PROPHYLAXIS AND ASYMMETRY IN YOKUTS*

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1. Introduction

The Yowlumne (formerly known as Yawelmani) dialect of Yokuts, a Penutian language of California (see fig. 1), has been of particular interest to phonologists over the years for its patterns of vowel harmony, lowering, and shortening. While much research on Yokuts has focused on the opacity in the interactions among these processes, the present paper is concerned with a challenge the Yowlumne dialect poses for theories of contrastive specification—in particular, for the Successive Division Algorithm of Dresher (1998, 2003).

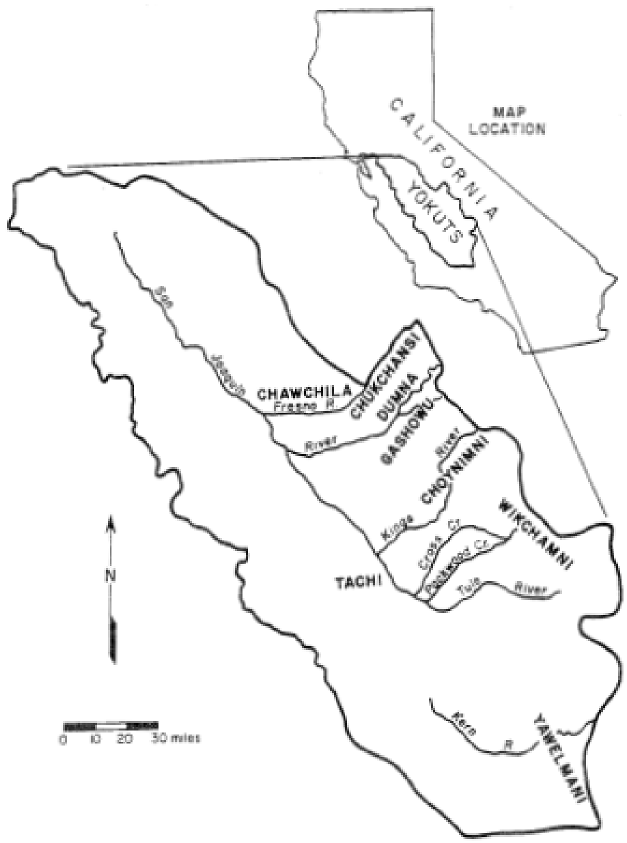

Figure 1: Geographic range of Yokuts and its dialects
(reproduced from Gamble 1994)

The problem, which is also discussed by D'Arcy (2003), arises from the fact that the phonemic four-vowel system of Yowlumne behaves as if it is symmetrical with respect to vowel harmony, but appears asymmetrical with respect to vowel

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lowering. The Successive Division Algorithm cannot assign a set of features that will fully account for this pattern. However, this paper argues that the behaviour of the Yowlumne vowels can be generated within a theory of contrastive specification that includes what Hall (2002) terms **prophylactic features**: redundant features that are present but not active in the phonological computation.

2. The Data

The data on Yowlumne used in the phonological literature are drawn from fieldwork conducted by Stanley Newman in 1930 and 1931, published in Newman (1944). This paper will be concerned primarily with two phonological processes affecting vowels: Harmony and Lowering.

The underlying inventory of vowel qualities in Yowlumne is shown in (1). There is also a contrast between long and short vowels, which may be attributed to the application of CV templates (Archangeli 1985: 341–2), rather than to the specification of a length feature on the vowels themselves.

(1) Underlying vowel qualities
/i/ /a/ /o/ /u/

Harmony and Lowering, together with two other processes with which they interact, can be seen in the derivation of /c’uum+hn/ [c’omhun] (‘destroy+aorist’), shown in (2).

(2)

UR	/c’uum+hn/
Epenthesis	c’uumhin
Harmony	c’uumhun
Lowering	c’oomhun
Shortening	c’omhun
SF	[c’omhun]

The derivation in (2) illustrates both the effects of the individual rules and the considerable opacity of their ordering. Epenthesis inserts an /i/ to break up unsyllabifiable consonant clusters. This rule feeds Harmony, which spreads backness and roundness rightward between vowels of the same height. Lowering, which follows Harmony, lowers all long vowels. (In the example in (2), Harmony and Lowering apply in counterbleeding order; in other contexts, the same ordering of the rules has a counterfeeding effect.) Shortening, which follows Lowering (a counterbleeding ordering), shortens long vowels in closed syllables.

2.1. Harmony

The effects of Yowlumne’s height-dependent vowel place harmony can be seen more systematically in (3). A vowel becomes back and rounded when it is preceded by a back round vowel of the same height. Thus the epenthetic /i/ inserted in the aorist suffix /-hn/ becomes [u] when it is preceded by an /u/ in the stem (3b), and the /a/ of the dubitative suffix becomes [o] under the influence of a preceding /o/ (3d). The pattern is summarized schematically in (4).

(3) Alternations showing the operation of Harmony
(Kenstowicz and Kisseberth 1977: 35)

	ROOT		AORIST /-hn/	DUBITATIVE /-al/
a.	/xil/	'tangle'	[xil-hin]	[xil-al]
	/giy'/	'touch'	[giy'-hin]	[giy'-al]
b.	/dub/	'lead by hand'	[dub-hun]	[dub-al]
	/hud/	'recognize'	[hud-hun]	[hud-al]
c.	/xat/	'eat'	[xat-hin]	[xat-al]
	/max/	'procure'	[max-hin]	[max-al]
d.	/bok'/	'find'	[bok'-hin]	[bok'-ol]
	/k'oʔ/	'throw'	[k'oʔ-hin]	[k'oʔ-ol]

(4) Summary of Harmony patterns

a.	/i…i/	→	[i…i]	/i…a/	→	[i…a]
b.	/u…i/	→	[u…u]	/u…a/	→	[u…a]
c.	/a…i/	→	[a…i]	/a…a/	→	[a…a]
d.	/o…i/	→	[o…i]	/o…a/	→	[o…o]

With respect to Harmony, then, the vowel inventory acts as if it is phonologically symmetrical. There are two pairs of vowels, one at each height: in the high vowels, /u/ is the round counterpart of /i/, and in the non-high system, /o/ is the round counterpart of /a/. This symmetry is schematized in (5).

(5) Harmony: symmetrical pattern

/i/ --------/u/

/a/ --------/o/

2.2. Lowering

The operation of Lowering, however, paints a different picture of the shape of the vowel inventory. The data in (6) show the lowering of long vowels; evidence for the underlying heights of the vowels comes from the application or non-application of height-dependent Harmony. (Note also that Shortening applies to the long vowels in the aorist forms, because of the consonant-initial suffix /-hn/.)

(6) Alternations showing the operation of Lowering
(Archangeli 1984; D'Arcy 2003)

	ROOT		AORIST /-hn/	DUBITATIVE /-al/
a.	/hiwiit/	'walk'	[xiwet-hin]	[xiweet-al]
b.	/c'uum/	'destroy'	[c'om-hun]	[c'oom-al]
c.	/ʔopoot/	'get up'	[ʔopot-hin]	[ʔopoot-ol]
d.	/p'axaat'/	'find'	[p'axat'-hin]	[p'axaat'-al]

The effects of Lowering are summarized in (7).

(7) Summary of Lowering patterns

a. /ii/ → [ee]
b. /uu/ → [oo]
c. /aa/ → [aa]
d. /oo/ → [oo]

What is unexpected, given the symmetrical pattern in (5), is the result of Lowering when it applies to /ii/. While we might expect a lowered /ii/ to be realized as its phonemic non-high counterpart /aa/, it instead surfaces as [ee], a vowel not present in the underlying inventory at all. The resulting asymmetrical pattern is schematized in (8).

(8) Lowering: asymmetrical pattern

/i/ /u/
[e] /o/
/a/

3. Theoretical Background

3.1 General Assumptions

This paper adopts a derivational model of the phonological computation that operates on non-linear representations. The features in these representations are assumed to be privative. Following Rice (1995), vowel place is encoded using only the features Coronal and Peripheral. Finally, and most importantly, this paper adopts the position that only those features that are phonemically contrastive are active in the phonological computation.

3.2 Contrastive Specification

The particular version of contrastive specification adopted here is that of Dresher, Piggott, and Rice (1994), Dresher (1998), and Dresher (2003), for which the disparate patterns in (5) and (8) present a challenge. In this approach to contrastive specification, features are assigned by the algorithm in (9).

(9) Successive Division Algorithm (privative version, based on Dresher 1998)[1]

1. The input to the algorithm is an inventory *I* of one or more segments that are not yet featurally distinct from one another.
2. If *I* is found to contain more than one phoneme, then it is divided into two (non-empty) subinventories: a marked set *M*, to which is assigned a feature [*F*], and its unmarked complement set $\bar{M}$.

[1] Dresher (1998) uses privative features and refers to the algorithm as the Successive Binary Algorithm (SBA). Dresher (2003) presents a more general version with *n*-ary features, and calls it the Successive Division Algorithm (SDA). The SBA is simply a special case of the SDA; it is binary because privative features make binary divisions. An earlier version of the algorithm is presented by Dresher, Piggott, and Rice (1994) as the Continuous Dichotomy Hypothesis.

3. M and $\overline{M}$ are then treated as the input to the algorithm; the process continues until all phonemes are featurally distinct, which is trivially the case when I contains only one phoneme.

Because every feature the algorithm assigns is introduced in order to mark a phonemic distinction, the resulting specifications are by definition contrastive. As Dresher (2003) points out, the SDA differs from the Minimal Pairs Test used in other theories of contrastive specification in that the SDA is always capable of assigning a set of features sufficient to distinguish the phonemes of an inventory, while the Minimal Pairs Test will frequently fail. The SDA also differs from other approaches to contrastive specification in that it allows for different languages to assign different specifications to superficially similar inventories; the differences follow from variation in the order in which the divisions are made, and thus in the relative scope of the features assigned. (Mackenzie and Dresher 2003 discuss the need for this variability in greater depth.)

3.3 Previous Approaches

The Yowlumne patterns discussed here have already received much attention in the phonological literature; previous accounts include those of Kuroda (1967); Kisseberth (1969); Kenstowicz and Kisseberth (1977, 1979); Archangeli (1984, 1985); Archangeli and Suzuki (1997); McCarthy (1998); and D'Arcy (2003).

Early generative accounts of Yowlumne employ binary features, with no underspecification, and rely on SPE-style (Chomsky and Halle 1968) rules. For example, Kenstowicz and Kisseberth (1977: 35) formulate the vowel harmony rule as shown in (10):

(10) Harmony (Kenstowicz and Kisseberth 1977: 35)

$$\begin{bmatrix} \text{V} \\ \alpha\,\text{high} \end{bmatrix} \rightarrow \begin{bmatrix} +\,\text{round} \\ +\,\text{back} \end{bmatrix} / \begin{bmatrix} \text{V} \\ +\,\text{round} \\ \alpha\,\text{high} \end{bmatrix} C_0 \_\_$$

These accounts capture the crucial opaque interactions among the phonological processes, but the rules themselves are expressed in a formalism that takes advantage of the power of full specification, binary features, and alpha-rules.

Archangeli (1984, 1985) presents an account that uses non-linear rules. In her approach, features are still binary, but subject to Radical Underspecification: all features that can be filled in by redundancy rules are absent from underlying representations. Accordingly, in Archangeli's approach, the vowels of the Yowlumne inventory have the feature specifications shown in (11).

(11) Radically underspecified representations (Archangeli 1985: 340)

	/i/	/a/	/o/	/u/
high		–	–	
round			+	+

However, Radical Underspecification does not actually restrict the role of redundant features in the phonology: “predictable values are inserted by rule *during the course of the derivation*” (Archangeli 1998: 192; emphasis added). Since redundancy rules are interspersed with other phonological rules, features that are absent from the underlying representation of a segment may still end up playing a crucial role in that segment’s phonological behaviour. For example, in the account of Yowlumne proposed by Archangeli (1985), the redundancy rule for the feature [high] is ordered so as to feed Harmony:

(12) Rule ordering proposed by Archangeli (1985)

1. …
2. Redundancy rule for [high]: [ ] → [+ high]
3. Harmony
4. …

In the extreme case, although Archangeli does not suggest this for Yowlumne, all the redundancy rules could in principle apply at the very beginning of the derivation, with the result that Radical Underspecification would become indistinguishable from full specification.

More recently, Optimality Theoretic approaches to Yowlumne have focused on the problem of accounting for opacity in a framework that dispenses with ordered rules. For example, Archangeli and Suzuki (1997) are led by the opacity in the Yokuts system to expand the power of OT in three directions. In order to deal with the counterfeeding relation between Lowering and Shortening, they introduce the mechanism “disparate correspondence” constraints such as the one in (13).

(13) Disparate correspondence (Archangeli and Suzuki 1997)

$\mu\mu\ {}_{I}\Re_{O}$ [– HIGH]

‘Output correspondents of input long vowels should be [– high].’

Unlike standard OT constraints, the one in (13) is neither a faithfulness constraint mandating the preservation of some aspect of the underlying representation, nor a markedness constraint enforcing surface well-formedness; instead, it relates one property (length) of input segments with a different property (height) of their output correspondents.

A similar mechanism is needed to deal with the opaque ordering of Harmony and Lowering. Because Harmony is height-dependent, Archangeli and Suzuki need a constraint to ensure that vowels harmonize only if they have the same value for [high], but the constraint has to refer to the vowels’ *original* height specifications, since their surface heights may be changed by Lowering. However, the constraint cannot simply refer to *input* values for [high], because Harmony also applies to epenthetic vowels, which by definition have no input correspondents. Accordingly, Archangeli and Suzuki posit the “input–else” constraint shown in (14).

(14) Input-else correspondence (Archangeli and Suzuki 1997)

RD/[α HIGH]^{IE}

‘Tokens of [round] in the output link vowels whose input specifications—if any, otherwise output specifications—for [high] are identical.’

Finally, Archangeli and Suzuki also propose well-formedness constraints on inputs, such as the one in (15).

(15) Input constraint (Archangeli and Suzuki 1997)
$\{V \approx [+\text{ HIGH}]\}^{I}$
'Input vowels should be [+ high].'

The constraint in (15) has no effect on the selection of any output candidate; rather, it is intended to play a role in determining underlying feature specifications, which in OT are standardly held to be selected through Lexicon Optimization, a mechanism that maximizes similarity between inputs and outputs. Archangeli and Suzuki introduce (15) in order to ensure that underlying /ii/ will not be reinterpreted by Lexicon Optimization as /ee/, since its output correspondents are always subject to Lowering. However, the need for a constraint of this sort would likely be obviated by a more sophisticated theory of Lexicon Optimization, such as the one proposed by Inkelas (1995), which takes alternations into account. Since the underlying height of /ii/ can be inferred from the effects of Harmony, it should not need to be stipulated by other means.

McCarthy (1998) offers a different approach to opacity in OT, based on Sympathy constraints, which enforce correspondence between the output and other members of the candidate set. Like the constraints proposed by Archangeli and Suzuki, Sympathy represents a substantial enhancement of the power of OT. Detailed theoretical and empirical criticisms of Sympathy are offered by Idsardi (1997, 1998), who shows how Sympathy constraints can make a grammar both delicate and chaotic.

D'Arcy (2003) offers an account of Yowlumne that is much closer to the one pursued here: she employs privative features, subject to contrastive specification as defined by the Successive Division Algorithm, within the general framework of Lexical Phonology. D'Arcy argues that Lowering is a post-lexical rule, and thus operates at a stage in the derivation at which redundant features have already been filled in. The present proposal potentially bears either of two relations to that of D'Arcy (2003): it can be seen as either a retreat or an advance. If there turn out to be reasons not to treat Lowering as post-lexical, then the present proposal offers a viable alternative. On the other hand, if Lowering is post-lexical, the account proposed here suggests that the role of redundant features may be highly restricted even in the post-lexical component of the grammar.

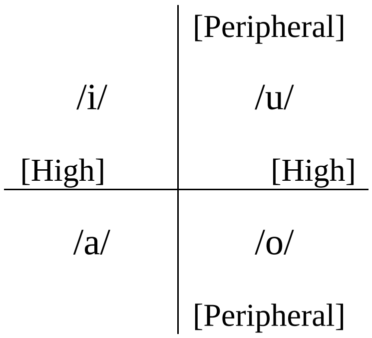
4. The Analysis

4.1 Harmony

In order to permit a satisfactory account of the attested height-dependent Harmony pattern, two things are required of the featural representations. First, the feature Peripheral (or its equivalent) must be active in the computation, since it must be spread by the Harmony rule. Second, the vowels must be represented as falling into two natural classes on the basis of height, with the high vowels /i/ and /u/ in one class and the non-high vowels /a/ and /o/ in the other.

A suitable set of representations can be assigned by the SDA, using exactly two features to distinguish the four segments of the phonemic vowel inventory, as shown in (16). Since the features fully cross-classify, it makes no difference whether the height contrast takes scope over the place contrast or vice versa.

(16) Feature specifications for Harmony



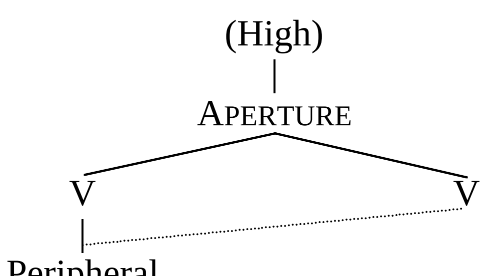
The Harmony rule must spread Peripheral rightward between vowels that share either the presence or the absence of the feature High. Since the features are monovalent, the notion of a ‘shared absence’ of High cannot simply be represented as [– high]. However, there are other ways of representing the fact that /a/ and /o/ constitute a natural height class. One possibility would be to say that the feature High is, in a universal feature geometry, a dependent of an organizing node APERTURE. Because APERTURE is not a feature, and its presence does not serve to distinguish one phoneme from another, it is not assigned by the SDA; rather, its presence is governed by the Node Activation Convention in (17):

(17) Node Activation Convention (adapted from Avery and Rice (1989))

The specification of a feature entails the presence of its dominating node on all segments in the domain in which that feature is contrastive.

In (16), the feature High is contrastive in the domain of the whole vowel inventory, and so its dominating node APERTURE will be present on all members of that inventory. Given representations along these lines, the Harmony rule can be formulated as in (18).

(18) Harmony:

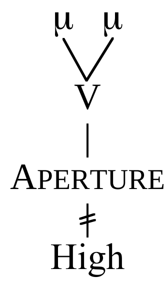


An alternative approach would be to use ‘coplanar’ representations like those proposed by Archangeli (1984, 1985). Such representations could be derived by giving High scope over Peripheral in dividing the inventory, and then mapping the order of divisions onto a feature geometry (cf. Dyck 1995, Béjar 1998).

4.2 Lowering

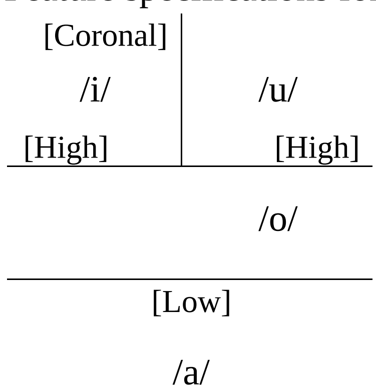
Assuming that the marked aperture feature is High, the rule of Lowering simply delinks High from any vowel associated with two moras, as shown in (19).

(19) Lowering:



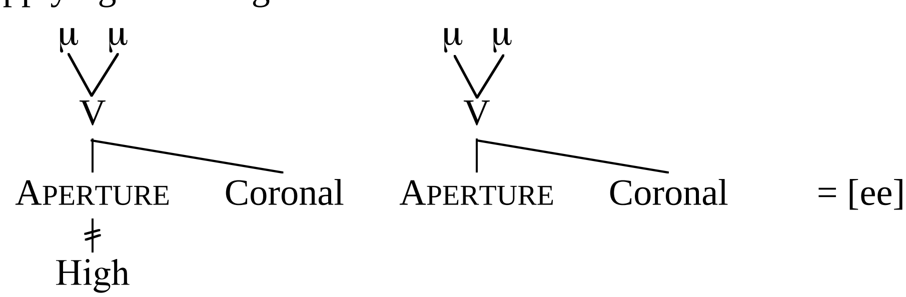
In order to derive the attested pattern of Lowering, the featural representations must be such that Lowering of /ii/ does not produce a segment that is featurally identical to /aa/. The SDA can produce such a set of representations by means of the divisions shown in (20).

(20) Feature specifications for Lowering



As shown in (21), the representations derived in (20) correctly predict that applying the Lowering rule in (19) to /ii/ will generate a segment that is not present in the underlying inventory.

(21) Applying Lowering to /ii/:



The problem is that the representations in (20) are incompatible with the needs of Harmony: Peripheral is absent, and /a/ and /o/ are not a natural class.[2]

[2] If the marked place feature among the high vowels in (20) were Peripheral rather than Coronal, Lowering of /ii/ would make it identical to /oo/.

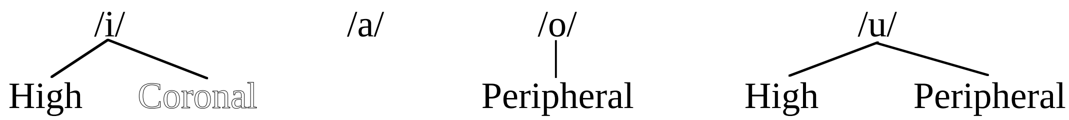
4.3 Prophylactic Features

The solution, which represents a minimal retreat from the strongest formulation of contrastive specification, involves the use of prophylactic features. Prophylactic features, proposed by Hall (2002), are redundant features that are present but not active during the phonological derivation. The phonology cannot make reference to them in any way: they cannot spread; they cannot block spreading; they cannot be deleted. They become visible only at the point of phonetic implementation. Although they are not contrastive, that serve to maintain an underlying contrast by preventing some rule from resulting in absolute neutralization.

The proposal, then, is that the features visible to the phonology are those shown in (16), but that there is in addition some prophylactic feature which serves to distinguish an /a/ from a lowered /i/.

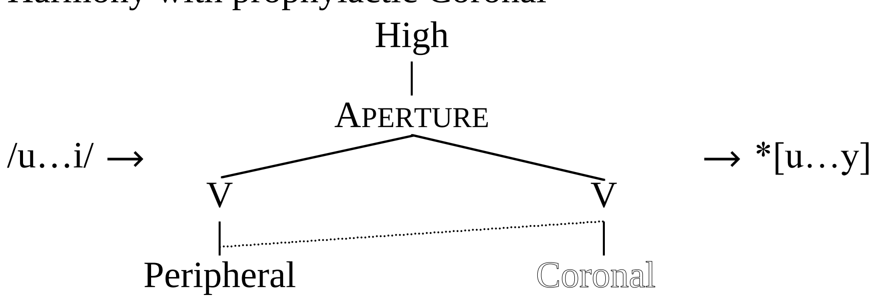
One possibility is that the prophylactic feature is on /i/. Suppose that Coronal is prophylactically specified on /i/, as in (22). (The invisibility of prophylactic features to the phonology is indicated by the use of outlined letters.)

(22) Specifications with prophylactic Coronal



Given these specifications, the results of Lowering /ii/ would be the same as in (21). However, prophylactic specification of Coronal on /i/ makes incorrect predictions about the application of Harmony, as shown in (23).

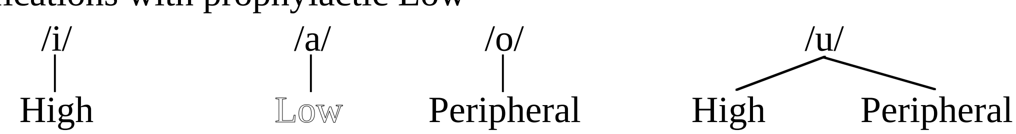
(23) Harmony with prophylactic Coronal



As (23) illustrates, an /i/ to which Harmony has applies should leave the derivation specified as both Coronal and Peripheral, and is thus incorrectly predicted to surface as a front round vowel [y].

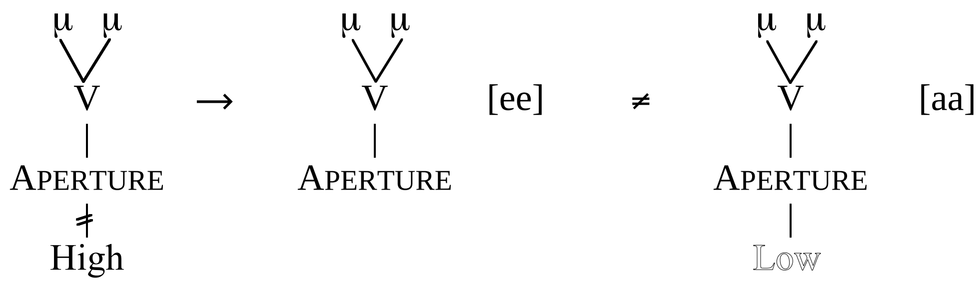
The other possibility, then, is that the prophylactic specification is on /a/ rather than on /i/. The presence of prophylactic Low on /a/ yields the set of feature specifications shown in (24).

(24) Specifications with prophylactic Low



In that case, a lowered /ii/ will be distinct from an /aa/ at phonetic implementation, because the former will have no aperture features, while the latter will have Low, as shown in (25).

(25) Lowering with prophylactic Low



However, the prophylactic specification of Low also has consequences for Harmony. The feature specifications in (24) predict that /a/ should remain Low even when it has been rounded. Just as harmonized /i/ with prophylactic Coronal should surface as [y], harmonized /a/ with prophylactic Low should surface as [ɔ].

In fact, it does. Newman transcribes the surface vowel inventory as [i, e, a, ɔ, u], and observes that "the back mid vowels ɔ and ɔ· are always open, as in German *voll* and English *law*" (Newman 1944: 19).

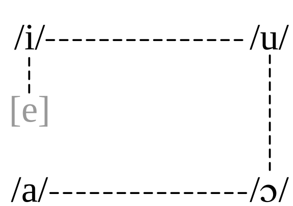
However, it is not only harmonized /a/ that surfaces as [ɔ]; lowered /u/ and unaltered /o/ are also phonetically low. So we must assume that phonetic implementation realizes all non-high Peripheral vowels as [ɔ], regardless of whether they are specified with the prophylactic Low feature. Non-Peripheral vowels will be phonetically realized as [i] if they are marked for High, as [a] if they have prophylactic Low, and as [e] if they have no aperture feature.

5. Conclusion

The account of Yowlumne Harmony and Lowering presented here allows the central claim of contrastive specification to be upheld: redundant features are not active in the phonological computation. Although the redundant feature Low is specified prophylactically on /a/, it is invisible to phonological rules, and has an effect only at the level of phonetic implementation, where it serves to distinguish /a/ from a lowered /i/.

Under this account, the combination of symmetry and asymmetry in the system, schematized in (26) (cf. (5) and (8)), results from representations in which the phonologically active features are symmetrical, but asymmetry is introduced by a prophylactic feature.

(28) Mixed symmetrical and asymmetrical patterns



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