Yowlumne reexamined: A challenge for contrastive specification*

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Yowlumne poses a challenge to any theory that seeks to limit phonological features to those that are contrastive (Dresher 1998, 2001; Dresher et al. 1994). In such a theory, redundant features would optimally enter after the lexical phonology. In Yowlumne, however, the application of a lowering rule results in a vowel not present underlingly, necessitating the addition of a feature to the phonemic system of contrast. The preferred solution would be to posit the introduction of non-contrastive features during post-lexical, phonetic processes. This position is supported by Structure Preservation, but is hampered here by the apparent sensitivity of the rule to morphological information. This paper reexamines the data and argues that when considered within the rubric of prosodic morphology (McCarthy & Prince 1986 et seq.), Lowering may be reclassified as post-lexical, thus eliminating the need for redundant features in Yowlumne phonological processes.

0. Introduction

First described by Kroeber in 1907, Yokuts—and the dialect of Yowlumne in particular—continues to thrive in phonological research. It has been treated in derivational accounts (e.g., Kuroda 1967; Kisseberth 1969a,b), autosegmental accounts (e.g., Archangeli 1984, 1985), and has been the subject of Optimality Theoretic analyses as well (e.g., Cole & Kisseberth 1995; McCarthy 1996; Archangeli & Suzuki 1997). Here Yowlumne is considered from a contrastive perspective.

An intriguing aspect of this dialect is the dilemma it presents to a theory that seeks to restrict the features appearing in phonological representations to those that are contrastive (Dresher 1998, 2001; Dresher et al. 1994). Within such a framework, redundant features would optimally enter after the phonology, during post-lexical, phonetic processes. In Yowlumne, however, there is an apparently lexical rule of lowering whose application results in a vowel that does not belong to the underlying inventory of the dialect. This is problematic for a theory of contrastive specification because it necessitates the implementation of a redundant feature in the phonology.

In this paper, I reexamine the data from Yowlumne and argue that there are phonological motivations to viewing Lowering as post-lexical. These motivations are

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(1) Structure Preservation and (2) the restriction of Lowering to application within morphemes (as opposed to between morphemes), the antithesis of a lexical rule. It will also be shown that within a contrastive framework, it is impossible to derive the correct output if Lowering is lexical. On the other hand, once post-lexical, the quality of lowered vowels is entirely predictable. However, apparent exceptions to this rule jeopardize a post-lexical analysis. In these forms, Lowering appears to access morphological information, since only bimoraic high vowels supplied by the morphological templates of the language seem to lower. This is problematic because such access is limited to the lexical component of the grammar. It is argued here that when Lowering is considered within the framework of prosodic morphology (McCarthy & Prince 1986 et seq.), this apparent sensitivity to morphological information is eliminated, enabling a post-lexical analysis of the lowering rule. The paper is organized as follows. The first section deals with the theory of contrast adopted here. The second section introduces the data from Yowlumne, and in the third section I present arguments in support of classifying Lowering as a post-lexical, rather than as a lexical, rule.

1. Contrast

The maxim of the theory adopted here is that contrast is the root of phonology. Accordingly, I assume an inventory-driven model of segment specification: features are introduced strictly to mark contrasts in the system (Dresher 1998, 2001; Dresher et al. 1994; cf. Avery & Rice 1989; Rice 1993, 1995; Rose 1993; Walker 1993). In contrastive theory, therefore, phonological features are minimally specified. Consequently, phonological representations are abstract, since phonetic details are omitted. However, this theory is not merely a stipulation on representations. A corollary of contrastive specification is that non-contrastive (i.e., redundant) features are not active in lexical processes. Instead, such features are restricted to the post-lexicon where they may function as enhancement mechanisms. Thus, unlike underspecification theory which allows redundancy rules to interact with phonological rules, a rule referring to redundant or default features in a contrastive analysis should apply after, rather than during, the lexical phonology.

2. Yowlumne

Yowlumne, formerly Yawelmani, is a dialect of Yokuts, a native language of California. This dialect has been the topic of considerable linguistic research (e.g., Kuroda 1967; Kisseberth 1969a,b; Archangeli 1983 et seq.; Noske 1985; Cole & Kisseberth 1995; McCarthy 1996; Zoll 1996; Archangeli & Suzuki 1997; Hansson 1999) and so is the focus of this paper. Although still spoken in California’s San Joaquin Valley, the majority of phonological and morphological analyses of Yowlumne are based

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1. This approach has interesting implications, as what is contrastive in one system may not be in another. Thus, two ‘similar’ segments may behave differently either phonologically or phonetically based on the system of which they are a part.

2. I use the term ‘Yowlumne’ rather than the traditional ‘Yawelmani’ as this is the current designation for both the tribe and the language; see Hansson 1999 or Latta 1977 for a discussion of this issue.
on the data presented in Newman’s (1944) grammar of Yokuts. In this section, I give a brief overview of Yowlumne’s vocalic system as described in Newman (1944) and as analyzed by Archangeli (1984, 1991) in particular. First, however, no discussion of Yowlumne is complete without reference to the roles of syllabification and morphological templates in the dialect, as both play a critical role in determining surface representations in Yokuts.

2.1 Syllabification and templatic morphology

Yokuts morphology is characterized by a sophisticated templatic system. In earlier accounts, the templates were analyzed as CV skeletons (e.g., Archangeli 1983, 1984, 1985), shown in (1) below. Later analyses, however, have focused on prosodic units as the basis of templatic structure (e.g., Archangeli 1991). In prosodic morphology (McCarthy & Prince 1986 et seq.) then, the templates are analyzed as in (2). This is the framework adopted here.

(1) CV templates of Yokuts:
   a. CVCC  
   b. CVVCC  
   c. CVCCVVC

(2) Prosodic templates of Yokuts:
   a. monomoraic syllable: \( \sigma_\mu \)
   b. bimoraic syllable: \( \sigma_\mu\mu \)
   c. iambic foot: \([\sigma_\mu\mu]\)

It is clear from (2) that the notion of what constitutes a syllable in Yowlumne is central to a prosodic analysis. The three possible surface syllables in this dialect are CV, CVC, or CVV. Consequently, if, following Itô (1986, 1989), languages define a syllable template independent of syllabification itself, the maximal syllable template in Yowlumne is bimoraic. Moreover, syllables must have onsets, but codas, consisting maximally of a single consonant, are optional. The syllable in Yowlumne can thus be defined as in (3).

   a. Template: \([\mu\mu]_\sigma\)
   b. Conditions: i. \( *_\sigma[V\ii. C]\)

The interaction of the templatic morphology with syllabification processes regulates surface representations in Yowlumne. Melody maps to the templates from left to right, but syllabification proceeds from right to left, syllabifying any melody that cannot

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3. This is not to suggest that Yowlumne is alive and well. Indeed, it is extremely endangered, having no more than 10-15 speakers (Hansson 1999). For an account of present-day Yowlumne, see Hansson (1999).
4. Prince (1990) argues for an alternative analysis of Yokuts in which only the heavy syllable and the iambic foot are available as templates, while the light syllable (2a) is considered to be a-templatic.
associate to the template. These directional constraints have been well motivated in Archangeli (1991), and so will not be discussed here. Nonetheless, one issue bears consideration, as it is relevant to the analysis at hand. Since codas are permitted in Yowlumne, the mapping of syllable-final consonants to the prosodic templates may proceed in one of two ways. These consonants may map directly to the syllable node, and are thus non-moraic, or alternatively, they may map immediately to a mora. Archangeli (1991) argues that in fact, both are the case in Yowlumne. In underlying representations, codas are non-moraic, mapping directly to the syllable. Then, at a late stage in the derivation, they are assigned a mora via Weight-by-Position (cf. Hayes 1989), shown in (4).

(4) Yowlumne Weight-by-Position (Archangeli 1991):

\[
\begin{array}{c}
\sigma \\
\mu \\
\alpha \beta \\
\end{array} \rightarrow \begin{array}{c}
\sigma \\
\mu \\
\mu \\
\alpha \beta \\
\end{array}
\]

This two-staged syllabification is motivated by the shortening of long vowels in closed syllables, which will be discussed in §2.3 below.\(^5\) The important point here, however, is that the moraic status of syllable-final consonants is variable: they are initially non-moraic, but at some point in the derivation, they come to bear a mora.

2.2 The vowel inventory

2.2.1 Phonemic segments

Yowlumne has four phonemic vowels, /i,a,o,u/, each of which has a short and a long form. Length is mediated by prosodic structure, supplied by either the bimoraic or the iambic template in (2). Within underspecification theory, the vowels are traditionally represented underlyingly as in (5) below (Archangeli 1984, 1985).\(^6\)

(5) Underspecified representations of Yowlumne vowels:

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>a</th>
<th>o</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>round</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

As (5) shows, the vowels can be contrasted using just two features, one to mark height and one to mark labiality. Although the current examination assumes privative rather than binary features, the contrastive representations in (6) closely resemble the underspecified representations above.

\(^5\) Mohanan (1989) also argues for two stages of syllabification in Malayalam.

(6) Contrastive representations of Yowlumne vowels:

<table>
<thead>
<tr>
<th></th>
<th>[high]</th>
<th>i</th>
<th>u</th>
<th>[high]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[labial]</td>
</tr>
<tr>
<td></td>
<td>a</td>
<td>o</td>
<td></td>
<td>[labial]</td>
</tr>
</tbody>
</table>

The difference between these two sets of representations is the implementation of the aperture feature. In (5), /a,o/ are marked as [–high] and the high vowels are unspecified, while in (6) the high vowels are marked as [high] and it is the low vowels that are unspecified.

At this point it is worth noting that the epenthetic vowel in Yokuts is /i/. Since the neatness of an unspecified epenthetic vowel is lost in the contrastive representations, the question begs as to why the binary features cannot be translated into privative ones. That is, why not simply specify the non-high vowels as [low] and leave the high vowels unspecified? I adopt the treatment in the literature that Yowlumne has a lowering rule. Given privative features, this requires that [high] be present in the lexicon, and lowering is the delinking of this aperture feature. A possible concern raised by a contrastive analysis, therefore, is that epenthesis is generally considered good evidence of markedness, since the expected output is the unmarked value. Moreover, in privative approaches to featural specification, a specified feature is considered the marked pole of the opposition. Consequently, epenthesis in the current analysis introduces a marked segment into representations. As pointed out by Rice (1999), however, epenthesis as a diagnostic for markedness is controversial, as cross-linguistically, epenthetic segments exhibit wide variation. For this exact reason, Mohanan (1991) rejects the correlation between markedness and epenthetic vowels.7

2.2.2 Phonetic segments

Although there are four phonemic short/long vowel pairs in Yowlumne, there are five such pairs in surface representations: [i, a, o, u] and [e]. It is this fifth vowel that is problematic for the theory presented here because it cannot be contrasted using the features [high] or [labial]. Thus, if the lowering rule that derives [e] is phonological, it is necessary to introduce a non-contrastive feature into the phonology. This is the solution Archangeli (1984) opts for, adding the feature [low] via a default rule that must precede other rules that she characterizes as phonological. The fully specified matrix is given in (7) below.8

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7. Moreover, Yokuts vowel harmony (discussed in §2.3 below) is complicated by having /i/ unspecified. In derivational analyses, a ‘last minute’ redundancy rule specifying /i/ as [+high] is required in order for Harmony to (correctly) apply on epenthetic vowels (e.g., Archangeli 1984). This complication is no more elegantly dealt with in Optimality Theoretic approaches, which require an Input-Else application on the harmony constraint (e.g., Archangeli & Suzuki 1997).

8. Although based on Archangeli (1984), the matrix in (7) does not include the feature [back], since this feature is not pertinent to the present discussion.
Archangeli’s (1984) fully specified matrix for Yowlumne vowels:

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>a</th>
<th>o</th>
<th>u</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>round</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>low</td>
<td>–</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

In a contrastive account, Archangeli’s solution is less than optimal because it allows the redundant feature [low] to enter during the phonology, rather than at a better-defined place such as in the phonetic, post-lexical component. Indeed, when we consider the operation of a series of rules that are most relevant to this issue, there is reason to believe that the application of two of these is post-lexical. If this is correct, the non-contrastive feature [low] is not present in the phonology of Yowlumne.

2.3 Vocalic processes

In order to understand the problem that Yowlumne creates for the theory of contrast, it is necessary to examine the rules found in this language, namely Epenthesis, Harmony, Lowering, and Weight-by-Position. Thus, in this section, I step back from the problem at hand and review the facts of the language as laid out by Newman and interpreted by Archangeli (1984 et seq.).

Under a prosodic analysis, the first of these rules, Epenthesis, is not a ‘rule’ at all. It is, in fact, an intrinsic aspect of syllabification. Although universally syllabification consists of projecting a syllable from either a vowel or a mora, in Yowlumne one may also be projected from a consonant (Archangeli 1991). That is, all segments may project a syllable in this dialect. This syllable is then a template, and so is subject to the universal conventions holding of templates. These conventions are Template Satisfaction (which states that the minimum requirements of syllable well-formedness must be met) and Maximization (which states that melody must be mapped to the template) (McCarthy & Prince 1986 et seq.). Each time a syllable is projected, it is immediately subject to these conventions. When a syllable is projected from a consonant that is not adjacent to a vowel, it must gain a mora. This is achieved through Template Satisfaction and Maximization, and the mora is then spelled out as /i/. In short, /i/ is inserted between tautosyllabic CC sequences. This process is exemplified in (8) below, taken directly from Archangeli (1991), in which both association to the morphological template and the first round of syllable projection have already been assumed to have occurred.9

(8) Epenthesis as an intrinsic aspect of syllabification (Archangeli 1991: 245):

9. Recall that syllabification proceeds from right to left in Yowlumne.
b. Template Satisfaction and Maximization

\[
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array} \\
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array} \\
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array}
\]

c. Syllable projection

\[
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array} \\
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array} \\
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array}
\]

d. Weight-by-Position

\[
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array} \\
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array} \\
\begin{array}{c}
\sigma \\
\mu \\
\text{l i n c a t n m i}
\end{array}
\]

e. Surface representation: [lin.ca.tin.mi] ‘having tried to speak’

The second rule is one of vowel harmony, which spreads labiality (and dorsality) rightward between vowels of the same phonological height.\(^{10}\) Harmony is therefore parasitic on height, as /i/ only rounds to [u] after /u/, and /a/ only rounds to [o] after /o/. Furthermore, no vowels are transparent: vowels of different heights act as blockers. Thus, Harmony is only operative between vowels with the same aperture specifications that occupy adjacent syllables. The examples in (9) demonstrate its operation.

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10. This treatment of vowel harmony assumes that a single mechanism is responsible for the spread of labiality within each set of vowels. See Hansson (1999) for a different perspective.
(9) a. /i ~ u/ alternations (Archangeli 1984):^{11,12}

\[
\begin{align*}
\text{hiwiit} + \text{hn} & > [\text{hiwethin}] \quad \text{‘walk’} \\
\text{p’axaat’} + \text{hn} & > [\text{p’axat’hin}] \quad \text{‘mourns’} \\
\?\text{opoot} + \text{hn} & > [\text{?opothin}] \quad \text{‘arises from bed’} \\
\text{duy} + \text{dy} + \text{hn} & > [\text{duydyhun}] \quad \text{‘stung (repetitive)’} \\
\text{cuum} + \text{hn} & > [\text{comhun}] \quad \text{‘destroy’} \\
\text{cuum} + \text{t} & > [\text{coomut}] \quad \text{‘destroy (passive)’} \\
\text{cuum} + (?\text{a} + \text{hn}) & > [\text{coomaahin}] \quad \text{‘destroy (continuative)’} \\
\text{suduuk} + (?\text{c}) & > [\text{sudookuc}] \quad \text{‘one who is removing’} \\
\text{suduuk} + (?)\text{y} & > [\text{sudok?uy}] \quad \text{‘that which is removed’}
\end{align*}
\]

b. /o ~ a/ alternations (Archangeli 1984):

\[
\begin{align*}
\text{hiwiit} + \text{al} & > [\text{hiweetal}] \quad \text{‘might walk’} \\
\text{p’axaat’} + \text{al} & > [\text{p’axaat’al}] \quad \text{‘might mourn’} \\
\?\text{opoot} + \text{al} & > [\text{?opootol}] \quad \text{‘might arise from bed’} \\
\text{k’o} + \text{al} & > [\text{k’o?ol}] \quad \text{‘might throw’} \\
\text{suduuk} + \text{al} & > [\text{sudookal}] \quad \text{‘might remove’} \\
\text{suug} + \text{al} & > [\text{soogal}] \quad \text{‘might pull out’}
\end{align*}
\]

The epenthized suffix vowels in the form for ‘stung (repetitive)’ in (9a) indicate that Epenthesis feeds Harmony because they surface as [u] and not as [i]. The realization of the epenthized vowel as [i] in coomaahin /cuum + (?\text{a} + \text{hn}/ ‘destroy (continuative)’, on the other hand, shows how the intervening non-high vowel blocks the spread of labiality. Furthermore, the failure of /a/ to undergo Harmony in soogal /suug + al/ ‘might pull out’ and in sudookal /suduuk + al/ ‘might remove’ in (9b) indicates that this rule is counterfed by the application of the rule that derives [oo] (since [oo] does not trigger Harmony). This rule is Lowering, which applies to long high vowels.

In CV skeleton accounts (e.g., Archangeli 1984, 1985), Lowering is formulated as in (10a). This version states that Lowering only applies to matrices that are linked to two adjacent vowel slots, changing the specification of the aperture feature from [+ high] to [− high]. Hansson (1999) gives a slightly different formulation, shown in (10b). This second version leans toward a prosodic explanation and captures the role of syllable structure in the operation of Lowering, since long vowels are only found syllable-internally in Yowlumne. It is not clear, however, whether Hansson intends Lowering to

11. Consonants marked in parentheses are ghost segments, and only surface under certain conditions; see Archangeli (1991) or Zoll (1996).
12. It could be argued that in the final two data in (9a), the final root vowels have undergone harmony, deriving from /ii/ (/sudk + [\sigma_v\sigma_m] + suffix/). However, I reject such an analysis for two reasons. First, there is no evidence of any such alternation, as these forms are always realized as [o/oo] (derived from /uu/ through Lowering, discussed in the subsequent paragraph). Consequently, although rounding would be predictable, there is no reason to suppose an underlying /ii/. Second, for independent reasons, Archangeli (1984) posits a rule of Copy to derive the second root vowel in bi- and triconsonantal roots on which the iambic template is imposed. This analysis captures a key generalization in Yowlumne: the quality of the second vowel in these forms is identical to that of the first, a fact that cannot be explained via an appeal to vowel harmony or any other vowel process in the dialect (e.g., hoyot (hoy + [\sigma_v\sigma_m] + t), yawalhin (/yawl + [\sigma_v\sigma_m] + hn/)).
apply vacuously in the case of non-high long vowels since he does not discuss phonological representations.

(10) a. Lowering (version 1):  
\[ \begin{array}{c}
+\text{high} \rightarrow [-\text{high}] / \\
\sigma \sigma \\
X X \\
\end{array} \]

b. Lowering (version 2):  
\[ \begin{array}{c}
\sigma \sigma \\
V V \\
\rightarrow \ \\
\rightleftharpoons \\
[-\text{high}] \\
\end{array} \]

I posit, however, that Lowering is not governed by the syllable, but rather that the mora is the mediating prosodic structure: bimoraic vowels lower. In other words, Lowering is a constraint against bimoraic high vowels. Consequently, if Lowering is lexical, it should be a straightforward matter of delinking the specification for [high]. This, however, is problematic given the features assumed in (6). Removing [high] from /uu/ derives a segment specified only as [labial]: [oo]. This alternation is demonstrated in (11). Removing [high] from /ii/, on the other hand, should derive a segment that is unspecified: [aa]. As the data in (12) show, however, /ii/ does not lower to [aa]; it lowers to [ee].

(11) /uu ~ oo/ alternations (Archangeli 1984: 125, 127):

\[
\begin{array}{l}
c\text{uum} + iin > [c\text{'oomon}] \quad \text{‘will devour’} \\
wuuwl + k\text{’a} > [w\text{woowulk’a}] \quad \text{‘stand up!’} \\
suduuk + (?c) > [sud\text{ookuc}] \quad \text{‘one who is removing’} \\
\end{array}
\]

(12) /ii ~ ee/ alternations (Archangeli 1984: 125, 127):

\[
\begin{array}{l}
diiy + a? > [deey\text{a}] \quad \text{‘one in front’} \\
?iidl + iin > [?\text{edlen}] \quad \text{‘will hunger’} \\
hiwiit + Ø > [hiw\text{et}] \quad \text{‘journey’} \\
\end{array}
\]

In order to account for this realization, Archangeli (1984) introduces the feature [low], which she argues must be added to representations before the application of the lowering rule. As discussed above, this solution is undesirable from a contrastive perspective as it introduces a redundant feature into the lexical phonology.

Before examining Lowering any further, however, I turn to Weight-by-Position, which assigns a mora to syllable-final consonants. An intrinsic aspect of Weight-by-Position is the shortening effect it has on bimoraic vowels in closed syllables. Since syllables are maximally bimoraic in Yowlumne (3a), the final consonant in super-heavy
sylabes cannot gain a mora through insertion. Instead, shown in (13), the second mora of the vowel is transferred to the final consonant, intrinsically shortening the syllable.

(13) Weight-by-Position and closed syllables with bimoraic vowels:14

\[
\begin{array}{c}
\sigma \\
\mu \\
\mu \\
C \quad V \quad C \\
\end{array} \quad \rightarrow \quad \begin{array}{c}
\sigma \\
\mu \\
\mu \\
C \quad V \quad C \\
\end{array}
\]

The forms in (14) below demonstrate the surface alternations that result from the application of this rule.

(14) Surface alternations resulting from Weight-by-Position:

a. /p'axaat'/ p'a.xaa.t'al ‘might mourn’
   p'a.xat'.hin ‘mourns’

b. /suduuk/ su.doo.kal ‘might remove’
   su.dok.hun ‘removes’

c. /biniit/ bi.nee.tal ‘might ask’
   bi.net.hin ‘asks’

Notably, examples (14b,c) demonstrate that Weight-by-Position and Lowering are extrinsically ordered: if allowed to apply first, Weight-by-Position will bleed the environment for Lowering (e.g., *sudukhun, *binithin). In derivational accounts, then, Weight-by-Position must apply after Lowering. Consequently, the implication for the current analysis is that if Lowering is reanalyzed as post-lexical, then by the ordering algorithm, so must be Weight-by-Position.

2.4 A challenge for the theory of contrast

The central tenet of this paper is that in a theory that treats phonology as the unique domain of contrast, any rule that introduces redundant features ideally applies post-lexically. In Yowlumne, Lowering is considered to be a lexical process (Archangeli 1984). This conclusion is problematic for the theory of contrast because it necessitates the introduction of a non-contrastive feature to phonological representations.

The division of rules into two distinct components is the cornerstone of lexical phonology (Kiparsky 1982a,b, 1985; Mohanan 1982), and is intended to capture the complex relationship between morphological structure and the application of phonological rules. In brief, this theory posits “a set of distinct properties for rules that apply within the lexicon” as opposed to those that apply outside this component (Kaisse & Shaw 1985). These properties are as follows. Lexical rules may exhibit lexical

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14. ‘C’ and ‘V’ are used here as informal abbreviations for segment bundles and are not meant to represent a CV skeleton.
exceptions, and may apply cyclically. They may not, however, derive novel forms (segments, sequences, or structures), nor may they apply to non-derived forms. In contrastive theory, this lexical component is the domain of contrastive features. Post-lexical rules, on the other hand, do not exhibit lexical exceptions and are non-cyclic, but they may derive novel forms and are not restricted in terms of the forms to which they may apply. That is, whenever their environment is met, post-lexical rules are expected to apply. The post-lexical component is therefore the domain of non-contrastive, or redundant, features in the current contrastive framework. It is to this component that I aim to constrain Yowlumne Lowering.

3. Lowering as a post-lexical rule

Having seen the problem, in this section I set out to propose an alternative analysis, one that allows the rule of lowering to apply after the introduction of non-contrastive features. I argue that there is in fact strong motivation to viewing this rule as properly belonging to the class of post-lexical rules that apply in the phonetic component of the grammar. Despite the apparent complications to this analysis, specifically, that long high vowels surface in Yowlumne, I argue that Lowering can be post-lexical if it is considered to be prosodically, rather than morphologically, determined.

3.1 Structure preservation

Discussed above, lexical phonology (Kiparsky 1982a,b, 1985; Mohanan 1982) divides rules into two distinct components, each with its own set of unique properties. The first of these components is the lexicon. Rules applying here do so cyclically, interacting with word formation rules which in turn gives them access to morphological information. As a consequence of their cyclic application, lexical rules are restricted to derived environments. Moreover, because they appear in the pre-syntactic component, a word boundary marks the end of their domain. Thus, while a lexical rule may apply at a word boundary, it cannot apply across one.

A popular example of a lexical rule is English Trisyllabic Laxing (TSL), which shortens long vowels when followed by two syllables, the first of which must be unstressed. TSL accounts for the alternations in the bolded vowels in words like seren/serenity and divi/divinity, but the rule is not exceptionless. Take, for example, a form such as obese/obesity in which the penultimate vowel fails to shorten when a suffix is added. Notably, TSL cannot apply in underived forms, and so words like nightingale and ivory, which do not contain any affixes, are exempt from laxing.

The second rule component in lexical phonology resides outside the lexicon. These post-lexical rules tend to be automatic, applying across the board whenever their environment is met. Crucially, because they apply outside the lexicon, they cannot access lexical properties such as morphological information. The paradigmatic example of a post-lexical rule is Flapping in most varieties of North American English. Flapping applies within underived forms (e.g., data), across morpheme boundaries (e.g., writing), and across word boundaries (e.g., but I want to) as well.

One aspect of lexical phonology is particularly relevant to the issue at hand: Structure Preservation. This constraint stipulates that phonological rules cannot
introduce distinctions that are not present in lexical entries, thereby restricting lexical processes to the derivation of phonemic forms. This limitation is exemplified by the English rules discussed above. In the case of TSL, the laxing of the penultimate vowel is structure preserving, since the derived vowels are phonemes of English. Flapping, on the other hand, is non-structure preserving because flaps are not phonemes of English and thus requires the addition of features to the underlying system of contrasts.

Now consider Yowlumne. When Lowering applies in this dialect, [ee] is derived from /ii/. As seen in §2, within a contrastive analysis neither [ee] nor the feature(s) necessary to contrast it from the phonemic vowels of the inventory are present underlyingly (only [high] and [labial] are specified in the contrastive inventory in (6)). Consequently, Lowering is non-structure preserving and by Structure Preservation, can only apply post-lexically. However, if one assumes that lexical rules can change feature values, as Archangeli (1984) does, this issue is circumvented. There Lowering is analyzed as a rule that “changes values, rather than inserting them” (125). Archangeli argues that the features of /ii/, unspecified by Universal Grammar, are provided by a series of redundancy rules as [+ high, – round, – low] just before the application of Lowering. In order to derive [ee] then, Lowering simply changes the value of [+ high] to [– high] and the resulting matrix corresponds to the specifications of [ee]: [– high, – round, – low]. Crucially, the only motivation for these rules is the need to sanction the insertion of the feature [low] and to specify its value for each segment in the lexical component. In the present analysis, however, no recourse to redundancy rules is available in the lexical phonology by virtue of the constraints of the theory; Lowering remains non-structure preserving.

Notably, once post-lexical, the derivation of [ee] from /ii/ becomes a straightforward matter of phonetic facts. As shown in (15), the phonetic enhancement of the Yowlumne vowels will result in the addition of place features to all vowels but [a], which will be marked for height. Thus, [i] will be enhanced with [coronal], while the back vowels [u,o] will be enhanced with [dorsal]. However, while I assume that back round vowels have both the features [labial] and [dorsal] phonetically, for ease of representation only [labial] is shown in subsequent representations. Finally, [a] is enhanced with [low].

(15) Phonetic representations of Yowlumne vowels (dotted lines mark enhancement):

```
(15) Phonetic representations of Yowlumne vowels (dotted lines mark enhancement):

<table>
<thead>
<tr>
<th>Vowel</th>
<th>Phonetic Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>[coronal] [high]</td>
</tr>
<tr>
<td>e</td>
<td>[coronal]</td>
</tr>
<tr>
<td>u</td>
<td>[dorsal] [labial] [high]</td>
</tr>
<tr>
<td>o</td>
<td>[dorsal] [labial]</td>
</tr>
<tr>
<td>a</td>
<td>[low]</td>
</tr>
</tbody>
</table>
```
In the meantime, Lowering affects only the height of the target. Thus, /uu/ lowers to [oo] because both are labio-dorsal vowels. Since /ii/ is coronal, [aa], which is central, is not an appropriate candidate for Lowering. Instead, /ii/ maintains its coronal status and [ee] is derived.

In addition to explaining why /ii/ lowers to [ee] and not to [aa], there is a certain advantage to an analysis of Lowering as post-lexical. As shown by the lines in (16), four extrinsic orderings hold between the rules discussed in §2.3 above.

(16) Extrinsic ordering of Yowlumne rules:

```
  Epenthesis
   Harmony
  Lowering
   Weight-by-Position
```

If, however, Lowering is post-lexical, part of the ordering burden stipulated for Yowlumne is eliminated. For example, there is no need to stipulate that Lowering must follow the rules ‘above’ it: its order late in the derivation now follows from its non-structure preserving nature. By the ordering algorithm, the same logic applies to Weight-by-Position: its ordering after Epenthesis becomes intrinsic as well, as Epenthesis is lexical while Weight-by-Position, ordered after Lowering, is post-lexical. The only remaining extrinsic relations are the orderings of Epenthesis before Harmony and of Lowering before Weight-by-Position. When considered in this purely mechanical fashion, the burden of extrinsic ordering is reduced from four rules to two.

However, it is possible to reduce further the need for ordering in Yowlumne. If, following Itô (1989), we consider syllabification—of which Epenthesis is a part—to be continuous, applying whenever possible, we get two ordering relations for free. That is, there is no need to stipulate that Epenthesis precedes either Harmony or Weight-by-Position, since the continuous application of syllabification ensures that Epenthesis will intrinsically have applied before either of these rules do. In the post-lexical component, it need only be stipulated that Weight-by-Position be the last rule to apply.\(^{15}\)

The question remains, however, as to whether or not there is independent evidence beyond Structure Preservation that Lowering is post-lexical, while the rules preceding it are lexical. Evidence of the latter is not hard to find. Harmony, which precedes Lowering, is not inhibited by morpheme boundaries (cf. (9) above) but word boundaries block its application. The phrase ‘let me hide (it)’, for example, is realized as \textit{wonxo na}? and not as \textit{*wonxo no}? (Kenstowicz & Kisseberth 1979: 407). Similarly, the phrase ‘(he) will walk where the world is blooming’ is realized as \textit{hiweeten hiyo?uk ?ileewan pa?an} and not as \textit{*hiweeten hiyo?uk ?uleewan pa?an} (Newman 1944: 101). Harmony is also structure preserving, as both outputs—[o] and [u]—are underlying segments of the vocalic inventory. Finally, this rule only appears to be operative in derived

---

15. Of course, the list in (16) is truncated; there are more rules in Yowlumne than just these four. The gains in the reduction of extrinsic ordering are much greater if we consider the full set of rules in the dialect. See Archangeli (1984), Kenstowicz & Kisseberth (1979), or Kuroda (1967) for full orderings.
environments; there is no evidence that it is operative within morphemes.\textsuperscript{16} Presumably for these reasons, Harmony is listed as a lexical rule in Archangeli (1984).

Regarding the post-lexical status of Weight-by-Position, in Newman (1944), unlike later analyses, shortening is viewed as a phonetic process, operating on surface representations to repair super-heavy syllables. This is the analysis argued for here, except that it is not shortening that constrains surface representations, but rather that Weight-by-Position does so by assigning a mora to codas, effectively licensing them. I believe this position is tenable. Super-heavy syllables rarely surface in Yowlumne. When they do, they can be accounted for via extraprosodicity because these exceptional syllables are constrained to the ends of prosodic domains such as the iambic foot (e.g., \textit{ni.neel.saa.hin} /nin + σ,σμ + ilsaa + hn/ ‘get someone to keep still’) or the phonological word (e.g., \textit{bee.mam.gooc} ‘humming bird’, \textit{?it.woop} ‘woman’s brother’s wife’). Consequently, I consider Weight-by-Position to be a post-lexical process, functioning to license coda consonants in closed syllables. An intrinsic aspect of this licensing is the reparation of super-heavy syllables created as a result of Syllabification and Template Association.

Compelling support that Lowering is post-lexical would be evidence of its application either at the phrasal level or in underived forms. However, recall that Yowlumne’s syllable template (3) allows only consonants in word-initial position since all syllables must have onsets. Consequently, the environment for Lowering is never met in the syntactic component as adjacent vowels are not licensed across syllable boundaries, let alone word boundaries. Since post-lexical rules may, but not must, exhibit cross-word application, the lack thereof in this instance is not critical (relevant domains are also the phonological word, the phonological phrase, etc.). Nevertheless, if Lowering could be seen to apply in underived forms, its status as post-lexical could be upheld, as such application is a unique property of post-lexical rules. Data of this kind are sparse. A possible candidate is \textit{hiwet} ‘journey’, which surfaces from underlying /hiwiit/ (cf. /hiwiit + iin/ > [hiweeten] ‘will walk’; /hiwiit + hin/ > [hiwethin] ‘walk’). Newman (1944: 145), however, posits a zero thematic suffix on this form, rendering it derived after all. A more convincing candidate is \textit{beemamgooc} ‘humming bird’, which Archangeli (1984: 145) lists as an underived noun. Furthermore, if we accept roots as underived forms, there are a few examples of Lowering in this environment (see Newman 1944: 42-53).

Interestingly, the cyclic status of Lowering posited by Archangeli (1984) is not accepted in all of the literature. A third component in lexical phonology is comprised of post-cyclic lexical rules. This component intercedes between cyclic lexical rules and non-cyclic post-lexical rules and was stipulated in order to account for instances in which rules appear to apply after all word formation rules have applied but before the resulting words are inserted into phrases. Kenstowicz (1994: 227) suggests that this component is the “natural location” for rules of absolute neutralization such as Yowlumne Lowering. However, if we consider Lowering to be a post-cyclic lexical rule, we encounter the same problem as when we consider it cyclic. Structure Preservation applies not only within the lexicon, but to the output of word-level rules as well (Kiparsky 1985). Consequently, even as a post-cyclic rule, Lowering continues to violate Structure Preservation.

\textsuperscript{16} See note 11.
In summary, I have argued that according to Structure Preservation, Lowering can be neither a cyclic nor a post-cyclic lexical rule. I have also argued that its failure to apply at the phrasal level is non-evidence of its lexical status because VV sequences are only licensed syllable-internally in Yowlumne. The fact that Lowering does not apply at the phrasal level is thus independent of the status of the rule itself and rather is an incidental result of autonomous language-specific facts. Furthermore, a post-lexical classification explains why /ii/ lowers to [ee], an anomalous realization if Lowering is lexical. Its non-structure preserving nature aside, however, there is a further characteristic of the lowering rule that requires a post-lexical analysis. I turn to this now.

3.2 Derived environments

As already discussed, a distinct property of lexical rules is that they are constrained to derived environments. In such environments, rules are seen to either 1) apply at or across morpheme boundaries, or 2) to be dependent on such boundaries (i.e., their structural description includes a morpheme boundary). Given these facts, a striking property of Yowlumne’s lowering rule is that it applies strictly within morphemes, whether the form is derived (e.g., coomon /c’uum + iin/, hiwet /hiwiit + Ø/) or not (e.g., beemamgooc /biimamguuc/). Compare this to Harmony, a lexical rule, in which labiality spreads rightward between morphemes. Unlike cross-word application, this tautomorphemic restriction is independent of the syllable template of the language, since this template simply circumscribes the way in which melody is imposed on prosodic structure. Moreover, a corollary of within-morpheme application is that Lowering is not dependent on morpheme concatenation: it simply requires that high vowels be bimoraic. Compare this to English TSL, discussed above, in which the structural description of the rule is crucially dependent on affixation. In this regard, Lowering more closely resembles Flapping, as morpheme boundaries are irrelevant to the application of the rule; it simply applies when its structural description is met. Thus, by applying solely within morphemes, Lowering exhibits no characteristics of lexical rule application in derived environments.

(17) Sample derivations showing both lexical strata:17

<table>
<thead>
<tr>
<th>Lexical stratum:</th>
<th>/cuum + hn/</th>
<th>/cuum + ti/</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Underlying representation</td>
<td>µ µ</td>
<td>µ µ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c u m h n</td>
<td>c u m t</td>
</tr>
<tr>
<td></td>
<td>[high] [labial]</td>
<td>[high] [labial]</td>
</tr>
</tbody>
</table>

17. In (17), I have ignored each repetition of syllable projection and the Conditions on Association (i.e., Template Satisfaction and Maximization of Association (McCarthy & Prince 1986 et seq.)), since these issues are discussed in detail in Archangeli (1991). Instead, all repetitions of these stages are subsumed within Association to the template (17b) and Syllabification (17c).
The derivations in (17) above show how Yowlumne surface realizations are derived once the rules discussed in §2.3 are separated into two distinct components of the grammar. Given Structure Preservation, the straightforward derivation of [ee], and the non-lexical characteristics of Lowering in derived environments, it is tempting to
conclude that Lowering is indeed a post-lexical rule. The issue is complicated, however, by other data from Yowlumne, and I turn to that now.

3.3 Complications to an analysis of Lowering as post-lexical

In §2, it was stated that there are five short/long vowel pairings in Yowlumne surface representations. If Lowering is post-lexical, however, only three such pairings are expected since just monomoraic forms of /i/ and /u/ should appear phonetically. Contrary to this expectation, we do find bimoraic high vowels in surface representations. These long forms are derived in two ways.\(^{18}\)

First, [ii] and [uu] surface through free variation in the realization of the causative morpheme -?ii (Newman 1944). This affix, which combines exclusively with triconsonantal roots, imposes an iambic template on the verb root. Within the rubric of CV skeleton morphology (McCarthy 1979; Marantz 1982; Clements & Keyser 1983), Archangeli (1984) analyzes the process as follows. The glottal stop of the causative affix associates by rule with the fifth skeletal slot. It may, however, be delinked near the end of the derivation if the vowel occupying the fourth skeletal slot spreads. A sample derivation is given in (18) below (syllabification is omitted).


\[
\text{hubs} + \text{CVCVXC} + \text{?ii} + \text{m} \quad \text{‘having made someone choose’}
\]

a. Underlying representation\(^{19}\)

```
  C   V   C   V   X C   V   V   C
h   u   b   u   ?s   i   m
```

18. A third way in which long high vowels are derived is a word game played by children. In this game, a prefix is added to the verb stem wi'y ‘do,say’, the vowel of which is then lengthened to indicate that the activity is done slowly (Archangeli 1984; Kuroda 1967; Newman 1944):

\[
\text{a. } [\text{hikwi}y] \quad \text{‘make a hiccup sound’} \quad \rightarrow \quad [\text{hiikwi}y] \quad \text{‘make a panting sound’}
\]

\[
\text{b. } [\text{paalwi}y] \quad \text{‘overspread quickly’} \quad \rightarrow \quad [\text{paalwi}y] \quad \text{‘overspread slowly’}
\]

The few examples of this kind tend to appear in comedic tales describing the antics of Coyote, and Newman (1944) points out that adults avoid these forms, regarding them as a kind of “linguistic playfulness” not suitable for adult behaviour (56). This information, coupled with the purpose of word games in general being to play with the sounds of the language, often bending or breaking rules, suggests that the bimoraic high vowels in these forms do not constitute exceptions to the lowering rule at all. Consequently, they are not accounted for here.

19. The second root vowel is derived through a rule of Copy; see note 12.
b. /?/ link and Syllable Internal Spread

\[
\begin{array}{c}
C \quad V \quad C \quad V \quad C + \quad V \quad V \quad C \\
\text{h \quad u \quad b \quad u} \quad ? \quad s \quad i \quad m
\end{array}
\]

\rightarrow [hubu?som]

or

c. Harmony and Lowering

\[
\begin{array}{c}
C \quad V \quad C \quad V \quad C + \quad V \quad V \quad C \\
\text{h \quad u \quad b \quad u} \quad ? \quad s \quad o \quad m
\end{array}
\]

\rightarrow [hubuusom]

d. Optional Vowel Spread

\[
\begin{array}{c}
C \quad V \quad C \quad V \quad X \quad C + \quad V \quad V \quad C \\
\text{h \quad u \quad b \quad u} \quad ? \quad s \quad o \quad m
\end{array}
\]

Second, bimoraic high vowels surface through contraction of the reflexive/ reciprocal suffix, -iws. This affix derives verbal nouns from verb roots. When affixed in nominative contexts, this suffix appears word-finally. Then, when Syllabification applies from right to left, a degenerate syllable is built from the final consonant cluster, resulting in Epenthesis. Thus, forms like pa.ti.wis /pat + iws/ ‘fight’ and tu.yu.wus /tuy + iws/ ‘shoot at’ are derived (Newman 1944: 150). Notably, the suffix is never contracted in these forms. However, in oblique contexts, reflexive -iws is not the final affix; the oblique morpheme -a follows the reflexive morpheme. The word-final affixation of the oblique suffix has direct consequences for syllabification, since the consonant cluster of the reflexive morpheme no longer syllabifies as onset and coda of the same syllable. Rather, right to left syllabification results in the final consonant of reflexive -iws syllabifying as the onset to the ultimate syllable – of which the oblique -a is the head – and the /w/ syllabifies as the coda of the penultimate syllable. Accordingly, forms such as *pa.tiw.sa /pat + iws + a/ ‘fight’ and *tu.yuw.sa /tuy + iws + a/ ‘shoot at’ are expected, but these are not the forms that surface. Instead, the vowel plus glide sequence of the reflexive affix contracts, deriving a long vowel (Newman 1944:30); the surface forms of oblique reflexive ‘fight’ and ‘shoot at’ are thus realized as pa.tii.sa and tu.yuu.sa respectively (150). This alternation between [iw ~ ii] and [uw ~ uu] in Yowlumne must be restricted to the reflexive suffix, however, as the sequences -iw- and -uw- occur elsewhere in the dialect (e.g., hiwtinay ‘while walking’ (136), ?utu?tuwfax?o? ‘stealing from each other’ (89)).

What the bimoraic high vowels of causative and oblique reflexive verbs have in common is the fact that they are derived through morpheme concatenation and rule

---

20. Curiously, contraction is restricted to the dialect of Yowlumne (Newman 1944: 30-1, 150n). In the Chukchansi dialect of Yokuts, for example, the oblique form of ‘washing’ is yuwsuwa and not *yuwsuwa.
application. Moreover, these are the only bimoraic vowels in Yowlumne that do not undergo Lowering. These facts appear to suggest, therefore, that Lowering only applies to bimoraic vowels that are supplied by the morphological templates of the dialect. Attention to morphological information, however, is the hallmark of lexical rules. The semblance of sensitivity to such information is therefore problematic for the analysis argued for here. However, when causative and oblique reflexive formation are considered in light of prosodic structure, this apparent attention to morphological detail is argued to be illusory.

3.4 A prosodic approach

The description of causative verb formation given in §3.3 above is based on Archangeli’s (1984) CV skeleton analysis of Yowlumne templatic morphology. In order to explain why the long vowels fail to lower, she orders Optional Vowel Spread after Lowering (cf. (18) above). While this in itself does not hinder an analysis of Lowering as post-lexical, it comes at the cost of stipulating an extrinsic ordering relation in the phonetic component. Moreover, Archangeli’s account of causative affixation is predominantly descriptive, offering little explanation of why the melodic segments are associated in the manner they are. If analyzed within prosodic morphology, however, the surface forms derived through affixation of the causative suffix -ʔiʔ can be shown to follow from general principles of prosody.

I suggest an alternative, prosodic analysis in which formation of the causative stem is partly templatic and partly a-templatic. The causative morpheme subcategorizes for the iambic template (cf. (2) above), which it imposes on the root. Melody is then mapped to this template from left to right (cf. §2.1), and in this regard, stem formation is templatic. However, the insertion of the glottal stop between the final root consonants, which is as yet unmotivated, leaves the final root consonant unassociated to the iambic template (see (19b) below). In this sense, stem formation is a-templatic (in Archangeli 1991, such segments are labeled extra-templatic). Unexplained, however, is the violation of affix integrity – the discontinuous realization of the causative morpheme – as well as the restriction of this affix to triconsonantal roots. I propose that both these facts derive from a single source: the glottal stop is underlingly associated to a mora.

Once underlyingly moraic, the glottal stop of the causative affix must 1) surface as a coda consonant and 2) cannot function as an onset for the following -ʔiʔ sequence, because onsets are not moraic. We have seen, though, that all syllables must have onsets in Yowlumne (cf. (3bi)). The imposition of a templatic iambic foot on the root is a further complication. However, if the causative morpheme associates with a triconsonantal root, these conditions are all satisfied. Given the iambic template, a moraic glottal stop will be inserted between the two final root consonants because this puts it in coda position (19a,b), explaining why affix integrity is violated. This also

21. This stipulation would follow some analyses of the ordering of Flapping and Canadian Raising, both post-lexical, in some dialects of North American English.

22. Alternately, the glottal stop could associate as the third segment in the root, which also enables it to act as coda and does not disrupt the iambic template (e.g., *huʔboosom). As a suffix, however, causative -ʔiʔ is edge-bound, affixed to the right edge of the root. Under the non-trivial assumption that the glottal stop will parse at the first opportunity, it will associate as close to the right edge of the root as possible. This
enables the final root consonant to be syllabified as the onset to the bimoraic vowel of the causative morpheme (19c).

(19) The proposed prosodic account of causative verb formation

\[
\text{hubs} + [\sigma, \alpha_{\mu\mu}] + ?\text{ii} + \text{m}
\]

a. Underlying representation

\[
\begin{array}{cccc}
\sigma & \sigma & \mu & \mu \\
\mu & \mu & \mu & \mu \\
\text{h u b } & \text{? s} & \text{ - i} & \text{ - m}
\end{array}
\]

b. Association to the template (left to right)

\[
\begin{array}{cccc}
\sigma & \sigma & \mu & \mu \\
\mu & \mu & \mu & \mu \\
\text{h u b } & \text{? s} & \text{ - i} & \text{ - m}
\end{array}
\]

c. Syllabify (right to left)

\[
\begin{array}{cccc}
\sigma & \sigma & \mu & \mu \\
\mu & \mu & \mu & \mu \\
\text{h u b } & \text{? s} & \text{ - i} & \text{ - m}
\end{array}
\]

d. Harmony, Copy, Lowering

\[
\begin{array}{cccc}
\sigma & \sigma & \sigma \\
\mu & \mu & \mu & \mu \\
\text{h u b} & \text{u} & \text{? s} & \text{o} & \text{ - m}
\end{array}
\]

e. Weight-by-Position

\[
\begin{array}{cccc}
\sigma & \sigma & \sigma \\
\mu & \mu & \mu & \mu \\
\text{h u b} & \text{u} & \text{u} & \text{? s} & \text{o} & \text{ - m}
\end{array}
\]

condition is captured in Zoll (1996) through a NO INTERVENING constraint, which penalizes any root segment that intervenes between any part of the affix and the right edge of the root. This constraint is ranked low, since it must be violated in order to account for partial infixation of glottalization, but is formulated to account for all suffixes in the dialect. The current analysis therefore provides independent support for the account of partial infixation proposed in Zoll (1996).
Now that the previously stipulative association of the causative morpheme has been accounted for, the free variation of causative surface forms (e.g., [hubu?som] ~ [hubuusom]) remains to be explained. In a CV analysis, this variation was posited to derive from the optional spreading of the penultimate vowel. In a prosodic analysis, this variation is better seen to derive from the optional delinking of the glottal stop. When this occurs, compensatory lengthening is triggered because the vowel spreads to satisfy the weight requirement of the empty mora (cf. Hayes 1989). As before, Lowering fails to apply. Consequently, the heavy iambic syllable must not meet the prosodic requirement for Lowering; Lowering must apply before the delinking of the glottal stop. There is, therefore, still a need for extrinsic ordering. However, there is no need to order Weight-by-Position and Glottal Delinking: the rules are unaffected. Consequently, we need only stipulate then that Lowering be the first rule to apply.

(20) Weight-by-Position, Glottal Delinking and Compensatory Lengthening:

a. Weight-by-Position

```
  σ  σ  σ
  µ  µ  µ  µ  µ
h u b u ? s - o - m
```

b. Glottal Delinking and Compensatory Lengthening

```
  σ  σ  σ
  µ  µ  µ  µ  µ
   |  |    |  or  n/a
h u b u ? s - o - m
```

c. Surface representation [hubu?som ~ hubuusom]

(21) Glottal Delinking and Compensatory Lengthening, Weight-by-Position:

a. Glottal Delinking and Compensatory Lengthening

```
  σ  σ  σ
  µ  µ  µ  µ  µ
   |  |    |  or  n/a
h u b u ? s - o - m
```
The question remains, however, as to whether or not the bimoraic high vowels of oblique reflexives can be explained similarly to those of causative verbs. Up to a point, they can be. In fact, the bimoraic high vowels are derived in these forms just as in the causative forms: the coda of the penultimate syllable is delinked, and the vowel spreads through compensatory lengthening. Since Lowering has already applied, the resulting bimoraic vowels remain high. In oblique reflexives, however, Delinking must be ordered after Weight-by-Position since the coda must be moraic if spreading is to be triggered. Otherwise, delinking of the glide would derive forms such as *patisa since it is only mora preservation that triggers compensatory lengthening.

(22) Oblique reflexive forms in Yowlumne:

/pat + iws + a/ ‘fight (oblique reflexive)’

a. Input to the post-lexical component

```
  σ  σ  σ
 /   /   /
/ µ  µ  µ

  p a t i w s a
```

b. Weight-by-Position

```
  σ  σ  σ
 /   /   /
/ µ  µ  µ

  p a t i w s a
```

c. Delinking and Compensatory Lengthening

```
  σ  σ  σ
 /   /   /
/ µ  µ  µ

  p a t i w s a
```

An outstanding issue is the apparent isolation of contraction to oblique forms of the reflexive affix. However, this isolation is perhaps a consequence of Yowlumne stress. Stress in this dialect is penultimate (Newman 1944), and while it may vary as a result of
phrase stress, this variation is largely restricted to function words. Lexical categories such as nouns and verbs tend to maintain stress on the penultimate vowel. In nominative reflexive verbs, the -i/uw sequence of the reflexive morpheme is heterosyllabic; the vowel is the head of the penultimate syllable, while the glide forms the onset of the ultimate syllable. In oblique reflexive verbs, on the other hand, this sequence is tautosyllabic and penultimate, and consequently, is stress-bearing. In the other forms in which we find this sequence tautosyllabically, it does not appear in a stressed position (e.g., hiw.'ti.nay ‘while walking’, ?u.tu?u.twax.'o? ‘stealing from each other’). It is likely, therefore, that it is not the combination of the oblique and reflexive suffixes that triggers contraction, but rather that stress assignment triggers it.

In summary, it has been argued here that when considered within a prosodic framework, Lowering does not apply in causative and oblique reflexive verbs because at the time the rule applies, the requisite prosodic structure is not met. The failure of the bimoraic high vowels to lower is thus independent of information contained in the morphological template, but rather is a consequence of prosodic requirements. These forms do not, therefore, constitute exceptions to the lowering rule.

4. Conclusion

The axiom of this paper has been that within a theory that seeks to constrain the lexical phonology to contrastive feature specifications, rules introducing non-contrastive features are optimally post-lexical. In the instance of Yowlumne Lowering, it was shown that the feature necessary to contrast [e] is not present underlyingly, as the phonemic system is minimally contrasted using [high] and [labial]. In order to account for the surface representations of lexical items then, the data was reexamined in order to determine whether Lowering could be reclassified as post-lexical or whether redundant features are truly active in the lexical phonology of Yowlumne.

It was argued that Structure Preservation forces an analysis of Lowering as post-lexical, as this condition stipulates that the output of lexical rules must be underlying segments of the inventory. Support for this analysis is the analytical gain in the derivation of lowered vowels, as their derived quality becomes a natural consequence of phonetic facts. A further motivation in the classification of Lowering as post-lexical comes from derived forms, as the rule exhibits no characteristics of lexical rule application in this environment.

An apparent complication for a post-lexical analysis of Lowering, however, is the realization of bimoraic high vowels in causative and oblique reflexive verbs. When considered according to prosodic structure, however, Lowering was seen to be

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23. Some forms take antepenultimate stress, but they are not relevant to the current discussion. See Newman (1944) or Archangeli (1984) for a discussion of these exceptions.
24. A possible complication for this analysis is the reflexive/reciprocal consequent adjunctive affix, -wsiil, which does not undergo contraction (e.g., lo.woo. 'niw.sel [lown + a,σiω + wsiil] ‘place where they attend each other’s feasts’). For this reason, Newman (1944) analyses it as a frozen form, but the suffix is subject to both Lowering (/ii/ > [ee]) and Weight-by-Position ([ee] > [e]). This remains an issue for further research.
prosodically regulated. Specifically, only bimoraic vowels lower, but the processes deriving bimoraic high vowels were argued to apply after Lowering.

The contribution of this paper, therefore, has been to show that in Yowlumne, the lexical phonology can be the unique domain of contrast, and redundant features can be constrained to the post-lexical component. A further, though unrelated, contribution has been to show that the unusual behaviour of the causative morpheme follows from general principles of prosody and does not involve any stipulative conditions on association.

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