate phonemes which can differentiate the meanings of words and forms. However, Strautina admits these phonemes do not occur completely freely, but have some positional constraints.

She calls the phenomenon which I term vowel harmony 'regressive distant assimilation,' giving the example (where the [u] constrains the preceding front, non-high vowel to be [æ], not [e]):

(19)	/væ:stul + e/	[væ:stule]	'letter'
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Such positional changes (i.e., regressive assimilation) occur within both the vocalic and the consonantal systems (for example, /g/ becomes [k] in /rag + as/ --> [raks], 'horn').

In another section, Strautina talks about the fronting effect of what she terms palatal vowels ([i] [i:], [e] [e:] and [ie]--these are all [-back]) upon neighboring consonants. In this environment, [k] becomes [t̥], and [g] becomes [dʒ]. In other words, velars are fronted, becoming palatals:

(20)	/si:k + as/	[si:ks]	'tiny'
	/si:k + iñ + s/	[si:t̥iñš]	'very tiny'
	/kuok + as/	[kuoks]	'tree'
	/kuok + el + is/	[kuocelis]	one dim. form of 'tree'
	/draug + as/	[drauks]	'friend'
	/draug + i:b + a/	[draudʒi:ba]	'friendship'

I am including these last examples to show that the vowels [i] and [e] not only operate in vowel harmony, but also in vowel-consonant assimilation.

### 3.2.2 Halle and Zeps

In Halle and Zeps' (1966) survey of Latvian morphophonemics, they posit seven basic rules or rule complexes which they claim determine all the alternations found in Latvian phonology. Unfortunately, this paper does not present arguments for their claims, as it is simply a survey.

The ones most pertinent to a study of vowel harmony are their rules 4 and 2:

- (21) 4. The  $\text{æ}/\text{e}$  rule  
 " / $\text{æ}$ / is narrowed to / $\text{e}$ / before / $\text{i}$ / or / $\text{y}$ /, with or without intervening consonants or glides."
2. The  $\text{i}/\text{y}$  rule  
 "All native instances of  $\text{j}$ ...point to (its) being (a) prevocalic realization of the vowel  $\text{i}$ ...(i> $\text{j}/\text{V}$ )."

The / $\text{j}$ / is taken from Latvian orthography, and is actually the high, front glide [y]. In my subsequent discussion, I shall revert to the more common symbol, glide [y].

Halle and Zeps also assume that / $\text{æ}$ /<sup>18</sup> is the underlying form of the front, non-high vowel [e].

Thus, for the operation of the  $\text{æ}/\text{e}$  rule (#4 in (21) above--  $\text{æ} > \text{e}/\text{i}$  or  $\text{y}$ ), Halle and Zeps cite the following examples:

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<sup>18</sup>Halle and Zeps classify both [e] and [æ] as front vowels.



a), Halle and Zeps claim the original conditions (which did not allow narrowing) have been obscured by metathesis and truncation (for example, #dææl + ai# > dæ:l+ia > dæ:li > [dæ:li] 'sons'). Their survey lists metathesis as rule #5 of the seven phonological rules in Latvian, and states that it is unconditioned, occurring to all appropriate sequences unless specifically blocked. Truncation is rule #6, according to which a vowel is deleted before a morpheme boundary and a vowel, a morpheme boundary and an [s], or before a word boundary:

(25) Rule #6  $V > \emptyset / \_ + \left\{ \begin{array}{l} V \\ S \\ \# \end{array} \right.$

Halle and Zeps mention another exception, [væ:dinat], which they do not explain. However, such a pronunciation is strange to me, as I have only heard this pronounced [ve:dinat], which does not conflict with the rules as set forth by Halle and Zeps.

In case b) (of 24 above), where narrowing has occurred in spite of an apparent lack of the proper environment, Halle and Zeps explain that such words have undergone medial or terminal vowel truncation. For example:

(26)                    #mæt + ti# 'to throw'  
       rule #4            met + ti  
           narrowing  
       rule #6            met + t  
           truncation  
       t > s             mest

Another exception is most loanwords, where the e is narrow, regardless of the following vowel:

- (27) [teçnika]<sup>19</sup> 'technology'  
 [veto:] 'veto'

A few loanwords with, as Halle and Zeps state, special conditions, have a broad

[æ]:

- (28) [æixɛ] 'Eiche'  
 [xærmanis] 'Herman'

They do not explain what these special conditions may be, but possibly they have to do with the pronunciation of the foreign word. Both these examples are proper names which are, at least at present, brought phonetically into Latvian.

In brief, then, Halle and Zeps here use a segmental, linear, rule-based approach to a description of Latvian. They assume underlying segments which subsequent rules adjust to the surface form. Many of Halle and Zeps' rules reflect the history of Latvian (see Berzina-Baltina, 1946), and do not seem to be a synchronic description.

### 3.2.3 Zeps, Metrics of Latvian Folksongs

In this next article, Zeps (1963) makes a metric study of 'trochaic' Latvian folksongs. Although these songs, on the surface, seem to have various meters, an assumption of morphophonemic truncation reveals their underlying regularity. This analysis bears on vowel harmony in Latvian because it demonstrates that the language has lost a suffixal vowel. Reinserting this vowel accounts for many of the exceptions in the vowel harmony system.

Zeps begins by citing the basic make-up of a verse. The 'X's in the following

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<sup>19</sup>Halle and Zeps use the symbol /x/ instead of /ç/ for the voiceless palatal fricative.

example represent syllables--thus, each line of the song is broken up into two sections of four syllables each (the last two of each section are linked by a 'bridge' and followed by a break):

(29)

XXXX	XXXX
XXXX	XXXX
XXXX	XXXX
XXXX	XXXX

Zeps argues that a description of the meter must account for all correct cola, while eliminating all incorrect ones. He finds this cannot be done, however, if the metric syllable is equated with the phonetic syllable.

Many words in the folk-songs occur in two forms, depending on where in the cola they occur. Zeps cites the following forms:

(30)	[dari:t]	‘to do’	active voice
	[dari:ti + e]		middle voice
	[vilk + s]	‘wolf’	nominative singular
	[vilka + m]		dative

He notes that before the truncation rule, ‘dari:ti’/‘dari:t’ and ‘vilka’/‘vilk’ consist of one more syllable than after the rule. When such a word occurs non-finally, either form may be used. The following example uses the forms ‘briest’/‘briesti’ ‘to burgeon’:

(31) briest + i rudzi (XXXX)

According to Zeps, the ‘i’ of the above example does not always appear on the surface, but it counts as a metric syllable, thus making the meter regular.

Zeps further supports this argument by citing the manner of recitation of



trochaic verse. Syllables which have been truncated by morphophonemic rule may be reinserted, although not necessarily with the truncated vowel.

Thus the correct cola, 'vietiña: + x' ('in the place') may be recited as 'vietiña:i.' A form which had not been truncated, such as 'ma:siñas' (sisters), never has an extra vowel added in recitation: \*ma:siñasi.

### 3.3. Possible Analyses

#### 3.3.1. The problem

Considering the above described harmony process, several questions need to be answered--whether [e] and [æ] are, underlyingly, one phoneme and if they are, which is the underlying form; how does the harmony process operate; and what features are involved.

#### 3.3.2. Harmonic Distinction

Before deciding which is underlying, we can extract harmonic sets from the examples in 3.1.5.1.2. (11) and (12):

(32)

Set 1	Set 2
i	u
e	o
	æ a

Except for [æ], the distribution is that of a [-back] set and a [+back] set of vowels. The problem is that [æ] is a front vowel, yet patterns with the back vowels (i.e., patterning with (inducing) [æ] in V1 position (as in /vesel + as/ [væsæls] 'healthy,'

/se:de:dams/ [sæ:dæ:dams] 'sitting'<sup>20</sup>). The Latvian [æ] is pronounced slightly forward in the mouth (with the jaw slid forward), not more centrally as in English.

Both Strautina (above 3.2.1.) and Malmberg (in his text on physiological phonetics--1963) describe front vowels as those where the tongue articulates toward the hard palate. However, they differ as to exactly which vowels are front (Strautina--/i/, /e/ and /æ/; Malmberg--/a/, /æ/, /e/ and /i/).

The low vowel /a/, then, for Malmberg is a front vowel. He goes on to describe back vowels as those where the back of the tongue rises toward the soft palate. In forming the Latvian [a], the tongue seems to rise not to the hard palate, but behind this, to the soft palate. Therefore, it seems reasonable to assume [a] to be a back vowel. Also, in almost all languages, a is assumed to be [-back].

Strautina's claim that, in producing [æ] the tongue rises toward the hard palate, seems debatable. More scientific evidence is necessary, but it seems to me that the back of the tongue may rise rather to the soft palate, and so a case might be made for positing that [æ] is a back vowel. (As the feature [+back] means that the vowel is not front, it can refer to a central vowel. The preceding paragraph suggests, then, that [æ] may be central.)

### 3.3.3. Analytic Approaches

In analyzing Latvian vowel harmony, three possible approaches can be taken, positing 1) that both /æ/ and /e/ are separate phonemes; 2) /æ/ underlies [e]; and

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<sup>20</sup> To be consistent, my underlying forms use /e/. For reasons, see 3.3.3.2.2. below.

3) /e/ underlies [æ]. I will first set each out, then evaluate all three.

### 3.3.3.1. Two phonemes

The first approach is to argue, as Strautina does, that [e] and [æ] are separate phonemes. Minimal pairs such as [t̥ep] ‘you bake,’ [t̥æp] ‘he bakes,’ and [nesu] ‘I carried,’ [næsu] ‘I carry’ can be found to support this assumption. However, besides these minimal pairs with contrasting [æ] and [e], many words in Latvian show complementary distribution of these two sounds. Sets such as [tæ:va] ‘father’ gen. sg. -- [te:viya] ‘fatherland’; [pældu] ‘I swim’ -- [peldi] ‘you swim’ are common, which shows that [æ] is followed by the back vowels [a] or [u], while [e] is followed by the front vowel [i]. These regularities are, according to the separate phoneme approach, totally fortuitous. The fact that the minimal pairs may be accounted for by synchronic rules such as final vowel elision (i.e., [t̥æpa] > [t̥æp]) in certain classes of verbs, or by historical rules (see below) is irrelevant. Strautina also cites an example ([nesu] ‘I carried’) from the past tense. If /æ/ and /e/ are accepted as separate phonemes, no explanation of the appearance of [e] is necessary.

However, the entire past indicative tense has [e] where we would expect to see [æ] (i.e., before a following back vowel):

(33)	/met + u/	[metu]	‘I threw’
	/met + a:m/	[meta:m]	‘we threw’
	/t̥ep + u/	[t̥epu]	‘I baked’
	/t̥ep + a:m/	[t̥epa:m]	‘we baked’

Actually, the past indicative has changed over time--[metu] ‘I threw’ and [meta:m] ‘we threw’ were originally \*mešu and \*mete:m (Berzina-Baltina:1946). Berzina-

Baltina states this was the pattern for all original past forms.

This may be described synchronically with a word formation rule, stating that past indicative verbs contain [e], not [æ].

To summarize this section, the only evidence which Strautina offers to support the separate phoneme approach is the existence of certain minimal pairs.

However, in many other cases, the sounds [e] and [æ] seem to be in complementary distribution and completely predictable. Where they are not predictable, synchronic rules may be formulated to account for exceptional forms. Positing separate phonemes misses this generalization.<sup>21</sup>

### 3.3.3.2. Underlying phoneme

The next two approaches both assume that the two alternating vowels are allophones of one another, in complementary distribution--[tæ:va] ‘father’s’ [te:viya] ‘fatherland.’ In one analysis /æ/ is posited as being the underlying sound, and in the second analysis /e/ is posited as underlying.

#### 3.3.3.2.1. Underlying /æ/

Halle and Zeps (1966), in their survey of Latvian morphophonemics, assume [æ] is underlying, and that all instances of [e] may be derived. Although they do not motivate this choice very clearly, all their rules support it.

In the remainder of this section, I will discuss some possible motivations for positing an underlying /æ/.

Burwell (1970), in his study of Old Prussian (an ancestor of the Latvian

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<sup>21</sup> Halle, in his articles on Latvian declension (1987 and 1991) seems to adhere to the separate phoneme approach, and does not address this apparent predictability of [æ] and [e].

language) vocalic phonemes, states that short, stressed /æ/ was raised to close /e:/ when it occurred in a stressed, open syllable. His vowel chart shows that at this point, no short /e/ existed (Burwell uses the symbol ‘e’ to represent both [e] and [æ], but their position in his vowel chart clarifies his meaning). As Burwell’s symbols are not phonetic, I add these in b:

(34)	a)		b)	
	i	u	[i]	[u]
	e	o	[e:]	[o]
	e	a	[æ]	[a]

The existence of /æ/ but not underived /e/ in Old Prussian seems to support the choice of /æ/ as underlying.

The data in (11) and (12), section 3.1.5.1.2. above are repeated below.

Looking at this data, two basic phonetic environments for the alternation of /æ/ and /e/ appear. In the first case, [æ] is followed by a [+back] vowel, while in the second, [e] is followed by either a [-back] vowel or a palatal consonant (the underlying forms are shown with phonemic /e/):

(35) a) Nouns

/te:v + a/	[tæ:va]	‘father’s’
/te:v + i + ya/	[te:vija]	‘fatherland’
/se:t + a/	[sæ:ta]	‘fence’
/se:t + iñ + a/	[se:tiña]	‘fence’ (dim.)
/ve:st + ul + e/	[væ:stule]	‘letter’
/ve:st + i:t/	[ve:sti:t]	‘to herald’

## b) Adjectives

/ve:l + u/	[væ:lu]	'late'
/dʒelten + a/	[dʒæltəna]	'yellow'
/veɫ + a/	[væɫa]	'old'

## c) Verbs

/redʒ + e:t/	[redʒe:t]	'to see'
/redʒ + uot/	[rædʒuot]	'seeing'

/se:d + i/	[se:di]	'you sit'
/se:d + e: + dams/	[sæ:dæ:dams]	'sitting'

/mel + uot/	[mæluot]	'lying'
consider /mel + is/ >	[melis]	'liar'

(36) /ɫeɫ + u/	[ɫeɫu]	roads (gen.pl.)
/ɫe:l + u/	[ɫæ:lu]	noble (adj-acc.sg.)

/ey + u/	[eyu]	I go
/esm + u/	[æsmu]	I am

/be:r + a/	[be:ra]	bay-horse (gen.sg.)
/be:r + as/	[bæ:rs]	birch

/se:n̄ + u/	[se:n̄u]	mushrooms (gen.pl.)
/sen + u/	[sænu]	old (gen.pl.)

/več + a/	[veča]	old man (gen.sg.)
/veɫ + a/	[væɫa]	old (gen.sg.)

/reĵ + u/	[reĵu]	sights (gen.pl.)
/redʒ + u/	[rædʒu]	I see

/mež + u/	[mežu]	forests (gen.pl.)
/med + u/	[mædu]	honey (gen.pl.)

/me:neš + u/	[me:nešu]	moons (gen.pl.)
/debes + u/	[dæbæsu]	skies (gen.pl.)

/dec + u/	[decu]	blankets (gen.pl.)
/sek + u/	[sæku]	consequences (gen.pl.)
/teçnoloĵi + a/	[teçnoloĵiya]	technology

Below are representations for the two cases of alternation of /æ/ and /e/ seen above:

(37) a)  $\begin{array}{c} \text{æ} \quad \text{C} \quad \text{V} \\ | \quad \quad | \\ \left[ \begin{array}{l} +\text{lo} \\ -\text{back} \end{array} \right] \quad \left[ +\text{back} \right] \end{array}$  for example, [tæ:va] 'father's'

b)  $\begin{array}{c} \text{e} \quad \quad \text{V} \\ | \quad \quad | \\ \left[ \begin{array}{l} -\text{lo} \\ -\text{back} \end{array} \right] \quad \left[ -\text{back} \right] \end{array}$  for example, [veʎis] 'old man'

If [æ] is underlying, then we can posit a vowel harmony rule in terms of a raising to [e] before a following [-back] element. This [-back] element may be either a vowel or a palatal or alveo-palatal consonant (/væʎ+is/ [veʎis] 'old man', /tæʎ+a/ [tʎeʎa] 'road' gen.sg.). In order to isolate the correct natural class of consonants, the feature [+high] must be specified in the following vowel harmony rule:

(38) a)  $\begin{array}{c} \text{æ} \rightarrow [\text{e}] / \_ \text{C} \quad \text{V} \\ | \quad \quad | \quad \quad | \\ \left[ -\text{back} \right] \quad \left[ -\text{lo} \right] \quad \left[ \begin{array}{l} -\text{back} \\ -\text{lo} \end{array} \right] \end{array}$

b)  $\begin{array}{c} \text{æ} \rightarrow [\text{e}] / \_ \text{C} \quad \text{V} \\ | \quad \quad | \quad \quad | \\ \left[ -\text{back} \right] \quad \left[ -\text{lo} \right] \quad \left[ \begin{array}{l} -\text{back} \\ +\text{high} \end{array} \right] \end{array}$

If a [-back, +high] consonant intervenes between vowels, the /æ/ is raised, no matter what the following vowel is.

The following words seem to exhibit unmotivated instances of [æ], and would thus support the premise that /æ/ is the underlying sound:

- (39) a) [tæ:fs] 'father'  
 [læ:zæns] 'shallow'  
 [ræd<sup>z</sup>æ:ç] 'seen'
- b) [læ:ni] 'slowly'  
 [ræti] 'rarely'
- c) [çæp] 'he bakes'  
 [mæt] 'he throws'
- d) [mæ:] a call to an animal  
 [bæ:] a call to an animal  
 [sæ:] a call to an animal

The words in (39a) seem to have no conditioning environment. However, if we admit historical information, both Baltina-Berzina (1946) and Halle and Zeps (1966) write about such changes as deletion of a certain vowel as well as metathesis. Taking these historical rules into account in the underlying forms, the conditioning environment does, in fact, exist, and vowel harmony is completely regular:

(40) Historical Suffixal Vowel Deletion

a) Nouns

/tæ:v+as/	[tæ:fs]	'father'
/bæ:rn+as/	[bæ:rns]	'child'

b) Adjectives

/læ:zæn+as/	[læ:zæns]	'shallow'
/d <sup>z</sup> æltæn+as/	[d <sup>z</sup> æltæns]	'yellow'

c) Verbs

/ræd <sup>z</sup> æ:t+as/	[ræd <sup>z</sup> æç]	'seen'
/izjæ:rpt+as/	[izjæ:rç]	'undressed'



## Historical Metathesis

### d) Adverbs

/læ:n+ai/	[læ:ni]	'slowly'
/ræt+ai/	[ræti]	'rarely'

The exceptions in (39c) ([tæp] 'he bakes' and [mæt] 'he throws') may also have been historically derived. (That is, present verbs such as [tæp], [tɛp] have historically lost their conditioning vowels, -a and -i resp.) If we assume that an underlying form of [tæp] is /tæp + a/, and an underlying form of [tɛp] is /tæp + i/, then vowel harmony is regular, and these verbs do not contain underived instances of [æ].

At this point, we are left with only three truly underived instances of [æ]-- [mæ:], [bæ:], and [sæ:] (listed in (39d)). These are very rare words (Berzina-Baltina), apparently ancient rural calls to animals (i.e., the cow, the sheep, and possibly the pig).

In every Latvian final suffix, any vowel but [æ] may appear. Of the two alternants, [æ] and [e], only [e] seems to appear in the final syllable of a word.

Following are some examples:

(41)	/se:n + e/	[se:ne]	mushroom (fem.sg.)
	/puc + es/	[puces]	flowers (fem. pl.)
	/zvaigzn + e:m/	[zvaigzne:m]	to/for the stars (fem.pl.dative)

A variant form of the nominal dative form may sometimes be heard<sup>22</sup>(for now, this form is shown with an underlying /iæm/):

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<sup>22</sup> Although Halle assumes this form (1987), I have not been aware of its usage. Before any statement of its distribution can be made, further investigation is necessary.

- (42) /tæ:v + iæm/ variant [tæ:viæm] instead of [tæ:viɛm] ‘for fathers’  
 /ab + iæm/ variant [abiæm] instead of [abiɛm] ‘for both’

I can find no rule, historical or synchronic, which might account for this phenomenon.

In other words, the [æ] in example (42) above seems underived. If these pronunciations are indeed common, then this fact would seem to support the choice of /æ/ as the underlying phoneme.

As the suffixal vowel in the above examples (41) cannot be accounted for by any raising, a phonotactic constraint must be posited, that only [e] may appear in suffixes. (It must be remembered, however, that [æ] may appear in the nominal dative plural suffix, as shown in (42) above, although this must be verified.)

Halle (1987) has posited the diphthong /iæ/ in infinitives (such as in /siæt/ [siæt] ‘to bind’), as well as in the nominal dative plural cited above. Halle and Zeps (1966) gave the historical form of [siæt] as \*siæti. If the pronunciation [iæ] is correct in this form, then, either we have a historical violation of vowel harmony, or the diphthong /iæ/ does not participate in vowel harmony. This would tend to support an underlying /æ/. I have only heard this pronounced [siɛt], which follows vowel harmony rules (as the historical form was \*siɛti).

A small set of undeclinable, single-syllable words exists, where no conditioning suffix seems recoverable. This aberrant set commonly occurs in other languages, and the words belong to several grammatical categories:

## (43) a) Adverbs

[sen]	'long ago
[bez]	'without'
[pret]	'against'
[zem]	'under'

## b) Conjunction

[bet]	'but'
-------	-------

## Particle

[ne]	'not'
------	-------

## c) Pronouns

[me:s]	'we'
[es]	'I'

The above words (in (43)) never have suffixes attached, so that a proper conditioning environment never appears, and we cannot motivate the appearance of [e] on the surface. The existence of these underived instances of [e] would seem to contradict an assumption of an underlying /æ/.

**3.3.3.2.2. Underlying /e/**

It is also possible to posit the underlying form /e/, in which case all instances of [æ] may, through either diachronic or synchronic rules, be predicted. The phonological motivation for this choice is the existence of the final set of undeclinable words listed in (43) above. In these examples, [e] cannot be derived from an underlying /æ/. Another motivation is that all suffixes in Latvian seem to have [e] instead of [æ] (keeping in mind the possibility of suffixal [-iæm] cited by Halle).

Other support for underlying /e/ is that, almost without exception, "recent" foreign borrowings (such as [tea:trs] 'theater,' [jeolojiya] 'geology') have [e] when we would expect to hear [æ] because of the following [+back] vowels.

The data in 3.1.5.1.2. (11) and (12), repeated below, demonstrate the pattern of alternation of [æ] and [e]. We can also see that alveo-palatal and palatal consonants (all of which are [+high, -back]) always pattern with a preceding [e], never [æ]:

(44) a) Nouns

/te:v + a/	[tæ:va]	'father's'
/te:v + i + ya/	[te:vija]	'fatherland'
/se:t + a/	[sæ:ta]	'fence'
/se:t + iñ + a/	[se:tiña]	'fence' (dim.)
/ve:st + ul + e/	[væ:stule]	'letter'
/ve:st + i:t/	[ve:sti:t]	'to herald'

b) Adjectives

/ve:l + u/	[væ:lu]	'late'
/d <sup>2</sup> elten + a/	[d <sup>2</sup> æltæna]	'yellow'
/veç + a/	[væça]	'old'

c) Verbs

/red <sup>2</sup> + e:t/	[red <sup>2</sup> e:t]	'to see'
/red <sup>2</sup> + uot/	[ræd <sup>2</sup> uot]	'seeing'
/se:d + i/	[se:di]	'you sit'
/se:d + e: + dams/	[sæ:dæ:dams]	'sitting'
/mel + uot/	[mæluot/	'lying'
consider /mel + is/ >	[melis]	'liar'

(45)

/t̥eʌ + u/	[t̥eʌu]	roads (gen.pl.)
/t̥e:l + u/	[t̥æ:lu]	noble (adj-acc.sg.)
/ey + u/	[eyu]	I go
/esm + u/	[æsmu]	I am
/be:r̥ + a/	[be:r̥a]	bay-horse (gen.sg.)
/be:r + as/	[bæ:rs]	birch
/se:n̄ + u/	[se:n̄u]	mushrooms (gen.pl.)
/sen + u/	[sænu]	old (gen.pl.)
/več + a/	[veča]	old man (gen.sg.)
/več + a/	[væča]	old (gen.sg.)
/reǰ + u/	[reǰu]	sights (gen.pl.)
/red <sup>Z</sup> + u/	[ræd <sup>Z</sup> u]	I see
/mež + u/	[mežu]	forests (gen.pl.)
/med + u/	[mædu]	honey (gen.pl.)
/me:neš + u/	[me:nešu]	moons (gen.pl.)
/debes + u/	[dæbæsu]	skies (gen.pl.)
/dec + u/	[decu]	blankets (gen.pl.)
/sek + u/	[sæku]	consequences (gen.pl.)
/teçnoloǰiy + a/	[teçnoloǰiya]	technology

The problem in describing this phenomenon is that it is unclear which feature is spread. We might describe [e] as [-low], and state that it becomes [+low] before a following back vowel. But [e] also becomes [æ] before a following front [æ] (as in /veselas/ [væsæls] ‘healthy.’)

Since [æ] patterns with the back vowels, yet is apparently itself a front vowel, it is difficult to set up a cohesive natural class. Perhaps it would be better to set up a class that is the complement of the set [-back, -low] (i.e., [i] and [e]). In this





the final two vowels (to *læ:nia* and *rætia*)-(-see section 3.2.2.), and then, perhaps as Latvian has no mono-syllabic (diphthong) /ia/, the final /a/ was deleted, leaving the forms as at present--[*læ:ni*] and [*ræti*]. Berzina-Baltina simply states that forms such as \**læ:nai* and \**rətai* existed.

Thus, under an analysis positing /e/ as underlying, vowel harmony must be ordered before metathesis, when the suffixal /a/ spread its [-A] to the preceding /e/, forming \**læ:nai* from /*le:n + ai*/ and \**rətai* from /*ret + ai*/. The order of rules should be vowel harmony, metathesis, then vowel deletion. The same rule order is supported by the derivation of [*tæ:fs*] ‘father’: /*te:v + as*/ > /*tæ:vas*/ > /*tæ:vs*/ > [*tæ:fs*] (the /v/ becomes [f] in a consonant assimilation).

Assuming /e/ to be underlying, we must explain exceptions such as [*tæ:vi*] ‘fathers’ and [*væ:ʔi*] ‘old’ (an entire class of masculine nominative plural nouns as well as nominative plural adjectives).

Such nouns and adjectives have undergone morphological leveling--that is, they were historically pronounced in accordance with the rules of vowel harmony as above stated (for example, \**te:vi* instead of the present [*tæ:vi*]). These plural forms are no longer pronounced in this way. In certain classes of nouns and adjectives, the root vowel of the plural forms remains the same as that in the singular paradigm (i.e., leveling by analogy to the singular paradigm took place):

(52) /*te:v+i*/    \**te:vi* ---> [*tæ:vi*]

Nom. sg. *tæ:fs*  
 Gen. sg. *tæ:va*  
 Dat. sg. *tæ:vam*  
 Acc. sg. *tæ:vu*



/veɫ+i/    \*veɫi    ---> [væɫi]

Nom. sg. væɫ  
 Gen. sg. væɫa  
 Dat. sg. væɫam  
 Acc. sg. væɫu

### 3.3.3.3. Evaluation of the three analytic approaches

The simplest of the three approaches is the first one. If we posit that /e/ and /æ/ are separate phonemes, we do not need to give any reason for their alternation. A statement of their distribution, along with their constraints, would be enough. There are indications, however, that such a claim is not entirely warranted. Fromkin and Rodman, in their introductory text (1988), state that the determining factor in deciding whether two sounds are different phonemes is that both a change in pronunciation and a change in meaning occur (p. 81). Strautina's minimal pairs exhibit both characteristics. However, in many cases, the pronunciation of the vowel does not affect the meaning of the word. For example, both [væ:stule] and [ve:stule] would be understood by a native speaker to refer to 'letter.' A similar phenomenon occurs throughout the language, except in a limited number of word classes (such as the ones cited by Strautina). Positing that /e/ and /æ/ are separate phonemes ignores this semantic fact. Also, such a claim misses the generalization that their distribution is regular, and that the sound which will appear can usually be predicted. In its favor is that this analysis relies solely on synchronic information, without having to look elsewhere in order to motivate any alternation. However, it seems crucial that a contrast in both pronunciation and meaning must occur for sounds to be considered separate

phonemes. The fact that this does not occur in so many different instances in Latvian would seem to argue convincingly against this hypothesis.

The second approach posits /æ/ as the underlying phoneme. In this way, apparently underived instances of /æ/ (such as [tæ:vi] 'fathers' and [tæp] 'he bakes' are accounted for. It is weakened, however, by the fact that I could find only three rarely-used words which have an underived surface [æ], (although a possibly underived [æ] appears in the nominal dative plural suffix diphthong as in [tæ:viæm] 'for fathers.')

I have also been unable to motivate the [e] appearing in words such as [sen] 'long ago' and [bet] 'but.'

This analysis relies heavily on diachronic information to explain unexpected occurrences of [æ] and [e]. Exceptions to the harmony rule, such as [metu] 'I threw,' (instead of \*[mætu]), can only be accounted for synchronically by positing an arbitrary word-formation rule (such that past indicative verbs have [e], not [æ]). However, Halle and Zeps did choose to posit an underlying /æ/, and resorted to a considerable use of historical rules in their analysis (rules such as metathesis and truncation).

An advantage of choosing underlying /æ/ is that it allows us to formulate a harmony rule in terms of raising--[+low] /æ/ becomes [-low] [e] in certain circumstances. Two rules as well as a phonotactic constraint are necessary: 1) dealing with following vowels (/æ/ is raised to [e] before a following [-low, -back] vowel ([i] or [e] in words such as /væɕ + is/ [veɕis] 'old man'); and 2) dealing with following consonants (/æ/ is raised to [e] before following [-back, +high]

consonants--that is, before palatal or alveo-palatal consonants--such as in /t̪æ/ + a/ [t̪e/ta] 'road' gen.sg.; as well as 3) a constraint to account for suffixes containing [e], not [æ]. If Halle's claim (1987) of -iæm as the nominal dative suffix is verified, the assumption of underlying /æ/ is strengthened, as [æ] in this position seems underived. That [e] rather than [æ] appears in all other suffixes would then need an explanation--vowel harmony would not account for it.

The third approach, which I favor, is to posit /e/ as underlying. There seems to be more justification for this choice, as the set of words with underived [e]'s (such as in [sen], [bet], etc.) is larger, and more commonly used than the rural animal calls cited above (in 39c). As all suffixes also contain [e] rather than [æ], and as foreign words enter Latvian with [e] and never [æ], the choice of underlying /e/ is supported. However, this approach, like the previous one, also relies heavily on diachronic rules (such as suffixal vowel deletion and metathesis) to provide the environment for the e -> æ rule.

A crucial disadvantage of this choice is that there is no natural class to which the two alternative vowels belong (that is, the back vowels [u], [o] and [a] as well as the front [æ] do not comprise any natural class, whereas the front vowels [i], [e] and [æ] do). Either the usual classification of [æ] as a front vowel must be questioned, or else complement sets must be set up.

The question of historical motivation for a phoneme underlying [e] and [æ] is complicated. Schmalstieg (1976:110) states that in Old Baltic (between Early and Late Baltic) [æ:] was created as a result of "apophonic and perhaps other reasons".

He also seems to state that /e/ in both long and short variants existed at that time, as well as short /æ/. He explains that the historical record is not very clear, mainly because Baltic linguists often deal with written, dead languages, and it is unclear how they were pronounced.

For these reasons, I do not believe that we can resort to a 'historical' original /e/ or /æ/, and we need to find other justification.

## Chapter 4

### Conclusion

In my foregoing analysis, I have tried to discover two main things: why [æ] patterns with the back vowels in the harmony system, and exactly how this system operates. Another question which has arisen is whether using historical facts is justified in a synchronic analysis.

When learning a language, a child does not normally have access to historical rules--all he has to deal with is the language as spoken at the present time--i.e., synchronic data. Strautina's analysis, positing two separate phonemes, is completely synchronic, but it is weakened by missing the harmonic generalization. (However, knowledge of this generalization aids greatly in pronunciation of Latvian.) Her analysis is also weakened by the fact that /e/ and /æ/ often do not semantically contrast. Both the analysis positing underlying /æ/ and the analysis positing underlying /e/ rely rather heavily on historical rules, but they do account for the regular alternation of the two sounds.

Further investigation is necessary to determine exactly what feature is spreading in Latvian vowel harmony, and perhaps verify that [æ], in Latvian, truly is [-back] (although it patterns with the back vowels). Investigation will also elucidate the status of the nominal dative plural suffix, -iæm--if the diphthong does contain [æ], then my argument that the suffixes support the choice of an underlying /e/ is seriously weakened.

Cross-linguistically, [back] is a common spreading feature--Aoki (see Section 2.1. above) terms this type of harmony Palatal. It is interesting that in Latvian, palatal and alveo-palatal consonants seem to participate in this harmony. The direction of harmony (right to left) as well as the domain (from suffixes inward to the root, and not beyond) are commonly found in languages which have vowel harmony.

Violations of the harmony system may be explained in several different ways. if we do not refer to historical rules, the autosegmental model allows us to prespecify (or lexically link) the proper vowel; however, the anomalous behavior is not really explained by this. Perhaps any explanation should incorporate a reference to morphology, as most violations do fall into definite grammatical classes. (Morphological vowel harmony is usually termed 'umlaut.')

Due to limitations of knowledge and time, however, I have had to resort to historical rules.

In his article on Latvian morphophonemics published in 1987, Halle used synchronic word-formation, metathesis, and assimilation rules to account for the discrepancies between the surface and the underlying representations of Latvian words. The question I have raised within Chapter 3 as to whether or not /iæ/ does indeed appear in the surface form [siæt] 'to bind' (as well as whether its distribution is free or limited), needs further investigation.

In a later article (1991), Halle posits what he calls 'abstract morphemes' with stem-associated diacritics. These diacritics determine the phonetic features of the 'Theme Vowel' (i.e., according to Halle, a Latvian noun is made up of the stem

plus theme vowel, plus the number or case ending: /veɫ + i + s/ [veɫis] 'old man' nominative singular; sɛ:t + a: + m/ [sɛ:ta:m] 'fence' dative plural). An analysis of Latvian vowel harmony using such abstract stem morphemes as well as diacritics may better elucidate the regularities of harmony mentioned in Chapter 3 above.

By studying the facts of Latvian vowel harmony, and the history of the language, it is clear that at one time vowel harmony was much more prevalent and productive. Today, new words are either formed as compounds (I have shown how vowel harmony does not cross the boundaries between halves of compounds), or borrowed from other languages. These borrowed words do not participate in vowel harmony. It seems as though vowel harmony as a process has become frozen in Latvian, and may, also, be eroding. I suggest this for several reasons-- morphological leveling in some entire paradigms has occurred, thus cancelling the effects of vowel harmony; conditioning environments have often been lost (perhaps due partly to dialect or language mixture); the fact that new words enter the language almost without exception with /e/; and also a contemporary sociolinguistic fact--the speech of young Latvian bilinguals (at least in America) more and more often contains [e] where [æ] used to be heard. Short, often-used words such as [tæ:fs] 'father' and [væ:ls] 'late' are pronounced uniformly. However, increasingly, multi-syllabic words such as [væ:stule] 'letter' (which seems, according to vowel harmony, to require a [æ]), are pronounced with [e], as [ve:stule]. It would seem worthwhile to study the speech of Latvian-Americans of various age groups, to determine what is really going on.

It would also be interesting to contrast Latvian-American speech with that of Latvians residing in Latvia, as well as in other countries. Latvian newspapers and journals write often of the "contamination" of the language from Russian, but the same thing must be happening with Latvian speech in Germany, France, etc. Further investigation is possible as to whether, or to what degree, these other languages may be affecting vowel harmony in Latvian.



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