VOWEL HARMONY IN KHALKHA MONGOLIAN

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1. A recent paper by Chinchor (1978) has laid out the basic facts of Khalkha vowel harmony and has argued for an autosegmental analysis of this phenomenon. The present paper will present a different analysis of the two harmony rules involved and will reach different theoretical conclusions: a maximally simple and revealing treatment of Khalkha harmony requires - I will argue - a formal system that combines features of the autosegmental framework with features of the metrical format for harmony rules proposed by Vergnaud and Halle, 1978, in addition to conventions absent from either system. In the interest of brevity I will assume some familiarity with the autosegmental analysis of vowel harmony as proposed in Clements, 1976, and acquaintance with the facts presented by Chinchor(1978). My sources on Khalkha are Street, 1963, Bosson, 1964, and Zimmer, 1967.

Obviously a work of this size cannot propose a systematic and complete answer to questions concerning which of the parameters of the system I will use for Khalkha must be universal components of vowel harmony rules. I have added however an appendix containing the argument that one of these parameters must be language specific: thus while the vowels participating in a certain harmony rule must be underlyingly unspecified for the harmonizing feature in Khalkha, they must be fully specified in Warlpiri. The appendix on the Warlpiri vowel assimilations is meant to establish this and secondarily, the fact that no meaningful autosegmental treatment of the Warlpiri rules is possible.

2.1. Khalkha has two harmony rules: a frontness and a roundness harmony (FH and RH henceforth). Its surface vowel inventory includes high front round (ü) and mid front round (ö) vowels in addition to the usual a e i o u colors but lacks a high back unrounded vowel. The high front unrounded vowel (i) acts as neutral with respect to both harmony rules in the sense that it seems not to undergo and not to stop them. The basic facts of both rules are illustrated in 1a) and 2a); the "neutral" behavior of i is illustrated in 1b) and 2b).

1)a

Stems	Infinitives	Causative + Infinitive	Plurals	Apprehensives
ünee	ir-ex	nül-üül-ex	ger-üüd	üz-üüzei
'cow'	'to come'	'to unite'	'yurts'	see- APPREH. 'what if he sees'
sudar	mart-ax	boogd-uul-ax	nom-uud	oč-uuzai
'chronicle'	'to forget'	'to hinder'	'books'	go-APPREH.

1)b

Stems	Infinitives	Causative + Infinitive	Plural	Apprehensives
güci	zaxir-ax	asigl-uul-ax	angi-nuud	zaxir-uuzai
'great great grandson'	'to direct'	'to cause to exploit'	'sections'	direct-APPREH

2)a

Stems	Infinitives	Distributives	Optatives	Passive + Infinitive
mont^{s} gor	ot-ox	xos-ood	bol-oosoi	sons-ogd-ox
'lump'	'to keep a watch on'	'by twos'	become-OPT	'to be heard'
öböl	örg-öx	dörb-ööd	örg-öösei[1]	örg-ögd-ox
'winter'	'to raise'	'by fours'	raise-OPT	'to be raised'
avxai	avr-ax	tab-aad	avr-aasai	al-agd-ax
'young lady'	'to save'	'by fives'	save-OPT	'to be saved'
gegeen	nem-ex	nej-eed	nem-eesei	nee-gd-ex
'dawn'	'to add'	'by ones'	add-OPT	to be opened

2)b

songino	oril-ox	xorin-ood	oril-oosoi	oril-ogd-ox
'onion'	'to weep'	'by twenties'	weep-OPT	'to be wept'

Chinchor notes however that initial i's do affect the harmonic character of their words: a word whose first vowel is i will contain only front vowels. Similarly, the non-high vowels of a word whose first vowel is i will always be [-round]. Thus Khalkha has CaCiCa and CoCiCo words, in virtue of the "neutral" character of internal i's but lacks either CiCu, CiCa, CiCo words or CiCö words.

Chinchor's decision concerning the harmonic status of i's is to exclude them from the set of harmony bearing units: they cannot become associated with a harmony. To account for the behavior of initial i's she sets up two morpheme structure constraints repeated here under 3) and 4):

3) $*\begin{bmatrix}\# \ C_0 i \\ +R\end{bmatrix}$ 4) $*\begin{bmatrix}\# \ C_0 i \\ +B\end{bmatrix}$

One of the ways in which this solution is unsatisfactory is that it leaves the problem untackled: why is it that only in the initial position do i's impose these restrictions on the choice of harmonies of a word? Are 3) and 4) reflexes of a unified phenomenon? What is the mechanism specifying which vowels belong to the harmonic set and which ones do not?

The second major objection is that, in Chinchor's system, where i is not a harmony bearing unit, restrictions like 3) and 4) represent a rather severe weakening of the theory of vowel harmony: if we adopt her analysis, we remain with the expectation that virtually any segment, no matter how irrelevant for a given harmony rule, might nevertheless impose restrictions on the harmonic character of words.

Finally, 4) encounters also one technical problem: initial i's do not prevent the appearance later in the word of high round vowels. Chinchor, however, represents u's and ū's as having a lexically associated +R harmony and does not tell us what will ensure that words like ilüü 'more', gisuun 'member' will not be marked as ill-formed by 4).

2.2 In proposing an alternative to Chinchor's analysis I will begin with an informal discussion of FH, then of RH, leaving the precise statement of these rules and questions relating to the formal means necessary to express them for the last part.

In the absence of strong counterevidence, the fact that words beginning with i are exclusively front should suggest immediately that i appears in the projection or harmonic set of FH and that FH is run off the first vowel of the word. This hypothesis needs a single additional assumption in order to yield the correct result: the underlying vowel inventory of Khalkha is identical to its surface inventory. In particular, there is no underlying high back unrounded vowel /ɨ/. The reader might wonder why I need to explicitly rule out this rather remote possibility: the reason is that once i is projected or, in autosegmental terms, included in the harmonic set, there is apparently nothing to stop it from undergoing back harmony in words like morin-uud. If i does undergo back harmony we must admit that at an intermediate level the Khalkha vowel inventory contains high back unrounded vowels: and if an /i/ : /ɨ/ distinction is postulated at any level an absolute neutralization rule is required to bring the theory in line with the fact that all high unrounded vowels of Khalkha are front at the surface. In this context the possibility that /ɨ/ is actually present in the underlying inventory no longer looks ridiculous and needs to be explicitly rejected: it should be clear by now that allowing underlying /ɨ/'s would undermine the very basis of this argument, which is the fact that in what I interpret to be the triggering position - the initial syllable - i behaves exclusively as a front vowel. Moreover, as Paul Kiparsky points out, the absence of underlying /ɨ/ might help explain the i/ɨ surface neutralization as a case of automatic adjustment of the output of a rule so that it will not introduce segments absent from the base inventory.

The scenario for FH that has emerged as an alternative to Chinchor's analysis necessitates then the following ingredients: an underlying vowel inventory identical to the surface inventory: a FH rule in which all vowels participate and which is triggered by the first

vowel of the root;a rule that reduces the ɨ's derived by FH to i. This scenario explains the difference in behavior between initial i's and word internal i's as stemming from the fact that initial i's are triggers whereas word internal i's are undergoers of FH.

2.3 Turning now to RH, we observe that there are several indications that here i's must not be projected: first, if i undergoes rounding, for example in morin-oos, it will become the high front round vowel ü which is present in the surface vowel inventory of Khalkha and therefore cannot be 'absoletly neutralized' back to i. Second, it appears from the additional data on RH given below under 5 that no high vowel triggers or undergoes RH: the only difference in their behavior is that high round vowels also block the progress of RH whereas i's do not.

5)a. High vowels do not trigger RH:

düü - gees	'from the younger brother'
gurba	'three'

b. High vowels do not undergo RH:

iluu	'more'
guči	'great great grandson'
dag-uul	'to cause to follow'
med-üül	'to cause to know'
morin	'horse'

c. High round vowels block RH:

Xoyor - dugaar	'second'
yös -dügeer	'ninth'
boogd -uul -ax	'to hinder'

The fact that all high vowels fail to trigger or undergo RH suggests that they should not be projected. I will clarify this proposal below an explain how the blocking effect of high round vowels on RH might be understood and represented. For the moment we should retain only the idea that high vowels are not projected. How could one then explain the fact that the non-high vowels of a word whose first vowel is i may only be unround? I see two types of answers to this question: the first is to hypothesize that a Khalkha word of Ci...Co shape is ill-formed for the same reason that a word of Cu...Co, Cü...Cö shape is ill-formed. The second is to claim that initial i's are projected and trigger RH.

The disadvantages of the second solution are obvious: it requires an unlikely projection consisting of non-high vowels and initial i's and it leaves the question of why Cu...Co is ill-formed to be solved by a separate and, as far as I can tell, equally arbitrary stipulation. We shall therefore adopt the first answer. The question is how to explain why there cannot be any non-high round vowels in a word whose first vowel is high. Again, the an-

swers fall into two classes: the first one corresponds to the idea that initial high vowels have a derounding effect on a following non-high vowel. The second, to the idea that RH is triggered only by the first vowel of the word, and that a non-initial non-high vowel is [+round] in Khalkha only if it has assimilated through RH to an initial [+round] vowel. I will choose a solution based on these ideas because the derounding solution fails to explain two apparent coincidences: the vowels derounded are precisely those that trigger and undergo RH; the position in the word from which the derounding rule is triggered is the same as the position from which FH is triggered. The first observation suggests that the derounding effect is part of RH and should follow from a proper statement of that rule; the second one suggests that the triggering position of RH is the same as that of FH. Both suggestions can be incorporated in the solution sketched above: recall that we have already established that FH is triggered by the first vowel of the word. Since high vowels are not in the RH projection, in a word whose first vowel is high, RH cannot apply. Notice that for FH our initial definition of the triggering position was ambiguous: 'first vowel' could have been either first in the word or first in the FH projection. Since all vowels are projected for FH, the two interpretations do not yield palpably different results. The meaning of 'first' was disambiguated once we have considered RH: here it is only the first vowel of the word that can be the trigger, if it also happens to be projected as [-high].

Thus, identifying the initial syllable of the word as the triggering position for both FH and RH and at the same time restricting the RH projection to non-high vowels are the key elements of our solution. They must be supplemented by an assumption: the non-high vowels of words like gurba or düü-gees are uniformly [-round] because a non initial [-high] vowel can only become round through the application of RH: underlyingly all these vowels are unspecified for roundedness. We could add, though nothing so far forces us to, that the vowels of al-agd-ax or nem-eesei are [-round] because they too have failed to undergo RH: in other words, that RH is a [+round] and not an [α round] rule.

According to this analysis, the underlying representations of ot-ox, sudar, guči, ünee, ger-üüd are, as far as RH and FH are concerned, the following:

6) a. $\begin{bmatrix}+\text{syll}\\-\text{high}\\+\text{round}\\+\text{back}\end{bmatrix}$ t - $\begin{bmatrix}+\text{syll}\\-\text{high}\\\text{round}\\\text{back}\end{bmatrix}$ x

b. s $\begin{bmatrix}+\text{syll}\\+\text{high}\\+\text{round}\\+\text{back}\end{bmatrix}$ d $\begin{bmatrix}+\text{syll}\\-\text{high}\\\text{round}\\\text{back}\end{bmatrix}$ r

c. g $\begin{bmatrix}+\text{syll}\\+\text{high}\\+\text{round}\\+\text{back}\end{bmatrix}$ č $\begin{bmatrix}+\text{syll}\\+\text{high}\\-\text{round}\\\text{back}\end{bmatrix}$

d. $\begin{bmatrix}+\text{syll}\\+\text{high}\\+\text{round}\\-\text{back}\end{bmatrix}$ n $\begin{bmatrix}+\text{syll}\\-\text{high}\\\text{round}\\\text{back}\end{bmatrix}$

e. g $\begin{bmatrix}+\text{syll}\\-\text{high}\\-\text{round}\\-\text{back}\end{bmatrix}$ r - $\begin{bmatrix}+\text{syll}\\+\text{high}\\+\text{round}\\\text{back}\end{bmatrix}$ d

In the initial syllable all yowels are fully specified; later in the word the yowels projected for a certain harmony rule are left unspecified with respect to the harmonizing feature of that rule: thus in guci, the second high vowel is fully specified for roundness since it doesn't participate in RH, but unspecified for frontness; in sudar, the second vowel is unspecified for both roundness and frontness because it belongs to both the RH and the FH projection. FH takes place in the derivation of all these forms; however RH applies only in otox: only here does a vowel belonging to the RH projection occupy the triggering position.

3.1. The first part of our analysis of RH leads us to an interesting conclusion: the vowels undergoing a certain harmony rule must enter the derivation unspecified for the harmonizing feature of the rule.[2] The autosegmental system incorporates a very similar assumption though, as far as I can see, Clements does not establish its necessity in his 1976 paper. The reader is referred to the Appendix for an argument that this aspect of a harmony rule must be language specific.

The evidence given so far in favor of this idea is the fact that in Khalkha the vowels that fail to undergo RH, because the triggering position is occupied by a high vowel, surface uniformly as [-round]. There is another way in which a non-high vowel may fail to undergo RH: if it is preceded by a high round vowel, initial or not. The relevant facts are repeated below under 7):

7)a.	xoyor - dugaar	'second'
	yös - dügeer	'ninth'
	boogd - uul - ax	'to hinder'
b.	oril - ogd - ox	'to be wept'
	songino	'onion'

7b) illustrates the fact that high unrounded vowels are entirely overlooked by RH, the expected behavior for an unprojected segment. 7a) shows that high round vowels block the rule in the sense defined by our solution: after a high round vowel the non-high vowels of Khalkha word may only surface as [-round].[3]

I will argue that the blocking effect of the high round vowels is due to the conjunction of two properties of the $\begin{bmatrix}+\text{syll}\\+\text{high}\\+\text{round}\end{bmatrix}$ set with respect to RH: the fact that they belong to the opaque set, specified as $\begin{bmatrix}+\text{syll}\\+\text{round}\end{bmatrix}$, and the fact that they do not belong to the projected set, specified as $\begin{bmatrix}+\text{syll}\\-\text{high}\end{bmatrix}$. This, of course, presupposes that the opaque set is defined independently of the projection. I will show now that the current practice of defining the opaque segments as a subset of the projected set cannot give a simple and straightforward expression of the blocking effect of high round vowels. I will also show that the only way in which the Khalkha RH can be translated into the present metrical format represents an unnecessary weakening of the theory of vowel harmony. This will be the main argument for revising the procedure for de-

fining the projection and the opaque set.

3.2 In a metrical format in which the notion opaque element covers both triggering and blocking segments, a rule like 8) is possible:

8) Projection: $\begin{bmatrix}+\text{round}\\+\text{syll}\end{bmatrix} \vee \begin{bmatrix}-\text{high}\\+\text{syll}\end{bmatrix}$

Opaque: leftmost [+syll] $\vee \begin{bmatrix}+\text{syll}\\+\text{high}\end{bmatrix}$

Harmony: $\begin{bmatrix}(+)\text{round}\\-\text{high}\end{bmatrix}$

Direction: left to right

The rule will project all vowels except i and will build a left-branching tree off every opaque element. The root of the tree will be specified as [-high] and will have the [(+)round] specification of its opaque element. Since u and ü are always opaque, they will start their own tree and this ensures that they will never undergo derounding in words of CaCu, CeCü shape. On the other hand, since the root of any RH tree is specified [-high], all trees started off a high vowel will be starred by the convention 9) (from Halle, 1979 (class lectures)):

9) A tree with root labelled [αF] is starred unless at least one opaque element is also [αF].

The interpretation given in 8) to the notion harmonizing feature is complex: it is, as far as the [(+) round] specification is concerned, the feature whose value is propagated from the triggering element up to the root of the harmony tree and then, by percolation, down to the other terminal nodes of the tree. For the [-high] specification however, the harmonizing feature must be interpreted as being imposed on the tree root irrespective of whether it matches the opaque element or not. The addition of [-high] in the harmonizing feature of 8) practically ensures that RH will only be triggered by a non-high vowel. However, it does this at the cost of claiming that the propagation of the [(+)round] feature is automatically accompanied by the spread of the [-high] feature. We don't see the effect of the [-high] propagation because it so happens that in Khalkha all [+high] vowels participating in RH are opaque: so, in practice, all vowels undergoing RH are already [-high]. But the implicit claim that the use of a harmony feature like that of 8) makes is that in another language, Khalkha', it will be possible to see such an effect: the vowels undergoing RH will both assimilate in roundness and become [-high]. Clearly then, a statement of RH like the one in 8) is a weakening of the theory of vowel harmony as long as languages like Khalkha' do not show up.

In 8), the opaque set consists of the leftmost vowel and any projected (i.e., round) high vowel. It is easy to see that the opaque elements in 8) really correspond to two different purposes: the leftmost vowel is listed redundantly as a trigger whereas the high vowels are listed not because they visibly trigger the rule

but because they do not undergo it and because they block its course. Finally, it is probable that the RH rule of Khalkha should be counted as a relatively complex one by any evaluation system; what is however suspicious about the statement of RH in 8) is the fact that the sources of complexity are scattered rather than concentrated in one point: the acknowledgement of the fact that high round vowels block the rule.

3.3. I propose that the format of metrical harmony rules be revised so as to allow for the existence of segments blocking a rule without either triggering or undergoing it.

One possibility is to introduce blocking elements as primitives in the system: a rule like 10) could then be formulated to represent the Khalkha RH:

10) Projection: $\begin{bmatrix}+\text{syll}\\+\text{round}\end{bmatrix} \vee \begin{bmatrix}+\text{syll}\\-\text{high}\end{bmatrix}$

Harmony: [(+)round]

Opaque: leftmost [-high]

Blocking: [+high]

Direction: left to right

However, 10) makes it a pure accident that the segments that block a Round Harmony rule are themselves [+round]. Moreover, in order to let in the blocking segments, we must maintain a disjuctive projection: 10) gives us no way to express the fact that the classes of sounds participating in RH are natural classes. The problem with 10) stems from the fact that we need to include in a single class, the projection, both the segments that trigger and undergo the rule and the segments that block it. The union of these classes is not necessarily a natural class, as the Khalkha data shows; if we accept this fact and resolve to define the two independently, we can maintain the general claim that a set of segments playing a certain role in a rule (trigger, blocker or undergoer) is always a natural class. It is clearly desirable to distinguish between a rule like the Khalkha RH which does not represent, when properly formulated, counterevidence to this claim and a hypothetical RH where neither triggers nor blockers nor undergoers can be reduced to natural classes.

Suppose now that for each harmony rule we select independently a set of opaque elements and a set corresponding to the projection in metrical rules. To avoid confusions with the terminology of metrical rules proposed by Halle and Vergnaud, I will call the first set A and the second B. We adopt now the following conventions:

11)a. The intersection of A and B defines the set of triggering elements.

b. The members of A not contained in B are the segments blocking the rule.

c. The members of B not contained in A are the segments undergoing the rule.

These conventions allow for the existence of three natural classes; one corresponding to the class of opaque elements, one corresponding to that of triggering elements and one corresponding to that of elements triggering and undergoing the rule.

We notice that the set of undergoers and that of blockers are not directly mentioned in a rule written in this format: the prediction is then that they do not necessarily form natural classes. David Nash has shown in his paper on Warlpiri (in this volume) how this prediction is borne out as far as the blockers are concerned: the progressive front harmony of Warlpiri is blocked both by labial consonants and by a.

Another prediction made by this system is that the phenomenon of blockers will occur only if A is not a subset of B, that is, in all and only the cases that can be directly covered by the conventions proposed here and that could not be described in the framework proposed by Halle and Vergnaud.

In Khalkha, where set A will be formulated as $\begin{bmatrix}+\text{syll}\\+\text{round}\end{bmatrix}$ and set B as $\begin{bmatrix}+\text{syll}\\-\text{high}\end{bmatrix}$ our conventions will define the triggers as $\begin{bmatrix}+\text{syll}\\-\text{high}\\+\text{round}\end{bmatrix}$, the blockers as $\begin{bmatrix}+\text{syll}\\+\text{high}\\+\text{round}\end{bmatrix}$, and the undergoers as $\begin{bmatrix}+\text{syll}\\-\text{high}\\-\text{round}\end{bmatrix}$ or $\begin{bmatrix}+\text{syll}\\-\text{high}\\\text{round}\end{bmatrix}$, if we accept the conclusions of section 2. In this framework, we can formulate an analysis of Khalkha RH that explains why certain high vowels block a rule in which no high vowel is either trigger or undergoer and why the blockers of a Round Harmony rule are [+round] segments.

3.4 The arguments presented here against rules like 8) or 10) were independent of our discussion in section 2: the reader might recall that one of the conclusions we had reached there was that high vowels are not projected for RH. An independent line of reasoning has led us in this section to a very similar conclusion, though our notion of projection has changed in the process: in our new terminology, the conclusion of section 2 can be translated as <u>High vowels do not belong to the set B (of triggers and undergoers) of Khalkha RH.</u>

4. We can now state both RH and FH:

	12)a. Front Harmony	b. Round Harmony
A:	$\begin{bmatrix}+\text{syll}\\-\text{back}\end{bmatrix}$	$\begin{bmatrix}+\text{syll}\\+\text{round}\end{bmatrix}$
B:	[+syll]	$\begin{bmatrix}+\text{syll}\\-\text{high}\end{bmatrix}$
Direction:	Left to Right	Left to Right
Harmonizing Feature:	[-back]	[+round]

We shall see in this section that, at least in Khalkha, only the first two entries of each rule are indispensable. This will become obvious once we have stated the well-formedness condition that ensures that only the first vowel of a word may trigger a harmony rule; the complementary aspect of this is that a vowel

participating (i.e., belonging to set B) of a harmony rule may be underlyingly specified for the harmonizing feature of the rule only in the triggering position: the initial syllable. As a first approximation, I will use 13) to express these conditions:

13) [+syllabic] is $\left\{ \begin{bmatrix} \pm round \\ -high \end{bmatrix} \right\}$ [±back]

in all and only the environments # C_0 -

The biconditional in 13) must function as a well-formedness condition on the underlying representation of Khalkha words. I chose to indicate the position where vowels are specified for backness and where non-high vowels are specified for roundness by means of boundaries because Khalkha compounds are non-harmonic: the assumption that the compound members are separated by # boundaries in conjunction with 13) will explain how this is possible.

Since 13)[4] will ensure that only underlying representations like those in 6) are well-formed in Khalkha it becomes now entirely predictable what FH will do to a representation like 6d), repeated here:

6)d $\begin{bmatrix} +syll \\ +high \\ +round \\ -back \end{bmatrix}$ n $\begin{bmatrix} +syll \\ -high \\ round \\ back \end{bmatrix}$

It is entirely predictable that a harmony rule where the difference between triggers and undergoers is that the former are $\begin{bmatrix} +syll \\ -back \end{bmatrix}$ and the latter are $\begin{bmatrix} +syll \\ back \end{bmatrix}$ will consist of copying in the [back] entry of the undergoers the specification found in the [back] entry of the trigger. It follows that a harmonizing feature entry in the rule itself would be entirely redundant. Similarly, since 13) ensures that only an underlying representation like 6a) is well formed:

6)a $\begin{bmatrix} +syll \\ -high \\ +round \\ +back \end{bmatrix}$ t $\begin{bmatrix} +syll \\ -high \\ round \\ back \end{bmatrix}$ x

the job of RH is defined in advance, without the need to mention the harmonizing feature of the rule.

In the same fashion, the existence of 13) makes the direction entry superfluous: the trigger being always the leftmost vowel there is no need to repeat that the propagation proceeds from left to right.

The choice to consider both harmony rules as + rather than α-rules is not arbitrary: the triggers of RH must be [+round] rather than [±round] segments because the A set of RH must be stated as $\begin{bmatrix} +syll \\ +round \end{bmatrix}$ in order to include u and ü but not i. This leads us to claim that in al-agd-ax, nem-eesei, forms already mentioned, the non-initial vowels are [-round] because they have failed to

undergo RH rather than because they have assimilated through RH to a first [-high, -round] vowel. However, the first yowels of these forms must be underlying represented as [-high, +back, -round] and [-high, -back, -round] respectively, rather than [-high, back, round] and [-high, -back, round] and, correspondingly, the condition in 13) must remain a biconditional rather than become a conditional statement. We shall see why in the next section.

5.1. In the last section I have couched in metrical terms the analysis I propose of Khalkha's harmony rules. I will show now that the autosegmental translation of this analysis is possible only at the cost of a number of changes in that framework, two of which represent abandoning, at least in their strong form, two claims central to the autosegmental theory of vowel harmony.

A central assumption of autosegmental analyses is that harmonies, like tones, are entities independent of the segments to which they associate. We shall see that a factually correct autosegmental analysis of the Khalkha harmony system must stipulate that the harmony, Round or Front, that characterizes a word is an underlying feature of the initial vowel of the word, more precisely that the triggering effect of the initial vowel must be represented as the autosegmentalization of a feature, front or round, of that vowel.

One of the conclusions of the preceding sections is that the harmony rules of Khalkha may be triggered only by the first vowel of the word. To represent this fact in the autosegmental system proposed by Clements one could, it may seem, add the following stipulation:

14) A representation consisting of a morpheme and its lexically associated harmony is well formed only if the harmony is associated with the first vowel of that morpheme.

Such a language specific restriction on the possible associations between harmonies and morphemee poses no problems for the autosegmental approach. Let us now flesh out this analysis of Khalkha in order to see exactly where it fails: there are two harmonies, R(ound) and F(ront). The set of segments that can associate with the first is specified as [+syll, -high], the harmonic set of the second is specified as [+syll]. Segments not belonging to the harmonic set of R are underlyingly specified as [+round] or [-round] and similarly for the segments not belonging to the harmonic set of F, with respect to [±back]. Conversely, segments belonging to the harmonic set of R are underlyingly unspecified for [±round], segments belonging to the harmonic set of F are unspecified for [±back]. A stem may or may not have a lexically associated harmony: R, F or both, or neither. The requirement that the harmony, if present, be linked to the first vowel of the word will have the effect of ruling out the lexical association of a R harmony to a stem whose first vowel is high: high vowels do not belong to the harmonic set of R. Thus we can rule out, correctly, forms of Ci...Co, Cu...Co, Cu...Co shape. However, nothing in this system will ensure that words whose first vowel is i will always be [-back]:

recall that a harmony may or may not be associated with a stem, therefore a word whose first vowel is [+high, -round] may have no associated harmony, neither F nor R: in this case all its vowels will be spelled out as [+back, -round] and the absolute neutralization rule, needed in order to account for the neutral behavior of internal i's with respect to F, will turn [+syll, +high, -round, +back] into i. The result will be that incorrect sequences #Ci...Ca, #Ci...Cu will be allowed. I leave it as an exercise to the reader to persuade himself that things do not improve if we replace the F harmony by a B harmony, by association with which a vowel is [+back], and in the absence of which the vowels of a word are spelled out as [-back].[5]

I submit that there is no interesting alternative to this solution within Clements' present system and that the only way in which the triggering function of initial vowels may be simulated is by changing the nature of autosegmental representations: by representing the harmonies as feature specifications of certain vowels, in this case of initial vowels. The R harmony will be the [+round] specification of a first, [-high] vowel of the word; the F harmony will be the [-back] specification of the first vowel of the word. In this way we can control directly the cooccurrences of the features High, Front, Round: since the underlying vowel inventory of Khalkha contains, as I argued earlier, /i/ but not /ɨ/, no vowel will offer in the underlying representation the configuration of features [+high, -front, -round]. We need to add now the condition stated in 13) and we obtain a partial translation of our analysis in autosegmental terms: the non-neutral begavior of initial i's with respect to F is now correctly taken care of by the condition that a first vowel be always underlyingly specified with respect to [±back] and by the fact that the underlying inventory of vowels automatically determines that a [+high, -round] vowel is also [-back].

We have here the argument for keeping 13) in biconditional form, promised at the end of section 4: in order to control the cooccurrence of the features Round, High and Back in the first vowels these must <u>always</u> be fully specified underlyingly.

5.2. To represent the blocking effect of high round vowels on RH we will need to introduce conventions identical to those in 11). For a critique of Chinchor's autosegmental approach to this problem, see footnote 3.

5.3. In the autosegmental framework vowel harmony rules are well-formedness conditions that must be met at all levels of representation: if twice during the same cycle they fail to be satisfied they will be twice restored. In the metrical theory they are rules and, as such, subject to the same ordering conventions on rule application that obtain elsewhere. We shall see here that the interaction of a Derounding rule (see footnote 1) with RH in two dialects of Khalkha is describable only on the assumption that RH is a rule and not a well-formedness condition in the sense

defined above.

Street (1967:41) notes that front- and round-vocalic words containing the comitative suffix -tai/-tei/-toi come in two variants, illustrated in 15) below:

15)a. nɔ̈xɔ̈r-tei-gɔ̈ɔ̈

friend-with-own, "with one's own friend"

b. nɔ̈xɔ̈r-tei-gɛ̈ɛ̈

The source of this variation is identifiable as the derounding rule whose effect is to turn ɔ̈i into ei. Let us assume that nɔ̈xɔ̈rteigɔ̈ɔ̈ and nɔ̈xɔ̈rteigee belong to different sub-dialects of Khalkha. In a metrical framework the difference between them arises from a difference between the orders in which Derounding and RH apply: in nɔ̈xɔ̈rteigee Derounding has bled an application of RH, in nɔ̈xɔ̈rteigɔ̈ɔ̈ it has not. Derounding must then be a cyclic rule in the dialect of nɔ̈xɔ̈rteigee, a postcyclic rule in the dialect of nɔ̈xɔ̈rteigɔ̈ɔ̈, with RH cyclic in both dialects:

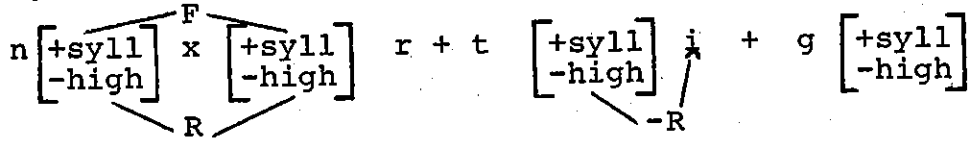
16)

	nɔ̈xɔ̈r + tei + gee	nɔ̈xɔ̈r + tei + gɔ̈ɔ̈
2nd cycle	nɔxɔr + t [+syll, -high, round, back] i	nɔxɔr + t [+syll, -high, round, back] i
	RH, FH [+syll, -high, +round, +back]	RH, FH [+syll, -high, +round, +back]
	Derounding ei	
3rd cycle	nɔxɔr + tei + g [+syll, -high, round, back]	nɔ̈xɔ̈r + tɔ̈i + g [+syll, -high, round, back]
	RH - inapplicable FH [+syll, -high, -round, -back]	RH, FH [+syll, -high, +round, -back]
Post cycle	nɔ̈xɔ̈rteigee	nɔ̈xɔ̈rtɔ̈i gɔ̈ɔ̈ e Derounding
Output	nɔ̈xɔ̈rteigee	nɔ̈xɔ̈rteigɔ̈ɔ̈.

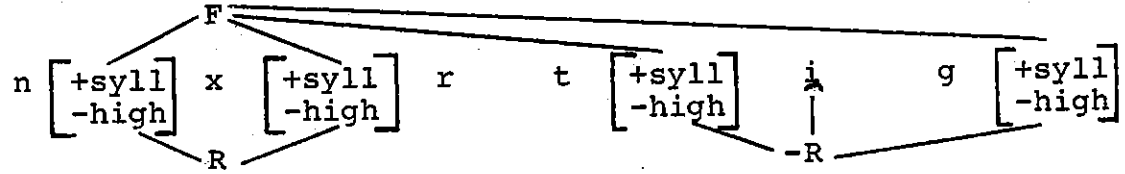
Nɔ̈xɔ̈rteigee could be derived autosegmentally by stating the Derounding rule as in 17):

17) [-cons, -syll, -back] → [-R, -cons, -syll, -back]

17) is a redundancy rule telling us that all front high glides of Khalkha have an associated -R (ound) harmony. Since the well-formedness conditions on association hold for all levels of representation, the association between the vowel preceding such glides within the same morpheme and the -R harmony will take place on the first cycle, before the R harmony of the preceding morpheme has come in sight. 18) represents the output of the first cycle:

18) 

In the output of the final cycle, the representation imposed by the well-formedness conditions on association will be as in 19):

19) 

To derive nóxórteigóó, we must assume that the Derounding rule is segmental in nature, as 20) below:

20) $\begin{bmatrix} +\text{syll} \\ -\text{high} \\ -\text{back} \end{bmatrix} \rightarrow [-\text{round}] \; / \; \text{——} \; \begin{bmatrix} -\text{syll} \\ +\text{high} \\ -\text{back} \end{bmatrix}$

The problem here is that in a derivation yielding the correct nóxórteigóó, the association line between the R harmony of the morpheme and the nucleus of the ei diphthong is deleted by 20 and never restored. The well-formedness condition Every vowel must be associated with at least one harmony [6] seems to hold in this dialect of Khalkha up to the moment in the derivation where 20) applies, but not afterwards. For an autosegmental solution the existence of a form like nóxórteigóó requires then the partial abandonment of the idea that the well-formedness conditions that replace the vowel harmony rules must be satisfied at all levels of representation.

6. The system of Khalkha harmony rules emerging from this discussion differs in fundamental respects from an autosegmental framework and, somewhat less radically, from a metrical one: in this concluding section I will recapitulate these differences.

The harmonic character of a Khalkha word is determined not by a harmony, F or R, entirely independent of the segmental tier but by a feature value of the first vowel: [±back], [±round].. On the other hand, a provision very similar to a feature of the autosegmental system and absent from the metrical rules of Halle and Vergnaud requires that Khalkha vowels undergoing a harmony rule be underlyingly unspecified for its harmonizing feature. With respect to the selection of triggering elements, our system differs from the metrical format insofar as it selects the opaque elements independently of the projection; still our analysis is

closer to a metrical analysis than to an autosegmental one because it makes crucial use of the notion of opaque element as applied to segments: in an autosegmental system the unit that may be opaque with respect to a harmony is not a segment but a morpheme or part of a morpheme insofar as it is within the scope of another harmony.

Finally, our harmony rules are cyclic rules (which, in view of the fact that unanalyzable stems are as harmonic as complex words, must apply on the first cycle) rather than well-formedness conditions exempted from the once-on-a-cycle limitation.

POSTSCRIPT

Morris Halle has pointed out to me that my argument for revising the format of metrical harmony rules has a hidden premise: that the definition of the opaque set (my A) must not be done contextually, i.e., that we should not allow specifications like Opaque: [αF]/---[βG] (where F and G stand for features) if we can avoid it. If however there were cases where such entries were unavoidable, we could not dismiss without discussion a different type of analysis of the Khalkha RH: one whose solution to the problem of the blocking segments (u and ü) is to define as opaque any vowel following them, thereby effectively removing that vowel from the set of undergoers. (I will give the more precise outline of this solution below.) The reader can notice immediately that this type of analysis requires no change in the format of harmony rules proposed by Halle and Vergnaud.

So the question we must address in deciding whether any radical revision is needed is: are the classes of sounds participating in vowel harmony rules ever found to be contextually specified and if so, what types of contextual specifications do we find attested ?

Halle has provided me with examples of two types: one is represented by vowel harmony rules whose domain is delimited by the stress pattern. Thus in Eastern Cheremis (for which, see Hayes 1979) stressed vowels assimilate vowels to their right in backness and roundness. A more complicated example is found in Andalusian Spanish where, according to Zubizaretta 1979, the stress of a projected vowel arrests the leftward spread of a laxing harmony. Finally, Khalkha Mongolian itself is an example of this type: suffixes attached to disharmonic loanwords (like the Russian loan lager' 'camp') harmonize with the stressed rather than the rightmost vowel of the stem: the plural of lager' is lager'uud with the backness of the suffixal vowel matching that of the stressed a. However, the fact that the metrical structure of the word may have a role to play in determining the opaque elements does not justify letting in the whole range of analyses permitted by the device of contextually determining the opaque elements.

In this respect, a more directly relevant example could be the Menomini Mid Vowel Raising discussed by Jensen and Stong Jensen 1979. The triggers of this rule, which makes mid long vowels high, are, in Bloomfield's formulation (Bloomfield 1962: 96), "the high vowels i, i·, u, u· or the semivowels y, w after a nonsyllabic". Since the high vowels of Menomini appear only postconsonantally it is clear that this postconsonantal limitation concerns only the glides. But in fact it may be the case that the postconsonantal glides that trigger the rule are underlying high vowels: this possibility which is adopted by Jensen and Stong Jensen in their paper, would allow the opaque set of the Mid Vowel Raising to be speci-

fied as [+syll, +high] with no further limitation. The only problem with this approach is that it requires, at least in its most rudimentary version, a curious condition on the underlying sequences of syllabics in Menomini : high vowels must be disallowed from appearing post vocalically in the underlying representations. If they were allowed to, sequences like ai, au would exist when Mid Vowel Raising applies and nothing would block their high vowels - later to be turned into glides - from triggering, incorrectly, the rule. However, without embarking on a full-fledged analysis of Menomini, this consideration is not enough to rule out the solution based on the desyllabification rule and, at this stage, it seems fair to conclude that the need for contextual specification of opaque elements has not been established.

Returning to Khalkha, we can now compare the analysis of RH adopted in the paper with the one based on Halle's idea of contextually defining the opaque elements, having thus established that neither approach has the advantage of using independently needed machinery.

Here is a restatement of RH following Halle's suggestion:

21) Projection: [+syll, -high]

Opaque: [+syll] / [+syll, +high, +round] C_0 ___ ; leftmost[+syll]

Harmonizing Feature: [(+) round]

Rule 21) is meant to work in collaboration with condition 13): 13) will ensure that words whose first vowel is high, round or not, will not contain any [+round, -high] vowel; 13) will also ensure that the first category of opaque vowels designated by 21) will not be [+round, -high] either, simply because they are by definition not the first vowels in their words.

Some of the comments already made on rule 8) apply to 21) as well: the opacity-forming role of high round vowels in this roundness harmony rule is not explained. The left context in the entry Opaque could just as well have been [+strident, +voice] or anything at all: it is easy to see that in this format a great many non-existent and not-expected-to-exist rules can be written.

Secondly, the entry Harmonizing Feature is required again: if we omit it from 21, we could not tell what feature is being propagated from the opaque onto the projected segments. However, insofar as all known rules of Vowel Harmony are assimilation rules it is highly important that their assimilatory character be somehow incorporated into their formal statement: I have proposed to achieve this by making the harmonizing feature predictable from the specification of the opaque set, which in

my formulation of RH is $\begin{bmatrix} +\text{syll} \\ +\text{round} \end{bmatrix}$. If we maintained this formulation, neither the harmonizing feature entry would be needed nor the convention 9), above, which in the Vergnaud-Halle system spells out the assimilatory character of an analysis like 21).

I conclude that the adoption of an analysis like 21) cannot be based on the strength of its intrinsic virtues but rather on its being unavoidable elsewhere: which, at this point, is still an open question.

APPENDIX: The Input Representations to Warlpiri's Vowel Assimilation Rules

1. This note is meant to serve as an appendix to both my paper on Khalkha and to Nash's paper on Warlpiri vowel harmony (in this volume)[7]: I will therefore repeat only briefly the facts (which come from Hale 1974, 1977 and Nash 1979) and their relevance to the ideas presented in the paper on Khalkha.

One of the key elements of a correct analysis of Khalkha's harmony rules is condition 13, which states that the vowels undergoing a harmony rule must be underlyingly unspecified for the harmonizing feature of the rule. Condition 13 bears some resemblance to the autosegmental idea that the harmony is not - at least not underlyingly - a feature of any of the vowels that "carry" it at the surface but a property of the morpheme as a whole. We shall see here that neither condition 13 nor the autosegmental combination of well-formedness conditions and assumptions about the underlying representations of the harmonic vowels can accommodate the Warlpiri vowel assimilation rules. The reader is referred to Nash's paper for evidence that the two rules I shall discuss have the definitory feature of harmony rules, i.e., operate on strings of vowels of indefinite length.

2. Warlpiri has three vowels (a, i, u) and two nonlocal vowel assimilation rules: the regressive harmony triggered by the Past morpheme/rnu/nu, exemplified in 1), and the progressive harmony triggered by any i, exemplified in 2):

1) kuju - rnunju - rnu
throw - INCEP - PAST
(cf. kiji - rninji - rni; kiji - rninji - nta)
- NOMIC PAST IMPER

2) maliki - kirli - rli - lki - ji - li
dog - COMIT - ERG - then - me - they
(cf. kurdu - kurlu - rlu - lku - ju - lu;
child -
paarlpa - rlu
calf of leg - ERG

Both the regressive and the progressive harmony are blocked by an intervening a (3a, b). The progressive harmony is also blocked by labial consonants (4):

3)a yirra - rnu
put PAST

b minija - kurlu - rlu - lku - ju - lu
cat -

4) miyi - kipurda
food - DESIDERATIVE
(cf. kurdu - kupurda)
child -

3. The progressive harmony applies inside stems as well as between stems and suffixes. The facts that lead to this conclusion are contained in Nash's ADDENDUM to his 1979 paper: Nash had noticed that nominal roots and prefixes contain sometimes disharmonic sequences of high vowels. He lists 10 such cases (kurdiji, kurriji, pukurdi, punjungiyingiyi, wakurnji, yukiri, yurdi, mirntipuru, nyinjiwu, wirntirpuru) and observes that only three of them (the last three on my list) contain iCu sequences and that in all three cases the iCu sequence contains a labial consonant. This pattern - as he notices - is similar to the pattern of the progressive harmony in that a labial consonant seems to block the fronting of a high vowel by a preceding high front vowel. In fact the pattern becomes identical and not just similar to that of the progressive harmony once we view the progressive harmony as a [-back] rather than as a [αback] rule: since the rule is triggered only by i and operates from left to right, underlying iCu sequences will assimilate to iCi (if C is not a labial) but underlying uCi sequences will survive unaffected (if there is no i to their immediate left). If one has a unified rule of fronting, one expects to encounter uCi sequences not only inside the stems but also when the two vowels are separated by a morpheme boundary: however it is normally the case that across a morpheme boundary both high vowels will have the same specification for round/back. If this were always the case one will have to concede that fronting is a [-back] rule inside the stems but an [αback] rule outside them. However, in a different section of his paper, Nash mentions a number of morphemes that 'resist' backing: -pinki 'etc', -nginti 'directional adessive', -wiyi 'prior', -mipa 'only', -yijala 'also'. We could now explain that these morphemes are in no way exceptional: they have underlying i's and keep them even when preceded by a u. The consequence of this move is that the bulk of clitics and nominal suffixes that contain alternating high vowels have underlying u's.

4.1. The preceding section contains, implicitly, one argument for specifying underlyingly the frontness of vowels participating in the progressive (front) harmony rule: we can account for the difference between alternating suffixes (like kirli/kurlu) and non-alternating suffixes (like nginti) by assuming that the vowels of the former are underlyingly back whereas those of the latter are front. The progressive harmony is triggered only by front vowels and this is why -nginti appears unchanged after u. We also explain in this way - and a solution based on exception features cannot do this - why Warlpiri has no non-alternating suffix *-nguntu.

4.2 The main evidence for entering the high vowels of Warlpiri fully specified for frontness in the underlying representations comes from a different source: the existence of segments blocking both harmony rules provides us with neutral environments, i.e., environments in which the surface frontness/

backness of a high vowel cannot be due to the application of a harmony rule. The argument is simple: if in the neutral environments we find high vowels of both colors, in a distribution unpredictable by any other means, then we must assume that the frontness/backness of these vowels is underlying. And if in some environments the high vowels must be assumed to be underlyingly marked as [+back] or [-back] then we have no reason left to think that this is not the case in all environments.

I have grouped the evidence backing up my argument in the following way: first, under 5a), come nominal stems and suffixes of CiCaCi shape, where the second i cannot have assimilated to the first via the progressive assimilation rule; under 5b) comparable forms of CiCaCu shape. Second, under 6), I list Ci [+labial] i and Ci [+ labial] u nominal stems. Finally, I give in 7) verbal stems - whose high vowels assimilate to the Past suffix -rnu/-nu when no a intervenes - : under 7a) CuCa stems, under 6b) CiCa stems:

5)a kirntangi 'moon'
minngarli 'tear'
pirrarni 'yesterday'
yimampi 'larp manna'
maliki - kirlangu - kari - kirli
dog - Poss - other - COMIT

b miyalu 'stomach'
yijardu 'true'
yirntatu 'emu hunting blind'

6)a jipilyaku 'water bird'

b mirntipurru - jarri 'to stay too long in one place'

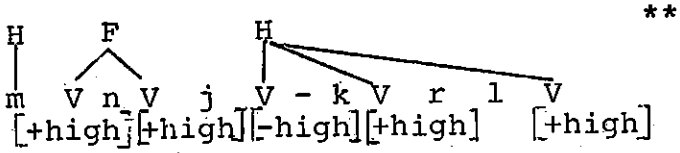
7)a purra-, nguna-, kulpa-, luwa-, yuka-, yunpa-, yurpa-

b yirra, jija-, nyina-, mina.

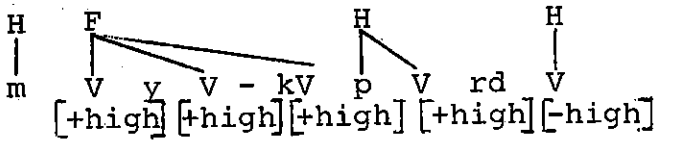
5.1 Aside from the question of the underlying representations of the harmonic vowels, the careful reader has probably spotted by now two other sources of trouble for an autosegmental account of the Warlpiri vowel harmony: the fact that both rules are directional and the existence of segments which block the rules.

5.2 Let us consider how these problems combine to render an autosegmental analysis difficult: suppose we represent the progressive harmony as the association between the high vowels of certain morphemes and a F(ront) harmony. In this case the existence of forms like kurdiji requires us to stipulate that the F harmony comes lexically associated with certain vowels (the second in the case of kurdiji) and that the association can only take place between F and a vowel to its right. In order to represent the blocking effect of a and of the labials on the spreading of F we must enter both a and the labials as having lexically associated harmonies: let us refer to them as a single H harmony. Let us also assume that

the high vowels are included in the harmonic set of H, i.e., that H may associate to a high vowel: nothing however hinges on this decision, which is solely meant to allow a more precise outline of the class of analyses permitted within an autosegmental framework. The representations of minija-kurlu... and miyi-kipurda will therefore be **

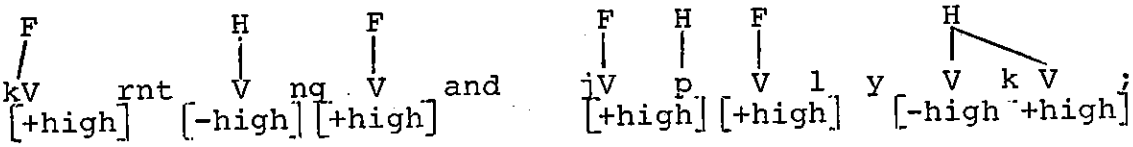


and

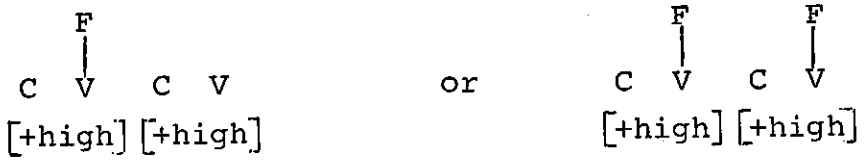


respectively.

The representations of kirntangi and jipilyaku must therefore include two F harmonies for the same morpheme:



in turn, the fact that we allow now several F harmonies per morpheme renders a surface form CiCi at least two ways ambiguous as to its underlying sources, which could be either:

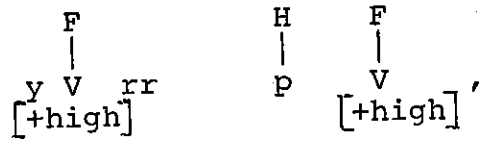


5.3.1. By assuming that a surface u in Warlpiri is either a high vowel unassociated to any harmony or else associated with H we have considerably narrowed down the choice of analyses available for the regressive assimilation. Recall that the basic alterations illustrating the regressive assimilation are kiji - rni, kiji - ka vs. kuju - rnu. I see two solutions compatible with the analysis of the progressive assimilation.

5.3.2. Verb stems of the type represented by kiji- could be represented as having associated F harmonies; kuju-rnu is then to be explained by a rule of Past Tense formation which consists of deleting the F of the root. The deletion rule must be formulated so as to avoid deleting the F of roots like yirra-, jija- whose high vowels do not alternate: at first sight we might think that we can take advantage of the fact that a's are entered with associated H's to formulate the Past Tense rule as deleting as F immediately adjacent to the Past morpheme -rnu. However we do not want every intervening H to block the deletion rule: the H associated with labials should not block it, as the alternations yurrpu-rnu 'put it in - PAST' vs. yirrpi-rni 'put it in - Non PAST' show. In short the main cause of trou-

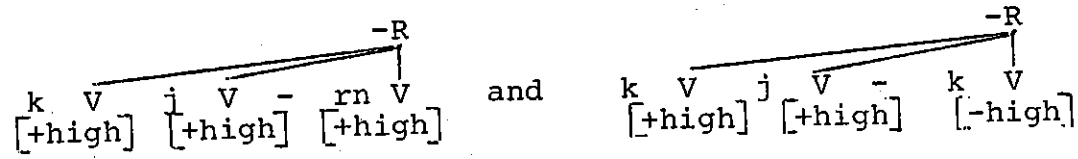
** Specifications [±high] in these diagrams refers only to vowels V. Ed.

ble is the fact that the progressive rule is blocked both by labials and by a whereas the regressive rule is only blocked by a. Yirrpi-, which must be represented as:

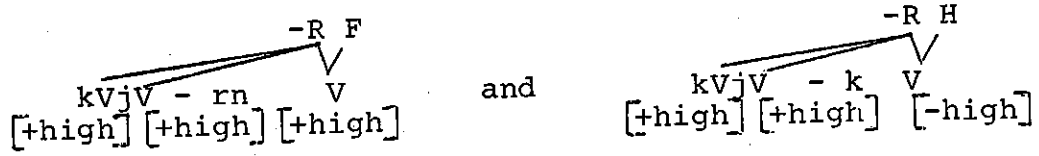


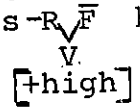
also shows that the Past Tense rule will have to delete not one but strings of F provided they are not interrupted by the H associated with an a; otherwise, instead of yurrpu-rnu only *yirrpu-rnu would be generated. It should be sufficiently clear now why we have to look for an alternative.

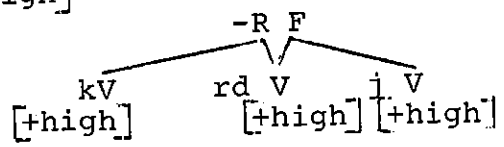
5.3.3. Kiji - rni and kiji - ka could instead be represented as:

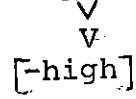


where -R would have to be interpreted as a harmony with deroun-ding effects. Since we have already decided that unalternating i's are high vowels lexically associated with F and that a's are always associated with H the more nearly correct representations would be:



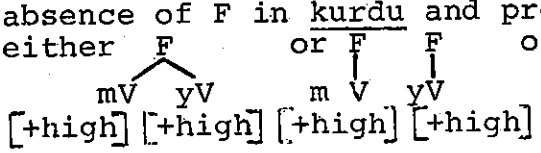
R differs from F in several respects; it comes lexically associated both with (certain) high and non-high vowels; it associates to vowels found to its left; its presence is restricted to certain verbal suffixes: the i's of nominal stems for example cannot be represented as 

because nominal stems like kurdiji would only surface as 

i.e. *kirdiji, and verbal stems like yuka or nominal stems like mula would similarly surface as*yika,*mila if their a's were represented as 

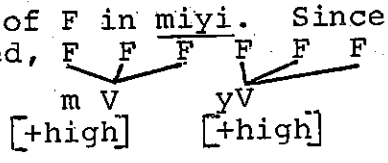
. Finally -R can spread over labials but not over a's (cf. yirrpi-rni, yirrpi-nta vs. yuka-rni, yuka-nta) which, for someone intent on pursuing an autosegmental analysis will mean that the decision to enter both labials and a with associated H harmonies must be somehow revised, though it's hard to see what revision will give the correct result.

5.4. To sum up the results of this section: an autosegmental analysis of the two non-local vowel assimilation rules of Warlpiri must include a provision restricting the association between a certain harmony, F, to vowels found to its right; must allow several F harmonies per morpheme, which, in addition to rendering the simplest F-harmonic forms structurally ambiguous, undermines the very possibility of characterizing the harmonic character of a word in segment-independent terms: it is not the case that the difference between a nominal stem like kurdu 'child' and a nominal stem like miyi 'food' is autosegmentally characterizable as the difference between absence of F in kurdu and presence of F in miyi. Since miyi is either

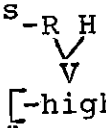


or

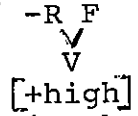
or indeed,



the property that distinguishes its harmonic behavior from that of kurdu is not so clearly separatable from a segmental property of its vowels. Finally, in order to cope with the regressive harmony, an autosegmental analysis will either have to adopt a rule (Past Tense Formation) which deletes strings of F's of indefinite length, ignoring intervening H's but provided that they are not interrupted by a's, or else will have to characterize certain a's as



, certain i's as



and will have to allow -R to "cross lines" with certain, but not all, harmonies.

6. For a metrical analysis of the rules the reader is referred to Nash's paper (in this volume). A comparison with a segmental approach might be instructive: the progressive harmony could be formulated as in 8) and should apply iteratively, from left to right.

8) $$[+syll] \rightarrow [-back] / \begin{bmatrix} +syll \\ -back \end{bmatrix} C_0 \_\_\_\_ [-labial]$$

Underlyingly all high vowels would be marked as [+back] or [-back]. The regressive harmony, if formulated as 9):

9) $$[+syll] \rightarrow [+back] / \_\_ C_0 \begin{bmatrix} +syll \\ +high \\ +back \end{bmatrix}]_{\text{PAST TENSE}}$$

poses however a problem of application: its Structural Description will be met only once in a derivation, in the immediate vicinity of the PAST TENSE labelled bracket, so that stipulating that the rule should apply iteratively - as it plainly must in kuju - rnunju - rnu - will be ineffectual. The only segmental alternative I can see is 10):

10) $$[+syll] \rightarrow [-back] / \_\_ \left(C_0 \begin{bmatrix} +syll \\ +high \end{bmatrix} \right)^* \quad C_0 \begin{bmatrix} +syll \\ +back \\ +high \end{bmatrix}]_{\text{PAST TENSE}}$$

whose use of the star notation might in itself be an argument for the superiority of Nash's metrical rules.

FOOTNOTES

* I have benefitted from discussions with Nancy Chinchor, Morris Halle, Paul Kiparsky, David Nash, David Pesetcky, Ken Safir and Tim Stowell.

1. ö̈rgö̈ö̈sei instead of the expected ö̈rgö̈ö̈sö̈i is due to the operation of a Derounding rule ö̈i → ei̊: there is no surface ö̈i̊ diphthong in Khalkha.

2. Strictly speaking our conclusion is only that the vowels undergoing a harmony rule are uniformly specified underlyingly with respect to the harmonizing feature. However, if the difference between unspecified and uniformly specified is that a segment unspecified for a certain feature is spelled out with the unmarked value of the feature (whereas a class of segments could be said to be uniformly specified for either the marked or the unmarked value of a feature) then we can in fact conclude from our discussion of RH that the vowels undergoing it are not only uniformly specified underlyingly but also unspecified for the feature Round.

3. Chinchor's solution to this problem is based on the idea that the high round vowels effect a de-rounding on the non-high vowels. A rule like this cannot be understood as a dissimilatory process: ï̈f anything, one would expect a dissimilatory effect in uCu, uCü̈, oCo, ö̈Cö̈ sequences whereas in fact such sequences abound in Khalkha: surguli 'university', xümüs 'people', ẍubun 'bird', ürzülex 'to multiply'. On the other hand we have several indications that the "derounding" is intimately related with the harmony rules, in a way which Chinchor's rule doesn't help to explain: like RH and FH, derounding does not occur across compound boundaries as compounds like but-tsoxix 'to smash' or bür-mösön 'show'; the vowels affected by derounding are exactly those participating in RH: [-high] vowels.

4. Something with the effect of Condition 13 exists in Turkish, where non-high vowels may be round only in the initial syllable. What is more interesting is that in Turkish, non-high vowels do not undergo RH, so that the effect of condition 13 is allowed to surface unaltered: words of Co...a, Cö̈...e form are well-formed. The Turkish situation indicates that our decision to keep Condition 13 separate from RH, despite their interaction in Khalkha, is correct.

5. I am indebted to Guy Carden for asking the questions and raising the objections that led to the final form of this argument.

6. Some charity is necessary in interpreting the condition thus stated since a literal interpretation applied to a form CöCö would predict the existence of eight other well-formed variants: CöCe, CoCö, etc: the representation is declared well-formed as long as every vowel is associated with at least one of the two harmonies, R and F, of the morpheme.

7. Nash, who generously supplied me with all the written and unwritten information on Warlpiri I could handle, is not to blame for anything I say. Thanks go also to Ken Hale, for discussion and help with the data.