

*Underspecification, the feature hierarchy and Tiv vowels**

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1 Introduction

The major issue with regard to underspecification theory¹ 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.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 ɔ

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):

- (2) a. i e a ɔ o u b. i e a ɔ o u
 high + - - - - + high + +
 low - - + + - - low + +
 round - - - + + + round + + +

To derive fully specified representations, the partially specified representations 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 ngb
 f s (sh) h
 m n ny ŋ
 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 trigraphs in (4) therefore represent single segments: [kp] and [gb] indicate labial-velar stops; [ts] and [dz] represent affricates; [mb], [nd], [ndz], [ng] and [ngb] 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 redi 1985, 1986a). In this paper entries by a diacritic tone-L. Unless specifically indicated here do not indicate surf conjunction with segment

3 Vowel cooccurrence

Reference to (2b) in the representations is actually i specifications for Tiv vowels 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 morpher

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3.1 No specifications

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 b. bēnde 'touch'
 c. èse 'sweep'
 d. yévese 'flee'

Support for analysing [e] a sidering the distribution of

and moras

vowels:³

the features [high], [low] and [round] are removed, in a manner to be underlyingly as in (2b):

	i	e	a	ɔ	o	u
high	+					+
low		+	+			
round			+	+	+	

the partially specified representations are removed by the redundancy rules:

the following represents the basic

the following represents the basic

and certain consonants are discussed in section 3.1. Where moras are assigned to vowels (short vowels) or to a word-final consonant (a

long to two tonal classes, H

and L. 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

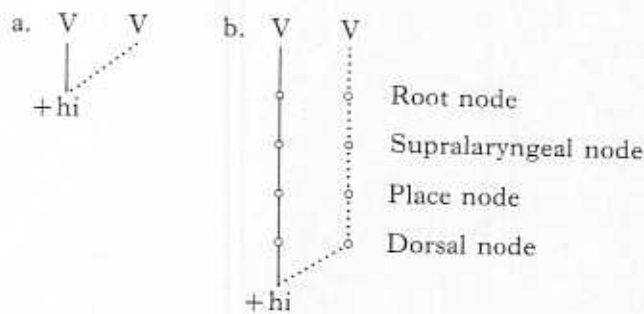
Given the hypothesis in (2) above, a vowel that has not received any morphemic specification will surface as [e] following application of vocalic redundancy rules. Morphemes such as the following are therefore represented as completely devoid of vowel specifications in their lexical entries:

- (5) a. gé[́]r 'be in excess'
 b. bè[̀]nde 'touch'
 c. è[̀]se 'sweep'
 d. yé[́]vese 'flee'

Support for analysing [e] as underlyingly unspecified comes from considering the distribution of this vowel in different positions of the word.

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):⁶

(9) *High Spread*



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.⁷ 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* 'dislocate, sprain', *pine* 'ask' and *gèse* '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

uency of the vowel [e] rises

parated by [h]) expressed as

a	ɔ	o	u
18	11	7	28
22	12	14	13
33	o	18	6
2	o	23	15
6	o	24	17

receives a straightforward
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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. búgh 'open'
 b. úndu 'leave person or thing behind'
 c. gúvul 'hem, make selvedge'
 d. gbúusu '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):

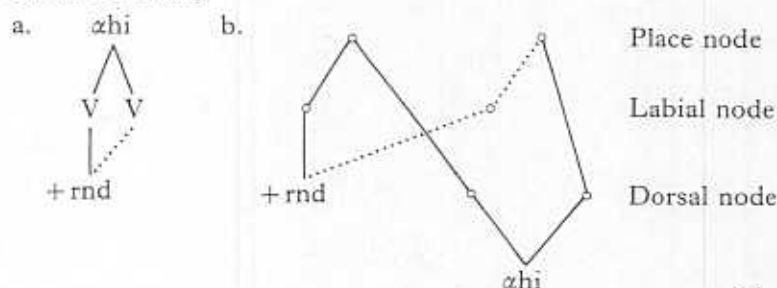
- (14) a. únde 'mount'
 b. búme 'be foolish'
 c. hùre 'drive away'
 d. númbe 'play'

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 Tiv where a round vowel follows an unrounded vowel; patterns such as the following are not attested:¹⁰

- (15) *...i...{ɔ, o, u}...
 *...e...{ɔ, o, u}...
 *...a...{ɔ, 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



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:¹¹

(17)

a. +rd	b. +rd	c. +rd	
⋮	⋮	⋮	
koso	guvul	bu(me)	Association Conventions
	+hi	+hi	
	+rd		
n/a		n/a	High Spread (9)
	guvul		
	⋮		
	+hi		
+rd			
koso	n/a	bume	Redundant [-high] (3)
∨		\	
-hi		+hi -hi	
+rd	+rd		
⋮	⋮		
koso	guvul	n/a	Round Harmony (16)
∨	∨		
-hi	+hi		
[koso]	[guvul]	[bume]	

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 that autosegments are assigned

3.4 [+low]

The third feature required for a feature's distribution is some evidence that the feature is not in that there is no evidence to the contrary. In this discussion, I will first consider a [+round] specification. In combination with [+high], a combination of [+high] and [+round] is the inherent incompatibility of

3.4.1 [+low] and [+round]. A low vowel may appear in an initial syllable if an additional [+round] specification is present.

- (18) a. dzàंबर 'beseech'
 b. táвер 'be happy'
 c. àнем 'melt'
 d. gbàngese 'be bright'

- (19) a. dzòмон 'twist'
 b. gbóngor 'shave'
 c. nyóngoso 'run'
 d. sòsom 'approach'

Assuming as with [+high] that [+low] and [+round] are linked by convention, [+low] is assigned to the first mora. Although Round Harmony is applicable in the absence of [+high], Round Harmony does not apply to [+low] and [-high] in order to maintain the inherent incompatibility of [+low] and [-high] specifically require [+high].

The distribution of low vowels is a complex one. The majority of vowels observed for trimoraic stems are dependent on whether or not

- (20) a. gànde 'be fully-'
 b. kàse 'surround'
 c. mànde 'go to pe'
 d. vànde 'precede'

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. dzamber 'beseech'
 b. táver 'be hard, tough'
 c. ànem 'melt'
 d. gbàngese 'be broad'

- (19) a. dzòmon 'twist'
 b. gbóngor 'shave head'
 c. nyóngoso 'run'
 d. sósom '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 (16), Round Harmony specifically requires agreement with respect to [high].

The distribution of low vowels in bimoraic 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. gànde 'be fully-grown, adult'
 b. káse 'surround'
 c. mánde 'go to person or place'
 d. vànde 'precede'

apply in cases like *kóso* 'keep
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 ust apply prior to its appli-

Association
 Conventions

High Spread (9)

Redundant [-high] (3)

Round Harmony (16)

[-high] feeds Round Har-
 in (17a) agree with respect to
 h] value is assigned by the
 obligatory Contour Principle
 i analogous to that observed

- (21) a. kómbo 'weed sparse grass of dry season'
 b. nòndo 'drip'
 c. tsóngo 'circumcise person'
 d. vóso '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 pattern is possible only in cases without a morphemic [+round] specification:

- (22) dzènda 'drive away'
 hèmba 'exceed'
 mgbégha 'jolt'
 tsèva 'curse'

I have no evidence in favour of any particular analysis of these exceptional cases. Possible accounts include prelinking the [+low] auto-segment, 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.¹⁵ 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 (Leben 1973; McCarthy 1986; and so on), which ensures that there will be no sequences of identical floating specifications.¹⁶ 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 in this position, there is nevertheless a characterisation involving the and [+round]:

- (23) a. búsa 'break fr
 b. húna 'mutter,
 c. nùngwa 'mix'
 d. kùma 'suffice'

Although the [+low] and [+high] vowel, they can link to different sequences. A couple of points are possible only with bimoraic verbs independently motivated for a specification to the second mora: exceptional property of bimoraic as those in (23) to exist. A sequence in (23) from those seen is possible only with not attested.¹⁷ Although I have asymmetric behaviour of [+high] morphemes and the restricted roots suggests that it is to be

To conclude, not only have various possible combinations and [+low], but as can be seen have also exhausted the various sequences of vowels occurring. It is seen that the inventory of [+high] encoding of vowel contrasts is maximally unspecified in uncontrolled through (i) the assignment of governed spreading of such context-free redundancy rules.

4 Supralaryngeal spreading

In examining the distribution of an absence of *[aCa] sequences as well as a consistent other hand, the vowel patterns

along the lines of Chomsky & Halle (1968), namely as incompatible, then it should not be possible for the Association Conventions to assign both a morphemic [+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. búsa 'break fragment off'
 b. húna 'mutter, grumble'
 c. nùngwa 'mix'
 d. kùma '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 it 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 *i...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 morpheme-level 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 [aha]. On the other hand, the vowel pattern [aCc], 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. dāa 'knock thing over'
 b. sāa 'become lost to'
 c. vāa 'weep, cry'
 d. pāase 'push aside (grass, etc.)'

- (25) a. kāha 'hoe'
 b. pāha 'throw off a person'
 c. tsāha 'punish'
 d. ndāhar 'be small'

This difference between [VV]/[VhV] and [VCV] sequences involving low vowels is attested in an entirely comparable way with sequences involving [ɔ] and [o] – that is, with a morphemic [+round]. The sequence *[ɔCɔ] is not attested, [ɔCo] only being possible.¹⁸ But in contrast, both [ɔɔ] and [ɔhɔ] are possible, while *[ɔ(h)o] is not:

- (26) a. ɔɔ 'breathe'
 lɔɔ 'sow by pressing the seed into the soil'
 yɔɔ 'make proclamation'
 nyɔɔso 'mix'
 b. kɔhɔ 'dig out with a pointed tool'
 lɔhɔ 'summon'
 sɔhɔ 'blow up (as of fire)'
 ndɔhɔr 'become wet'

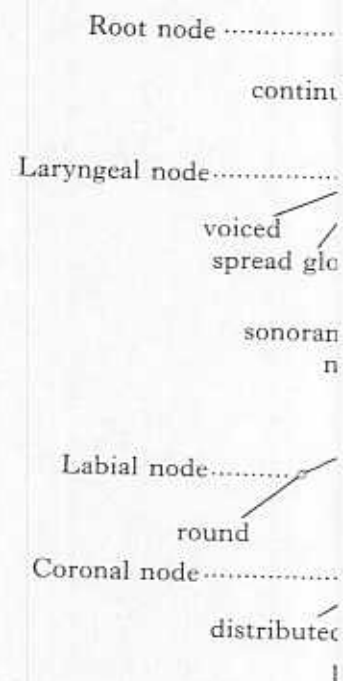
These differences in vowel patterns depend on two factors: (i) whether there is, or is not, a consonant intervening between two vowels, and (ii) whether a consonant, if present, is [h] or not. The first property can straightforwardly be accounted for by a special rule of assimilation restricted in such 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 hierarc

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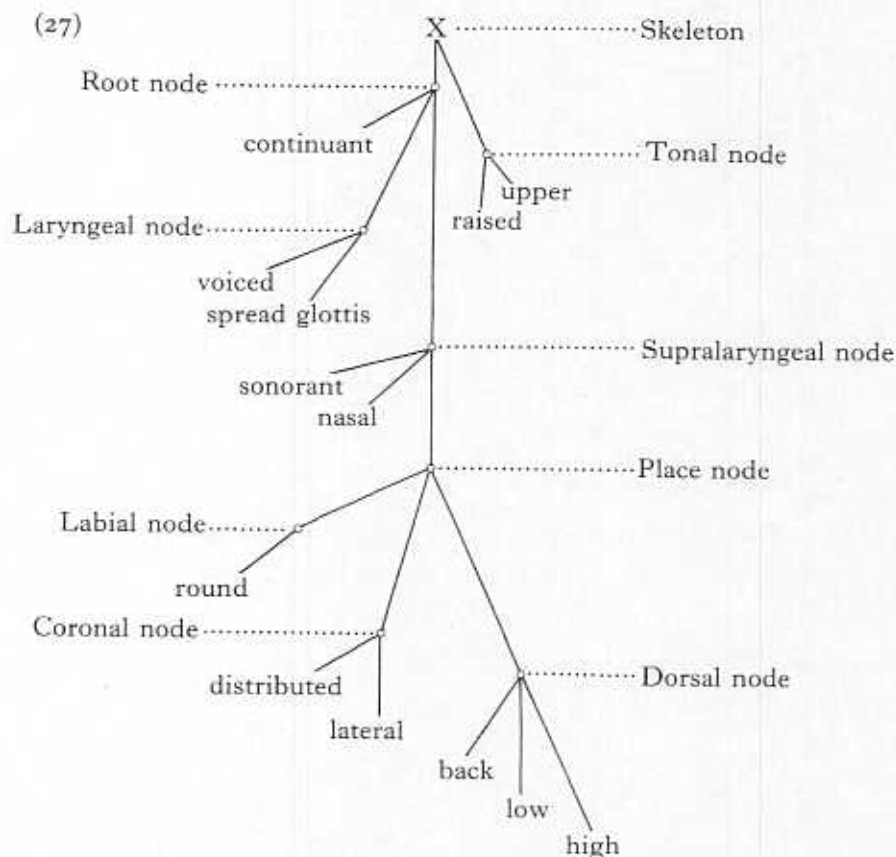
(27)



Those aspects of the substructure analysis of Tiv presented here

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



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

ly unattested with [h], and
t: *[ahe], *[ae]:

l [VCV] sequences involving
parable way with sequences
mic [+round]. The sequence
sible.¹⁸ But in contrast, both
: not:

d into the soil'

tool'

id on two factors: (i) whether
between two vowels, and (ii)
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zen in (4) above, in particular
Prenasalised consonants are
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y the specification [+spread
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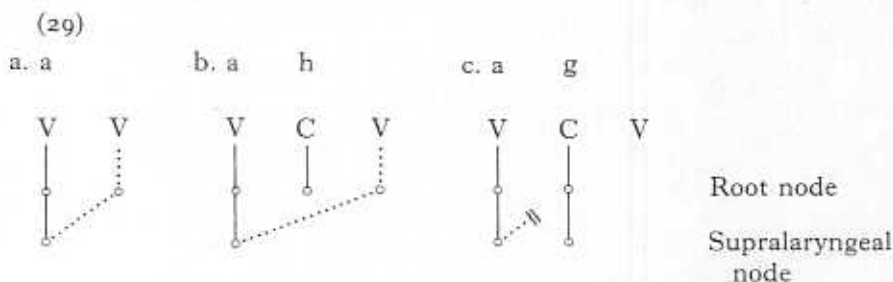
4.2 The hierarchy and supralaryngeal spreading

In a cross-linguistic survey, Steriade (1987a) makes the following observations concerning supralaryngeal harmony:²⁰

- (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), translaryngeal 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 translaryngeal 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):

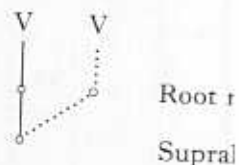


If one were to posit spreading of the root node instead of the supralaryngeal node, this would incorrectly predict that even the consonant [h] should act as a blocker, since even [h] has a root node as support for its laryngeal specification.

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 that we have place specifications for adjacent vowels in sequences with [VV] sequences. But if one place specification is present (as in, for example, Kipa), the rule incorrectly expects consonant harmony with respect to 'translaryngeal' harmony. An account of harmony based on a node account of harmony would raise fewer potential problems.

(30) Translaryngeal Harmony



5 Single features vs. multiple features

In the last section, it was argued that the spreading of a class node (the supralaryngeal node) accounts of spreading a class node (the supralaryngeal node) 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):

Surface examples of total translaryngeal spreading of the supralaryngeal node (31) are the result of spreading the supralaryngeal node over vowels of (32) are the result of translaryngeal harmony rules – one spread

- (31) a. káha 'hoe'
 b. vaa 'weep, cry'
 c. lóho 'summon'
 d. sóo 'sting'

- (32) a. tindi 'send'
 b. gúvul 'hem, mangle'
 c. nyóoso 'be fully'

It is possible, moreover, for a set of redundancy rules to have

One might ask whether the assimilation is the result of

reading

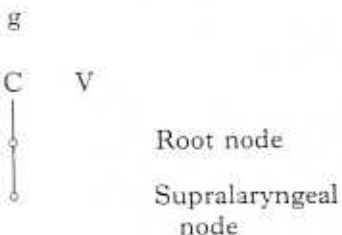
37a) makes the following
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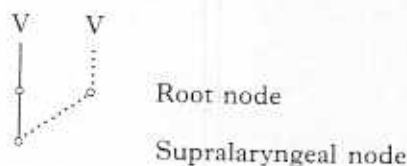


root node instead of the
predict that even the con-
i] has a root node as support

the place node, this would
out raising certain potential

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) *Translaryngeal Harmony*

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]:²¹

- (31) a. káha 'hoe'
b. vaa 'weep, cry'
c. lǝhǝ 'summon'
d. sǝǝ 'sting'

- (32) a. tíndi 'send'
b. gúvul 'hem, make selvedge'
c. nyóoso 'be fully grown'

It is possible, moreover, for vowels to be identical simply because the same set of redundancy rules have applied, for example, *yévese* '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 transalaryngeal 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.²²

6 Vowel deletion

Before turning to an analysis of the interaction of the above account of vowel distribution with the Tiv process of vocalic ablaut, 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...i C_{nf}: tɪndi 'send'
 e...e C_{nf}: yévese 'flee'
 a...e C_{nf}: vānde 'precede'
 ɔ...o C_{nf}: tsɔ́ngɔ 'circumcise'
 o...o C_{nf}: kóso 'keep thing for a person'
 u...u C_{nf}: kúsu 'grip tightly'

- (35) i...e C_{nf}: híde 'return'
 C_f: píne 'ask'
 e...a C_{nf}: dzènda 'drive away'
 C_f: tsèva 'curse'
 u...e C_{nf}: nùmbe 'play'
 C_f: ùme 'be thick, bushy'
 u...a C_{nf}: kùmba 'collect for consultation'
 C_f: húra 'weed farm or road'

The crucial point to t restricted to occur only v word finally, while the oth Phrased differently, an a systematic absence of the *[oC_fo] and *[uC_fu], wher following Pulleyblank (19 second vowel in appropria following are derived via d in (34) above but where th

- (36) i C_f: gbil 'put a
 e C_f: hén 'learn
 a C_f: sáv 'levy c
 ɔ C_f: gòv 'be cu
 o C_f: mòr 'puff c
 u C_f: búgh 'open'

The above examples mak types of conditions. First, v vowels and not others. Sec consonant that intervenes formulating the rule, I will

A consideration of the ca apply the sequence of vov [round]. Agreement with re: applicability of deletion to the features [high] and [roun vowels of adjacent moras ag Harmony (16) applies to cre: agreement with respect to [round], only the former r formulation such as the one

Concerning the requireme bility is to simply include v description of the rule (as, fo is somewhat problematic, hc obviously characterised as a v is suggested in Pulleyblank (1 this is problematic for [v] anc a rule changing such sonorant a more plausible way to char that is, as those consonants rhyme. Under such a charact refer explicitly to the C_f class need simply assume that the v the output of deletion is a p consonant is of the C_f 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 $*[iC_i]$, $*[eC_i]$, $*[aC_i]$, $*[ɔC_i]$, $*[oC_i]$ 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) $i C_i$: gbil 'put a thing down'
 $e C_i$: hén 'learn'
 $a C_i$: sàv 'levy dues on'
 $ɔ C_i$: gòv 'be curved'
 $o C_i$: mòr 'puff out'
 $u C_i$: bùgh '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 $[aC_i]$ and $[ɔC_i]$. Concerning the features [high] and [round], it should be recalled that in all cases where vowels of adjacent moras agree with respect to the feature [high], Round Harmony (16) applies to create agreement with respect to [round].²³ Since 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*

$$V \rightarrow \emptyset / \begin{array}{c} V _ \# \# \\ \vee \\ \text{ahi} \end{array} \quad \text{Rhyme projection}$$

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

(38)

a.	b.	c. +rd	d. +rd	
		+lo ↓	+lo ↓	
gbili	pi(ne)	gɔvo	tsɔngo	After Association
+hi	+hi			
gbili	n/a	n/a	n/a	High Spread (9)
+hi				
n/a	pine	+rd	+rd	Redundant [-high] (3a)
	\	+lo ↓	+lo ↓	
	+hi -hi	gɔvo	tsɔngo	
		∨	∨	
		-hi	-hi	
n/a	n/a	+rd	+rd	Round Harmony (16)
		+lo ↓	+lo ↓	
		gɔvo	tsɔngo	
		∨	∨	
		-hi	-hi	
gbil	n/a	+rd	BLOCKED	Vowel Deletion (37)
		+lo ↓	C ≠ C _f	
+hi		gɔv		
		-hi		
[gbil]	[pine]	[gɔv]	[tsɔngo]	

Additional support vocalic ablaut with the ablaut are discussed in of vowels agreeing in h

(39)	Past	Recent
a.	hembà	hèm
b.	cíngè	cíngí
c.	'búsà	bósó
d.	kùndè	kùnc

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

(40)	Past	Recent
a.	'géghà	gégh
b.	'tírè	tír
c.	'kùrà	kòr
d.	'búmè	búm

This alternation between for straightforwardly by derived by ablaut.

7 Ablaut

In this last section, I tu ablaut, paying particular properties of Tiv vowel d Recent Past and Habitual. properties of a stem. A s change is given in the fir undergo change are listed. changes will be given a below:

(41)	Ablaut: vowel char
a.	e...a → e...e
b.	i...a → i...e/e..
c.	i...e → i...i
d.	ɔ...o → e...e
e.	ɔ...ɔ → e...e
f.	ɔ...C _f → e...C _f
g.	u...a → o...o
h.	u...e → u...u

is formulated as follows:

is projection

is 'put a thing down', pine

+rd
+lo
tsongo
After
Association
(9)

n/a
High
Spread
(9)

+rd
+lo
tsongo
Redundant
[-high]
-hi
(3a)

+rd
+lo
tsongo
Round
Harmony
-hi
(16)

BLOCKED
C ≠ C_r
Vowel
Deletion
(37)

[tsongo]

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.²⁵

(39)	Past	Recent Past	
	a. hembà	hembé	'exceed'
	b. cingè	cingí	'wind rope, etc. round thing'
	c. búsa	bósó	'break fragment off'
	d. kùndè	kùndú	'mix things together'

Note that all the examples in (39) involve consonants of the C_{nr} class. When verbs with comparable vowel sequences involve consonants of the C_r class, then ablaut results in forms lacking a final vowel:

(40)	Past	Recent Past	
	a. géghà	gégh	'gulp' ²⁶
	b. tírè	tír	'halt'
	c. kùrà	kór	'tend'
	d. búmè	búm	'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 Tiv 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	Ablaut: no change
a. e...a → e...e	i. a...a
b. i...a → i...e/e...e	j. a...e
c. i...e → i...i	k. e...e
d. o...o → e...e	l. i...i
e. o...o → e...e	m. o...o
f. o...C _r → e...C _r	n. u...u
g. u...a → o...o	
h. u...e → u...u	

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 V_2 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 suffixation.

7.3 Place Delinking

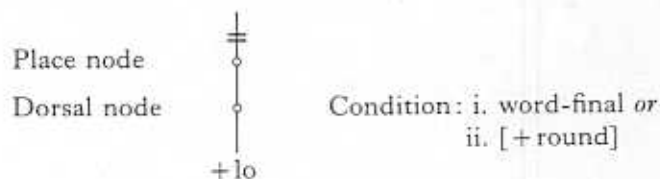
In addition to the cases of ablaut discussed so far, there are two classes of verbs involving low vowels that appear to require an ablaut-specific rule:

(46)	Past	Recent Past	
a.	'vá	vé	'come'
	hèmbà	hèmbé	'exceed'
	'géghà	gégh	'gulp'
b.	'tôv	tév	'investigate'
	'dzôhò	dzéhé	'wrangle'
	'sòò	séé	'fire (as in pot)'
	fôngò	féngé	'flee (as into bush)'

In the cases of (46a), the [+low] specification of the final vowel is lost, the ablaut forms surfacing with mid vowels; in the examples of (46b), the [+round] and [+low] values of the vowel [ɔ] 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:

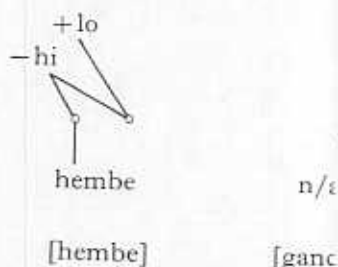
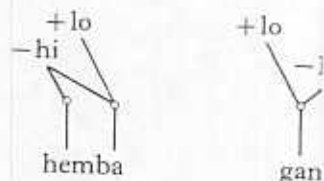
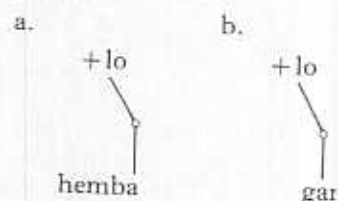
(47) Ablaut Place Delinking



To illustrate, consider derivations of the Recent Past ablaut forms *hèmbé* 'exceed', *gàndé* 'be fully-grown', *féngé* 'flee (as into bush)' and *pòsò*

'untie' (for ease of exposure: laryngeal and root nodes ε

(48)



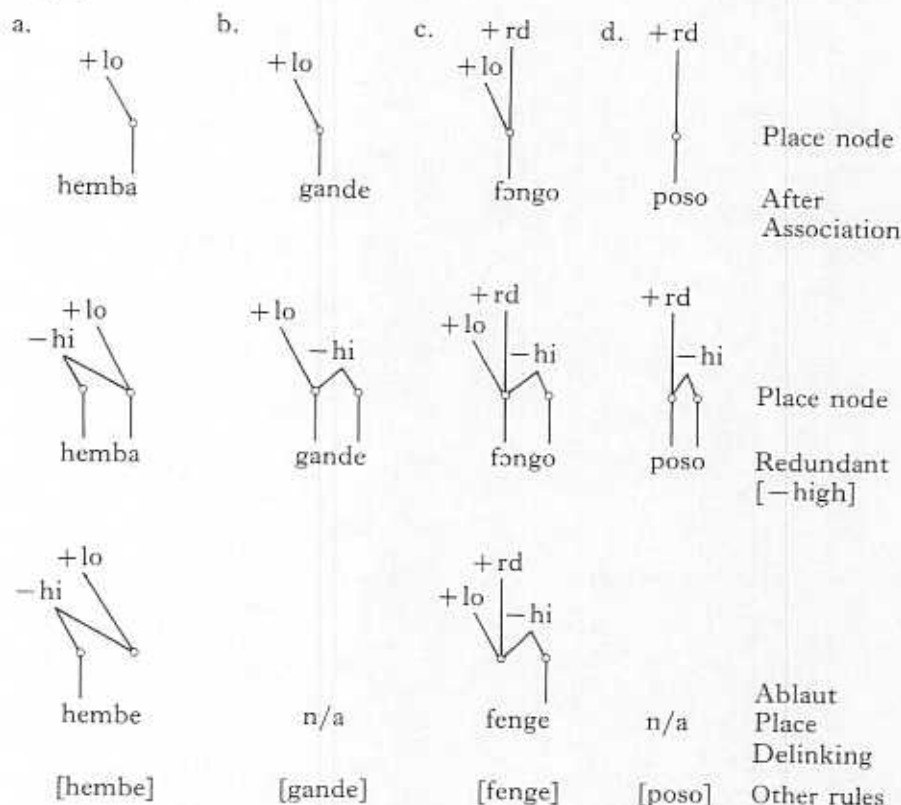
The [+low] and [+round] (48c); the [+round] specification (48d); the [-hi] (48e) vs. (48b)). After delinking and the application of redundancy rules would assign the correct surface forms for

8 Conclusion

Properties of the Tiv verbs are underspecified. The investigation of the underlying segmental specifications and morphemic feature values: [contrastive specifications in

'untie' (for ease of exposition, articulator nodes (labial, dorsal), supralaryngeal and root nodes are not included):

(48)



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-

re values for [high] and [low] in a case, resulting in surface

forms in (43). To derive the surface linking of [+low] to V₂ in the ablaut forms. As such, take place, and surface mid appropriate redundancy rules (3). Though Spread under ablaut, this suggests, again suggesting at least

so far, there are two classes of forms that require an ablaut-specific

(not) 'bush'

of the final vowel is lost, the examples of (46b), the [ɔ] and [o] are both lost in the ablaut forms showing mid vowels. Suggesting a rule that delinks (or loses) an ablaut-inducing tense:

- i. word-final or
- i. [+round]

Present Past ablaut forms *hembé* (as into bush)' and *pòsò*

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)**Monomoraic verbs*²⁸

i	2
e	3
a	10
ɔ	–
o	–
u	1

Bimoraic verbs

[VCV]: V ₁ /V ₂	i	e	a	ɔ	o	u
i	7/16	31	3	–	–	–
e	–	27/43	44	–	–	–
a	–	30/51	3	–	–	–
ɔ	–	1	–	–	15/34	–
o	–	–	–	–	13/21	–
u	–	47	56	–	–	8/20

[VV] V ₁ /V ₂	i	e	a	ɔ	o	u
i	6	2	6	–	–	–
e	–	10	–	–	–	–
a	–	–	17	–	–	–
ɔ	–	–	–	11	–	–
o	–	–	–	–	6	–
u	–	–	2	–	–	3

[VhV]: V ₁ /V ₂	i
i	3
e	–
a	–
ɔ	–
o	–
u	–

Trimoraic Verbs (V₁V₂)

[VCV]: V ₂ /V ₃	i
i	31
e	–
a	–
ɔ	–
o	–
u	–

[VV]: V ₂ /V ₃	i
i	10
e	–
a	–
ɔ	–
o	–
u	–

[VhV]: V ₂ /V ₃	i
i	–
e	–
a	–
ɔ	–
o	–
u	–

Trimoraic Verbs (V₂V₃)

[VCV]: V ₂ /V ₃	i
i	2/35
e	–
a	–
ɔ	–
o	–
u	–

NOTES

- * Thanks to Diana Archibald for comments and to a *Phonology* reviewer for comments.
- [1] See, for example, Kiparsky & Pulleyblank (1987).
- [2] See, for example, Clements & Pulleyblank (1987).
- [3] All examples in this paper are from the 900+ verbs listed in Arnott (1958, 1964).

s attested on the surface. In fundamental 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 :s except [h] as blockers, since specifications.

[VhV]:	V_1/V_2	i	e	a	ɔ	o	u
		3	1	-	-	-	-
		e	-	7	-	-	-
		a	-	-	6	-	-
		ɔ	-	-	-	6	1
		o	-	-	-	-	1
		u	-	1	1	-	-

Trimoraic Verbs (V_1V_2)

[VCV]:	V_2/V_3	i	e	a	ɔ	o	u
		i	31	1	1	-	-
		e	-	65	3	-	-
		a	-	57	-	1	-
		ɔ	-	-	-	1	26
		o	-	-	-	-	33
		u	-	-	1	-	-

[VV]:	V_2/V_3	i	e	a	ɔ	o	u
		i	10	2	8	-	-
		e	-	15	-	-	-
		a	-	-	10	-	-
		ɔ	-	-	-	13	-
		o	-	-	-	-	8
		u	-	1	1	-	-

[VhV]:	V_2/V_3	i	e	a	ɔ	o	u
		i	-	1	-	-	-
		e	-	2	-	-	-
		a	-	-	3	-	-
		ɔ	-	-	-	3	-
		o	-	-	-	-	4
		u	-	-	-	-	-

Trimoraic Verbs (V_2V_3)

[VCV]:	V_2/V_3	i	e	a	ɔ	o	u
		i	2/35	4	-	-	-
		e	-	12/132	-	-	-
		a	-	4/23	-	-	-
		ɔ	-	-	-	3/13	1
		o	-	-	-	3/69	-
		u	-	-	-	-	6/54

NOTES

- * Thanks to Diana Archangeli, Ted Pulleyblank, Moira Yip and an anonymous *Phonology* reviewer for comments on an earlier draft of this paper.
- [1] See, for example, Kiparsky (1982), Pulleyblank (1986a,b), Archangeli (1984), Archangeli & Pulleyblank (forthcoming), Itô & Mester (1986), Steriade (1987).
- [2] See, for example, Clements (1985), Schein & Steriade (1986), Sagey (1986), Archangeli & Pulleyblank (forthcoming).
- [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 900+ verbs listed in Abraham (1940), in conjunction with the work of Arnott (1958, 1964).

o u
- -
- -
- -
15/34 -
13/21 -
- 8/20

o u
- -
- -
- -
- -
6 -
- 3

- [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). Were 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 §3.4.2). 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 (*mgbághom* 'to approach').
- [11] The Redundancy Rule Ordering Constraint (Archangeli 1984; Pulleyblank 1986a, b; Archangeli & Pulleyblank forthcoming) would automatically achieve this effect.
- [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 281 bimoraic verbs in Abraham (1940) involving low vowels, 175 fall into the expected pattern (that is, 62%).
- [15] There are actually three cases of [aCa] found in Abraham's (1940) dictionary (*kàma* 'knock against', *kpàma* 'annoy' and *màna* '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 extraprosodicity 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: *gbòrəm* 'be slack'.
- [19] This version of the hierarchy contains certain modifications of the proposal made by Clements (1985), notably a tonal node linking to the skeleton (Archangeli & Pulleyblank forthcoming) and the articulator nodes (labial, coronal, dorsal) of Sagey (1986).
- [20] Steriade also discusses additional points that are not relevant for Tiv. For example, she points out that /h/ and /ʔ/ are never distinguished in translaryngeal harmony, but since the consonant inventory of Tiv does not include /ʔ/ 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 Sagey (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: *kòse*, 'to abrade lightly with the fingernail and gently squeeze out pus' and *mgbághom* 'approach'. As noted in note 10 above, *mgbághom* is also

exceptional in that its [+to-right] manner.

- [24] Note that Vowel Deletion. If High Spread up (see §3.2 above), then th Pulleyblank (1985, 1986a) ordering of Vowel Deletion.
- [25] Non-ablaut tenses are represented by Recent P tense forms include the (1985, 1986a) for discussion.
- [26] The sequence [eC,a] of th This could be accounted investigated here. At the v of Vowel Deletion in (37) deletion. This is somewhat make reference to the val letion is blocked if it were only arise in a case involv [high] rather than delete t a situation that would not be that the exceptional n relates to the fact that [a stems, instead of on the discussion).
- [27] Hierarchical structure is r only.
- [28] Where two numbers are vowel sequence appears on application of vowel deleti

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al vowel is deleted by Vowel De-

dition Conventions argued for in spreading to be via convention, low vowels. See §3.4.

a high vowel is followed by a low to a constraint prohibiting the [+low] to a single vowel.

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that of Tiv (in that assimilation several features), see Clements

ingent) conditions that must be wever, the rule cannot spread a ce feature (cf. Steriade 1987b).

I found only two exceptions to fingernail and gently squeeze out note 10 above, *mgbághom* 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 feeds 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, 1986a) 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, 1986a) for discussion.

[26] The sequence [eC_a] 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 (37) 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 afloat, a situation that would only arise in a case involving a final [a]. A third possibility would be to delink [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 that 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 trimoraic verbs (see §3.4 for discussion).

[27] Hierarchical structure is not included in this example for ease of exposition only.

[28] Where 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.

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Transparenc vowel harmo

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1 Introduction

Phonologists have known the theory of generative phonology of vowel harmony. Ringen (1975, 1977) can be solved by abandoning the theory, developed in the Pulleyblank, incorporates how Hungarian can be analysed by adopting Goldsmith's (1985) involves the spreading of the vowels in Hungarian are de [-back] to these vowels, although derivation because its structure transparent vowels involve from the domain of harmony in e.g. McCarthy (1984), or & Pulleyblank (1987), for the correct, it raises the following transparent vowels? Can they have a similar source?

2 Background data

The vowels of the standard (1):

(1)		Fr
	Short	Long
High	i [i]	í [i:]
Mid	e [ɛ]	é [e:]
Low	e [ɛ]	
	Unrounded	