Phonology Yearbook 2 (1985) 253–275
Printed in Great Britain

*Vowel harmony in Khalkha Mongolian, Yaka, Finnish and Hungarian**

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1 Introduction

The discussion of vowel harmony in this paper continues the theoretical discussion that was sparked by Clements' first proposals concerning an autosegmental treatment of vowel harmony in general (1980 [1976]). I will attempt to show that problems that arose in early autosegmental treatments of certain types of vowel harmony can be elegantly overcome and that autosegmental theory more generally provides an attractive framework for the treatment of vowel systems and vowel harmony. I will discuss three distinct types of systems here: the slightly asymmetrical system of Khalkha Mongolian, the canonical five-vowel system as it can be seen in Bantu (Yaka, in this case), and the well-known Finnish/Hungarian type of system. The kinds of advances made here answer, I believe, the critical comments made in Anderson (1980), in which significant sceptical questions are raised concerning whether the successes of autosegmental accounts of West African systems can be extended to other types of vowel harmony systems.

Earlier treatments of Khalkha Mongolian within an autosegmental framework include Chinchor (1979) and Djamouri & Rialland (1983), the last of which directly inspired the account given in this paper, though the present account differs in a number of important respects. Steriade (1979) also discusses Chinchor's work, though she ultimately opts for an analysis within a metrical framework. The discussion of vowel harmony in Yaka represents a departure from earlier discussions of processes of this sort. Finally, the discussion of the Finnish/Hungarian vowel harmony systems follows in a long tradition of discussion of vowel harmony, including work by Kiparsky, Skousen, Clements, Vago, Anderson, Ringen, van der Hulst and Georges-Pichot (the final reference being one which had considerable influence on the present paper, despite the difference in conclusions reached).

The most important result of this paper is the explanation of the neutral vowel status of *i* in Mongolian and of *i*, *e* in Finnish/Hungarian without

any stipulation, either explicit or implicit, a result that renders this analysis strikingly different from all previous accounts.

From a theoretical point of view, I will use an autosegmental representation in which vowel features are placed on separate autosegmental tiers, an approach which is, by definition, the autosegmental approach to vowel harmony. The age-old, traditional idea that mid vowels are – in some sense – combinations of low vowels and high vowels can be incorporated into this framework by placing the feature [low] on a separate tier, and analysing a mid vowel as a skeletal position associated with both a [low] segment ([a]) and a unit which, if solely associated to the V-slot, would produce a high vowel:

(1)


[o]

Such an approach emphasises the proposition that all assimilations are to be analysed autosegmentally (since assimilation can be analysed as addition of association lines) and that, by implication, Greek variable notation plays little or no role in phonology per se, a proposal first discussed explicitly in Goldsmith (1981). The fruitfulness of this approach to vowel quality has recently been emphasised in a number of presentations by J.-R. Vergnaud. Donegan (1978), Schane (1984a,b), Rennison (1984), and Anderson & Jones (1974) have also investigated models incorporating the view that [a], [i], and [u] are the fundamental components of vowels, the last paper presented within the developing framework of dependency phonology. On this framework one may also now see Lass (1984). Firthian prosodic analysis (see e.g., Waterson 1956; Palmer 1970) has been taken to include similar possibilities. I hope to illustrate how this insight can best be utilised within an autosegmental framework. By no means are the four other frameworks mentioned merely notational variants of each other, or of autosegmental phonology; the asymmetrical dominance of [i] and [a] that can be found in dependency phonology has no parallel in autosegmental phonology, for example, and it is by no means obvious that such a notion should not be built into autosegmental representations. My purpose here is not to compare these theories explicitly, theories which in many important respects can be said to be converging, for in the ultimate analysis the task of the linguist is not to *choose* among theories so much as it is to select and then integrate the best of all currently available frameworks into a new, more satisfactory model.

I will also assume, as Trubetzkoy (1967 [1939]), among others, has suggested, that the oppositions expressed by phonological features can be either EQUIPOLLENT or PRIVATIVE (this is discussed, for example, in Trubetzkoy 1967: 76–80). An equipollent distinction is one, as in the *SPE* tradition, whose two values (+ and −) have the same logical status in the

system. Neither value can be thought of, as Trubetzkoy would say, asymmetrically as the negation of the presence of the other value. Whether a feature functions in an equipollent or a privative way depends on the language. In Finnish, as we shall see, the feature [round] is equipollent, whereas in Mongolian it is privative. The formal side of this distinction is easily explained. A feature which is equipollent (in a given language) is always specified as either [+] or [−]; a feature which is privative is specified only for the presence of the feature, and its absence is not marked; thus no plus or minus value is necessary or appropriate. I shall attempt to illustrate the ways in which this kind of specification for each feature in each language – far from simply enriching the notational power of the theory of phonology – yields directly a model in which both the phonological inventory and the nature of the language's rules flow from this more abstract and fundamental parameter.

Following in the tradition of pre-*SPE* generative phonology, as well as current approaches known collectively as 'underspecification theory', I assume that a feature may have a positive value when specified, and take on the other value when no specification is made. If the symbol [a] is used to abbreviate the feature specification [+low], then a vowel position with [a] associated with it will be [low] (equivalently, [+low]), while one without that association will not be [+low] (equivalently, will be [−low]).

One perspective from which these suggestions can be regarded is to view them as an attempt to represent *formally* what has traditionally been viewed *substantively*. That is, attempts to account for the inherent differences between the behaviour (in the broadest sense) of various vowels have traditionally either focused on the inherent phonetic qualities of the vowels (or worse yet, simple cross-linguistic observation), or else have attempted to elaborate markedness measures for vowels (see *SPE*, and Archangeli 1984 for a recent version). If there is some ultimate merit to the present approach, it consists in part in the link it helps to establish between the geometry of the phonological representation needed to write the rules of the grammar, on the one hand, and the complexity of the representation of the actual vowels involved.

I will also assume that unless specific provisions are made, autosegments will automatically associate to skeletal positions only if they themselves are unassociated and there is an unassociated position to which they may associate, much as argued in Pulleyblank (1983).

2 Khalkha Mongolian vowel harmony

2.1 Initial generalisations

Khalkha Mongolian (as distinct from other forms of Mongolian, such as Classical Mongolian) has basically a seven-vowel system, as in (2):

(2) i ü u
e ö a o

There are, thus, two vowel heights, a binary front/back opposition, and a round/unround distinction. Only seven of the eight conceivable combinations of these distinctions are found; there is no high, back, unround vowel.

There are two general principles of vowel harmony generally cited in Mongolian: Backness Harmony and Rounding Harmony. Backness Harmony involves the generalisation that all vowels of a word must show agreement in backness: they must all be front vowels, or all back vowels. This is illustrated in (3) (after Chinchor 1979). A qualification must be added to this general statement, however, for a stem which otherwise contains only back vowels may contain (the front vowel) [i] without violating the otherwise regular back-vowel pattern of the word. In this sense, then, [i] is a NEUTRAL vowel; it can appear in either back-vowel or front-vowel spans of vowels, although when appearing in a back-vowel word it must not be in word-initial position:

(3) a. back vowel stems
xara 'to look at something'
ulaang 'red'
galuu 'goose'
untuu 'anger'
oyuun 'wisdom, intellect'
doloong 'seven'

b. front vowel stems
temeen 'camel'
ünee 'cow'
enüün 'this, he, she, it'
yümbüü 'bullion'
xöxüür 'wineskin'
göröös 'antelope'

The second principle of harmony is Rounding Harmony, which involves only non-high vowels. Rounding Harmony will round a non-high vowel immediately after a round non-high vowel (skipping over the neutral vowel [i] if one should intervene):

(4) $\begin{Bmatrix} o \\ ö \end{Bmatrix} C_0 \begin{Bmatrix} e \\ a \end{Bmatrix} \Rightarrow \begin{Bmatrix} ö \\ o \end{Bmatrix}$

Both kinds of harmony can be illustrated in the alternations displayed by the first person voluntative suffix:

(5) yaba-yaa 'let me go'
oro-yoo 'let me enter'
suu-yaa 'let me sit down'
nee-yee 'let me open'
ögö-yöö 'let me give'
nüü-yee 'let me move'

2.2 The solution: part

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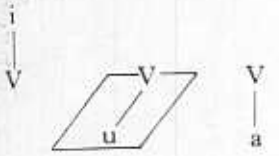
(6) *The vowels of Kha*



[i] [u] [a]

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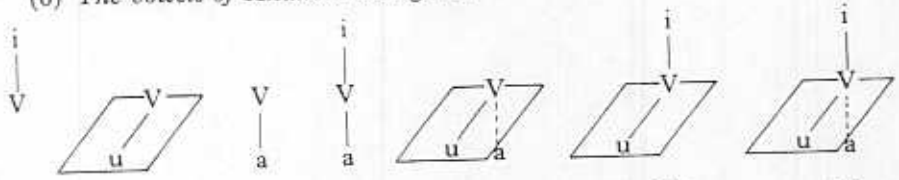
2.2 The solution: part one

The seven vowels of Mongolian are the seven vowels that can be created by the combinations of the feature [front] (represented as [i]), the feature [round] ([u]), and the feature [low] ([a]). These combinations arise through the association of a skeletal position with segments on three distinct tiers, one for each of these three features. This is illustrated in (6), where I have attempted to use perspective to represent four distinct tiers:

(6) *The vowels of Khalkha Mongolian*



I would like to emphasise that the symbols [i], [u], and [a] are being used ambiguously, to serve sometimes as phonetic representations as well as at other times as cover symbols for the feature values [front], [round], and [low]. Context will make clear in each case which sense is intended.

It is immediately apparent that there are only seven combinations possible, each corresponding to one of the seven actual vowels of Mongolian. The 'missing' vowel, from the binary, equipollent view of (2), no longer seems to be missing, or, in any event, its unusual status is matched by a formal oddity. The only way to represent a back, non-low, non-round vowel would be by means of a vowel position associated to no autosegments at all; and it is this 'vacant' structure that is not allowed.

This observation brings out most clearly the difference between an autosegmentalised version of vowel features, and its inherent measure of complexity of vowels, on the one hand, and more familiar notions of markedness, for while vowel positions associated with fewer vocalic elements are formally less complex in this system, there is no equivalence, intended or found, between less complex and more common. The least complex vowel would be one associated with no vowel feature at all; and it is precisely such a vowel which is *not* allowed in Khalkha Mongolian (or in the similar system of Hungarian). Thus we must be careful not to equate formal complexity in this model straightforwardly with markedness in the sense that many linguists have appealed to in the past.

The full range of seven vowels is found in the first syllable of the word, which is, furthermore, the stressed syllable of the word, a point of no little significance. However, in non-initial position, only three vowels can appear underlyingly: the three cardinal or PRIMARY vowels, [i], [u], and [a], an observation which can be found, for example, in Trubetzkoy (1967: 123).

Because of the fundamental significance of this restriction – here and more generally – it is worthwhile to formulate the restriction succinctly. Let us define a RESTRICTED position as a position in the skeletal tier which

cannot be associated with more than one vocalic autosegment; a position subject to no such restriction we will call a FREE position. Then we may say that:

(7) In Mongolian, in underlying representations, only metrically strong [= stressed] positions are free positions.

It must be emphasised that the restriction to primary vowels in unstressed position is an underlying restriction, and is certainly not true on the surface, as even a glance at the forms given so far will attest. All seven vowels can appear on the surface in non-initial position, but they arise through the two rules of harmony from the primary vowels. The restriction to primary vowels in non-initial position leads directly to an account of the limited distribution of vowels hitherto noticed but not explained, and an explanation of the fact that [i] is the only neutral vowel.

2.3 Front/back Harmony

Virtually all accounts of Mongolian (and Finnish) have taken 'front' as the unmarked value of the front/back contrast; this is, I shall suggest, a crucial error, and I shall make the opposite choice. Such a choice is, it may be seen, the conceptual side of the formal move to adopt [i] = [+front] as the specified member of the privative opposition.

If the vowels of a word must be either all back or all front, then they must, on our account, all be associated with the autosegment [i], or none of them must be. This result is achieved by positing the rule of Front Harmony in (8), which spreads an [i] associated with the first vowel over all the following vowels:

(8) *Front Harmony*

word

We should note that it does not matter whether one of these vowels is itself associated with an [i] (an observation pointed out by Harry van der Hulst); the first [i] will spread across the word. In general, autosegmental rules that spread associations up to a point that is defined *morphologically* will apply regardless of intervening associations, and overriding any associations in the way. On the other hand, autosegmental rules which are purely phonological in their definition of the target and trigger elements do not apply if their application would lead to one association line crossing another (this is the case for the rule of rounding harmony, as we shall see below).[1]

2.4 [i] as a neutral vowel without stipulation

Since non-initial positions are restricted positions, we find only [i], [u], and [a] there underlyingly. There is, thus, only one front vowel underlyingly

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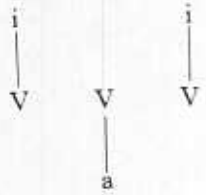
(9) underlying form



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2.5 Rounding Harm

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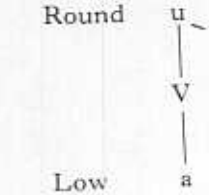
(10) *Rounding Ha*



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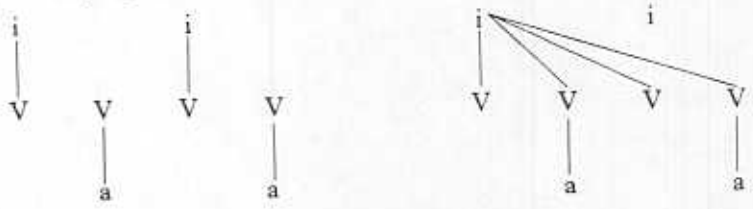
in non-initial position ([i]). The [i] autosegment attached to the skeletal position will not spread either leftward or rightward (there is no automatic spreading in the language and the *rule* of Front/back Harmony applies only to an [i] autosegment linked to the initial position).

Hence a 'back-vowel word' in Mongolian is a word without a front vowel (= [i] autosegment) in the first syllable; all following syllables will be back (since a vowel is back unless specified otherwise) except vowels that are underlyingly front, and the only possible candidate for an underlying front vowel in non-initial position is [i]. Thus we have the desired conclusion: the vowel [i] can appear in the middle of a back-vowel word in Mongolian without violating the principles of vowel harmony, but [i] is the only front vowel with that property.

It is now clear, too (as Harry van der Hulst noted) that the spreading rule (8) must spread the [i] of the initial syllable in an underlying structure such as /i a i a/, which yields the surface form [i e i e], and not *[i e i a], as shown in (9):

(9) underlying form: correct surface form:

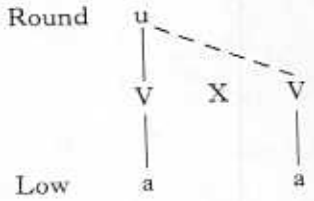


Since we know that non-initial [i]s do not spread, the second [i] in (9) is not responsible for fronting the final vowel to [e]; it is rather the first [i] that accomplishes that, as indicated in the surface representation in (9).

2.5 Rounding Harmony

We may formalise Rounding Harmony (4) as in (10). Recall that this rule involves only non-high vowels, both as trigger and as target, rounding a vowel after a round vowel:

(10) *Rounding Harmony*



Two additional observations should be made. First, note that the tiers involved are the Round tier and the Low tier (and the skeleton, of course), but not the Front tier, which is not indicated, and is projected out. The

structural condition for the rule to apply is that the vowels on the Low tier be adjacent. This allows for the possibility of an intervening vowel associated only with an element on the unrepresented [i] tier; conceived of in segmental terms, the rule 'skips over' [i], but that is the wrong way to think of it. Rather, once the rule is formalised, it follows that [i] is as irrelevant to the application of Rounding Harmony as intervening consonants would be: cf. forms like *orxiyoo* 'let's throw it away', *öcigdör* 'yesterday'.

In fact, the irrelevance of intervening consonants is what makes it clear that there must be an (implicit) variable between the V-positions in the skeleton in (10), since the vowels involved will never be literally adjacent. Hence the only adjacency condition that *can* be imposed is on the [a] autosegments, the desired result.

The second observation that should be made involves the fact that it is rounding (i.e. the [u] autosegment) that spreads, but subject to the condition that it be part of a multiply associated segment; a solitary [u] does not spread. This seems not to be fortuitous; there is a noticeable tendency for multiply associated positions to spread, observed in other vowel systems. Let us turn now to our second case, that of Yaka, a Bantu language, where the feature [low] is on one tier and [round] is on a second tier. In the Yaka system, it is [low] that spreads, but as is found in most Bantu languages, it is only when [low] is associated to a multiply associated segment (i.e. is part of a mid vowel) that [low] spreads rightward, thus paralleling the case of rounding harmony in Khalkha.

3 The vowel system of Yaka

3.1 Introduction

The following discussion of Yaka is based on material provided in van den Eynde (1968).

The importance of the Yaka system derives from the fact that, on the one hand, Yaka has just a familiar five-vowel system, and yet on the other, a strong case can be made for analysing it as arising out of an autosegmental structure with the (privative) feature [low] on one tier, and an equipollent feature (which we shall take to be [round]) on another.

Simple 'combinatorics' – the accounting of allowable combinations – tells us that if there are two autosegmental tiers (and thus features) in a system, and if one is privative and the other equipollent, then there will be five possible combinations (restricting our attention to true vowels, i.e. cases where the skeletal V-slot is not unassociated). We will take the equipollent feature represented on the upper tier to be the feature [round], and add the phonetic specification that [−round] vowels are front, given in (12). The feature [front] thus plays no phonological role in Yaka. I will use 'u' as a simple shorthand for the feature [round] here:

(11) *Yaka vowel syst*

Round −u
|
V

Low
[i]

(12) *Front Specific*
Associate [fro

We will discuss below
be taken to be.

3.2 Discussion

The forms that foll
CV(V)C) followed b
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in the past tense, or -
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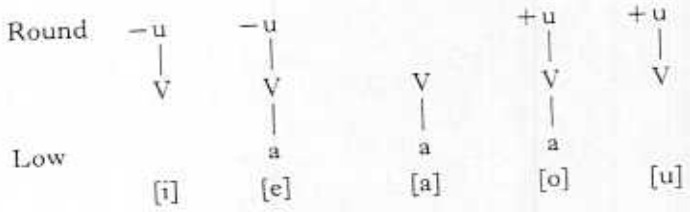
(11) *Yaka vowel system*



(12) *Front Specification*
Associate [front] with any [−round] V-slot

We will discuss below (§4.1) what the relative heights of [a] and [o] should be taken to be.

3.2 Discussion

The forms that follow are verbal stems, that is, radicals (of the form CV(V)C) followed by any number of the suffixes that Bantuists call 'extensions', followed by an obligatory 'Final Suffix', which is either *-ili*, in the past tense, or *-a*, in the other tenses. An actual verb will in addition have inflectional prefixes, including minimally a tense marker and a subject agreement marker, both of which are ignored here, as they do not participate in the vowel harmony patterns.

It is a well-known fact that while any vowel can appear in the verb radical, there is a restriction on the vowels that appear in the extensions; there only high and low vowels appear, to the exclusion of the mid vowels. Using the vocabulary suggested in the text above, the first vowel position on the stem is a FREE position, while all the following positions are RESTRICTED. This parallels exactly the observation made above for Mongolian in (7). We may note that while Mongolian stresses the first syllable of the word, and the free vowel position is thus clearly the metrically strongest position, the first vowel of the Bantu stem (the free position, in our sense) is the only position of the verb stem with an underlying tone; all extensions are underlyingly toneless.

In the examples given below, two simple segmental rules should be noted in advance, for I will not mention them further. The first changes an [l] in a suffix to [n] when a simple nasal appears in the radical (a simple nasal is one that is not part of a prenasalised stop). The second changes [l] to [d] before [i].

As I mentioned above, in the past tense a Final Suffix appears whose basic form might be said to be [ili], though it appears with a number of allomorphs (whose distribution is the point of the present analysis). When the consonant that immediately precedes is a coronal consonant, it takes on the form [i].[2] We will analyse this suffix as in (13):

(13)

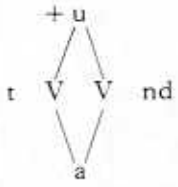
There is a rule of vowel harmony in Yaka which applies only when the past Final Suffix of (13) is present, a rule which spreads the lowness ([a]) of the radical over all the following suffixes. However, this rule only applies when the radical contains the vowels [e] or [o]; it does not apply when the radical contains the simple vowel [a]. These facts are illustrated in (14):

(14)

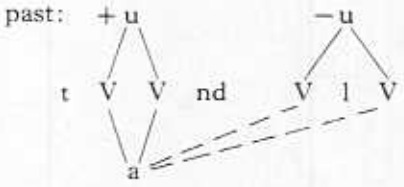
infinitive	past	gloss
a. ku tal a	tad idi	to look at
b. ku kun a	kun ini	to plant
c. ku toond a	toond el e	to love

(14c) is derived as in (15):

(15) infinitive:

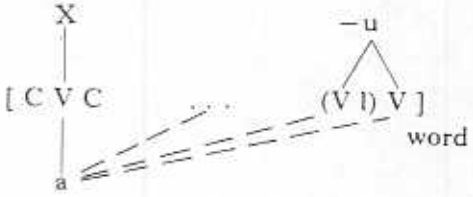


past:



Let us formulate the harmony rule, then, as in (16):

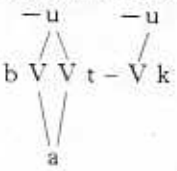
(16) *Low Harmony*[3]



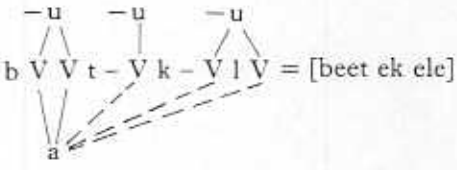
When there are additional extensions between the radical and the Final Suffix *-ili*, they undergo sympathetic Low Harmony:

(17) *ku beet ik a* 'to hit with a stick'

a. infinitive:



b. past:



Notice that in (17a) ther

(18) *ku kond id ik a* '

a. infinitive: +

k

b. past: +u

k V nd

a

When the extensior harmony process at wo a low segment on to th will in turn spread left that it encounters alo Condition. This proc multiple association of that appears to be trig coincidence.

Thus, as (19) illustr tense:

(19) *ku tel ung a* 't

a. infinitive:

b. past:

As the final [−u] [u]s of the extension

Notice that in (17a) there is no spreading of the feature [low]:

(18) *ku kond id ik a* 'to bend something'

a. infinitive: +u −u −u

k V nd – V l – V k

a

b. past: +u −u −u −u

k V nd – V l – V k – V l V = [kond el ek ele]

a

When the extensions contain the vowel [u], we see another vowel harmony process at work. When – but only when – Low Harmony spreads a low segment on to the Final Suffix, the high segment of the Final Suffix will in turn spread leftward all the way to the radical. Other high segments that it encounters along the way are delinked, by the Well-formedness Condition. This process appears to be optional. Once again, it is the multiple association of a vowel (in this case, the final vowel of the word) that appears to be triggering the harmony rule – our third example of this coincidence.

Thus, as (19) illustrates, *ku tel ung a* becomes *tel weng ene* in the past tense:

(19) *ku tel ung a* 'to slide'

a. infinitive: −u +u

t V l – V ng

a

b. past: −u +u −u by Low Harmony

t V l – V ng – V l V = [tel ong ene]

a

−u +u −u

t V l – V ng – V l V = [tel weng ene]

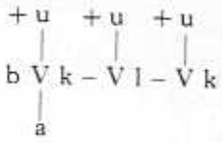
a

As the final [−u] spreads leftward, it can, as we have seen, delink the [u]s of the extensions that it encounters along the way. In all cases of this

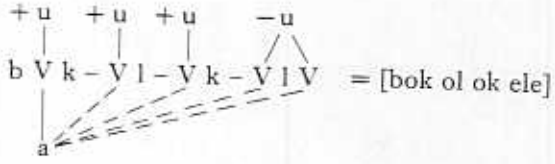
sort, the radical-final consonant is followed by labialisation, which is the only place, given our formalism, where the [u] can associate without association lines crossing (though it is not a linguistic necessity that this labialisation should have remained; still, we as linguists are grateful that it did). This is clearly illustrated in (20):

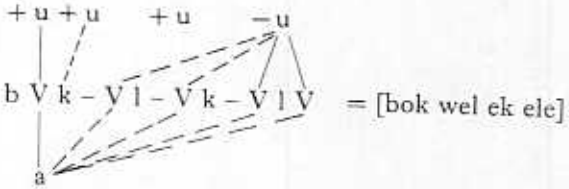
(20) *ku bok ul uk a* 'to bend down'

a. infinitive:



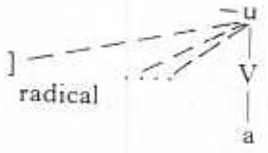
b. past:



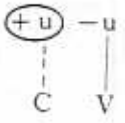


The rule of Leftward High Harmony, then, is as given in (21); a separate rule of [u]-association is given in (22):

(21) *Leftward High Harmony*



(22) *Floating-[u] Association*



Finally, if an extension should have the vowel [a], then it will trigger a Low Harmony rule, lowering the past suffix vowels, which in turn triggers the Left High Harmony. Thus the infinitive *ku tsuk am a* has the past tense stem *tsuk em ene*, as illustrated in (23):

(23) +u

ts V k – Vm –

a

There appear to be extensions that may f den Eynde (1968), the clarify the picture. Th RESTRICTED POSITION canonical structure) i is clear that the exter

4 On Finnish an

4.1 Introduction

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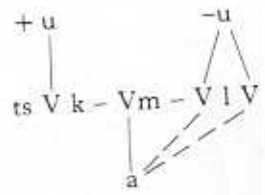


There appear to be a number of restrictions on possible sequences of extensions that may follow a radical, on the basis of the material in van den Eynde (1968), though further work with speakers will be necessary to clarify the picture. Thus it may be the case that not only are the extensions RESTRICTED POSITIONS, but that all extensions of the form -VC- (the canonical structure) must agree in vowel quality underlyingly, though it is clear that the extension -u- can co-occur with low-vowel extensions.[4]

4 On Finnish and Hungarian vowel harmony

4.1 Introduction

In the two preceding sections we have investigated the functioning of two types of vowel systems in which the privative feature [low] functions on one tier. In Yaka there was one other autosegmental feature, [round], plus the Front Specification rule (12). The reader will recall that the Front Specification rule operates (postlexically) to insert a front autosegment on a V-position associated with the feature [−round]. In Mongolian, [front] was on a separate autosegmental tier, and there was no Front Specification rule.

In this section we will see that these types of mechanism can be found acting together in concert. We will explore two systems which have a privative feature [low] on one tier, and which have (like Yaka) an equipollent feature [round] on another with a Front Specification rule as in (12), but which furthermore (like Mongolian) have the (privative) feature [front] on a distinct autosegmental tier, even at the stage of word-level phonology. These two systems are those of Finnish and Hungarian, and in this final section we shall briefly consider the general outlines of the treatment of these systems from the autosegmental point of view proposed here.

The two systems are not identical, to be sure. They differ essentially with regard to a point that was touched on above, the number of distinct heights in a five-vowel system, a point to which we return now. Given the analysis of a five-vowel system as in Yaka, the question remains open as to whether there is a phonological sense in which the vowel [a] is lower than the secondary vowels [e] and [o].

Consider the representations of [e], [o], and [a] in (24):

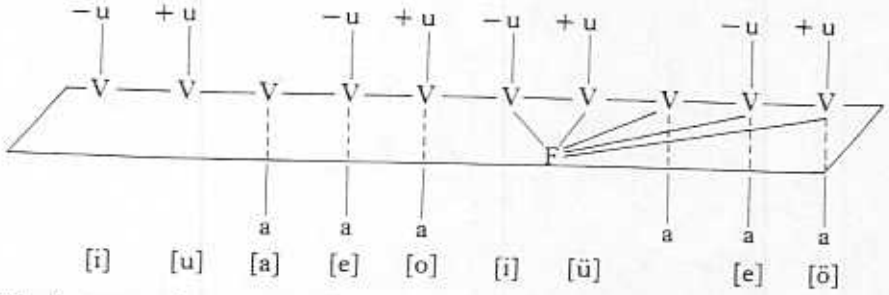
(24) a. −u b. +u c.

We shall suppose that the height of the vowel [a] in (24c) relative to the vowels of (24a, b) must be determined language-specifically. In a simple and pure five-vowel system the matter seems to be of no importance; but as we shall see, if there is an independent means of fronting the [a] of (24c), then the issue amounts to whether or not such a fronting will merge [a] with [e]. Much more could and should be said on the matter; we may wonder why, for example, there is virtually unanimous agreement, without discussion, that familiar four- and five-vowel systems should be viewed phonologically as having three vowel heights, with /a/ lower than the most common non-high round vowel. For present purposes, however, a good deal can be accomplished if we simply assume that five-vowel systems can differ in the way noted. Let us refer to this as the two height/three height parameter; a language with the feature [low] will choose to be a two- or a three-height system.

Consider, then, what a vowel system would look like if it had a canonical five-vowel system with the Front Specification rule (12) (as in Yaka), plus an autosegmentalised privative feature [front]. There would then be two sources for phonetically fronted vowels: association with the feature [front], on the one hand, and specification as [−round], on the other, followed by the effects of the Front Specification rule (12), the autosegment-insertion rule associating a [front] autosegment with any [−round]-associated V-position.

We would arrive at the following system:

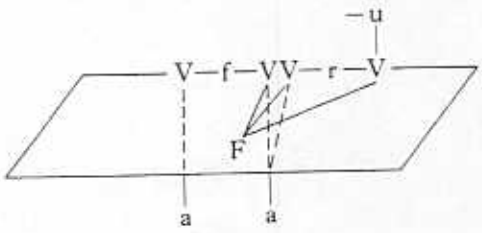
(25)



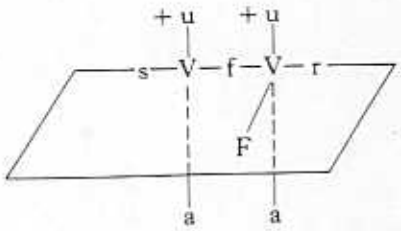
The interpretation of all of these vowels except one is straightforward, and is given in (25). In the case of the eighth vowel, however, there is an open point in the interpretation. If the language chooses the three-height value of the parameter mentioned above, it will be a low front vowel [æ]; if the language chooses the two-height value, it will be [e], and there will thus be three 'sources' (in this new sense) for the vowel [e]. The first choice describes Finnish, the second Hungarian.

In both Finnish and Hungarian[9] the principal harmony system is Front/Back Harmony (or 'palatal/velar', as it is sometimes called). In both there are minor rules (in some cases still open to dispute) of rounding harmony or disharmony. In both, native stems display consistent obedience to vowel harmony, while modern borrowings can violate it. Derivational suffixes have often quite complex and apparently idiosyncratic properties (see Anderson 1975 for a detailed discussion of these last two points), but in general are governed by the principle of Front/Back Harmony. In both, inflectional suffixes more generally obey vowel harmony, and suffixes which are intent on obeying vowel harmony will harmonise in frontness with the vowel immediately on their left (skipping, it is typically said, over the neutral vowels of the language – a codicil that the present analysis dispenses with). The exceptions ('disharmonic roots') must be analysed here as having a feature F associated with only a subset of the vowels of the word, as in (26):

(26) a. Finnish *afääri-* 'affair'



b. Hungarian *soför-* 'chauffeur'



An important point is that in the case of the disharmonic forms the feature F can spread to a suffix vowel – indeed, *must* spread to a suffix vowel if F is associated with the final vowel of the stem – but it does not spread to the other stem vowels. This asymmetry is the subject of Levergood (1983), dealing with a similar harmony system (though one that has traditionally been viewed as being of a different typological sort; see Rigsby & Silverstein 1969, Zwicky 1971, Kenstowicz 1979, Hall *et al.* 1974, for example, for general discussions of these systems, as well as Halle & Vergnaud 1981), the dominant–recessive ATR harmony system of Masai. A dominant–recessive system such as is found in Masai and a range of Chari-Nile languages differs from that of Finnish/Hungarian in one way: in such languages, non-roots can be associated lexically with the privative

autosegment feature ([front] or [ATR], as the case may be). Thus, in Masai the [+ATR] feature may spread from a suffix over an entire stem (the reverse – spreading from root to suffixes – can occur as well, needless to say). However, as Levergood shows in detail, an [ATR] autosegment associated with a *stem* vowel does not spread across to the other vowels of the stem. This she suggests is due to the effects of the Strict Cycle Condition proposed by Mascaró (1976) and Kiparsky (1982), according to which a phonological rule involving a feature which is contrastive, or distinctive, at the level in question will only apply if some relevant part of the input material has been derived on the current level (Kiparsky in fact speaks of rules that are 'structure-changing' rather than involving 'contrastive' features; I take the liberty of modifying the principle in the light of the present framework). We will, in this paper, adopt Levergood's proposal, which then blocks the automatic spreading of a vowel harmony autosegment strictly within a stem. (Thus, if this is correct, the regularity of the spreading of the feature [front] throughout the Khalkha Mongolian stem must be due to the fact that the stem is regularly composed of a monosyllabic root plus derivational suffixes; for representative data, see Djamouri & Rialland 1983.) In the light of the significant amount of scholarship that exists on vowel harmony in Finnish and Hungarian, in this present paper I can only sketch the outlines of the relevant data from these languages and the improvements that this present paper affords the analyst. I believe that the incompleteness of the discussion does not give an unrealistic picture of the successes of the account.

4.2 Finnish

Finnish has an eight-vowel system, as given in (27); following general custom, I will represent the front high rounded vowel [ü] as 'y', and [æ] as 'ä', reflecting standard Finnish orthography:

(27) i y u
e ö o
ä a

The vowels {i, e} play a special role in the system as NEUTRAL VOWELS. Non-neutral vowels (those from the set {u, y, o, ö, a, ä}) must respect Front/Back Harmony within a word; each word has either only front or only back vowels. The neutral vowels {i, e} may appear in front harmony words, of course, but also in back harmony words. This is illustrated in (28) (some of the examples are taken from Anderson 1975):

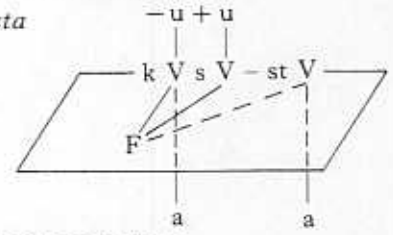
(28) a. front vowels
pöytä 'table'
sävy 'trait, character'
tyhmä 'stupid'
b. back vowels
pouta 'fair weather'
tuhma 'naughty, stupid'

c. words with back and neutral vowels
tuuli 'wind, mood, temper'
pelastua 'to be saved'
d. words with front and neutral vowels
pelästyä 'to be frightened'

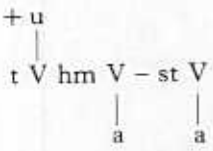
The general principles that emerge from these Finnish data are the following: Finnish has the complete set of vowels described in (25) above. Harmonic stems – those that do not violate vowel harmony – are of two sorts: (a) those with no autosegmental feature F in their lexical entry, and which thus take back vowel suffixes (e.g. *-sta*); and (b) those with the autosegmental feature F in their stem, which spreads to all vowels in the stem, and to any suffixes, fronting them (e.g. *-stä*). There is no suffix which is underlyingly associated with the feature F, but otherwise no restriction is placed on the vowels of the suffixes, and thus there are five possible suffix vowels (the canonical five vowels, so to speak). There is no vowel whose special status as a 'neutral vowel' need be marked; all vowels operate the same way, and there is no abstract vowel.

At the level of the stem in Finnish, there is a (lexical) rule which spreads the feature F (when it is present) over all the V-positions of the stem. Borrowings can generally violate front harmony within a stem. Examples of a front harmonic stem and a back harmonic stem are given in (29) with the same suffix, whose underlying form is given in (29c):

(29) a. front harmonic stem
kesy-sta



b. back harmonic stem
tuhma-sta



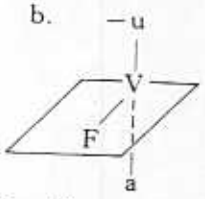
c.

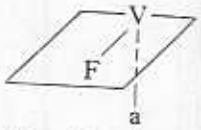
In (29a) the feature [front] spreads to the suffix, and it is realised as the front vowel [a]; in (29b), the feature [front] is not present on the stem, and it does not spread; hence the suffix is realised as a back vowel.

4.3 Hungarian vowel harmony

There has been a good deal more in the recent theoretical literature concerning Hungarian vowel harmony than Finnish.[6] The type of analysis proposed for Finnish above, utilising the schema in (25) for the vowel inventory, carries over very naturally to an account of Hungarian as well. We specify here, however, that there are *two* vowel heights in Hungarian, as noted earlier, so that the association of the feature [front] with the [low] autosegment yields a vowel identical to [e], rather than the low front vowel of Finnish. Thus the following three phonological structures are phonetically indistinguishable:

(30) a. 

b. 

c. 

From a descriptive point of view, Hungarian is traditionally said to have the vowel inventory in (31) (using standard orthography, in which the single or double acute accent marks length, and either of the double diacritic marks (diaeresis or double acute) marks rounding).[7]

(31) a. short vowels

	front	back
high	i/ü	u
non-high	e/ö	a/o

b. long vowels

high	í/ű	ú
non-high	é/ő	á/ó

It is generally noted that the short [a] is phonetically round (a result effected, on our analysis, by a postlexical rule associating the feature [+u] ([+round]) with a short [a]). The long vowel is itself somewhat fronted, and this may be viewed as the result of a similar postlexical rule.

The analysis provided by the present proposal is once again straightforward. There is a feature [front] on one tier, and on the other two tiers a five-vowel system is formed from the features [round] and [low]. Harmonising suffixes are never specified for the feature [front], and thus may come from one of the family of five canonical vowels. The two [−round] vowels will be fronted by rule (12) whether or not they are associated to a [front] autosegment of the stem, and will thus appear to be invariant (as with the suffixes *-ig*, *-ni*, *-int*, *-kent*, *-ek*, *-lek*, etc.). Those not associated with [−round] in the word-level phonology will be fronted when adjoined to a [front] stem, providing us with a class of alternating suffixes, whose vowels show alternations between *u* and *ü*, *ú* and *ű*, *ó* and *ő*, *a* and *e*, *á* and *é* – and *o*, *ö* and *e*, where a special rule of derounding must be posited to make [−round] any short [ö] that immediately follows a [−round] vowel.

5 Conclusions

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5 Conclusions

It should be clear that if the spirit of the analyses of Khalkha Mongolian, Yaka, Finnish, and Hungarian that are presented here is fundamentally correct, then the revisions of our conception of phonological representation that we must adapt to are far-reaching, affecting both our view of autosegmental geometry and our understanding of traditionally segmental features. We will have to come to grips with truly rampant autosegmentalism, as the conclusion looms nearer that each phonological feature can indeed form a separate tier. The vowel systems discussed here involve systems with two or three vowel feature tiers distinct from the central skeletal tier. We have seen that these tiers interact with each other in ways that we have never observed autosegmental tiers to do in the past. We need, it appears, new ways to think about these issues.

We might coin the term 'chart' to mean a set composed of three things: the skeletal tier, an autosegmental tier, and the set of associations between these two tiers. Charts, in this sense, have typically been thought to be autonomous; for example, the presence or absence of a tone associated with a vowel does not affect the ability of a vowel to associate with vowel harmony autosegments. But the charts that compose the vowel system of a language are by no means as autonomous as other pairs of autosegmental systems. What we have found in the vowel systems explored in this paper, I believe, is that it is the interdependence of these vowel feature charts that is what lies at the heart of the notion of the segment.

In addition, this study suggests that the relation of generative rule systems – in essence, morphophonemics – to the nature of the inventory of consonants and vowels should also be addressed in a more central way than it has been in recent generative work (this is characteristic also, to some extent, of the recent suggestions of Archangeli 1984). At the very least this step, which is in the final analysis a traditional one, shows one more way in which different parts of grammars are interconnected.

Finally, we have reason to reconsider the very notion of the traditional distinctive feature within this framework. It appears to be a reasonable conclusion that the types of feature distinctions drawn by Trubetzkoy – in particular, the contrast between equipollent and privative features – have a natural and useful basis in a formal theory. Privative features, as we have seen, are those where only one feature value plays a role in the language; equipollent features are like the more familiar *SPE* features with both values at play. This kind of language-specific distinction can play a role as a richly predictive parameter across language phonologies.

NOTES

• I would like to thank G. N. Clements, Harry van der Hulst, and Catherine Ringen for their generous criticisms of the proposals in this paper and an earlier draft.

[1] There are a number of issues at stake here which should be made explicit, especially in the light of the fact that this is one of the aspects of the present analysis most open to modification. The primary issue concerns to what extent

autosegmental spreading rules will take the simple form: 'Spread the autosegment A to all segments accessible to it (i.e. without crossing an association line)' – in essence, the Well-formedness Condition of the earliest autosegmental work. In large measure the success of an autosegmental prosodic theory is dependent on the pervasiveness of this account of unbounded assimilation.

In some cases, though, autosegmental spreading which cuts through prior association lines is well motivated within the context of the facts of a given language; the case of [i]-spreading in Yaka discussed below is just such a case. The suggestion that is made in the text in the present paper relates this (presumably exceptional) property to the partially morphological conditioning of the rule in question. This seems not unreasonable, if a spreading rule is concerned with re-attaching an autosegment to a position that is morphologically defined. However, it is by no means obvious, as we suggest here, that such is the case in the rightward spreading of [i] in Khalkha. Many alternative modifications are conceivable, to be sure. G. N. Clements has pointed out, for example, that one could distinguish between surface /i/s in the root, which would be analysed as is done here, and those suffixes analysed here as having /i/s in them; in the latter case, one could propose that such suffixes have an empty vowel slot, thus solving the blocking problem directly. This is certainly an alternative which yields an attractive solution to the thorny phonological question, though it does render less balanced the symmetrical account of the underlying vowel system.

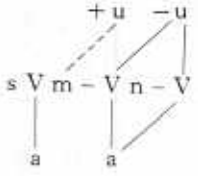
An alternative to the analysis given in the text which seems most promising to this writer involves word-level merging of the adjacent [i]s in (9), a so-called 'OCP (Obligatory Contour Principle) effect'; rule (8) would have to be appropriately modified. Alternatively, if an [i] were deleted after another [i], no modification would have to be made to (8).

[2] It is well known that this suffix derives from an original form **ide* or **ile*, and that even in the synchronic grammars of most languages which retain the full /ile/, there is a morpheme boundary between the /il/ and the /e/; the passive /w/, and the synchronically lexically restricted causative marker /y/ appear between /il/ and /e/ regularly in the Lacustrine Bantu languages.

[3] There are a number of considerations involving the morphology of the Bantu verb that are relevant to the ultimate formulation of the rule of Low Harmony and may be mentioned, but which are not germane to the present discussion. The Final Suffix is, like the prefixes, but unlike the (derivational) extensions, part of the inflectional morphology. Since there are only two inflectional suffixes – the two Final Suffixes mentioned above – the rule of Low Harmony is specified as a word-level rule that applies when the suffix has a vowel on the Round tier; it thus does not apply when the word is formed with the other Final Suffix *-a*.

[4] If the final consonant preceding the past-tense Final Suffix is a coronal, and if it contains the vowel /u/, then it is modified before the past-tense Final Suffix to:

In practical terms, this means that an extension with the vowel [u] followed by a coronal triggers Low Harmony just as if it contained a [low] vowel. For example, *ku sam un a* takes the past tense form *samwene*:



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[6] See Tompa (1972:
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Row.

[5] An excellent survey of the Finnish system can be found in Karlsson (1974: 120–121). He observes concisely:

> Något övergeneraliserat kan man säga att vokalharmonin manifesterar sig på två olika men besläktade sätt: (i) som ett fonotaktistkt villkor på rotmorfem, enligt vilket vokaler ur klasserna /y ö ä/ och /u o a/ inte får kombineras sinsemellan, varvid /i e/ är neutrala...samt (ii) som en fonologisk regel som assimilerar harmonierande suffixvokaler till främre/bakre beroende på om den närmast föregående harmonivokalen är främre/bakre samt till främre om endast neutralvokaler föregår...Det finns två starka argument för att inte beskriva (i) och (ii) med samma regel. Dels har morfemstrukturvillkoret undantag i det lånade ordförrådet (jfr *kalkyyli*, *monttööri*) medan den fonologiska regeln normalt opererar på lånord, dels är /i e/ neutrala blott i rötter medan de vad suffixassimilationsregeln beträffar går med de främre harmonivokalerna /y ö ä/. [Overgeneralising somewhat, one can say that vowel harmony manifests itself in two different, but related ways: (i) as a phonotactic condition on root morphemes, according to which vowels from the classes /y ö ä/ and /u o a/ may not combine among themselves, where /i e/ are neutral... and (ii) as a phonological rule which assimilates harmonising suffix vowels to front/back depending on whether the immediately preceding harmony vowel is front/back, and to front if preceded by neutral vowels only...There are two strong arguments for not describing (i) and (ii) in the same rule. Firstly, there are exceptions to the morpheme structure condition to be found in the loan-word vocabulary (cf. *kalkyyli*, *monttööri*), whereas the phonological rule operates normally on loan-words; secondly, /i e/ are neutral only in roots, whereas in suffix assimilation they belong to the front harmony vowels /y ö ä/.]

Tompa (1972: 15) notes (I have removed his examples in the interest of clarity):

> Eine gewisse *Vokalharmonie* ist charakteristisch für die lautliche Gestaltung der einfachen ung. Wörter: in ein und demselben Wort kommen nämlich entweder nur palatal Vokale vor...oder nur velare....Mit den velaren [i.e. back] Wörtern enger als mit den palatalen verwandt sind die sog. *gemischttonigen*, also in denen ausser velaren Vokalen auch Laute der palatalen Gruppe e, é, i, í vorkommen....Selbstverständlich kann die Vokalharmonie nach den oben beschriebenen Regeln weder in neueren Fremdwörtern...noch in zusammengesetzten Wörtern...gesucht werden.

[6] See Tompa (1972: 13–19) for an excellent survey of the facts (cf. also note 5 above); also Vago (1976, 1980a); van der Hulst (1985). See also now Vago (1984) for a rather different approach within an autosegmental framework.

[7] This vowel system is sometimes recorded (cf., e.g., Vago 1980c) as having three heights, with short *e*, and *a* and *á* as low vowels. Tompa (1972) describes the system as having four heights, with long *á* being lower than short *e*, *a*. To my knowledge, the strictly phonological evidence does not support more than a two-way height contrast.

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