ELSEVIER

Lingua 108 (1999) 247–268

Lingua

www.elsevier.nl/locate/lingua

A feature geometric description of Finnish vowel harmony covering both loans and native words☆

Riitta Välimaa-Blum

University of Lille 3/Centre National de la Recherche Scientific (CNRS), ESA 7018, P.O. Box 149, 59653 Villeneuve d'Ascq, France

Received 3 July 1998; revised version 1 December 1998

Abstract

Loanwords sometimes pose problems for phonological rules which otherwise cover the native vocabulary in the language. Finnish vowel harmony is a case in point. The native vocabulary is governed by a clear set of regular harmony rules for both roots and suffixes. Long loanwords, however, be they harmonic or disharmonic, typically manifest free variation in the suffixes. The existence of inter and intraspeaker suffixal variation has been well documented in both introspective studies and written experiments. In this paper, we use experimental evidence from spoken language to establish that one and the same individual indeed manifests free variation in loans. To account for this variation, we use the feature geometry of autosegmental phonology, with separate tiers for the coronal and dorsal vowels. It is further proposed that a general precedence constraint assigns primacy to the value [dorsal] in the spreading process, which precedence is absolute in the native vocabulary. In loanwords, this stipulation is suspended, and the autosegmental spreading can take place freely from one vowel place tier or another. This freedom is only restricted by the exclusively local nature of coronal spreading, which is inherently present in the native vocabulary as well. Which value actually spreads in any given word and at any given moment probably depends on factors such as rhythm, speaking style, information structure and the rate of speech.

☆ I wish to express my gratitude to Nick Clements at the CNRS in Paris for his generous comments on a draft of this paper. I also thank Joel Nevis at the University of Hong Kong for discussing the early stages of this study with me. I am grateful to David Odden at The Ohio State University for answering my overseas queries about vowels and wine. Thanks are due as well to the anonymous reviewers of *Lingua*, whose comments helped me clarify several points. All potential misconceptions remain my own. I would also like to thank the following members of the technical staff at Université de Lille 3 for assistance with the computers: Jean-Claude Desruque, Daniel Hazebrouck, Erwan Le Morvan, Jean-Yves Schonseck and Patrice Théry.

* Phone: +33 3 20 47 8030; E-mail: blum@univ-lille3.fr

0378-2166/99/$ – see front matter
PII: S0024-3841(99)00003-0

Keywords: Vowel harmony; Feature geometry; Finnish

1. Introduction

Finnish has eight vowels, each occurs as phonemically short and long, and there are also eighteen diphthongs, which are not unitary but sequences of two single vowels. Primary stress is always on the first syllable of the word, and after that, there is secondary stress on, roughly, all odd numbered syllables, especially it they are heavy. Finnish is a synthetic language where words can be very long due to derivational and inflectional suffixing, but native roots are characteristically disyllabic. The vowels can be organized as follows from the harmonic point of view:

(1)

FRONT		BACK
neutral	harmonic	harmonic
i	y	u
e	ø*	o
	æ*	ɑ*

* Orthographically, [ɑ] is written with {a}, [æ] with {ä} and [ø] with {ö}. The orthography of Finnish being phonological, the examples below can be pronounced as they are spelled.

There are two parts to Finnish vowel harmony, root harmony and suffix harmony. In a native root, vowels from the two harmonic sets never co-occur while the neutral vowels combine with any vowel, and they can also appear alone in a root. That there is a phonological constraint excluding the co-occurrence of the two harmonic sets in the same root can be seen from the difficulty native speakers can have when pronouncing disharmonic loans. For example, a word such as *olympialaiset* 'Olympics' is often pronounced with an /u/ replacing the /y/, *olumpialaiset*, thus making the word harmonic. The capital of Korea in Finnish, *Söul*, is seldom *Söul* but rather *Soul* or *Söyl*. And *kysta* 'cyst' may become *kystä*. So there is strong pressure to make disharmonic words conform to the native pattern of root harmony.

Suffix harmony, which the native vocabulary also follows strictly, stipulates that if the root has even one back vowel, the suffix vowel has the same value, and otherwise the suffix has a front vowel. The neutral vowels do not participate in the suffixal harmony. The following examples illustrate the workings of root and suffix harmony:

(2)

Root vowels	*Suffix vowels harmonize*
Only neutral:	peili+ssä 'in the mirror'
Only front harmonic:	syövä+stä 'of cancer'
Only back harmonic:	kuokka+na 'as a hoe'
Neutral + front harmonic:	isä+llä 'with father'
Neutral + back harmonic:	kesto+a 'of duration'

Loanwords may violate root harmony and can therefore have vowels from both harmonic sets. In the following examples, the first two have harmonic back vowels

before the harmonic front vowels, and in the third, this order is reversed, and the harmonic back vowel follows the front /y/.

(3) katalyysi 'catalysis'
konduktööri 'ticket collector'
hyasintti 'hyacinth'

The largely prescriptive rule, learned at school, is essentially the one stated above: take a back vowel in the suffix if there is a back vowel in the root, otherwise take a front vowel. Kiparsky (1973: 36) proposes the following rule, which has more of a descriptive character:

(4) $[+back] \rightarrow [\alpha\ back\ ] / [\alpha\ back\ ] (C_0\ [^{-round}_{-low}]_0\ C_0)_0\ \#\ X\_$

This rule states that the last harmonic vowel in the word determines the suffix value, and if there are no harmonic vowels, it is the first vowel in the word which serves as the trigger. In disharmonic loans, however, which contain vowels from both harmonic sets, we can observe free variation between the front and back suffixes:

(5) katalyysi+ko~kö 'a/the catalysis?'
konduktööri+ko~kö 'a/the ticket collector?'
hyasintti+ko~kö 'a/the hyacinth?'

But also loanwords which do conform to native root harmony may nevertheless show suffixal variation. We may note here that Kiparsky's rule does not account for the examples in (5) and (6) since it predicts no suffixal exceptions:

(6) reumatismi+lla~llä 'with rheumatism'
arkkitehti+na~nä 'as the/an architect'
karamelli+lla~llä 'with candy'

Once we observe a specific vowel in the suffix, we want to know why it is this vowel and not the other. In the native vocabulary, there is no problem to know the 'why' because there are no exceptions,[1] but loans with their free variation are harder to explain. Most studies have used evidence from experiments where the subjects reported in writing what they would say in such and such a word, or the evidence is largely introspective. The written experiments typically use university students as subjects, a population which is often highly fluent and opinionated in the intricacies of vowel harmony. The experimental studies establish clearly that there is extensive

[1] There are two native exceptions to suffix harmony, both in the partitive case only. In all the other grammatical cases, e.g., in the inessive below, suffix harmony works normally:

Nominative	*Partitive*	*Inessive*
meri 'sea'	merta/*mertä 'of the sea'	meressä/*meressa 'in the sea'
veri 'blood'	verta/*vertä 'of blood'	veressä/*veressa 'in the blood'

inter and intraspeaker variation in the suffixes (Levomäki, 1972; Heinämäki and Ringen, 1988; Ringen and Heinämäki, ms.)

To interpret this variation, it has been proposed that it is socially conditioned and that different rules can be selected in different social contexts (Campbell, 1980; Välimaa-Blum, 1986). Another interpretation is that speakers occasionally analyze the long sequences into 'prosodic compounds' where the second part of the speech-based 'compound' then determines the suffix vowel, just as in true compounds (Sadeniemi, 1949; Levomäki, 1972; Välimaa-Blum, 1986; Ringen and Heinämäki, ms.). A true compound in Finnish is signalled by secondary stress on the first syllable of the second member, and these stress cues include certain phonetic patterns including duration, spectral characteristics, vocal fold activity and nasalization (Lehiste, 1964). Sadeniemi (1949) found these cues on the 'second' part of long loans, and Levomäki (1972) notes that they can also be observed in long native non-compounds. In fact, the trained ear of a phonetician can discern them very clearly as a certain prominence relation. The compound analysis is largely motivated by the fact that native roots are typically disyllabic, and when a word has four or more syllables, speakers of Finnish intuitively analyze them prosodically into smaller constituent parts so as to make the word conform to the native root pattern.

Halle and Vergnaud (1981) suggest that there may be two dialects using two different harmony rules. Also, the number of neutral vowels has been extended to include [y] (Saarimaa, 1971: 16) and [ø] (Campbell, 1980). Heinämäki and Ringen (1988) propose, following Anderson (1980), that primary stress may be a factor: an unstressed front harmonic vowel is more likely to be treated as a neutral vowel than a corresponding stressed one. More recently, Ringen and Heinämäki (ms.) treat Finnish vowel harmony in the framework of Optimality Theory. The authors propose a set of constraints, some of which are unranked, and these enable them to predict specific percentages of variation in specific words; we will return to this study in detail presently. The experiment to be reported on next, based on oral productions of long loanwords, addresses all these issues. As a result, we will propose a relatively simple account of the harmonic facts of Finnish using the feature geometry of autosegmental phonology as presented in Clements and Hume (1995).

2. The experiment

The experiment consisted of a reading task where the subjects had to articulate the required harmonic forms without knowing what was being studied. The subjects were three females, ages 78, 50 and 22. In what follows, they will be called grandmother, mother and daughter, but in reality, they are not related to each other. Grandmother has a middle school education, and has been a home maker practically all her adult life. Mother is a high school drop-out who went to a commercial school and has been working as a book-keeper for almost 30 years now. Daughter has a high school diploma and is about to graduate from a vocational institute in hospital sanitation. Grandmother lived in south-western Finland (Turku) her first 25 years and after she has lived mostly in southern Finland (Uusimaa). Mother lived in south-

ern Finland (Uusimaa) her first 22 years and after that she has been continuously in eastern Finland (Lappeenranta). Daughter has lived all her life in eastern Finland (Lappeenranta). When asked afterwards, none of the subjects had guessed the object of the study, and none of them were able to spell out a rule for vowel harmony.

The subjects read 54 sentences, each typed on a separate line, in five different random orders in a normal speech rate. The first word in the sentences was left blank, and under the blank there was a lexeme in the nominative case that the subjects were instructed to substitute for the blank, and the syntactic context forced the choice of an inflected form with a specific, harmonic suffix. The sentences were long and complicated in order to maximally distract attention away from the purpose of the test. The test items were 14 loanwords, all having a minimum of four syllables in the root; every test word occurred three times in each of the five sets. Among the initial words, there were four different native filler words with a back suffix, each occurring three times, also with the eye of distracting the subjects' attention away from the harmonic choices. The recordings were made separately at the home of the subjects.

The 14 test items can be divided into four groups on the basis of how the various vowels are distributed in the first two and the remaining syllables.

(7) Group 1: analyyttinen 'analytic'
konduktööri 'conductor'
analyysi 'analysis'

In this group, the first two syllables contain only back vowels, followed by one front harmonic vowel and one or two neutral vowels. The words are thus disharmonic.

Group 2: karamelli 'candy'
akateeminen 'academic'
akvarelli 'watercolor'
reumatismi 'rheumatism'

Here, the first two syllables contain back vowels, followed by two or three neutral vowels. These words are harmonic.

Group 3: appelsiini 'orange'
arkkitehti 'architect'
ateisti 'atheist'
omeletti 'omelette'

In this group, the first syllable has a back vowel which is followed by three neutral vowels. These, too, are harmonic.

Group 4: hyasintti 'hyacinth'
hypoteesi 'hypothesis'
dynamiitti 'dynamite'

This group has a harmonic front vowel in the first syllable, followed by a back vowel in the second and then followed by two neutral vowels. These roots are disharmonic.

3. The results

A phonetically trained, native speaker of Finnish, the author, categorized the suffix vowels on the basis of auditory evidence into their respective phonological groups, expecting to find either [æ] or [ɑ] for each word. What the results in Table 1 actually show is three different vowels. The third vowel will be discussed presently. Let us first see what can be said about the two harmonic suffix vowels, [æ] and [ɑ]. In group 1, where the harmonic front vowel comes after the back vowels, we find predominantly [æ], but in group 4, where the back vowel follows the harmonic front vowel, [ɑ] is in the majority. In groups 2 and 3, where there is one or two early back vowels followed by only neutral vowels, and which words are thus harmonic, we can observe extensive variation, without clear dominance of either one of the two vowels. The word *omeletti* in group 3 was the only one of all the words that showed 100% uniformity – it had systematically a back vowel in the suffix for all speakers, which fact might indicate that it has been fully nativized.

Table 1
Suffix vowels in four types of root for three subjects

	$syll._1$ + $syll._2$ + $syll._3$ + $syll._4$...	N	[æ] %	[ɑ] %	[a] %	speech error %
1.	back+back+front+neutral	135	84	4	5	7
2.	back+back+neutral+neutral	181	47	40	10	3
3.	back+neutral+neutral+neutral	180	51	39	10	0
4.	front+back+neutral+neutral	135	19	60	19	2

The [a] marks a vowel which was auditorily not readily identifiable as either [ɑ] or [æ]. One could suggest that this vowel was due to some assimilatory effect on [ɑ] from [i] (as pointed out by Ilse Lehiste, p.c.), which is the typical root final vowel in loans in Finnish, but whatever the source of the assimilation, one would still expect it to be auditorily identifiable as one phoneme or another. Heinämäki and Ringen (1988) note that, in their study, the subjects proposed more front vowels after the plural [i] and [j] than after the corresponding singular forms. But in the present study, there was no systematicity in the data, all three suffix vowels occurring not only after [i] and [j], but also after the consonant cluster [st], which is, of course, also coronal. In a control study with only native words, to be discussed below, there was no special effect observed from [i] or [j].

To see how the intermediate vowel [a] relates to the other two, we measured the averages of the first three formants of all grandmother's suffix vowels (Välimaa-Blum, 1997). We can see these values in Table 2. It shows that [ɑ] and [æ] have a

statistically significant difference between the second and third formant averages, which is as it should be, for they realize two different phonemes. As for the comparisons of the intermediate 'UFO' with [ɑ] and [æ], we can observe that for [ɑ] and the UFO, the F_2 differences are statistically significant, and for [æ] and the UFO, the differences approach significance for both F_2 and F_3.

Table 2
The mean formant values (Hz) of grandmother's suffix vowels

	N		F_1	F_2	F_3
[ɑ]	107	mean	686.8	1909.7	3166.0
		st.dev.	99.7	132.9	344.6
[æ]	80	mean	682.6	2060.8	3378.1
		st.dev.	89.3	124.7	560.4
UFO	29	mean	681.9	2014.7	3204.5
		st.dev.	82.6	122.4	465.1

The statistical differences of the above formant means

	F_1	F_2	F_3
[ɑ] versus [æ]	N.S.	$p = 0$	$p \leq .01$
[ɑ] versus UFO	N.S.	$p = 0$	N.S.
[æ] versus UFO	N.S.	$p = .08$	$p = .1$

It is of interest to note that our intermediate vowel is not unique in Finnish. Wiik (1995) has observed that, in disharmonic loans such as, e.g., *olympialaiset* 'Olympics', native speakers of Finnish often pronounce the {y} as a vowel which is neither the expected /y/ nor the harmonically more plausible /u/ – in other words, the speakers seem to 'create' a vowel, not present in the standard phoneme inventory. The intermediate vowel in the present study appears to be one of these odd objects whose phonemic category is unclear. We will return to this question below.

4. Control test

To see if the same three sounds and the same kind of free variation would be found in the harmonic suffixes of the native vocabulary as well, grandmother was given another reading task. This time she read 17 sentences in the same fashion as above except that the initial words were all polysyllabic native or fully integrated loanwords; she read the sentences six times. The initial words were the following, which in the inflected form gave words with a minimum of four syllables:

(8) kriikuna '(a kind of) plum'
metsikkö 'small forest'

ylimmäinen	'topmost'
alimmainen	'the lowest'
aitaus	'a small fence'
meikäläinen	'one of us'
suloinen	'sweet'
tyytymätön	'dissatisfied'
kaunistamaton	'unkempt'
lukematon	'countless'
pojan+viikari	(= compound) 'little rascal'
kirvelevä	'burning (sensation)'
tikittämätön	'not doing tick-tock'
hyllyvä	'jelly-like'
kellari	'cellar'
syöpäläinen	'vermin'
pyryinen	'flurry'

The listening task by the same native listener, the author, distinguished only two suffix vowel variants this time, the expected [ɑ] and [æ]. There was not one instance of free variation in the suffixes, nor was there any uncertainty as to the phonemic identity of the suffix vowels. The basic result of the control test then clearly supports the claim that suffix harmony is exceptionless in the native vocabulary. Also, the native filler words in the first experiment were perfectly regular.

5. Discussion

Campbell (1980) and Välimaa-Blum (1986) have proposed that the choice of the harmonic value may depend on social factors such as the immediate context. Obviously, this element was not operative, for there was no intraspeaker uniformity in the choice of the suffix vowel. Heinämäki and Ringen (1988) and Ringen and Heinämäki (ms.) show that when subjects were explicitly asked which suffix sounds 'better', socially speaking, the outcome was still free variation, which indicates the absence of a uniform social norm.

The prosodic compound analysis, which was initially proposed by Sadeniemi (1949) and later adopted by Levomäki (1972), Välimaa-Blum (1986), Heinämäki and Ringen (1988) and Ringen and Heinämäki (ms.), would trigger the harmonic value on the basis of the third and the later vowels, because this is where the second part of the 'prosodic compound' would begin. The clue that the speaker has indeed applied the composite analysis, however, comes exclusively from the stress pattern of the word: as noted above, the prosodic compound has the stress pattern of a true compound. If there is no such evidence, the compound analysis obviously has not taken place. As far as the present listener-author could judge auditorily, there was only sporadic application of such an analysis in the present data. Therefore, the compound analysis, which, in fact, would have given front suffixes in all the test words, does not explain the choice of the suffix vowel in our study. Heinämäki and Ringen

(1988) and Ringen and Heinämäki (ms.) account for part of their data with this kind of analysis. Their studies, however, use only written responses and therefore this solution is only hypothetical, for the prosodic compound analysis is not admissible without actual production data.

We cannot, of course, speak of two dialects (Halle and Vergnaud, 1981), for nothing justifies dialect-switching in the present reading context. Two of the subjects, grandmother and mother, have mastered at least two different dialects in the course of their lives, but presently each of them speaks a more or less uniform variety, and daughter has never even learnt another dialect than the one spoken in south-eastern Finland. Anderson (1980) suggests that primary stress influences the harmonic value, but if primary stress were an important factor, groups 1, 2 and 3 in Table 1 would have essentially back vowels and group 4 front vowels, which is not the case at all.

In a thorough experimental study, using written questionnaires, Ringen and Heinämäki (ms.) propose an account of Finnish vowel harmony in terms of Optimality Theory. Let us consider their analysis. First, the authors make the following claim: "... when the last harmonic vowel in a disharmonic loan word is back, the choice is categorical" and the suffix vowel is always back (ms.: 10) They also make the following two assumptions:

a. Except in the primary stressed position, the neutral vowels are underlyingly unspecified for place. In words with only front vowels, be they harmonic or neutral, the neutral vowels can (but apparently need not) be specified for place.

b. All suffix vowels are underlyingly unspecified for place.

The actual choice of the harmonic suffix value depends on seven different constraints, of which the first three are ranked but the last four are not:

(1) Corresponding segments in the inputs and outputs of roots have identical specifications for all features.
(2) An inventory constraint forbids back, non-low, unrounded vowels, [ɨ] and [ʌ].
(3) A right-edge constraint prevents any vowel from intervening between the feature [+back] and the right edge of the word.

It is proposed that these three constraints cover native words with back vowels and those disharmonic loans whose last harmonic vowel is back so that these words always have back suffix vowels.

The next four, unranked constraints account for native words with only front vowels, harmonic and/or neutral, and those disharmonic words whose last harmonic vowel is front:

(4) A right-edge constraint prevents any vowel from intervening between the feature [-back] and the right edge of the word.
(5) All vowels have the same specification for backness as the primary stressed vowel.
(6) All vowels have the same specification for backness as the secondary stressed vowel.

(7) All vowels have the same specification for backness as the most sonorous vowel in the root. The assumed sonority scale is the following, going from the most sonorous to the least sonorous vowel (sequence):
ää, aa>>öö, oo, ee>>uu>>ä, a>>ö, o, e>>ii, yy>> i, y, u

The first claim that disharmonic loans whose last harmonic vowel is back show no variation but always have a back suffix is clearly wrong as far as our data are concerned. Table 1 shows that in group 4, the amount of variation is large, though it is in favor of the back suffixes. This claim is right only for those disharmonic loans where the last back vowel is root final, for then the suffix is always back.

Nevertheless, with these constraints, Ringen and Heinämäki are able to predict actual percentages of specific suffixes in particular words in their sample. To see how their predictions fare with other observed data, let us consider a word which was used also in two other studies, and for which predictions were computed by Ringen and Heinämäki – *analyysi*. Their prediction for this word was 62.5% front vowels and they actually observed 58% of them. In the present study, there were 93% front vowels, and Levomäki's (1972) corresponding, observed (written) value is 81.4%.

This one word does not necessarily prove anything about the general validity of the predictions of Ringen and Heinämäki, but the deviance of our and Levomäki's observations from the calculations of Ringen and Heinämäki is nevertheless considerable. As another illustration of how the distribution of the suffix vowels matches in different studies, let us compare the percentages of front suffixes in four words. In table 3, we have first the written judgements of 30 subjects in Ringen and Heinämäki (ms.), then the written judgements (forced choice) of 144 subjects in Levomäki (1972), and last, the oral productions of 45 tokens by three subjects in the present study, also forced choice. The first number of the ranges in the Ringen and Heinämäki column gives the percentage of the subjects proposing only front vowels, and the second, this same percentage with the addition of the percentage of those who gave the two possible suffix alternatives.

Table 3
Front suffix vowels actually observed

	Ringen and Heinämäki (ms.)	Levomäki (1972)	Present study
arkkitehti	48–66 %	73%	73 %
ateisti	0–4 %	–	44.4 %
karamelli	16-22 %	52.6%	72 %
dynamiitti	8-28.8 %	28.6%	16 %

Dynamiitti represents the disharmonic type that is claimed to show no variation since the back vowel follows the front vowel, but the other three loans are harmonic with one or two back vowels followed by two or three neutral vowels. *Arkkitehti* and *dynamiitti* show a relatively small range across the three studies, indicating agreement, but the ranges get wider in *ateisti* and *karamelli*.

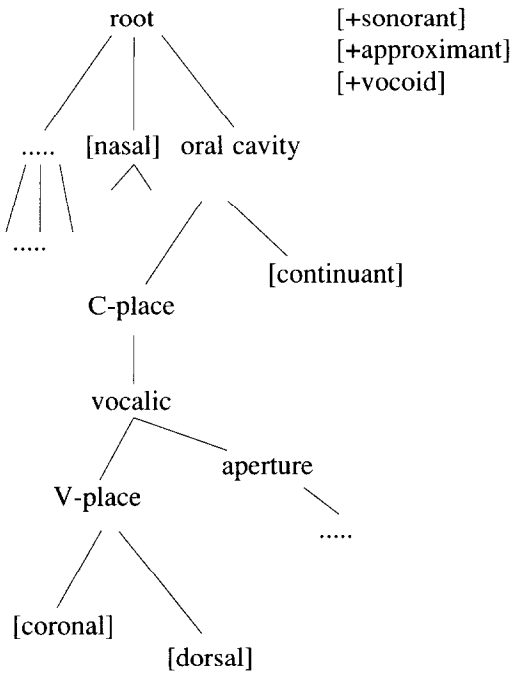
The discrepancies observed above argue that it might be very difficult to predict with any degree of accuracy the occurrence of one or the other vowel in the suffix, contrary to the following conclusion by Ringen and Heinämäki (ms.): "Not only are we able to predict where variation will occur, but such a theory [i.e., a constraint based theory where at least some constraints are not ranked, RVB] is capable of modeling, with considerable accuracy, the observed variation" (ms.: 19). In fact, Ringen and Heinämäki do not predict variation where we found it: in disharmonic loans where the harmonic back vowel is followed by only neutral vowels. That is, e.g., the disharmonic *hypoteesi* with a [−back] harmonic vowel followed by a [+back] vowel is as likely to vary as the equally disharmonic *analyysi* with its [+back] followed by a [−back] harmonic vowel.

6. A feature geometry for Finnish vowel harmony

We will next propose a much simpler account of Finnish vowel harmony using the feature geometry of autosegmental phonology. We propose to treat the neutral vowels on a par with the other front vowels, but we make no further assumptions concerning primary or secondary stress, sonority, order of the harmonic vowels or the right edge. Except for the relaxing of a precedence constraint in the loans, the same mechanism operates in both the native and loan vocabulary. All but the alternating suffix vowels are underlyingly fully specified for place, be they stressed or unstressed, neutral or harmonic.

The feature geometrical structure of the relevant V(owel)-place features can be represented as seen in (9) (Clements and Hume, 1995: 292). The feature [dorsal] is used instead of [+back] and [coronal] for [−back]. Clements and Hume discuss evidence for consonants and vowels forming natural classes together in terms of the labial, coronal and dorsal place features, and consequently, vowels and consonants share the C(onsonant)-place node. This allows for various assimilation phenomena that consonants and vowels undergo together. But the C-place node dominate a separate vocalic node and this prevents the crossing of association lines in cases such as the present, where the V-place features spread only to vowels.

(9)



Neutral vowels are a problem in the description of vowel harmonies such as that in Finnish, because they co-occur with dorsal vowels, which otherwise exclude coronal vowels in the same word and must therefore be skipped by the autosegmental spreading of the harmonic value. To avoid the crossing of lines in spreading, one could suggest that the neutral root vowels are specified for place in a 'segmental core', and that only the alternating suffixes are underspecified. Their place values would then be filled in by spreading from the autosegmentally specified harmonic root vowels, and in their absence, by a late default rule. This is the view we adopted earlier (Välimaa-Blum, 1986). If we suppose, however, that the coronal and dorsal places are on separate tiers, as described in the structure above, then there would be no danger of any lines crossing. We take this approach then and propose that all vowels but those in the alternating suffixes are underlyingly fully specified for place. Therefore, neutral vowels and front harmonic vowels alike are prelinked to the same, coronal place tier. This means that the neutral vowels would be able to spread their coronal value to the suffixes just as the front harmonic vowels do. This also means that no default rules are needed.

The reason why we choose not to have default rules is that there is no compelling evidence in Finnish that would argue for them and underspecification as against full underlying specification, and without this evidence, full specification is preferred. But also, there is no overriding general principle that would make underspecification with default rules, say, more 'economical' than full specification. On the contrary, the full specification of the neutral vowels simplifies Finnish grammar, and it may also avoid certain excesses. For example (as pointed out by David Odden, p.c.), there

is nothing that would prevent the default rules from applying right at the beginning of the derivation, or as the second or the third rule, etc. They would thus be turning underspecification into full specification at any convenient, but not necessarily principled point in the derivation. Hence, this would not only allow for a large number of possible underlying representations, but we could also make very many grammars, each differing only in the point where the features are filled in. Therefore, in the absence of positive evidence for default rules, we assume full specification also for the neutral vowels.

The only reason why Finnish would have default rules for place specification has to do with the neutral vowels. The two problematic cases in the native vocabulary are the assignment of the harmonic value (a) in the roots and suffixes of the words which contain only neutral vowels, and (b) in the neutral vowels when they co-occur with back vowels. But both cases can be resolved if we accept the frontness of /i/ and /e/ and link them directly to the coronal tier underlyingly. The strongest evidence for their absolute frontness comes from the fact that, in the absence of harmonic vowels, they systematically assign coronal suffix values. The 'problem' with the neutral vowels is thus not in the specifying of the suffix value but in their exceptional distribution with respect to the other front vowels: only the neutral vowels co-occur with the back vowels in native words. But if the coronal and dorsal places are on separate tiers, the assignment of the suffix vowel values does not result in the crossing of lines between dorsal and coronal vowels.

Now, if we group the neutral vowels with the other front vowels, they seem to lose some of their specificity. But it remains a fact, as just noted above, that they are different from the other vowels in that they co-occur with both kinds of harmonic vowels in native roots, while the two harmonic sets are mutually exclusive. The non-discriminating co-occurrence patterns of the neutral vowels can perhaps be explained by another difference they have vis-à-vis the harmonic vowels: /i/ and /e/ are the only two vowels that have no back counterparts, for the others have a pair each, and only the paired vowels participate in suffix harmony:

/y/ pairs with /u/
/ø/ pairs with /o/
/æ/ pairs with /ɑ/
/i/ and /e/ are not paired

The absence of a dorsal mate for the neutral vowels leads to the idea that maybe they have front allophones in words with front vowels and back allophones in words with back vowels. Karlsson (1982: 55) states that Finnish vowels do not have any auditorily discernible allophones that would need to be described by special allophonic rules, but that every vowel has only one main allophone. This statement is not quite adequate, though, for all vowels have at least nasalized allophones before and after nasal consonants in the same word.

As for potential front and back allophones of the neutral vowels, we did a pilot study on read speech with three speakers, one 22-year-old female (fem-1) and two males, 27 and 36 years old (male-1 and male-2, respectively). Fem-1 comes from the

Helsinki dialect area, male-1 from central Finland (Tampere) and male-2 from eastern Finland (Joensuu). The data are drawn from a database where the subjects did reading tasks in five different speaking modes: normal, fast and slow speaking rate, and hyper and hypoarticulation. The present samples come from a short passage read in the normal speaking rate and hyperarticulation. The mean values of the first two formants were measured of all tokens of the neutral vowel /i/ when it occurred alone, that is, as not part of a diphthong; some samples are slightly smaller than the others due to speech errors. The data were divided into two groups: one had /i/ coming from words with back vowels and the other from words with front harmonic and/or neutral vowels. We next compared the formant means in the two groups in both modes. Although the sample sizes were small, the differences between the means in the normal speaking rate were, except for F_1 of male-1, statistically significant at levels ranging from .001 to .10, as can be seen in Table 4.

Table 4
The results of a pilot study of the neutral /i/ in dorsal and coronal contexts: Comparison of F_1 and F_2 means in two speaking styles

[i]		Fem-1		Male-1		Male-2	
		Normal	Hyper	Normal	Hyper	Normal	Hyper
F_1							
Dorsal context	N	22	22	21	24	25	24
	Mean	445.5 Hz	400.9Hz	370.8 Hz	338.8 Hz	339.1 Hz	338.2 Hz
	st.dev.	35.6 Hz	21.1 Hz	31.2 Hz	24.4 Hz	34 Hz	30.3 Hz
Coronal context	N	17	16	13	16	16	16
	Mean	414.6 Hz	390.8 Hz	352.5 Hz	337.4 Hz	351.7 Hz	351.3 Hz
	st.dev.	22.8 Hz	33.2 Hz	21.1 Hz	34.4 Hz	43.2	28.9 Hz
p-value of difference		.001	N.S.	.05	N.S.	N.S.	N.S. (p =.17)
F_2							
Dorsal context	N	22	22	21	24	25	24
	Mean	1862.5 Hz	2146.2 Hz	1675.8 Hz	1881.0 Hz	1730.2 Hz	1879.9 Hz
	st.dev.	213.6 Hz	226.1 Hz	169.2 Hz	206.5 Hz	233.2 Hz	179.4 Hz
Coronal context	N	17	16	13	16	16	16
	Mean	2156.6 Hz	2158.4 Hz	1862.4 Hz	1891.2 Hz	1836.3 Hz	1916.7 Hz
	st.dev.	155.2 Hz	319.8 Hz	232.1 Hz	260.7 Hz	183.4 Hz	250.3 Hz
p-value of difference		0	N.S.	.01	N.S.	.10	N.S.

We can note that, except, again, for male-2, the distance between the F_1 and F_2 means is smaller in the back-harmonic words than in those with front vowels, which might indicate that they were indeed backed (Ladefoged, 1975: 179). If this assimilation of the neutral vowels to the back harmonic vowels in the same word is obligatory, then we should find similar data in hyperarticulated speech. As Table 4 shows, the differences between the formant means disappear in hyper speech, and this

would mean that the assimilation, if there is one, is style dependent. And if it is style dependent, we propose that it is the result of some late phonetic assimilation rule applying in speech contexts which are either less formal (Joos, 1961) or which require lesser clarity of presentation (Eskénazi, 1993). Obviously, much more research with larger sample sizes is needed, but it may well be, as Lindblom has proposed (1990), that in careful pronunciation, reaching the underlying place-targets is more essential than in other styles, where, as in the case at hand, ease of articulation may create a dorsal 'pull' for all vowels in back-harmonic words. The consonants in Finnish have both optional and obligatory assimilations to the place and rounding of the following consonants and vowels (Suomi, 1996), so it would not be surprising for the neutral vowels as well to assimilate to the backness of the vowels in the same word. Of course, dialect may also be a factor here, for the dialect of male-2 is slightly more regionally colored than that of the other two speakers.

The members of each of the three harmonic pairs differ from each other only in terms of their backness value while their aperture and rounding match. If the neutral vowels were to harmonize in Finnish and this harmony were to obey the same principle, Finnish would have to add two unrounded back vowels into the system, one corresponding to /i/ and one to /e/. So, the neutral vowels, regardless of whether they have front and back allophones, are different from the harmonic vowels in two ways. They are not paired, and also, and perhaps just because of this, they do not participate in suffix harmony. But they are front vowels and, as stated above, the clearest evidence for this comes from the fact that roots with only neutral vowels always trigger front suffix vowels, just as the harmonic front vowels do. Is it a loss to promote the neutral vowels among the other front vowels? To solve the problem of the suffix vowels in disharmonic loans, there have been proposals extending the class of neutral vowels. For example, it has been suggested that [y] (Saarimaa, 1971: 16) and also [ø] (Campbell, 1980) are neutral. If we accept this, we are watering down the whole concept of neutral vowels. And in some sense, this is what we propose to do, too, but not by extending the class of neutral vowels but by regrouping them with the rest of the front vowels.

The back vowels have a property that makes them more marked than the front vowels in the harmonic system, which is that their normal spreading patterns can be both local and nonlocal, while the coronal vowels always have the less marked pattern of local spreading. In fact, in a native word with only front vowels, be they harmonic and/or neutral, the coronal spreading can only *be* local. Since the neutral vowels have no distributional restrictions, they can occur in a word before, in between and after the harmonic vowels. Therefore, the dorsal spreading, since it can, and in fact, must skip any neutral vowel following it, has nonlocal spreading as part of its normal 'behavior.' This difference has significance in loanwords as well, as we will see presently.

We then propose, following Clements and Hume (1995), that the coronal and dorsal places are on separate tiers. To fill in the underspecified place value in the harmonic suffixes in native words, a precedence constraint is proposed: if the word has a vowel linked to the dorsal tier, this feature obligatorily spreads to the suffix. And only in the absence of dorsal vowels, does the suffix get the coronal value. To

account for the observed free variation in loans, the precedence stipulation is relaxed, and the spreading can take place freely from one place tier or the other, respecting, of course, the 'only-local-spreading' for coronals.

Let us take the native rule first. It is responsible for all the examples in (10)–(14). According to the back precedence constraint, any back vowel in the root conditions a back vowel in the suffix. We can also note that in all cases the neutral vowels pattern exactly like the harmonic front vowels. For the sake of typographical simplicity, the structures presented below show only the coronal and dorsal tiers, without any of the intervening structure. The first word (10) is a native word with both back and neutral vowels.

(10) [DORSAL]

k a u l i m e + l l a 'with a/the rolling pin'

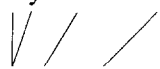
[CORONAL]

We can note here right away that the spreading of the dorsal value is nonlocal because of the two intervening neutral vowels.

In (11), since there are only front harmonic vowels, the spreading takes place automatically – and locally – from the coronal tier.

(11)

p ö y d ä + l l ä 'on a/the table'



[CORONAL]

In (12), we have a disharmonic loan with two early back vowels followed by a front harmonic and a neutral vowel. All front vowels are skipped because of back precedence.

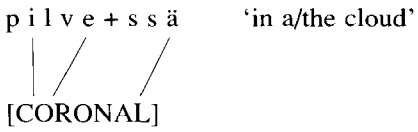
(12) [DORSAL]

k o n d u k t ö ö r i + l l a 'with a/the ticket collector'

[CORONAL]

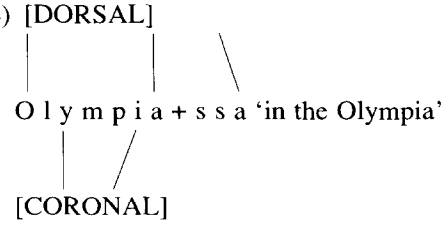
The following example has only neutral vowels in the root and the spreading is the same as in (11), from the coronal tier.

(13)



The loanword in (14) has a back vowel, a front harmonic vowel, a neutral vowel and a word-final back harmonic vowel, and back precedence operates as usual. We will return to this word in 14' below.

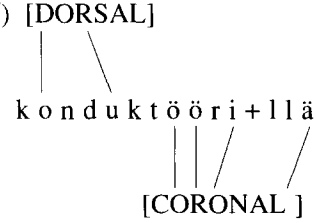
(14)



To allow for the free variation in the loans, the precedence clause is suspended, and when it is suspended, the choice of the spreading feature probably depends on, still poorly understood, factors such as speech rate, rhythm, information structure, style, etc. In other words, the observed free variation in the suffixes is indeed 'free' in the sense of not depending on contextual segmental information. These same conditions may also determine whether a word is analyzed into a prosodic compound or not. Under the present proposal, however, the compound analysis becomes less important from the harmonic point of view, but the compound analysis is still independently needed to explain the distribution of the acoustic markers of compound stress in long loans. And if the compound stress pattern is observed in any kind of loan, then we would indeed expect the harmonic value of the suffix to follow from the second part of the 'compound'.

The following example shows the word in (12) after the relaxing of the precedence constraint, which would allow (but not force) the spreading from the coronal tier.

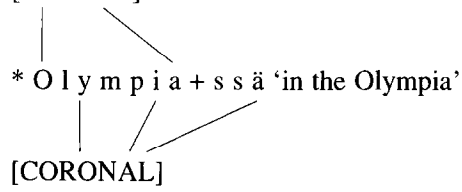
(12′)



In principle, the relaxing of the dorsal precedence would allow front suffixes in words like *Olympia* in (14), and *kysta* 'cyst', but, in fact, these words are not possi-

ble with a front suffix. The front suffix is prevented from occurring here by the requirement that coronal spreading is always local. Therefore (14′), with non-local spreading from the coronal tier, is not a possible pronunciation, nor is **kysta+ssä*.

(14′) [DORSAL]



With the relaxing of back precedence, the occasional front suffix in trisyllabic disharmonic words like *tyranni+lla/llä* 'with a/the tyrant' and *symptomi+lla/llä* 'with a/the symptom', where the back vowel is penultimate, followed by a single neutral vowel, would then be licenced by the final, neutral vowel. Finnish typically inserts the neutral /i/ at the end of a borrowing, but since we consider neutral vowels on a par with the other front vowels, the local spreading from the /i/ assigns the required front value as predicted.

In words of this type, where the harmonic back vowel is separated from the end by a single neutral vowel, the back vowels dominate in the suffix (in Ringen and Heinämäki, ms., *tyranni+lla/llä* had 98% and *symptomi+lla/llä* 96% back vowels). And when the penultimate harmonic vowel is front, followed by a single neutral vowel, as in *afääri+lla/llä* 'with the affair', the front vowels dominate: in Ringen and Heinämäki (ms.), *afääri* had a back vowel only in 16% of the choices and in Levomäki (1972) in 16.9%. But coronal spreading in this word is local, as it should. So, the locality of coronal spreading guarantees back-suffixes in words such as *Olympia* and *kysta*, and the frontness of the neutral vowels allows coronal suffixes when the harmonic back vowel is antepenultimate, as in *tyranni*.

Finnish has also suffixes with neutral vowels. What would happen to alternating suffixes in disharmonic loans whose last vowel is dorsal and where the first suffix has a neutral vowel, such as in *Olympia+lle 'to Olympia'*? Our account predicts that these words would show free variation, and indeed, e.g., both *Olymbia+lle+ko* and *Olympia+lle+kö* 'to Olympia?' are possible. The coronal vowel in the alternating suffix (*ö* here), which is excluded immediately after the dorsal root vowel, as seen above, becomes pronounceable after the neutral (coronal) suffix vowel. This follows directly from the local character of coronal spreading.

According to van der Hulst and van de Weijer (1995: 530), Kiparsky has proposed that the velar /kk/ may block spreading from the left, and the following forms (ibidem) are supposed to illustrate this blocking:

(15) etikka 'vinegar'
itikka 'mosquito'(colloquial)
tiirikka 'lock pick'

We do not think that a particular consonant in a word may block the spreading. For us, the words in (15) are clearly lexicalized forms, which are synchronically not trans-

parently derived from anything. For example, *etikka* is a virtually sound for sound loan from the Swedish *ättika* so that it is not clear what would be blocked in this word, that is, there is no suffix onto which a value would spread from the root. Further evidence for the non-blocking character of /kk/ comes from the abundance of alternating forms involving this same velar consonant, as the following examples show:

(16)	näpy+kkä	'little pimple'	nupu+kka	'little flower bud'
	typy+kkä	'little girl'	tupu+kka	'little fatso'
	lähe+kkäin	'close to each other'	alle+kkain	'one under the other'
	perä+kkäin	'one after the other'	vasta+kkain	'face-to-face'
	itse+käs	'selfish'	uhma+kas	'defiant'

It is true that Finnish does have harmonically opaque derivational suffixes which are linked to the dorsal tier underlyingly, and these incorporate the above /kk/. We have proposed to treat these words as fully lexicalized, frozen forms (Välimaa-Blum, 1986). But whether they are lexicalized or not, the point is that words like those in (17) can never have front suffixes in spite of the fact that the preceding roots contain only front vowels. Being prelinked, these suffixes are thus opaque to spreading from the left, and the suffixes get their value from the prelinked morpheme (Clements and Sezer, 1982). It is thus a question of morphemes blocking the spreading, not specific consonants. In the following examples, the opaque suffix is capitalized:

(17)	kehi+KKO+j+a/*ä	'frames'
	liit+OS+ta/*ä	'of connection'
	men+O+j+a/*ä	'expenses'

In this discussion, we have evoked three different views of Finnish vowel harmony, each with slightly different emphases: the traditional, prescriptive rule, Kiparsky's descriptive rule and our approach, whose aim is to capture the essence of the first two. The prescriptive rule concentrates exclusively on the presence or absence of dorsal vowels as the factor in the choice of the suffix vowel, and, in theory, this would not permit any exceptions in either the native or the loan vocabulary. In the loan vocabulary, however, this rule fails entirely, for even harmonic words containing dorsal vowels show suffixal vacillation.

Kiparsky's rule, on the other hand, assigns importance to the position in the word of the trigger vowel: the last harmonic vowel in the word determines the suffix value, and in the absence of harmonic vowels, the first vowel in the word serves as the trigger. This would, in theory, allow for exceptions, since it is only the position of the vowel in the word and not its simple presence that matters. We saw that, in the disharmonic loans in the experiment (groups 1 and 4), there was indeed a strong tendency for the last harmonic value to dominate in the suffixes, but this did not hold in the harmonic words (groups 2 and 3). But if the word, be it native or not, has no harmonic vowels, then the first vowel in that word, which can only be neutral, determines the suffix value. In this view then, the fact that the neutral vowels assign the front value in the suffixes looks rather like an accident: they do so only because the 'real' triggers were not present. And, as discussed above, if we were to assume that

the neutral vowels are underlyingly underspecified for the front–back dimension, the first (and the subsequent) vowel(s) in these words would then have nothing to spread to the suffix, and a default rule or some other device would be obligatory in both the root and the suffix. This scenario would also be present in the case of the prescriptive rule. In the descriptive rule, the same mechanism would likewise need to take care of those neutral vowels which occur in back harmonic words.

Our approach integrates the substance of both the prescriptive and the descriptive rule: what matters is, at the same time, the presence/absence of the dorsal vowels and the position in the word of the vowel whose value spreads to the suffix. In native words, there could be no exeptions since the presence of even one dorsal vowel would automatically exclude the coronal value from the suffix. But in loans, when the dorsal spreading loses its precedence, the coronal spreading has the option of taking place freely as long as it would do so locally, and in this case the position of the vowel in the word comes into play. And since all root vowels, including the neutral ones, are underlyingly fully specified for the dorsal–coronal dimension, words with only neutral vowels would not require any special apparatus, nor those neutral vowels co-occurring with back vowels. In this account then, the fact that the neutral vowels assign the coronal feature in the suffixes is motivated.

7. The UFO vowels reconsidered

We saw in the reading test that there was, among the expected /ɑ/ and /æ/, a UFO vowel, which we symbolized by /a/, a low central unrounded vowel. Wiik (1995) proposed that the phoneme /y/ in words such as *olympialaiset* is often pronounced as something in between [y] and [u], and we might suggest, in analogy with our study, that this sound is close to [ʉ], a high, round vowel which is neither front nor back. And if the speakers of Finnish follow the same pattern of behavior all though the loans, then we would expect to find also a third odd vowel, a mid, central, round one, such as the third alternative in the interrogative suffix below:

(18) analyysi+ko~kö~[kɵ] 'analysis?'

What is the status of these intermediate vowels? In our experiment, they were not stratified according to the age of the speakers, but each generation had a roughly equal number of them – grandmother had 29 tokens, mother 18 and daughter 21 – which means that we are not dealing with language change but a stable situation (Välimaa-Blum, 1997). We propose that the UFO vowels are due to a situation where the harmony fails to apply properly, and these vowels get assigned neither the [coronal] nor the [dorsal] features, and the Clements and Hume model (1995) would then predict central realizations. So, as for the phonetic identity of the UFOs, it would seem that the speaker would be unlikely to change the rounding or the aperture status since, as we have seen now, these features are not concerned in the harmonic process in any way. Thus, in accordance with our acoustic data and auditory judgement, we keep the rounding and the vowel height constant and the actual sounds would then be close to the sounds which correspond to the phonetic symbols for the intermediate vowels above.

We have suggested elsewhere (Välimaa-Blum, 1997) that a UFO vowel stems from the fact that, when uttering these long loans, native speakers of Finnish are obliged to violate the basic phonotactics of their native language, and apparently, while trying to produce a fluent pronunciation of a disharmonic loan, occasionally fail to reach the intended – or obscured – target, ending up with a vowel which is not part of the basic inventory. These words also violate the basic morphotactics of Finnish in being 'too' long, for native roots are usually disyllabic. This may also cause an occasional misfire as word boundaries may get blurred.

8. Conclusion

Finnish vowel harmony has two parts to it, root harmony and suffix harmony. Loanwords may violate both of these and therefore it appears at first sight to be difficult to describe suffix harmony in both native and loanwords with the same set of rules. Ringen and Heinämäki (ms.) suggest that, because there is so much variation, no set of rules at all would be able to account for all the data in Finnish, and therefore they prefer a constraint based Optimality Theory description. But, as we have seen now, one autosegmental rule with a precedence stipulation, active only in the native lexicon, accounts for all the cases of suffix harmony in Finnish. If the coronal and dorsal place features are on separate tiers, and the neutral vowels are equated with the rest of the front vowels, the suffix vowels get their values without any cumbersome apparatus. The only proviso needed for loanwords is the relaxing of the back precedence constraint. The locality of coronal spreading in native words can be maintained in loans as well, where it explains the absence of variation in certain disharmonic words.

This account is simple and transparent, and needs no extra assumptions about the vowel inventory, primary and secondary stress, the order of the harmonic vowels, or sonority. We only assume what needs to be assumed in Finnish grammar in any case, and we cover all the data. And we preserve the essence of Finnish vowel harmony: it is a one-step phonological process, where only the place feature is significant. Our analysis can, of course, be directly reformulated in the framework of Optimality Theory, but the specific constraints proposed by Ringen and Heinämäki (ms.) do not allow a satisfactory analysis of Finnish. Their constraints seem unmotivated in view of the considerable variability observed within and across speakers. Also, they fail to predict and account for the variability observed in those disharmonic loans where the harmonic front vowels precede the non-final back vowels.

Since loanwords may violate both root harmony and the basic morpheme structure of native roots, it is not surprising to find free variation in the harmonic suffixes. And, if this kind of variability represents the typical data that a child learning Finnish has to face, it is also not surprising that it should persist in the language, as the variation patterns in the speech of the three generations of speakers in our experiment demonstrate. Wiik (in Levomäki, 1972) has suggested that vowel harmony may be on its way to disappearing from Finnish. The amount of variation and the intermediate vowel in our data would certainly accord with this claim, but only on

the part of loan vocabulary, for the native words still seem to conform strictly to the traditional harmonic norms.

References

Anderson, L., 1980. Using asymmetrical and gradient data in the study of vowel harmony. In: R. Vago (ed.), Issues in vowel harmony, 271–340. Amsterdam: Benjamins.

Campbell, L., 1980. The psychological and sociological reality of Finnish vowel harmony. In: R. Vago (ed.), Issues in vowel harmony, 245–269. Amsterdam: Benjamins.

Clements, G.N. and E.V. Hume, 1995. The internal organization of speech sounds. In: J. Goldsmith (ed.), The handbook of phonological theory, 245–306. Cambridge: Blackwell.

Clements, G.N. and E. Sezer, 1982. Vowel and consonant disharmony in Turkish. In: H. van der Hulst and N. Smith (eds.), The structure of phonological representations, part 2, 213–255. Dordrecht: Foris.

Eskénazi, M., 1993. Trends in speaking styles research. Proceedings of Eurospeech '93, Berlin, 501–505.

Halle, M. and J.-R. Vergnaud, 1981. Harmony processes. In: W. Klein and W. Levelt (eds.), Crossing the boundaries in linguistics, 1–22. Dordrecht: Reidel.

Heinämäki, O. and C.O. Ringen, 1988. Finnish vowel harmony: An empirical study. A talk at the annual meeting of the LSA in New Orleans, December.

Joos, Martin, 1961. The five clocks. New York. Harcourt.

Karlsson, F., 1982. Suomen kielen äänne- ja muotorakenne. Helsinki: WSOY.

Kiparsky, P., 1973. Phonological representation. In: O. Fujimura (ed.) Three dimensions of linguistic theory, 1–136. Tokyo Institute for Advanced Studies in Language.

Ladefoged, Peter, 1975. A course in phonetics. New York: Harcourt.

Lehiste, Ilse, 1964. Juncture. In: E. Zwirner and W. Bethge (eds.), Proceedings of the Fifth International Congress of Phonetic Sciences, 172–200. Basel: Karger.

Levomäki, M., 1972. Vierasperäisten sanojen suffiksaali vokaalisointu. Virittäjä 76, 254–262.

Lindblom, B., 1990. Explaining phonetic variation: A sketch of the H&H theory. In W.J. Hardcastle and A. Marchal (eds.), Speech production and speech modelling, 403–439. Kluwer: Academic Publishers.

Ringen, C.O. and O. Heinämäki, ms. Variation in Finnish vowel harmony: An OT Account.

Saarimaa, E.A., 1971. Kielenopas. Helsinki: WSOY.

Sadeniemi, M., 1949. Metriikkamme perusteet. Helsinki: Otava.

Suomi, Kari, 1996. Fonologian perusteita. University of Oulu, Publications of the Department of Finnish, Saami and Logopedics, 4.

Välimaa-Blum, R., 1986. Vowel harmony as a prescriptive and descriptive rule: An autosegmental account. In: A. Miller and J. Powers (eds.), ESCOL 1986, 511–522. Columbus: The Ohio State University.

Välimaa-Blum, R., 1997. A UFO in the Finnish vowel space: Language change or linguistic uncertainty? Proceedings of the workshop on 'Vowels of All Kinds, Sizes and Shapes', University of Nantes, December.

van der Hulst, H. and J. van de Weijer, 1995. Vowel harmony. In: J. Goldsmith (ed.), The handbook of phonological theory, 495–534. Cambridge: Blackwell.

Wiik, K., 1995. Finno-Ugric prosodic substrata in Germanic languages and vice versa. ICPhS '95, 75(1), vol. 4, 168–171.

Riitta Välimaa-Blum is Associate Professor at the Department of English of the University of Lille 3. She received her Ph.D. in Linguistics from The Ohio State University in 1988. Her research interests include: interaction of grammatical constructions, intonation and pragmatics, speaking styles, inter and intraspeaker comparison of multilingual speakers, and Finnish phonetics and phonology.