Underspecification, the feature hierarchy and Tiv vowels*

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1 Introduction

The major issue with regard to underspecification theory\footnote{1} is whether all types of redundant information should be excluded from underlying representations, or if not, then what the principles are that determine the inclusion or exclusion of particular types of information. The vowel system of Tiv, a Niger-Congo language of Nigeria, is particularly interesting in this regard since the representation of individual vowels in verbal roots requires a type of radical underspecification: no features are actually assigned to vowels underlyingly; surface forms result from the interaction of morpheme-level specifications with rules of spreading and redundancy.

Apart from properties of the underlying representations themselves, the rules of assimilation required for an adequate account of Tiv are interesting in that they require crucially the notion of feature geometry developed in much recent work.\footnote{2} It is argued that the three assimilation rules that are required for verbs exhibit a range of behaviour whose properties are predicted by an appropriate theory of feature geometry. It will be shown in particular that processes of complete assimilation may derive from very different sources: On the one hand, complete assimilation may be the result of a single rule spreading a set of relevant features; on the other hand, complete assimilation may result from the combined application of more than one rule, each affecting a single feature. Within a hierarchical feature theory, the choice between such alternatives is not arbitrary, but governed by a range of conceptual and empirical considerations.

The paper is organised as follows. First, some brief background information about Tiv is presented. An account of the distributional properties of the morphemic vowel features observed in verbal roots is then presented. Finally, properties of vowel deletion and vocalic ablaut are examined.
2 Background: vowels, consonants and moras

The vowel system of Tiv consists of six oral vowels: 3

(1) i u e o a o

These vowels are distinguished by the three features [high], [low] and
[round]. Fully specified, the appropriate specifications for these features
are as in (2a); with redundant specifications removed, in a manner to
be argued for below, the same vowels appear underlyingly as in (2b):

(2a) ia e ao o au

high + -- + - high + +
low - - + - - low + +
round - - + + - round + + +

To derive fully specified representations, the partially specified represen-
tations of (2b) are filled out by the following redundancy rules:

(3) a. [ ] → [−high]
b. [ ] → [−low]
c. [ ] → [−round]

Regarding the consonants of Tiv, the following represents the basic
inventory:

(4) p t ts c k kp
    b d dz j g gb
    mb nd ndz nj ng nb
    f s sh h
    m n ny g
    v l r y gh w

There are no consonant clusters in Tiv, except in cases where a syllabic
nasal precedes a heterosyllabic consonant. All digraphs and trigrams in
(4) therefore represent single segments: [kp] and [gb] indicate labial-velar
stops; [ts] and [dz] represent affricates; [mb], [nd], [ndz], [ng] and [nb]
indicate prenasalised stops; [ny] is a palatal nasal; [gh] is a voiced velar
fricative; and [c], [j], [nj] and [sh] are the palatalised counterparts of [ts],
[dz], [ndz] and [s].

Vowels in Tiv may be either long or short, and certain consonants are
permissible in a word-final coda (see §6 for discussion). Where moras are
referred to in this paper, this therefore refers to vowels (short vowels
constituting one mora; long vowels, two) or to a word-final consonant (a
single mora).

As a final background point, Tiv verbs belong to two tonal classes, H
and L. The appropriate l root vowel and non-initial a verb's tense or via redh
1985, 1986a). In this paper entries by a diacritic tone- L. Unless specifically indicated here do not indicate surf conjuction with segment

3 Vowel cooccurrence

Reference to (2b) in the representations is actually i specifications for Tiv vo
properties of particular n vowels of Tiv are under
specifications, with their spreading of underlyingly with the application of th
means is that the inventory representations; it simply
ventions affecting morpheme.
The central thesis of th freely combining any of tl [+ round] (see also Archan
illustrate the various com account for those combine
somewhat special property

3.1 No specifications

Given the hypothesis in (4) morphemic specification will
redundancy rules. Morphemes presented as completely de
entries:

(5) a. ĝér 'be in exc
    b. bende 'touch'
    c. ēse 'sweep'
    d. yévese 'flee'

Support for analysing [c] a
sidering the distribution of
and moras
vowels:  

The appropriate lexical tone associates by convention to the first root vowel and non-initial vowels are assigned tones either as a function of a verb's tense or via redundancy rules (for discussion, see Pulleyblank 1985, 1986a). In this paper, the lexical tone of a verb is indicated in simple entries by a diacritic tone-mark on the initial vowel: acute for H, grave for L. Unless specifically indicated as a tensed verb, representations given here do not indicate surface tones, such tones being derivable only in conjunction with segmental and/or tonal tense morphemes.

3 Vowel cooccurrence patterns

Reference to (2b) in the last section as constituting 'underlying' representations is actually inaccurate. I argue here that (virtually) all specifications for Tiv vowels are underlyingly unlinked, constituting properties of particular morphemes, not particular vowels. Individual vowels of Tiv are underlyingly represented as completely devoid of specifications, with their surface values resulting from the linking and spreading of underlyingly floating morphemic features, in conjunction with the application of the vocalic redundancy rules of (3). What this means is that the inventory represented in (2) has no status in underlying representations; it simply constitutes the end result of rules and conventions affecting morphemic vowel specifications.

The central thesis of this paper is that vowels of Tiv are derived by freely combining any of the three feature values [+high], [+low] and [+round] (see also Archangeli this volume). In the following sections, I illustrate the various combinations that such a proposal predicts, and account for those combinations that are either unattested or that have somewhat special properties.

3.1 No specifications

Given the hypothesis in (2) above, a vowel that has not received any morphemic specification will surface as [e] following application of vocalic redundancy rules. Morphemes such as the following are therefore represented as completely devoid of vowel specifications in their lexical entries:

(5) a. gévé 'be in excess'
    b. bénéd 'touch'
    c. ésc 'sweep'
    d. yévé 'flee'

Support for analysing [e] as underlyingly unspecified comes from considering the distribution of this vowel in different positions of the word.
As can be seen in the following table, the frequency of the vowel [e] rises significantly in V₁ and V₂ position:

(6) Vowel frequencies (short vowels not separated by [h]) expressed as percentage

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>a</th>
<th>o</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>V₁: 470 bimoraic verbs</td>
<td>12</td>
<td>24</td>
<td>18</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>V₁: 259 trimoraic verbs</td>
<td>13</td>
<td>26</td>
<td>22</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>V₂: 470 bimoraic verbs</td>
<td>5</td>
<td>38</td>
<td>33</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>V₂: 259 trimoraic verbs</td>
<td>12</td>
<td>47</td>
<td>2</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>V₃: 361 trimoraic verbs</td>
<td>16</td>
<td>42</td>
<td>6</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>

This skewing in favour of the vowel [e] receives a straightforward explanation in terms of the left-to-right application of the Association Conventions. In order to derive a vowel other than [e], some morphemic specification must be present. Such specifications link up from left to right, assigning their specifications to the first vowel of the root. In some, but not all, configurations subsequent vowels receive specifications via spreading. To get an [e] on V₁, a morpheme must have no morphemic specifications; to get an [e] on V₂ or V₃, a morpheme can either have no specifications or else be of a type that does not trigger spreading rules.

3.2 [+high]

The first morphemic specification that I consider is a [+high] specification. If a morpheme contains solely the vocalic specification [+high], then that feature's obligatory appearance in initial position is accounted for by the left-to-right application of the Universal Association Conventions. Any remaining vowels surface as [e], giving us words such as the following:

(7a) g̟i bil ‘put a thing down’
    b. pine ‘ask’
    c. hine ‘hoot’
    d. kine ‘groan’

In addition to such cases, we observe a pattern where the morphemic [+high] specification spreads to non-initial vowels:

(8a) tindi ‘send’
    b. livi ‘dislocate, sprain’
    c. vügili ‘knead into a ball’
    d. nyišshi ‘change one’s mind’

That the non-initial [+high] specification in such cases is the result of spreading is clear from the fact that no such non-initial high vowel is possible unless the preceding vowel is also high. A pattern such as the logically possible *e...e* is completely unattested in Tiv.

The rule of High Spread must extend the domain of a [+high] segment from one mora to an im... Anticipating the incorporation discussed below, I assume (9b):

(9) High Spread

```
  a. VV
     +hi
```

There is, of course, a problem that High Spread applies in cases such as (7) - even though it is not evident in the examples (129 verbs), rough phonological analysis suggests two basic reasons. Firstly, the high [e] is not contrastive between bimoraic and trimoraic forms but almost two to one. Secondly, it exhibits spreading in their initial conditions of ablaut (see §).

While nothing central to our account of the association of [e] with the relevant feature is driven by this property, the Parallel Structure of Tiv ablaut presentation of the morphemic [+high] specification to the domain and (iii) redundant values...
from one mora to an immediately following mora, as represented in (9a). Anticipating the incorporation of a hierarchical approach to features to be discussed below, I assume the formal expression of this rule to be as in (9b).  

(9) High Spread

\[ \text{Root node} \]
\[ \text{Supralaryngeal node} \]
\[ \text{Place node} \]
\[ \text{Dorsal node} \]

There is, of course, a problem with the analysis so far. Although High Spread applies in cases such as (8), it does not apply in cases such as those in (7) - even though its structural description is apparently met.

To deal with this problem, I simply propose that the examples like (7) are marked as exceptions to the rule. As concerns trimoraic verbs, this proposal is supported by the fact that with \([V_1CV_2]\) sequences, where \(V_1\) is a high vowel, 33 of 39 cases exhibit the effects of spreading. With bimoraic verbs, it is not as clear whether the class exhibiting spreading or the class without spreading is the marked class. Of the relevant class of examples (129 verbs), roughly 40% exhibit spreading, while 60% do not. I nevertheless analyse the class without spreading as the exceptional class for two basic reasons. First, the overall number of examples (both bimoraic and trimoraic) exhibiting spreading outnumber those that do not almost two to one. Second, even those bimoraic verbs that do not exhibit spreading in their isolation form do show the rule's effects under conditions of ablaut (see §7 below).

While nothing central to the analysis of Tiv presented here depends on any particular view of the appropriate exception feature, I assume here that the relevant feature is extraprosodicity (Hayes 1980, 1982; Kiparsky 1985; Pulleyblank 1986a; and so on). That is, the final mora of appropriate verb roots is lexically marked as extraprosodic.

To illustrate the various properties of the proposed analysis of vowel height, consider the derivations of *livir* 'dissociate', *spraït* 'sprain', *pïn* 'ask' and *pëse* 'make a detour', where (i) the Association Conventions link a morphemic [+high] specification to the first vowel, (ii) the rule of High Spread extends the domain of the [+high] specification (where possible), and (iii) redundant values of [−high] (3a) are assigned to the left-over...
vowels of a verb without a morphemic [+ high] (after the loss of extraprosodicity markings):\(^8\)

\[
\begin{array}{ccc}
\text{a. livir} & \text{b. pi(ne)} & \text{c. gese} \\
\begin{array}{c}
+hi \\
\end{array} & \\
\begin{array}{c}
livir \\
+hi \\
\end{array} & \\
\begin{array}{c}
\text{n/a} \\
\text{n/a} \\
\end{array} & \\
\begin{array}{c}
\text{gese} \\
- hi \\
\end{array} & \\
\begin{array}{c}
\text{Redundant [−high]} \\
\text{(3)} \\
\end{array} \\
\end{array}
\]

Additional evidence in favour of this analysis of the feature [high] will be seen below as we consider the interaction of [high] with other features.

3.3 [+round]

In conjunction with the patterns involving [+high], the following possibilities are predicted to occur in combination with a morphemic [+round] specification:

\[
\begin{array}{ccc}
\text{a. no specification for [high]; morphemic [+round]} \\
\text{b. morphemic [+high]; High Spread; morphemic [+round]} \\
\text{c. morphemic [+high]; no High Spread; morphemic [+round]} \\
\end{array}
\]

These three patterns are indeed attested, as illustrated below. As with [high], the property of being round is not determined on a segment-by-segment basis; either a morpheme includes round vowels (as in the cases below), or it does not (as in the cases in §§ 3.1 and 3.2).

The first pattern is one involving no underlying specifications for [high] (or [low]), the only specification being a morphemic [+round]. Such cases constitute the rounded counterparts of the cases seen in (5) above:

\[
\begin{array}{ccc}
\text{a. mór 'puff out'} \\
\text{b. kóso 'keep thing for a person'} \\
\text{c. nghóor 'receive'} \\
\text{d. nyóoso 'be fully grown'} \\
\end{array}
\]

Such examples exhibit round vowels throughout the stem. As will be shown below, this is the result of left-to-right association of the [+ round]

specification, followed by off-formulating this rule,\(^1\)

The second pattern is conjunction with a morpheme is, the [+round] counterpi-

\[
\begin{array}{ccc}
\text{a. hčgh 'open'} \\
\text{b. undu 'leave'} \\
\text{c. gčvíul 'hern'} \\
\text{d. gčuíus 'be abu} \\
\end{array}
\]

As with the examples in association and spreading.

The final pattern of (11) i from spreading (as seen in §: of verbs such as those in (7)

\[
\begin{array}{ccc}
\text{a. undé 'mount'} \\
\text{b. búné 'be fooli} \\
\text{c. húre 'drive at'} \\
\text{d. núngbe 'play'} \\
\end{array}
\]

The last cases establish tw they show unambiguously t place from left to right, that i Conventions in their unmark with the feature [high], one vowel follows an unrounded attested:\(^10\)

\[
\begin{array}{ccc}
\text{+i..[o, u]}... \\
\text{+..[o, u]}... \\
\text{+..[o, u]}... \\
\end{array}
\]

A second point established of [+round] is conditioned b applying only if the trigger i feature [high]. The rule of Re follows, where the formalisat pates the discussion in §4.1

\[
\begin{array}{cc}
\text{15} \\
\text{Round Harmony} \\
\text{a. ahi} \\
\text{b. } \text{+} \\
\text{V V} \\
\text{+ rnd} \\
\text{+} \\
\end{array}
\]
Feature hierarchy and Tiw vowels

Specification, followed by a rule spreading the round specification. I put off formulating this rule, however, until we examine patterns (11b,c).

The second pattern is one involving a [+round] specification in conjunction with a morphemic [+high] that is subject to spreading—that is, the [+round] counterparts of examples like those in (8):

(13) a. bigh  'open'
    b. ùndu 'leave person or thing behind'
    c. guvul 'hem, make selvage'
    d. gbufi 'be abundant'

As with the examples in (12), such verbs exhibit a combination of association and spreading.

The final pattern of (11) involves a [+high] specification that is blocked from spreading (as seen in §3.2). Examples of this pattern, the counterparts of verbs such as those in (7), are given in (14):

(14) a. ùnde 'mount'
    b. bime 'be foolish'
    c. hure 'drive away'
    d. nümbe 'play'

The last cases establish two aspects of the behaviour of [+round]. First, they show unambiguously that the initial association of [+round] takes place from left to right, that is, by the application of Universal Association Conventions in their unmarked form. In a manner comparable to that seen with the feature [high], one never observes verbs in Tiw where a round vowel follows an unrounded vowel; patterns such as the following are not attested:

(15) * ...{3, o, u}...
    * ...{3, o, u}...
    * ...{2, o, u}...

A second point established by the examples in (14) is that the spreading of [+round] is conditioned by the height of the vowels involved, the rule applying only if the trigger and target vowels agree with respect to the feature [high]. The rule of Round Harmony can therefore be expressed as follows, where the formalisation in terms of the feature hierarchy anticipates the discussion in §4.1:

(16) Round Harmony

\[
\begin{align*}
\text{a. } & \text{ahi} & \text{b. } & \text{ahi} \\
\text{V} & \text{V} & \text{Labial node} & \text{Dorsal node} \\
+\text{rd} & +\text{rd} & \text{Place node} & \\
\end{align*}
\]
This rule is illustrated below as it would apply in cases like koso ‘keep thing for a person’, guvul ‘hem’ and bume ‘be foolish’. Note that (i) High Spread feeds and therefore must precede Round Harmony, and (ii) because Round Harmony refers to both ‘+’ and ‘−’ values of [high], the redundancy rule assigning [−high] (3c) must apply prior to its application.\(^{12}\)

\[
\begin{align*}
(17)\quad a. &\quad +rd & b. &\quad +rd & c. &\quad +rd \\
&\quad \vdots & &\quad \vdots & &\quad \vdots \\
&\quad \text{koso} & &\quad \text{guvul} & &\quad \text{bu(me)} \\
&\quad \vdots & &\quad \vdots & &\quad \vdots \\
&\quad +hi & &\quad +hi & &\quad \text{Association} \\
&\quad \text{Conventions} \\
&\quad \vdots & &\quad \vdots \\
&\quad \text{+rd} & &\quad \vdots & &\quad \vdots \\
&\quad \text{n/a} & &\quad \text{guvul} & &\quad \text{n/a} \\
&\quad \vdots & &\quad \vdots & &\quad \vdots \\
&\quad +hi & &\quad +hi & &\quad \text{High Spread} (9) \\
&\quad +rd & &\quad \vdots & &\quad \vdots \\
&\quad \text{koso} & &\quad \text{n/a} & &\quad \text{bume} \\
&\quad \vdots & &\quad \vdots & &\quad \vdots \\
&\quad −hi & &\quad +hi & &\quad −hi \\
&\quad \vdots & &\quad \vdots & &\quad \vdots \\
&\quad \text{+rd} & &\quad \text{+rd} & &\quad \text{Round Harmony} (16) \\
&\quad \text{\textbackslash \textbackslash} & &\quad \text{\textbackslash \textbackslash} & &\quad \text{\textbackslash \textbackslash} \\
&\quad \text{koso} & &\quad \text{guvul} & &\quad \text{n/a} \\
&\quad \vdots & &\quad \vdots & &\quad \vdots \\
&\quad −hi & &\quad +hi & &\quad \text{\textbackslash \textbackslash} \\
&\quad \text{[koso]} & &\quad \text{[guvul]} & &\quad \text{[bume]} \\
\end{align*}
\]

Note that the redundancy rule supplying [−high] feeds Round Harmony by ensuring that vowels such as those in (17a) agree with respect to [high]. This suggests that a single [−high] value is assigned by the redundancy rules, consistent with the Obligatory Contour Principle (McCarthy 1986), to derive a representation analogous to that observed

with a branching [+high] argues against the assumption auto segments are assigned

3.4 [+low]

The third feature required feature’s distribution is shown in that there is no evidence discussion, I will first consider a [+round] specification. I with [+high], a combination the inherent incompatibil cit:

3.4.1 [+low] and [+round].

Low vowel may appear is initial additional [+round] specified

\[
\begin{align*}
(18)\quad a. &\quad \text{dzãmber} & \text{‘bese} \\
&\quad \text{b. tãver} & \text{‘be há} \\
&\quad \text{c. ãnem} & \text{‘melt} \\
&\quad \text{d. gbangese} & \text{‘be br} \\
&\quad \vdots & &\quad \vdots \\
&\quad \text{+rd} & &\quad \vdots \\
&\quad \text{koso} & &\quad \text{n/a} & &\quad \text{bume} \\
&\quad \vdots & &\quad \vdots & &\quad \vdots \\
&\quad −hi & &\quad +hi & &\quad −hi \\
&\quad \vdots & &\quad \vdots & &\quad \vdots \\
&\quad \text{Round Harmony (16)} \\
&\quad \text{\textbackslash \textbackslash} & &\quad \text{\textbackslash \textbackslash} & &\quad \text{\textbackslash \textbackslash} \\
&\quad \text{[koso]} & &\quad \text{[guvul]} & &\quad \text{[bume]} \\
\end{align*}
\]

Assuming as with [+high] are linked by convention, it assigned to the first mora. A via the application of the rule Harmony is applicable in the of Round Harmony does [high] and [low] in order to Harmony specifically require.

The distribution of low complex. The majority of observed for trimoraic stems the initial vowel, and a nor dependent on whether or not

\[
\begin{align*}
(19)\quad a. &\quad \text{dzõmon} & \text{‘twist} \\
&\quad \text{b. gbõngor} & \text{‘shave} \\
&\quad \text{c. nyõngoso} & \text{‘run} \\
&\quad \text{d. sõson} & \text{‘appro} \\
&\quad \vdots & &\quad \vdots \\
&\quad \text{[koso]} & &\quad \text{[guvul]} & &\quad \text{[bume]} \\
\end{align*}
\]

(20) a. giinde ‘be fully-

b. kisse ‘surroun-

c. màninde ‘go to pe

d. vënde ‘precede
apply in cases like ᵃⁿᵉ 'keep foolish'. Note that (i) High Round Harmony, and (ii) and ' - ' values of [high], the last apply prior to its appli-

with a branching [+high] specification (derived by spreading). This argues against the assumption made in Pulleyblank (1986a) that redundant autosegments are assigned one per anchor. ¹²

3.4 [+low]
The third feature required to contrast morphemes of Tiv is [+low]. This feature's distribution is somewhat different than that of [high] and [round] in that there is no evidence for spreading of any kind. In the following discussion, I will first consider the behaviour of [+low] with or without a [+round] specification. I will then consider the interaction of [+low] with [+high], a combination that behaves somewhat specially because of the inherent incompatibility of the two feature values.

3.4.1 [+low] and [+round]. In trimoraic verbs, the only position where a low vowel may appear is initial position. ¹³ Examples with and without an additional [+round] specification are given below:

(18) a. dzámber 'beseech'
    b. tável 'be hard, tough'
    c. ánem 'melt'
    d. gbândisé 'be broad'

(19) a. dzámón 'twist'
    b. gôôngor 'shave head'
    c. nyíngós 'run'
    d. sósém 'approach'

Assuming as with [+high] and [+round] that morphemic specifications are linked by convention, the [+low] specification of such examples is assigned to the first mora. All subsequent moras surface as [−low, −high] via the application of the regular redundancy rules (3). Note that Round Harmony is applicable in the relevant cases (19). This shows that the rule of Round Harmony does not require agreement with respect to both [high] and [low] in order to apply. As already formulated in (19), Round Harmony specifically requires agreement with respect to [high].

The distribution of low vowels in trimoraic verbs is somewhat more complex. The majority of verbs belong to a pattern comparable to that observed for trimoraic stems. ¹⁴ That is, the [+low] specification falls on the initial vowel, and a non-initial vowel is mid – its value for [round] dependent on whether or not Round Harmony (16) is applicable:

(20) a. gándé 'be fully-grown, adult'
    b. kása 'surround'
    c. mánde 'go to person or place'
    d. vándé 'precede'
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(21) a. kĩmbo 'weed sparse grass of dry season'
b. nĩndo 'drip'
c. tsõngõ 'circumcise person'
d. vĩsõ 'man have sexual intercourse with woman'

There is, however, a major class of exception to this pattern, cases where the morphemic [+ low] specification falls on the second vowel. Interestingly, however, this exceptional patterns is possible only in cases without a morphemic [+ round] specification:

(22) dzẽnda 'drive away'
    hĕmha 'exceed'
    mbeghã 'jolt'
    tsẽva 'curse'

I have no evidence in favour of any particular analysis of these exceptional cases. Possible accounts include prelinking the [+ low] autosegment, marking the first vowel extraprosodic, or positing a special rule of 'initial [+ low] assignment'. Whatever the correct solution, it should be noted that such exceptionality is restricted to morphemes that are (i) bimoraic, and (ii) without a [+ round] specification (although see §3.4.2).

As an additional point, note that even though a [+ low] specification may appear on either the first vowel of a bimoraic verb (regularly), or on the second vowel (exceptionally), it is impossible to have a sequence of [+ low] vowels. The absence of morphemes with more than one [+ low] specification is the automatic result of assuming that morphemic specifications are floating, in conjunction with the Obligatory Contour Principle (Lehén 1973; McCarthy 1986; and so on), which ensures that there will be no sequences of identical floating specifications. Such considerations also ensure that all sequences of [+ high] or [+ round] vowels in a root are the result of spreading — not from the underlying presence of multiple [+ high] or [+ round] specifications.

To summarise the discussion so far, we have seen that morphemes may freely select a morphemic specification from the class [+ high], [+ round] and [+ low]. In addition, morphemes are attested that combine [+ round] with [+ high], and [+ round] with [+ low]. The basic patterns attested with such features involve the linking of morphemic specifications via the left-to-right application of the Universal Association Conventions followed in appropriate configurations by rules spreading [+ high] and [+ round]. Bimoraic cases that deviate from the above pattern are accounted for by exceptionally preventing the application of High Spread, and by exceptionally assigning a [+ low] specification to the second mora of a root.

3.4.2 [+ low] and [+ high]. The set of possible combinations that have not yet been discussed involve patterns where [+ low] would be in combination with [+ high]. If the features [+ low] and [+ high] are interpreted along the lines of Chomsky & it should not be possible for a morphemic [+ high] specification to the same vowel. And while position, there is nevertheless characterised as involving the and [+ round]:

(23) a. bũsõ 'break fr'
b. hũnã 'mutter,'
c. nũngwa 'mix'
d. kũmã 'suffice'

Although the [+ low] and [+ vowel, they can link to differ sequence. A couple of point possible only with bimoraic independently motivated for specification to the second mor exceptional property of bime as those in (23) to exist. A se cases in (23) from those seen sequence is possible only wit not attested. Although I ha asymmetric behaviour of [ morphem and the restricti roots suggest that it is be

To conclude, not only ha various possible combination and [+ low], but as can be ; have also exhausted the v; sequences of vowels occurri seen that the inventory of encoding of vowel contrasts ; maximally unassigned in un through (i) the assignment o governed spreading of such context-free redundancy rul

4 Supralaryngeal spr

In examining the distributi an absence of *aCa sequ sequences as well as a consic other hand, the vowel patte
season'

...rse with woman'

exception to this pattern, on falls on the second vowel.

nerns is possible only in eation:

...articular analysis of these prelinking the [+low] autonic, or posturing a special rule correct solution, it should be
to morphemes that are (i) ration (although see § 3.4.2).
ough a [+low] specification bimoraic verb (regularly), or on
sible to have a sequence of
with more than one [+low]
assuming that morphemic
ith the Obligatory Contour
so on), which ensures that
ating specifications.16 Such
es of [+high] or [+round]
3 = not from the underlying
specifications.

we seen that morphemes may
the class [+high], [+round]
ted that combine [+round]

The basic patterns attested
phemic specifications via the
Association Conventions fol-
d spreading [+high] and
om the above pattern are
application of High Spread,
cification to the second mora.

The combinations that have not
[+low] would be in corn-
[+high] are interpreted

along the lines of Chomsky & Halle (1968), namely as incompatible, then
it should not be possible for the Association Conventions to assign both a
orphic [+high] specification and a morphemic [+low] specification
to the same vowel. And while evidence from Tiv appears to support this
position, there is nevertheless a verb class that appears accurately
characterised as involving the morphemic specifications [+high], [+low]
and [+round]:

(23) a. bọsà 'break fragment off'
b. hùna 'mutter, grumble'
c. nụngwa 'mix'
d. kùmà 'suffice'

Although the [+low] and [+high] specifications cannot link to the same
vowel, they can link to different vowels, deriving a [+high][+low]
sequence. A couple of points are worth noting. First, this pattern is
possible only with bimoraic roots. This correlates with the ability
independently motivated for bimoraic roots of assigning a [+low]
specification to the second mora (22). Whatever the formal account of this
exceptional property of bimoraic roots, it makes possible for verbs such as
those in (23) to exist. A second point, and one which distinguishes the
cases in (23) from those seen earlier in (22), is that the [+high][+low]
sequence is possible only with [+round] morphemes: the pattern *h...a
is not attested.17 Although I have no explanation for this difference, both the
asymmetric behaviour of [+round] with respect to [+high]/[+low]
morphemes and the restriction of such a height combination to bimoraic
roots suggests that it is to be analysed as a marked phenomenon.

To conclude, not only have we now exhausted a consideration of the
various possible combinations of the three features [+high], [+round]
and [+low], but as can be seen by a consideration of the appendix, we
have also exhausted the various vowel patterns observed in Tiv on
sequences of vowels occurring over consonants other than [h]. We have
seen that the inventory of vowels attested in Tiv plays no role in the
encoding of vowel contrasts in verbs. On the contrary, vowels in verbs are
maximally unspecified in underlying representation, receiving their values
through (i) the assignment of morphemical specifications, (ii) the rule-
governed spreading of such specifications, and (iii) the application of
context-free redundancy rules.

4 Supralaryngeal spreading

In examining the distribution of low vowels, it was noted that there is
an absence of *[aCa] sequences. There are, however, numerous [aa]
sequences as well as a considerable number of examples of [sha]. On the
other hand, the vowel pattern [aCe], widely attested in cases where the
relevant consonant is not [h], is completely unattested with [h], and impossible as well if two vowels are adjacent: *[ahc], *[ae]:

(24) a. dâa  ‘knock thing over’
b. sâa  ‘become lost to’
c. vâa  ‘weep, cry’
d. pââ  ‘push aside (grass, etc.)’

(25) a. kââ  ‘hoe’
b. pââ  ‘throw off a person’
c. tsââ  ‘punish’
d. ndââ  ‘be small’

This difference between [VV]/[VnV] and [VCV] sequences involving low vowels is attested in an entirely comparable way with sequences involving [e] and [o] – that is, with a morphemic [+round]. The sequence *[õCõ] is not attested, *[õCõ] only being possible.¹³ But in contrast, both [õõ] and [õõ] are possible, while *[õ(õ)õ] is not:

(26) a. õõ  ‘breathe’
    lõõ  ‘sow by pressing the seed into the soil’
    yõõ  ‘make proclamation’
    nõõsõ  ‘mix’
    b. kõõ  ‘dig out with a pointed tool’
    lõõ  ‘summon’
    sõõ  ‘blow up (as of fire)’
    ndõõ  ‘become wet’

These differences in vowel patterns depend on two factors: (i) whether there is, or is not, a consonant intervening between two vowels, and (ii) whether a consonant, if present, is [h] or not. The first property can straightforwardly be accounted for by a special rule of assimilation restricted in such a way as to apply only when the vowels involved are strictly adjacent. Viewed properly, I argue that the required rule also accounts for the examples involving [h].

Recall the consonant inventory of Tiv given in (4) above, in particular with respect to laryngeal specifications. Prenasalised consonants are redundantly voiced, fricatives are redundantly voiceless and sonorants are redundantly voiced. The only class of segments that require underlying voicing specifications are the stops. The segment [h] is therefore in a class of its own in that the only feature required to specify it ([spread glottis]) is not required for any other segment. By the specification [+spread glottis], [h] is uniquely identified, making any non-laryngeal specifications superfluous. It is this point that can contribute to an explanation of why it is the only consonant occurring between vowels that do not normally cooccur across a consonant.

4.1 The feature hierarchy

Following a growing body of work by Schein & Steriade 1988; Pulleyblank 1988; and so on, constituting individual set structure. In set, the tonal features are set. Using a tree format to model can be represented:

(27)

Root node

Laryngeal node

Spread glottis

Voiced

Sonorant

Labial node

Round

Coronal node

Distributed

Those aspects of the subst...
4.1 The feature hierarchy

Following a growing body of recent research (Clements 1985; Sagey 1986; Schein & Steriade 1986; Archangeli & Pulleyblank forthcoming; Pulleyblank 1988; and so on), I assume that the distinctive features constituting individual segments are internally organised into a highly articulated set structure. For example, the laryngeal features constitute a set, the tonal features constitute a set and the place features constitute a set. Using a tree format to represent such set structure, the hierarchical model can be represented as follows. 19

[Diagram of a tree structure showing the hierarchical organization of features.]

Those aspects of the substantive proposal in (27) that are crucial for the analysis of Tiv presented here will be made clear below.
4.2 The hierarchy and supralaryngeal spreading

In a cross-linguistic survey, Steriade (1987a) makes the following observations concerning supralaryngeal harmony.50

(28) a. always a multiple feature harmony
b. the node spread cannot be a single articulator node (labial, coronal, dorsal)
c. the presence of /h/ between a harmonic trigger and target is never a requirement for harmony, merely a possibility

All of these observations are supported by the Tiv data discussed here, and an analysis along the lines of that proposed by Steriade derives them in an explanatory way. First, supralaryngeal harmony affects all the contrastive vowel features of Tiv, [high], [low] and [round] (28a), since there is complete identity (i) of adjacent vowels and (ii) of vowels over an [h]. Were the relevant harmony rule to affect only [+low], leaving the effect on [high] and [round] to the rules formulated previously, there would be no explanation for the differences in behaviour between [low], [round] and [high]. Given a hierarchical structure as in (27), transaryngeal harmony must affect one of the three following nodes: (i) the place node, (ii) the supralaryngeal node, (iii) the root node. Single articulator nodes are excluded since no single node (labial, coronal, dorsal) dominates all three features required by the Tiv vowel inventory (28b).

Following Steriade (1987a), I propose here to analyse transaryngeal harmony as the spreading of the supralaryngeal node. Represented graphically below, we see that such a hypothesis straightforwardly accounts for the rule's applicability between adjacent vowels (29a), as well as its applicability over a consonant devoid of supralaryngeal specifications (the consonant [h]) (29b); when a consonant bears one or more supralaryngeal specifications (all consonants other than [h]), such a consonant of necessity blocks the rule (29c):

(29)

\[ a \quad b \quad h \quad c \quad g \]

\[ V \quad V \quad V \quad V \quad V \]

\[ \text{Root node} \]

\[ \text{Supralaryngeal node} \]

If one were to posit spreading of the root node instead of the supralaryngeal node, this would incorrectly predict that even the consonant [h] should act as a blocker, since even [h] has a root node as support for its laryngeal specification.

If, on the other hand, one were to spread the place node, this would derive essentially correct results, but not without raising certain potential problems. To the extent have place specifications sequences with [VV] set sequences. But if one plot (as in, for example, Kipa incorrectly expect conson with respect to transaryngeal underspecified account of node account of harmony raise fewer potential problems.

Transaryngeal harmony

(30) Transaryngeal H

\[ V \quad V \]

\[ \text{Root node} \]

\[ \text{Supralaryngeal node} \]

5 Single features c.s.

In the last section, it was as of spreading a class node [round]. The rule involves Round Harmony (16) in that to block the rule's applicative consequences.

Surface examples of tot autosegmental spreading of (31) are the result of spready vowels of (32) are the rest harmony rules - one spread

(31) a. kaha 'hoe'
    b. vii 'weep, c
    c. ibho 'summon'
    d. sib 'sting'

(32) a. tinci 'send'
    b. gauvi 'hem, m:
    c. nyos 'he fully'

It is possible, moreover, for y set of redundancy rules have. One might ask whether assimilation is the result of
Feature hierarchy and Tiv vowels

313

problems. To the extent that all intervening consonants other than [h] have place specifications, the putative rule would correctly group [VhV] sequences with [VV] sequences, distinguishing them both from [VCV] sequences. But if one place of articulation were to be assigned redundantly (as in, for example, Kiparsky's 1985 analysis of Catalan), then one would incorrectly expect consonants articulated at that place to act as transparent with respect to 'translaryngeal' harmony. Although I do not investigate an underspecified account of Tiv consonants here, I select the supralaryngeal node account of harmony over the place node account, since it appears to raise fewer potential problems.

Translaryngeal harmony can therefore be formulated as follows:

\[ (30) \quad \text{Translaryngeal Harmony} \]

\[ \begin{array}{c}
V \\
\text{Root node} \\
\text{Supralaryngeal node}
\end{array} \]

5 Single features vs. nodes: Constituent Spreading

In the last section, it was argued that translaryngeal harmony is the result of spreading a class node dominating the features [high], [low] and [round]. The rule involved differs crucially from High Spread (9) and Round Harmony (16) in that any supralaryngeal specification is sufficient to block the rule's application. This result has a number of interesting consequences.

Surface examples of total assimilation need not be the result of the autosegmental spreading of a class node. Hence the identical vowels of (31) are the result of spreading the supralaryngeal node, while the identical vowels of (32) are the result of the combination of two independent harmony rules - one spreading [high], the other spreading [round].

\[ (31) \]
\[ a. \, \text{kaha} \quad \text{‘hooe'} \]
\[ b. \, \text{vaa} \quad \text{‘weep, cry'} \]
\[ c. \, \text{laho} \quad \text{‘summon'} \]
\[ d. \, \text{gii} \quad \text{‘sting'} \]

\[ (32) \]
\[ a. \, \text{tindi} \quad \text{‘send'} \]
\[ b. \, \text{guvul} \quad \text{‘hem, make seivedge'} \]
\[ c. \, \text{nyosso} \quad \text{‘be fully grown'} \]

It is possible, moreover, for vowels to be identical simply because the same set of redundancy rules have applied, for example, ye'esce 'flee' (5).

One might ask whether the existence of a pattern whereby total assimilation is the result of several features spreading separately entails
rejection of the Constituent Spreading Hypothesis (Clements 1985, 1986; Sagey 1986, 1987; Archangeli & Pulleyblank forthcoming; etc.):

(33) Constituent Spreading Hypothesis
A single phonological rule may spread no more than a single node of the feature hierarchy

From the above discussion, such a conclusion does not seem warranted. Certainly if all else is equal, general considerations of simplicity would select a rule spreading a single class node over a rule or rules spreading multiple features. As seen in Tiv, however, all else may not be equal. Specifically, the pattern of blocking predicted by the spreading of a class node is systematically different from the pattern predicted by the spreading of a single terminal feature. As noted in Steriade (1987a), the blocking pattern observed in transglaryngeal harmony cannot follow from single feature spreading. Hence the Constituent Spreading Hypothesis can be maintained with the proviso that cases of complete or partial assimilation may in some cases be the result of more than one rule. Since nothing has ever ruled out such a possibility, the real importance of the Constituent Spreading Hypothesis is therefore its predictions as to the properties associated with any single rule affecting some particular set of features. As illustrated here, spreading of a node or feature N is predicted to be blocked by the presence of an intervening segment specified for N.

6 Vowel deletion

Before turning to an analysis of the interaction of the above account of vowel distribution with the Tiv process of vocalic ablativ, it is important to discuss a productive process of vowel deletion. Consider the examples in (34) and (35), which summarise the various vowel sequences that have been shown above to occur across a consonant other than [h]:

(34) i. . . C_{af}:  
   tıdi 'send'
   e. . . e C_{af}:  
   yévese 'flee'
   a. . . C_{af}:  
   vánde 'precede'
   a. . . o C_{af}:  
   tsángo 'circumcise'
   o. . . o C_{af}:  
   kósó 'keep thing for a person'
   u. . . u C_{ht}:  
   kusu 'grip tightly'

(35) i. . . e C_{af}:  
   hide 'return'
   e. . . C_{af}:  
   dzánda 'drive away'
   G_{i}:  
   tsevá 'curse'
   u. . . e C_{af}:  
   númbé 'play'
   C_{i}:  
   ùmbe 'be thick, bushy'
   u. . . a C_{af}:  
   kumbá 'collect for consultation'
   C_{i}:  
   húrú 'weed farm or road'

The crucial point to be noted is that deletion is restricted to occur only when the vowel finally, while the other vowels remain. Phrased differently, an analysis may be proposed whereby the absence of the vowels *[oGʃo] and *[uGʃu], where the vowels are assumed to be the result of the following Pulleyblank (1987) analysis of vowel spreading in Tiv follows derived via d in (34) above but where the vowels are not.

(36) i. . . C_{af}:  
   gbíl 'put a'
   e C_{af}:  
   hén 'learn'
   a C_{af}:  
   sáv 'levy'
   o C_{af}:  
   gów 'be cut'
   u C_{af}:  
   mór 'puff'
   u C_{af}:  
   bigh 'open'

The above examples make it clear that there is a typology of conditions. First, there are vowels and not others. Second, consonants that intervene in the formation of the rule I will refer to as 'core' consonants. A consideration of the case for the vowel sequences show that agreement with respect to the features [high] and [round] (vowels of adjacent moras ag Harmony (16) applies to core agreement with respect to [round], only the former r formulation such as the one above is shown to apply the sequence of vox [round]. Agreement with respect to applicability of deletion to the features [high] and [round] is suggested in Pulleyblank (this is problematic for [v] and a rule changing this consonant to a more plausible way to change that is, as those consonants rhyme. Under such a character that refer explicitly to the C_{i} class need simply assume that the the output of deletion is a p consonant is of the C_{i} class.
The crucial point to be observed is that one class of sequences is restricted to occur only with the class of consonants that cannot occur word finally, while the other class of vowel sequences is not so restricted. Phrased differently, an account of Tiv vowels must account for the systematic absence of the sequences *[cC_i], *[eC_i], *[aC_i], *[oC_i], *[oC_i] and *[uC_i], where C_i is the class {v, l, r, gh, m, n}. My proposal, following Pulleyblank (1985, 1986a), is to posit a rule that deletes the second vowel in appropriate cases of [VC_iV]. That is, examples like the following are derived via deletion from sequences of vowels such as those in (34) above but where the consonant is a C_i:

(36) i C_i: ghbl 'put a thing down'
   e C_i: hën 'learn'
   a C_i: sàv 'levy dues on'
   o C_i: gòv 'be curved'
   o C_i: morb 'puff out'
   u C_i: bugh 'open'

The above examples make it clear that Vowel Deletion is subject to two types of conditions. First, deletion takes place with certain sequences of vowels and not others. Second, deletion is sensitive to the nature of the consonant that intervenes between the two vowels. Before actually formulating the rule, I will consider briefly each of these conditions.

A consideration of the cases in (34) shows that in order for the rule to apply the sequence of vowels must agree with respect to [high] and [round]. Agreement with respect to [low] is not required, as shown by the applicability of deletion to the sequences [sC_i] and [sC_o]. Concerning the features [high] and [round], it should be recalled that in all cases where vowels of adjacent morae agree with respect to the feature [high], Round Harmony (19) applies to create agreement with respect to [round]. As agreement with respect to [high] entails agreement with respect to [round], only the former needs to be included in the rule—unlike a formulation such as the one given in Pulleyblank (1985, 1986a).

Concerning the requirements on the intervening consonant, one possibility is to simply include a reference to the C_i class in the structural description of the rule (as, for example, in Pulleyblank 1985, 1986a). This is somewhat problematic, however, since the set {v, l, r, gh, m, n} is not obviously characterised as a single class in terms of distinctive features. It is suggested in Pulleyblank (1985, 1986a) that the class is [+ sonorant], but this is problematic for [v] and [gh]. If they are analysed as sonorants, then a rule changing such sonorants into fricatives would be required. Perhaps a more plausible way to characterise this class is to define it syllabically, that is, as those consonants that can appear in a (word-final) syllable rhyme. Under such a characterisation, it would no longer be necessary to refer explicitly to the C_i class in the formulation of Vowel Deletion. One need simply assume that the rule is constrained so as to apply only when the output of deletion is a permissible syllable, that is, when the final consonant is of the C_i class.
The rule of vowel deletion can therefore be formulated as follows:

(37) Vowel Deletion

\[
V \rightarrow \circ / V - \#
\]

A few representative derivations follow (gbil 'put a thing down', pine 'ask', govo 'be curved', tsango 'circumcise'):24

(38)

a. gbili
   + hi
   + lo

b. pi(uc)
   + hi
   + lo

c. govo
   + hi
   + lo

d. tsango
   + hi
   + lo

After Association

(39) Past Recen

a. hëmbá hem
b. cingé cing
b. bùsa bósó
b. kundè künde

Note that all the example verbs with comparable \( v \) then ablaut results in fo

(40) Past Recen

a. gégba gégh
b. tìrè tìr
b. kùra kör
b. bùmè buùm

This alternation between for straightforwardly by derived by ablaut.

7 Ablaut

In this last section, I turn ablaut, paying particular properties of Tiv vowel d
Recent Past and Habitual properties of a stem. A subs
change is given in the fr
undergo change are listed chn changes will be given a b

(41) Ablaut: vowel char
a. e...a → e...e
b. i...a → i...e...
c. i...e → i...
d. o...e → e...e
e. a...a → e...e
f. a...C → e...C

[gbil] [pine] [govo] [tsango]
Additional support for this analysis comes from the interaction of vocalic ablaut with the rule of Vowel Deletion. The vocalic properties of ablaut are discussed in the next section. Of interest here is that sequences of vowels agreeing in height are often the result of ablaut.  

(39) Past    Recent Past
a. hembá hembé  'exceed'
b. cinge cingí  'wind rope, etc. round thing'
c. búsá bósó  'break fragment off'
d. kündé kündí  'mix things together'

Note that all the examples in (39) involve consonants of the C<sub>r</sub> class. When verbs with comparable vowel sequences involve consonants of the C<sub>t</sub> class, then ablaut results in forms lacking a final vowel:

(40) Past    Recent Past
a. gégáh gég'íh  'gulp'
b. tîrê tîr  'halt'
c. kúra kór  'tend'
d. bûmè bûm  'be foolish'

This alternation between vowel and consonant final forms is accounted for straightforwardly by the application of Vowel Deletion to the forms derived by ablaut.

7 Ablaut

In this last section, I turn to a discussion of the vocalic properties of ablaut, paying particular attention to the relation of ablaut to general properties of Tiù vowel distribution. Ablaut is a process observed in the Recent Past and Habitual 2 tenses that involves the modification of vocalic properties of a stem. A summary of the vowel sequences that undergo change is given in the first column of (41). The sequences that do not undergo change are listed in the second column. Examples of the various changes will be given as the particular subprocesses are discussed below:

(41) Ablaut: vowel change
a. e...a → e...e
b. i...a → i...e/e...e
c. i...e → i...i
d. o...o → e...e
e. o...o → e...e
f. a...C<sub>t</sub> → e...C<sub>t</sub>
g. u...a → o...o
h. u...e → u...u

Ablaut: no change
i. a...a
j. a...e
k. e...e
l. i...i
m. o...o
n. u...u
7.1 High Spread

The first pattern of ablaut to be considered involves cases where a high vowel...mid vowel sequence is changed to a high vowel...high vowel sequence (41c. h), as seen in the following examples:

\[
\begin{align*}
\text{Past} & \quad \text{Recent Past} \\
'cĩŋē' & \quad 'cĩgi' & \quad \text{'wind rope, etc. round thing'} \\
'kũndē' & \quad 'kũndū' & \quad \text{'mix things together'} \\
'nũmbē' & \quad 'nũmbū' & \quad \text{'play'}
\end{align*}
\]

The important point to note is that it is actually the non-ablaut forms that require special treatment. According to the analysis of the feature [high] presented in §3.2 above, one expects the [+high] specification of the initial vowel in such forms to spread – as is indeed the case in the ablaut forms. It was suggested in §3.2 that the bizonor verb roots that do not exhibit the effects of High Spread (9) should be lexically marked in some way. The behaviour of such marked roots under ablaut shows clearly that such special marking should be removed in the appropriate tenses, resulting straightforwardly in the application of High Spread.

Note moreover that if one adopts the approach to such lexical marking that involves final extrametricality, then the loss of extrametricality could at least historically be the automatic result of the addition of a suffix in the ablaut tenses. As discussed in Pulleyblank (1985, 1986a), both the Recent Past and the Habitual 2 tenses involve the addition of tonal suffixes to the verb stem. If we assume that at an earlier stage such suffixes contained segmental/skeletal material in addition to their tones, then such material would render a final extraprosodic mora of a verbal base non-peripheral. As an automatic consequence of such non-peripherality (Hayes 1986, 1988a; Harris 1983, etc.), the extraprosodicity would be lost. Hence in ablaut forms, High Spread would become applicable even in those stems for which it was lexically marked inapplicable.

7.2 [+low] on V₂

The second ablaut class to be considered involves sequences of the type high vowel...low vowel. Such cases – only possible where the low vowel is [a] because of the completely exceptionless assignment of [a] to initial position – exhibit the following pattern:

\[
\begin{align*}
\text{Past} & \quad \text{Recent Past} \\
'bũsã' & \quad 'bũsõ' & \quad \text{'snort'} \\
'bũrã' & \quad 'bõr' & \quad \text{‘inflict grazing wound on’} \\
kũrã' & \quad 'kõr' & \quad \text{‘tend’} \\
bũsã' & \quad 'bõsõ' & \quad \text{‘break fragment off’}
\end{align*}
\]

As already noted in §, violating the pattern established by the lexical [+low] specification in a case like kũrã ‘tend’, the [-low] specification link mechanism – see §3.4.1),

\[
\begin{align*}
\text{(+4i) } & \quad +hi \\
\text{ +rd} & \quad \text{ +lo}
\end{align*}
\]

All rules of spreading would already discussed, hence the surface form kũrã.

But consider what would specification were not assign a case, simple left-to-right would assign both the [+hi] vowel:

\[
\begin{align*}
\text{(+4i) } & \quad +hi \\
\text{ +rd} & \quad \text{ +lo}
\end{align*}
\]

But since such a configuration [+high, +low], the Associating such a result. If if [+low] to the first vowel rest to scan rightwards, then both to a single vowel, the second formed manner in which the priority is assigned to either

My suggestion for Tiv is neither the [+low] value nor associate, given (i) the impossibility of the assumption that the A to all features (that is, for each.
As already noted in §3.4.1, the non-ablaut forms of these examples violate the pattern established unexceptionally in trimoraic verbs in that the lexical [+low] specification is assigned to the second mora. Consider a case like kūra 'tend'. This morpheme contains three vocalic specifications underlyingly: [+high], [+low], [+round]. Given that the [+low] specification links exceptionally to second mora (by whatever mechanism—see §3.4.1), the Association Conventions apply as follows:

\[
(44) \quad +hi \\
\quad \uparrow \\
\quad kura \\
\quad \uparrow \\
+rd \quad +lo
\]

All rules of spreading would be inapplicable in such a case for reasons already discussed, hence the redundancy rules would derive the correct surface form kūra.

But consider what would happen to such a verb stem if the [+low] specification were not assigned in some way to the second vowel. In such a case, simple left-to-right application of the Association Conventions would assign both the [+high] and the [+low] specifications to the initial vowel:

\[
(45) \quad +hi \\
\quad \uparrow \\
\quad kura \\
\quad \uparrow \\
+rd \quad +lo
\]

But since such a configuration is ruled out by the prohibition against \( [+\text{high}, +\text{low}] \), the Association Conventions should be prevented from producing such a result. If failure to effect an association of [+high] and [+low] to the first vowel results in the Association Conventions continuing to scan rightwards, then both features would again be incorrectly assigned to a single vowel, the second one. The problem is that there is no well-formed manner in which the Association Conventions can apply unless priority is assigned to either [high] or [low].

My suggestion for Tiv is that no such priority clause exists. As such, neither the [+low] value nor the [+high] value in such a morpheme can associate, given (i) the impossibility of a \( [+\text{high}, +\text{low}] \) combination, and (ii) the assumption that the Association Conventions apply *simultaneously* to all features (that is, for each feature, they apply whenever and wherever
they can (Goldsmith 1976)). As a result, feature values for [high] and [low] would be assigned by redundancy rule in such a case, resulting in surface mid vowels.

This is the result required for the ablaut forms in (43). To derive the correct results, the special proviso that ensures linking of [+ low] to V₂ in non-ablaut forms is no longer active in the ablaut forms. As such, association of [+ high] and [+ low] cannot take place, and surface mid vowels result from the application of the appropriate redundancy rules (3). As with the exceptionless applicability of High Spread under ablaut, this brings such cases in line with trimoraic forms, again suggesting at least historical suffusion.

7.3 Place Delinking

In addition to the cases of ablaut discussed so far, there are two classes of verbs involving low vowels that appear to require an ablaut-specific rule:

\begin{align*}
(46) & \text{Past} & \text{Recent Past} \\
& a. & \text{vé} & \text{vé} & \text{‘come’} \\
& & \text{hèmbé} & \text{hèmbé} & \text{‘exceed’} \\
& & \text{géghé} & \text{géghé} & \text{‘gulp’} \\
& b. & \text{tòv} & \text{tòv} & \text{‘investigate’} \\
& & \text{dzèhè} & \text{dzèhè} & \text{‘wrangle’} \\
& & \text{sèé} & \text{sèé} & \text{‘fire (as in pot)’} \\
& & \text{féngé} & \text{féngé} & \text{‘flee (as into bush)’}
\end{align*}

In the cases of (46a), the [+ low] specification of the final vowel is lost; the ablaut forms surface with mid vowels; in the examples of (46b), the [+ round] and [+ low] values of the vowel [ə] are both lost in the ablaut forms, again with the surface forms therefore showing mid vowels.

The required effects can be derived by positing a rule that delinks (or deletes) the place node of a [+ low] vowel in an ablaut-inducing tense:

\begin{align*}
(47) \text{Ablaut Place Delinking} \\
\text{Place node} & & \text{Dorsal node} \\
& & +lo \\
\text{Condition:} & \text{i. word-final or} \\
& & \text{ii. [+ round]}
\end{align*}

To illustrate, consider derivations of the Recent Past ablaut forms hèmbé ‘exceed’, gándè ‘be fully-grown’, féngé ‘flee (as into bush)’ and pósè ‘untie’ (for case of exposure laryngeal and root nodes):

\begin{align*}
(48) & a. & b. \\
& \text{hèmbé} & \text{gán} \\
& \text{hèmbé} & \text{gán} \\
& \text{hèmbé} & \text{gán}
\end{align*}

The [+ low] and [+ round] (48c); the [+ round] specific [+] (as in (48d)); the [+] ((48a) vs. (48b)). After delinking redundancy rules would assist to derive correct surface for.

8 Conclusion

Properties of the Tiv verb underspecification. The inverse underlying segmental specific morphemic feature values: [ ]

To contrastive specifications in
rc values for [high] and [low] in such a case, resulting in surface forms in (43). To derive the linking of [+low] to V₂ in the ablaut forms. As such, the spread under ablaut, this time, again suggesting at least two classes of require an ablaut-specific rule: ‘untie’ (for ease of exposition, articulator nodes (labial, dorsal), supralaryngeal and root nodes are not included):

(48) a. +lo b. +lo c. +rd d. +rd
   hemba  gande  fango  poso
   Place node  After Association

+lo
-hi
   hemba  gande  fango  poso
   Place node  Redundant [+high]

+lo
-hi
   hembe  n/a  fenge  n/a
   Ablaut Place
   Delinking Other rules

The [+low] and [+round] specifications of an [ɔ] are always lost (as in (48c)); the [+round] specification of an [o] is never affected since it is not [+low] (as in (48d)); the [+low] of an [a] is lost only in final position ((48a) vs. (48b)). After delinking of the appropriate place specification, redundancy rules would assign the value [−high], [−low] and [−round] to derive correct surface forms.

8 Conclusion

Properties of the Tiv verbal system argue for the adoption of radical underspecification. The inventory of surface vowels is the result not of underlying segmental specifications, but of the free combination of three morphemic feature values: [+high], [+low] and [+round]. These three contrastive specifications interact with universal conventions and lan-
guage-specific rules to derive the six vowels attested on the surface. In addition, an account of Tiv requires in a fundamental way the notion of feature geometry since rules of assimilation differ depending on the node in the hierarchy that is spread.

The Constituent Spreading Hypothesis has been maintained. That is, a rule affecting two or more nodes/features must be formulated so as to affect a single class node dominating the individual nodes/features affected. Such a constraint is necessary to prevent rules from affecting completely unnatural classes and rendering the inherent constraints of a hierarchical feature theory vacuous. But the Constituent Spreading Hypothesis does not exclude the possibility that multiple rules may combine to create a result that under different circumstances could be the result of a single rule. While at first glance, it might appear that this renders vacuous the constraining power of the Constituent Spreading Hypothesis, it has been shown that this is not the case. For example, the feature hierarchy in conjunction with underspecification makes a range of testable predictions about the classes of segments that act as blockers for rules applying to particular nodes. For Tiv, the rules spreading [high] and [round] — distinct, single-feature rules because of their differing conditions — treat all consonants as transparent; the rule spreading the supralaryngeal node, on the other hand, treats all consonants except [h] as blockers, since all consonants but [h] bear supralaryngeal specifications.

APPENDIX
Attested vowel patterns (Abraham 1940)

<table>
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<th>Monomoraic verbs</th>
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<th>Bimoraic verbs</th>
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<th>Trimoraic Verbs (V₁V₂V₃)</th>
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NOTES
- Thanks to Diana Archam Phonology reviewer for c
- [2] See, for example, Clement Archangeli & Pulleyblank.
s attested on the surface. In the natural way the notion of differ depending on the node
is been maintained. That is, a must be formulated so as to e individual nodes/features prevent rules from affecting the inherent constraints of a the Constituent Spreading
ity that multiple rules may at circumstances could be the re, it might appear that this f the Constituent Spreading ot the case. For example, the specification makes a range of ments that act as blockers for the rules spreading [high] and se of their differing conditions spreading the supralaryngeal is except [h] as blockers, since specifications.

| [VhV]: V₁/Vᵣ | i | e | a | o | u |
| :-----------: | :|: | : | : | : |
| i | 3 | 1 |   |   |   |
| e | 7 |   | 6 |   |   |
| a |   |   |   | 1 |   |
| o |   |   |   |   | 1 |
| u |   |   |   |   |   |

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<th>Trimeric Verbs (V₁/Vᵣ)</th>
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| [VV]: V₁/Vᵣ |
| :-----------: | :|: | : | : | : |
| i | 10 | 2 | 8 |   |   |
| e | 15 |   | 10 |   |   |
| a |   | 13 |   |   | 1 |
| o |   |   | 3 |   |   |
| u |   | 1 |   | 18 |   |

| [VhV]: V₁/Vᵣ |
| :-----------: | :|: | : | : | : |
| i | 2 |   |   |   |   |
| e | 3 |   |   |   |   |
| a |   |   |   |   |   |
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* Thanks to Diana Archangeli, Ted Pulleyblank, Moira Yip and an anonymous Phonology reviewer for comments on an earlier draft of this paper.


[3] All examples in this paper are taken from Abraham (1940). Observations concerning the vowel cooccurrence patterns are based primarily on an examination of the 920+ verbs listed in Abraham (1940), in conjunction with the work of Arnott (1958, 1964).
Douglas Pulleyblank

[4] These figures include examples where the final vowel is deleted by Vowel Deletion. See §6 below.

[5] I assume the one-to-one version of the Association Conventions argued for in Pulleyblank (1986a). Other autosegmental spreading to be via convention, various problems would arise, particularly for low vowels. See §3.4.

[6] The rule does not apply in a sequence where a high vowel is followed by a low vowel (see §3.5.2). I assume this to be due to a constraint prohibiting the assignment of the specifications [+high] and [-low] to a single vowel.

[7] Unless otherwise indicated, I use 'C' in a sequence of Cs and Vs to indicate any consonant other than [h]. The reason for excluding [h] is discussed in §4 below.

[8] The features [round] and [low] are not shown in these derivations, but see §§3.3 and 3.4 below. For an argument in favour of introducing a single redundant specification in the third example, see §§3.3 and 6.

[9] Although examples such as this one exhibit a single vowel on the surface, it is clear that spreading of [+high] has taken place because of the application of vowel deletion. See §6.

[10] I found a single exception to this statement (nyaugbighom 'to approach').


[12] Note the arguments, however, in Archangeli & Pulleyblank (1987, forthcoming) that not all rules require the structural similarity condition assumed for this argument.

[13] There are a few exceptions to this statement in Abraham (1940). See appendix.

[14] Out of 288 bimoraic verbs in Abraham (1940) involving low vowels, 175 fall into the expected pattern (that is, 61%).

[15] There are actually three cases of [aCa] found in Abraham's (1940) dictionary (kama 'knock against', kpama 'annoy' and mana 'slip' (as in slip one's mind')). Interestingly, however, all three are exceptional in that the final [a] would normally be expected to delete via the productive rule of Vowel Deletion (discussed below, §6).

[16] This result provides one argument in favour of accounting for the exceptional behaviour of bimoraic [+low] roots in terms of either extraprosodically or a rule of initial linking.

[17] Strictly speaking, I found three examples of the bimoraic pattern i...a compared to 56 examples of the pattern u...a.

[18] There is one exception that I am aware of: gbon 'be slack'.

[19] This version of the hierarchy contains certain modifications of the proposal made by Clements (1983), notably a tonal node linking to the skeleton (Archangeli & Pulleyblank forthcoming) and the articulator nodes (labial, coronal, dorsal) of Sagi (1986).

[20] Steriade also discusses additional points that are not relevant for Tiv. For example, she points out that /h/ and /f/ are never distinguished in translaryngeal harmony, but since the consonant inventory of Tiv does not include /h/ this is not relevant here.

[21] For an example comparable in many ways to that of Tiv (in that assimilation results from the independent spreading of several features), see Clements (1986) and Sagi (1987) on Barra Gaelic.

[22] There may of course be additional (more stringent) conditions that must be met before a rule may apply. Minimally, however, the rule cannot spread a feature across another specification of the same feature (cf. Steriade 1987b).

[23] Out of the entire lexicon of Abraham (1940), I found only two exceptions to this pattern: kbe, 'to abrade lightly with the fingernail and gently squeeze out pus' and nyaugbighom 'approach'. As noted in note to above, nyaugbighom is also exceptional in that its [+to-right-manner].

[24] Note that Vowel Deletion, if High Spread ap (see §3.2 above), then the Pulleyblank (1985, 1986a) ordering of Vowel Deletion.

[25] Non-ablaut tense is represented by recent P tense forms include the (1985, 1986a) for discussion.

[26] The sequence [aCa] of this could be accounted for in Abraham. This is somewhat make reference to the valent deletion is blocked if it were only arise in a case involv [high] rather than delete to a situation that would not be the exceptional in relation to the fact that [a] stems, instead of on the discussion).

[27] Hierarchical structure is retained.

[28] Where two numbers are vowel sequence appears or application of vowel delet-

REFERENCES


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al vowel is deleted by Vowel Deletion Conventions argued for in precluding to be via convention. low vowels. See §3.4.

A high vowel is followed by a low [-low] to a constraint prohibiting the low vowels. See §6.

A sequence of [i] and [u] to indicate excluding [h] is discussed in §4.

In these derivations, but see §§3.3f introducing a single redundant vowel.

A single vowel on the surface, it is ace because of the application of *ngbi̞d̄Οm* 'to approach'. (Archangeli 1984; Pulleyblank 1987) would automatically achieve.

Pulleyblank (1987, forthcoming) has shown condition assumed for this.

Abraham (1949). See appendix.

2) involving low vowels, 175 fall

In Abraham's (1949) dictionary *m* 'silp (as as slip one's mind')

All in that the final [a] would not rule of Vowel Deletion (discussed of accounting for the exceptional e bimoric pattern i...a compared

by *m* 'be slack'.

In modifications of the proposal 1 role linking to the skeleton of the articulator nodes labial,

are not relevant for Tiv. For exer distinguished in translaryngeal vowels does not include /R/ this is that of Tiv (in that assimilation several features), see Clements' (1978) conclusion that must be vowel, the rule cannot spread a feature (cf. Steriade 1987b).

I found only two exceptions to fingernail and gently squeeze out note 10 above, *ngbi̞d̄Οm* is also

exceptional in that its [+round] specification does not link in the regular left-to-right manner.

24 Note that Vowel Deletion must follow High Spread since spreading leads deletion. If High Spread applies lexically, as suggested by its lexical conditioning (see §3.2 above), then this order follows automatically from the proposal in Pulleyblank (1985, 1988a) that Vowel Deletion must apply postlexically. The ordering of Vowel Deletion with respect to Round Harmony is not crucial.

25 Non-ablaut tenses are represented by General Past forms; ablaut tenses are represented by Recent Past forms. Transcriptions of Past and Recent Past tense forms include the appropriate tonal representations. See Pulleyblank (1985, 1988a) for discussion.

26 The sequence [eCa] of the non-ablaut form is not subject to Vowel Deletion. This could be accounted for in a variety of ways, the choice of which is not investigated here. At the worst, a stipulation could be added to the formulation of Vowel Deletion in (77) to the effect that only [+low] vowels are subject to deletion. This is somewhat undesirable, however, since no other rule needs to make reference to the value [-low]. Alternatively, one might propose that deletion is blocked if it were to set any vowel feature afoot, a situation that would only arise in a case involving a final [a]. A third possibility would be to delay [high] rather than delete the vowel, subsequently pruning a featureless vowel—a situation that would not arise with a final [a]. As a final possibility, it might be the exceptional nature of such cases with respect to Vowel Deletion relates to the fact that [a] appears exceptionally on the final vowel of such stems, instead of on the initial vowel as in all trisyllabic verbs (see §3.4 for discussion).

27 Hierarchical structure is not included in this example for case of exposition only.

28 While two numbers are given, the first indicates cases where the relevant vowel sequence appears on the surface; the second indicates cases where the application of vowel deletion removes the second vowel.

REFERENCES


Introduction

Phonologists have known a theory of generative phonology. Ringen (1975, 19) can be solved by abandon representations are simply specific vowel harmony should be at theory, developed in the Pulleyblank, incorporates how Hungarian can be anal adopting Goldsmith’s (1985) involvement the spreading of the vowels in Hungarian are de [−back] to these vowels, derivation because its structure transparent vowels involve from the domain of harmony in e.g. McCarthy 1984), or & Pulleyblank 1987, forth the correct, it raises the following transparent vowels? Can of have have a similar source?

2 Background data

The vowels of the standard (1):

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<td>/i:/</td>
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