

## Positional Markedness in Vowel Harmony

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### 1. Introduction

A key issue in research on vowel harmony is the role of positional privilege. Vowels in prominent positions are frequently granted a special status in their function as triggers or targets in harmony. Studies of harmony patterns in which linguistically-prominent positions display a unique triggering role have identified *positional faithfulness* as a source of privilege in strong locations (Beckman 1998, Walker to appear). In these cases, the feature specification is consistently preserved in the strong position. This paper focuses on the distinct set of patterns in which the target vowel resides in a prominent site, that is, where a strong position exhibits alternations via attraction of features. Phenomena of this kind cannot be attributed to positional faithfulness, because when active, it makes the contrary prediction that strong positions will resist change.

This paper studies strong target alternations in two height harmonies. The first is the case of Veneto Italian, where harmony triggered by a suffix vowel targets a stressed vowel (1a) (Maiden 1991). Only high vowels trigger the harmony, as evident by comparing (1b-c). The second case, in (2), is a height transfer in Esimbi which targets initial syllables (Hyman 1988). In this pattern the height feature of a non-initial root vowel is transferred to an initial prefix vowel, and the non-initial vowel is neutralized to high.

- |     |                |   |           |                            |
|-----|----------------|---|-----------|----------------------------|
| (1) | Veneto Italian |   |           |                            |
| a.  | /tornevi/      | → | [tornívi] | ‘return (2 sg. imp. ind.)’ |
| b.  | /tornevo/      | → | [tornévo] | ‘return (1 sg. imp. ind.)’ |
| c.  | /torneva/      | → | [tornéva] | ‘return (3 sg. imp. ind.)’ |
| (2) | Esimbi         |   |           |                            |
| a.  | /u-to/         | → | [otu]     | ‘insult (inf.)’            |
| b.  | /u-re/         | → | [ɔri]     | ‘daub (inf.)’              |

Building on a proposal by Zoll (1996, 1998), I argue that such targeting of strong positions comes about through the activity of positive *positional markedness* constraints, which call for affiliation of features with linguistically-strong sites. In this paper I argue that all height features are subject to licensing. However, licensing requirements are violable, and their conflict and interplay with other phonological demands can produce different outcomes—results felicitous

with an optimality-theoretic approach. Two outcomes are analyzed here: (i) licensing restricted to feature specifications regarded as less marked ([+high]; Veneto), and (ii) licensing of more marked specifications ([-high]; Esimbi).

In the course of examining these patterns, some additional matters of theoretical interest are explored. One area concerns some intriguing root-affix asymmetries presented by the harmonies under scrutiny. In Veneto, affixes are capable of triggering an alternation in roots. In Esimbi, prefix vowels are the targets and display the full range of vowel heights; although root vowels determine the height of the prefix, they are consistently realized as high. I argue that despite these characteristics, the generalization expressed by the Root-Faith >> Affix-Faith metaconstraint is maintained (McCarthy & Prince 1994). A second matter concerns featural faithfulness. The transfer of height features in Esimbi is analyzed here as driven by prioritization of MAX<sub>RI</sub>(F), preventing deletion of root height features. A brief investigation of the outcomes predicted by a theory admitting both IDENT(F) and MAX(F) constraints points to some positive results. The third area relates to the theory of featural markedness. The analysis of metaphony developed in this work explores the possibility that this phenomenon involves an assimilation to the unmarked (in the terminology of Baković 2000).

This paper is organized as follows. §2 centers on the case of Veneto metaphony, where spreading of [+high] targets a stressed syllable. In §3 I turn to Esimbi height transfer, wherein the vowel in the initial syllable attracts height features from non-initial positions. §3 considers some typological implications for featural faithfulness growing out of this work. In §4 I present the conclusion.

### 2. Stressed vowel targets: Veneto Italian

Many dialects of Italian and Spanish display a height harmony, commonly known as “metaphony”, where stressed stem vowels raise in the context of a high vowel suffix. I focus here on the pattern observed in Veneto Italian, the northern dialect(s) spoken in Vicenza, Padova, Rovigo, Verona, and Grado.

#### 2.1 Vowel raising in Veneto Italian

The description of Veneto Italian metaphony is drawn from Rohlfs (1966), Calabrese (1988), and Maiden (1991). Veneto presents a seven vowel inventory consisting of [i, e, ε, a, ɔ, o, u]. Following Calabrese (1988), I assume that [e, a, ɔ] are [-ATR], and the remaining vowels are [+ATR]. For ease of exposition, I will assume binary features, but this is not crucial to the analysis.

The data in (3) illustrate the harmony. As shown in (3a), metaphony in Veneto raises stressed [+ATR] mid vowels to [+high] in the context of a high vowel suffix. Vowels that are [-ATR] are not affected by metaphony, as in (3b). Triggers are restricted to high vowels; non-high suffix vowels do not affect the height of stressed vowels (3c). Sources are indicated at the right: data from Calabrese is notated “AC”, from Maiden “MM”, and from Rohlfs “GR”.



lies under study in this work. Within Italian, unstressed mid vowels raise to become high in certain dialects, such as Northern Salentino (Calabrese 1988). In Esimbi post-initial vowels are neutralized to [+high], as will be discussed in §3.<sup>3</sup>

The positional markedness approach to licensing in height harmony is previewed in (7), with a Veneto form. Candidate (7a) obeys both licensing constraints, because the [+high] feature in the suffix is linked to the stressed syllable, as in (6a). The faithful candidate in (7b) has an autosegmental representation like that shown in (6b), and is accordingly ruled out by LIC(+high).

(7) Exemplification of positional markedness approach

/vedi/	LIC([-high] <sub>JA6</sub> , ǫ)	LIC([+high] <sub>JA6</sub> , ǫ)	IDENT-IO(high)
a. <sup>ESP</sup> vídi			*
b. védi		*!	

A chief assertion is that the positional markedness approach is crucial for harmonies that target strong positions—positional faithfulness cannot be substituted here. A faithfulness-based approach would attribute the positional neutralization to a constraint enforcing faithfulness in a strong position (Beckman 1997, 1998). The kind of constraint that would be expected for harmony sensitive to a stressed syllable is IDENT-ǫ-IO(high): “A segment in a stressed syllable in the output and its correspondent in the input must have identical values for [high].” However, positional faithfulness is not capable of characterizing a strong target, because in such a pattern it is the prominent position that alternates. To illustrate, let us suppose that a spreading constraint for [high] drives the height harmony, and it is ranked between positional and general IDENT(high) constraints, as in (8). In this tableau “<sup>ESP</sup>” marks the attested form and “⊗” marks the form wrongly selected by the hierarchy. The metaphony output in (8a) is the attested form in Veneto, but it is not selected by this constraint hierarchy, because the stressed vowel is unfaithful. The faithful form in (8b), or the candidate in (8c), in which the stressed vowel triggers [high] spreading to the suffix, are each more harmonic than (8a) with respect to positional faithfulness. This example makes clear that positional faith cannot be what underlies the special status of a strong position when it forms the target of harmony. Hence, this must be a case where positional markedness supercedes positional faithfulness.

<sup>3</sup> The universal markedness statement expressed by LIC(-high) >> LIC(+high) might require further refinement. It is intended to characterize languages in which high vowels pattern as unmarked in relation to mid vowels or both mid and low vowels, which I suggest is appropriate for the languages under examination here (and many others). However, as discussed by Flemming (1995), Rice (1999a, b), and others, different inventory structures have the potential to impact segmental markedness relations. In addition, Rice suggests that there are languages in which non-high vowels pattern as less marked than high vowels, although some of her diagnostics for assessing markedness are different from those considered here.

(8) Positional faithfulness is inadequate for strong target positions

/vedi/	IDENT-ǫ(high)	SPREAD(high)	IDENT(high)
a. <sup>ESP</sup> vídi	*!		*
b. védi		*!	
c. ⊗ véde			*

Although the positional licensing effect in these patterns is not a result of positional faithfulness, it does not deny the existence of such constraints. Positional faithfulness has been used in several accounts to successfully characterize certain kinds of position-sensitive phenomena (e.g. Beckman 1997, 1998, Féry 1998, Lombardi 1999, Curtin 2001, Walker to appear, among others). Moreover, even analyses that utilize positional markedness often themselves utilize some kind of positional faithfulness constraint as well, such as root-sensitive faithfulness (Zoll 1998, Balassa 2000), and that will also be the case in the analysis of Esimbi height transfer developed in §3.

### 2.3 Analysis of metaphony

I turn now to the rankings for Veneto metaphony. The analysis focuses on five main descriptive points: (i) [high] licensing produces alternations, (ii) only [+ATR] vowels raise, (iii) only [+high] spreads, (iv) affixes are capable of triggering alternations in root vowels, and (v) harmony is regressive and terminates at the stressed syllable. In what follows, I discuss each of these in turn.

The first point is that licensing for [high] produces alternations. In order for this to be the case, licensing constraints must outrank IDENT-IO(high), as shown in (9) (which repeats (7)). The metaphony output in (9a) is the winner, as determined by LIC(+high). Satisfaction of LIC(+high) is at the cost of faithfulness for [high] in the target vowel. The sub-optimality of a third candidate [véde] for the input /vedi/ will be addressed presently.

(9) LIC(-high) >> LIC(+high) >> IDENT-IO(high)

/vedi/	LIC(-high)	LIC(+high)	IDENT(high)
a. <sup>ESP</sup> vídi			*
b. védi		*!	

The next point for the account is that only [+ATR] vowels raise. I attribute this to a well-documented dispreference for [-ATR] high vowels (Calabrese 1988, Archangeli & Pulleyblank 1994, Baković 2000). As shown in (10), \*[+high, -ATR] and IDENT-IO(ATR) together outrank licensing. This hierarchy selects the faithful output for a stressed [-ATR] vowel, in (10a), over (10b), which violates the feature co-occurrence constraint, and (10c), which alters the [ATR] value of the target vowel.

- (10)  $*[+high, -ATR], IDENT-IO(ATR) \ggg LIC(-high) \ggg LIC(+high)$
- | /mɔdi/                 | *[+high, -ATR] | IDENT(ATR) | LIC(-high) | LIC(+high) |
|------------------------|----------------|------------|------------|------------|
| a. <sup>ESP</sup> mɔdi |                |            |            | *          |
| b. mɔ̃di               | *!             |            |            |            |
| c. m̃di                |                | *!         |            |            |

The third item to be addressed is that [+high] alone spreads. This pattern resembles a set of phenomena that Baković (2000) refers to as “the assimilation to the unmarked”—cases in which a feature specification regarded as unmarked actively spreads, while its marked counterpart remains inert. Baković discusses examples of assimilation to the unmarked in [ATR] harmony and voice assimilation. Veneto plausibly presents a case in harmony involving the feature [high].

Following Baković, I analyze assimilation to the unmarked as the effect of a local conjunction of a markedness constraint and faithfulness constraint for the same feature.<sup>4</sup> The local conjunction necessary for Veneto is given in (11).

- (11)  $*[-high] \&_I IDENT-IO(high)$ : An output segment must not be specified as [-high], if its input correspondent is not specified as [-high].

The intuition that underlies this constraint is that it is worse to gain a marked feature specification in the output than it is to have that specification by virtue of faithfulness to an input representation. The local conjunction is interpreted as violated if both \*[-high] and IDENT-IO(high) are violated in a single segment, which is the smallest domain that can be evaluated by each of the conjuncts.

The conjunction  $*[-high] \&_I IDENT-IO(high)$  suppresses the activity of LIC(-high) in Veneto, and accordingly it must dominate licensing. The ranking is presented in (12) in relation to a schematic form with a mid vowel suffix. The assimilation candidate in (12b) violates the conjunction, because the first mid vowel incurs a mark with respect to both \*[-high] and IDENT(high). This violation is fatal; the winner in (12a) obeys the conjunction at the cost of LIC(-high). I defer discussing the sub-optimality of a third candidate [i • i] to (16) below.

- (12)  $*[-high] \&_I IDENT-IO(high) \ggg LIC(-high)$
- | /i • e/                 | *[-hi] & <sub>I</sub> IDENT(hi) | LIC(-high) | LIC(+high) | IDENT(high) |
|-------------------------|---------------------------------|------------|------------|-------------|
| a. <sup>ESP</sup> i • e |                                 | *          |            |             |
| b. é • e                | *!                              |            |            | *           |

Since the local conjunction inhibits only spreading of [-high], it does not interfere with the metaphony outcome in (9), wherein [+high] spreads—height harmony involving assimilation to unmarked feature values is alone admissible.

The fourth item for the analysis is that affixes are capable of triggering

<sup>4</sup> The proposal that constraints may be locally conjoined is due to Smolensky (1993).

alternations in roots. This property is not particularly unusual, it simply is diagnostic of a harmony in which root/stem dominance is not active. Such a pattern indicates that the relevant root and affix faithfulness constraints are both situated in the hierarchy below the constraints governing harmony. Specifically, IDENT-IO<sub>R</sub>(high) and IDENT-IO<sub>A</sub>(high) are located below licensing and the local conjunction, as shown by the metaphony example in (13) (see also Baković 2000). The precedence of Root-Faith over Affix-Faith is not denied here; the pertinent constraints are simply located sufficiently low in the hierarchy to render the harmony insensitive to a root-affix asymmetry. Observe that the local conjunction rules out the progressive spreading of [-high] from the stressed syllable to a [+high] suffix in (13c)—an assimilation to the marked. This is the candidate that remained to be considered after the portion of the ranking established in (9).

- (13)  $*[-high] \&_I ID(high) \ggg LIC(-hi) \ggg LIC(+hi) \ggg ID_R(hi) \ggg ID_A(hi)$

/vedi/	*[-hi] & <sub>I</sub> ID(hi)	LIC(-high)	LIC(+high)	ID <sub>R</sub> (hi)	ID <sub>A</sub> (hi)
a. <sup>ESP</sup> vídi				*	
b. védi			*!		
c. véde	*!				*

The last points to be addressed for Veneto are that harmony is regressive and terminates at the stressed syllable. Let us first consider a case that is straightforward under the hierarchy established thus far. As shown in (14), since licensing of [high] is restricted to instances of the feature in affixes, we do not expect pretonic root vowels to be affected. Hence for /morosi/, the winning output is (14a), with regressive spreading of [+high] to the stressed syllable, as driven by LIC(+high) (compare 14c). Spreading does not persist to the pretonic vowel, as in (14b), because that would incur a gratuitous faithfulness violation. Since the separate ranking of IDENT(high) for roots and affixes is not decisive, these constraints are collapsed into one column in this tableau and the next.

- (14) Only affix vowels are subject to licensing

/morosi/	*[-hi] & <sub>I</sub> ID(hi)	LIC(-high)	LIC(+high)	IDENT <sub>R(A)</sub> (hi)
a. <sup>ESP</sup> morúsi				*
b. murúsi				**!
c. morósi			*!	

The question remains why assimilation to the unmarked is not bidirectional in Veneto. Specifically, why does a form with a stressed high vowel followed by a mid vowel not spread [+high] progressively, e.g. /fiume/ → \*[fiumi]? This outcome is unsuccessful even though it obeys LIC(-high) in contrast to the attested form, [fiume] ‘river’. The hierarchy thus far is silent on the sub-optimality of this progressive raising output. The constraint I propose to call upon is given in (15). It aligns a feature to a faithful position, adapted from

the notion of “basic-alignment”, discussed by Cole & Kisseberth (1995).

- (15) ALIGN-R([high], sponsor-seg): “For every feature [high] in an output, the rightmost segment to which it is associated must obey IDENT-IO(high).”

The constraint in (15) requires that the rightmost link of a [high] feature be faithful. It will discourage progressive spreading and prevent a final vowel from being the target of assimilation. As shown with a schematic form in (16), ALIGN-R outranks LIC(-high) in order to select (16a), with a faithful final mid vowel. To distinguish different autosegmental structures, candidates are shown here with labeled brackets that indicate the vowels to which a featural autosegment is linked. For example, (16b) represents a form in which [+high] is linked across both vowels, whereas (16c) represents separate [+high] specifications linked to each vowel. ALIGN-R rules out (16b), which obeys licensing via progressive spreading.<sup>5</sup> This constraint also eliminates (16c), which replaces an unlicensed [-high] with the less marked specification [+high]. ALIGN-R thereby handles the residual sub-optimal form \*[i • i] for an input /i • e/, mentioned in discussion of (12). The local conjunction rules out (16d), which satisfies licensing and ALIGN-R by undergoing an assimilation to the marked.<sup>6</sup>

- (16) ALIGN-R([high], sponsor-seg) >> LIC(-high)

/i • e/	*[-hi] & Id(hi)	ALIGN-R	LIC(-hi)	LIC(+hi)	Id(hi)
a. $\begin{bmatrix} \text{[i]} \\ \text{[e]} \end{bmatrix}$			*		
b. $\begin{bmatrix} \text{[i} \bullet \text{i]} \\ \text{[+hi]} \end{bmatrix}$		*!			*
c. $\begin{bmatrix} \text{[i]} \\ \text{[+hi} \bullet \text{[i]} \\ \text{[+hi]} \end{bmatrix}$		*!		*	*
d. $\begin{bmatrix} \text{[é} \bullet \text{e]} \\ \text{[+hi]} \end{bmatrix}$	*!				*

A ranking summary for Veneto metaphony is given in (17).

- (17) Ranking summary  
 ALIGN-R, \*[-high] & IDENT-IO(high), \*[-high, -ATR], IDENT-IO(ATR)  
 >> LIC(-high) >> LIC(+high) >> IDENT-IO<sub>R</sub>(high) >> IDENT-IO<sub>A</sub>(high)

The top tier of constraints includes ALIGN-R, the local conjunction, and constraints involving [ATR]. These constraints dominate the fixed licensing complex LIC(-high) >> LIC(+high), which in turn outranks the fixed faithfulness complex IDENT-IO<sub>R</sub>(high) >> IDENT-IO<sub>A</sub>(high).

<sup>5</sup> Notice that a constraint aligning a [high] feature towards the *left* of the word could not be substituted for ALIGN-R to prevent progressive spreading, since (16b) would obey it.

<sup>6</sup> The ill-formedness of /vedei/ → [véde] ((13c) above) could be attributed to either \*[-high] & IDENT(high) or ALIGN-R, since it involves both an assimilation to the marked and a final vowel unfaithful to its [high] specification. The local conjunction and ALIGN-R are nevertheless each independently required in order to rule out (16d) and (16b-c), respectively.

To review, in this section I have argued that the targeting of a strong position in Veneto height harmony is diagnostic of a positional markedness distribution. The posited active constraint requires that height features in affixes be licensed via association to a stressed syllable. I have suggested that the restriction of visible licensing to [+high] could be an instance of an assimilation to the unmarked. This analysis nevertheless accommodates a fixed ranking in which licensing of more marked structure (-high) is prioritized over that which is less marked (+high). The system of ranked and violable constraints allows for the suppression of LIC(-high) by the local conjunction, which blocks assimilation to the marked. Finally, although Veneto metaphony does not display root/stem dominance, it does not undermine the Root-Faith >> Affix-Faith generalization, which will play a role in the analysis of Esimbi.

### 3. Word-initial syllable targets: Esimbi

I shift attention now to the case of Esimbi in which the role of LIC(-high) is clearly visible. Esimbi is a Bantoid language spoken in Cameroon. It presents a rather unusual distribution of vowel height in outputs. The output set of prefix vowels displays a range of (at least) three degrees of vowel height [i, e, a, ə, ɔ, o, u], while root vowels are uniformly high [i, i, u].

Previous work by Stallcup (1980) and Hyman (1988) has established that the output distribution in Esimbi is produced by a transfer of vowel height features from root to prefix. Their research identifies an underlying distribution, wherein roots present a set of eight vowels [i, e, ə, a, ɔ, o, u], which display the full range of height contrasts, and a reduced vowel set [i, a, u] originates in the prefix (adapted from Hyman 1988). (The underlying prefix vowel represented by [a] has a “downstepping” property that will be elaborated on below.) Data supporting the transfer of vowel height are discussed in the next section.

#### 3.1 Prefix height alternations in Esimbi

The following data and evidence for height transfer are drawn from Stallcup (1980) and Hyman (1988). A given prefix in Esimbi will exhibit a three-way variation in vowel height, where the choice of height variant is determined by the root to which it is affixed; however, the rounding and backness of the prefix remain fixed. Examples are given in (18) for the infinitive prefix, with alternants [u-, ɔ-, ə-]. The underlying vowels are listed at the right, following the analyses of Stallcup and Hyman. The infinitive prefix is posited as [u-] underlyingly,<sup>7</sup> and the root vowels are either high, mid, or low. In the output, root height is shifted to the prefix—yielding the alternation—and root vowels are neutralized to high.<sup>8</sup>

<sup>7</sup> Under Hyman’s assumptions, this prefix is the archiphoneme /U-/.

<sup>8</sup> Alternatively transferred height features could be analyzed as floating underlyingly. The constraint hierarchy for Esimbi must nevertheless be capable of producing grammatical outputs for hypothetical inputs in which height features are linked to root vowels.

- (18) Hypothesized underlying vowels
- |    |                   |            |       |
|----|-------------------|------------|-------|
| a. | High <sup>9</sup> | Infinitive | u - i |
|    |                   | ‘eat’      | u - u |
|    |                   | ‘kill’     | u - e |
| b. | Mid               | ‘laugh’    | u - o |
|    |                   | ‘insult’   | u - ə |
|    |                   | ‘steal’    | u - ε |
| c. | Low               | ‘daub’     | u - ɔ |
|    |                   | ‘knead’    | u - a |
|    |                   | ‘come’     |       |

The data in (19) show a similar state of affairs with a prefix vowel that is fixed front and unrounded. It exhibits alternants [i-, e-, ε-]. The vowel in this prefix (nominal class 9 singular) is posited as /i-/. (Diacritics mark tones.)

- (19) Cl. 9 Singular Hypothesized underlying vowels
- |    |      |        |            |       |
|----|------|--------|------------|-------|
| a. | High | ì-bì   | ‘goat’     | i - i |
|    |      | ì-sù   | ‘fish’     | i - u |
| b. | Mid  | è-gbì  | ‘bushfowl’ | i - e |
|    |      | è-sù   | ‘hoe’      | i - o |
|    |      | è-bì   | ‘cane rat’ | i - ə |
| c. | Low  | è-jìsì | ‘hole’     | i - ε |
|    |      | è-zù   | ‘snake’    | i - ɔ |
|    |      | è-tlì  | ‘place’    | i - a |

A third kind of prefix vowel alternates in height at a step below the /u-/ and /i-/ vowels, an effect termed “downstep” by Hyman. An example is observed in the class 6 plural prefix, which exhibits alternants [o-, ɔ-/(e-), a-], as in (20).<sup>10</sup> For comparison, corresponding class 3 singular nouns with the prefix /u-/ (identical to the infinitive) are listed at the right.

- (20) Cl. 6/3 Plural Hypothesized underlying vowels Singular
- |    |      |        |         |       |        |
|----|------|--------|---------|-------|--------|
| a. | High | o-tìlì | ‘end’   | a - i | u-tlì  |
|    |      | ó-ku   | ‘death’ | a - u | ú-ku   |
| b. | Mid  | é-ki   | ‘tail’  | a - e | ó-ki   |
|    |      | ó-tu   | ‘ear’   | a - o | ó-tu   |
|    |      | ɔ-tì   | ‘spear’ | a - ə | o-tì   |
| c. | Low  | a-sìmi | ‘grain’ | a - ε | ɔ-sìmi |
|    |      | á-bu   | ‘hand’  | a - ɔ | ó-bu   |
|    |      | á-bì   | ‘broom’ | a - a | ó-bì   |

<sup>9</sup> There appear to be no roots containing underlying [i]. I hypothesize that this represents the residue of a historical gap in Esimbi roots, whereby high central vowels were disallowed, but this remains to be verified.

<sup>10</sup> A further complexity is that this affix displays a front alternant [ε] with root /e/.

The downstepping phenomenon is discussed by Hyman (1988) and Clements (1991), and it will not be analyzed here. I will simply characterize this prefix vowel as /a-, a vowel bearing a height downstepping property; in Hyman’s analysis, this vowel has a [-ATR] specification that depresses vowel height.

The class 7/8 singular/plural prefixation in (21) provides further confirmation for a height transfer. These data illustrate that the height of prefix vowels attaching to a given root is not random: it is consistent across prefixes. The same generalization across regular and downstepped prefixes is seen in (20), where the plural prefix is predictably downstepped by one level from the singular.

- (21) Cl. 7/8 Singular Plural
- |    |      |       |       |          |
|----|------|-------|-------|----------|
| a. | High | ki-ku | bi-ku | ‘bone’   |
| b. | Mid  | ke-hì | be-hì | ‘bundle’ |
| c. | Low  | kè-sì | bè-sì | ‘comb’   |

In summary, a key insight of the studies of Esimbi by Stalleup (1980) and Hyman (1988) is that a three-way height contrast is a synchronic phonological property of the root that is transferred to the prefix. Unlike more familiar cases of harmony with spreading, height actually shifts from one vowel to another. Prefix vowels contribute a two-way property influencing height, which determines whether the prefix alternates at the regular level or downstepped. These studies thus reveal that underlying prefix height is in fact a subset of root height.

### 3.2 Analysis of height feature transfer

I propose that as in the Veneto metaphony, Esimbi vowel height alternations are driven by a licensing constraint. Esimbi height transfer involves a strong position (in this case word-initial) attracting a feature from other locations. Hence, this is another distribution brought about by positional markedness. The relevant constraint for Esimbi is LIC([high], wd[σ]): “[high] is licensed by word-initial syllables”. Notice that in the Esimbi height harmony, linkage to a root vowel is not sufficient to license [high], and the optional restriction of the licensing condition to features affiliated with a specific weak position is not warranted (compare the constraint for Veneto in (5)). The analysis for Esimbi must address the following four points: (i) licensing for [high] produces height alternations in the initial syllable, (ii) height transfer preserves root features, (iii) non-high root features realized in the prefix are not also realized in root position, and (iv) prefixes contribute a reduced set of height contrasts. I focus first on cases where a marked height specification originates in the root and continue to use [-high] as a descriptive designation for marked non-high height configurations.

Item (i) for the analysis is that licensing produces height alternations in the first syllable. Such alternations are indicative of markedness dominating faith; in particular LIC-(high) must supercede IDENT-IO(high). This ranking is

shown in (22) together with the fixed ranking  $\text{LIC}(\text{-high}) \gg \text{LIC}(+\text{high})$ . The optimal output in (22a) transfers a root [-high] specification to the initial syllable, satisfying  $\text{LIC}(\text{-high})$  at the cost of violations of  $\text{LIC}(+\text{high})$  and  $\text{IDENT-IO}(\text{high})$ . The faithful candidate in (22b) is eliminated by a violation of  $\text{LIC}(\text{-high})$ . The activity of  $\text{LIC}(\text{-high})$  in Esimbi is thus firmly apparent.

(22)  $\text{LIC}(\text{-high}, \text{wd}[\sigma]) \gg \text{LIC}(+\text{high}, \text{wd}[\sigma]), \text{IDENT-IO}(\text{high})$

/i - so/	$\text{LIC}(\text{-high}, \text{wd}[\sigma])$	$\text{LIC}(+\text{high}, \text{wd}[\sigma])$	$\text{IDENT-IO}(\text{high})$
a. $\text{ɛsù}$		*	**
b. $\text{ìsò}$	*!		

As in the metaphony case, positional faithfulness is unsuccessful in characterizing the licensing effect. The problem for a positional faithfulness approach is that the licensing initial position in Esimbi is not a faithful site. Accordingly, a constraint enforcing faithfulness to the initial syllable cannot drive the prefix alternations, as shown in (23).

(23) Positional faithfulness is inadequate for height transfer

/i - so/	$\text{IDENT-}\sigma(\text{high})$	*[-high]	*[+high]	$\text{IDENT-IO}(\text{high})$
a. $\text{ɛsù}$	*!	*	*	**
b. $\text{ìsò}$		*	*	

The next point for analysis is that height transfer rescues root features. I attribute the preservation of root height features via transfer to  $\text{MAX-IO}_R(\text{high})$ , a member of the  $\text{MAX}(\text{F})$  family. Such constraints evaluate correspondence between features directly, requiring that every occurrence of a feature specification [F] in the input have a correspondent in the output. Independent motivation for  $\text{MAX}(\text{F})$  constraints comes from floating feature phenomena, as first noted by McCarthy & Prince (1995). Additional analyses calling on featural correspondence include Lombardi (1995), Causley (1996), Zoll (1996), and Ringen & Vago (1998), among others.  $\text{MAX}_R(\text{high})$  holds specifically of [high] specifications morphologically affiliated with the root. As mentioned above, the notion of distinguishing root and affix faith is due to McCarthy & Prince (1994), and it has enjoyed extensive application in phonological theory. Root faithfulness is a morphologically-based positional faithfulness. Hence this account agrees with the studies by Zoll (1998) and Balassa (2000), wherein positional markedness does not exclude the activity of positional faithfulness in a language. Indeed, both kinds of constraints may play distinct roles in the same grammar.

$\text{MAX}_R(\text{high})$  and  $\text{LIC}(\text{-high})$  together outrank  $\text{MAX}_A(\text{high})$ , as seen in (24) with /i-so/. The winner in (24a) transfers [-high], violating only  $\text{MAX}_A(\text{high})$ .<sup>11</sup>

<sup>11</sup> I assume that in the optimal output for a case like that in (24), the [+high] feature in the root is an inserted default specification. A conceivable alternative is that [+high] originates

The faithful form in (24b), which retains [-high] in the root, is eliminated by  $\text{LIC}(\text{-high})$ , and (24c), which deletes [-high], is ruled out by  $\text{MAX}_R(\text{high})$ .

(24)  $\text{MAX}_{\text{Root}}(\text{high}), \text{LIC}(\text{-high}) \gg \text{MAX}_{\text{Affix}}(\text{high})$

/i - so/	$\text{MAX}_R(\text{high})$	$\text{LIC}(\text{-high})$	$\text{MAX}_A(\text{high})$
a. $\text{ɛsù}$			*
b. $\text{ìsò}$		*!	
c. $\text{ìsù}$	*!		

The role that  $\text{MAX}(\text{high})$  plays in preserving root features here is crucial— $\text{IDENT}(\text{high})$  cannot motivate a *transfer* of features. The problem for an account calling solely on  $\text{IDENT}$  is illustrated in (25), where  $\text{IDENT}$  is substituted for  $\text{MAX}(\text{high})$  in the hierarchy. The attested form in (25a) violates both  $\text{IDENT}_R$  and  $\text{IDENT}_A$ . This form incurs a superset of the violations incurred by (25b), which spreads the root feature, and by (25d), which deletes the root [-high] specification. Hence, no ranking of this constraint set can obtain transfer as optimal.

(25)  $\text{IDENT}(\text{high})$  alone is insufficient

/i - so/	$\text{IDENT}_R(\text{high})$	$\text{LIC}(\text{-high})$	$\text{IDENT}_A(\text{high})$
a. $\text{ɛsù}$	*!		*
b. $\text{ɛsò}$			*
c. $\text{ìsò}$		*!	
d. $\text{ìsù}$	*!		

The failure of  $\text{IDENT-IO}(\text{high})$  to drive feature transfer does not deny  $\text{IDENT}(\text{F})$  constraints, it simply indicates that they are dominated in Esimbi. In order to achieve the transfer of [high],  $\text{MAX}_R(\text{high})$  must outrank  $\text{IDENT}(\text{high})$ , as in (26). Here the transfer candidate in (26a) is optimal, even though it violates  $\text{IDENT}(\text{high})$  twice. Candidate (26b), which deletes [-high], is ruled out by  $\text{MAX}_R(\text{high})$ , and the faithful candidate in (26c) is excluded by  $\text{LIC}(\text{-high})$ .

(26)  $\text{MAX}_{\text{Root}}(\text{high}), \text{LIC}(\text{-high}) \gg \text{IDENT}(\text{high})$

/i - so/	$\text{MAX}_R(\text{high})$	$\text{LIC}(\text{-high})$	$\text{IDENT}(\text{high})$
a. $\text{ɛsù}$			**
b. $\text{ìsù}$	*!		*
c. $\text{ìsò}$		*!	

The third item for the account is that non-high root features realized in the prefix do not retain a link to their original position in the root. I attribute this

ing in the prefix is transferred to the root. Although both forms would sound the same, I opt for the former since the character of root vowel height is regularly default in Esimbi outputs, and there is no evidence to support the retention of affix height features in the root. The latter possibility can be ruled out by the ranking:  $\text{LINEARITY}(\text{F}) \gg \text{MAX}_A(\text{high}), \text{DEP}(\text{high})$ .

outcome to a constraint  $\text{CRISP}(\sigma, [\text{high}])$ , which bans cross-syllable linkage of [high]. This constraint is a member of the Crisp-edge family, which prevents linkage of structure across prosodic categories (Itô & Mester 1999, Walker to appear). Locating  $\text{CRISP}(\sigma, [\text{high}])$  over  $\text{IDENT}(\text{high})$  and  $\text{LIC}(+\text{high})$  will prevent a root height feature from remaining linked to a root vowel when it is also linked to a prefix. The tableau in (27) illustrates. Labelled brackets are used again to indicate autosegmental structure. The optimal output in (27a) obeys  $\text{CRISP}(\sigma, [\text{high}])$ , because it transfers [-high] from a root vowel to the first syllable. This outcome incurs violations of  $\text{IDENT}(\text{high})$  and [+high] licensing in the root syllable. A candidate that spreads marked height from the root to the initial position is ruled out on the basis of the cross-syllable linkage of [-high].

(27)  $\text{CRISP}(\sigma, [\text{high}]) \gg \text{LIC}(+\text{high}), \text{IDENT}(\text{high})$

/i – so/	$\text{MAX}_{\text{Rt}}(\text{hi})$	$\text{LIC}(-\text{hi})$	$\text{CRISP}(\sigma, [\text{hi}])$	$\text{LIC}(+\text{hi})$	$\text{ID}(\text{hi})$
a. $\text{[e̞]_{-hi}[s̩]_{+hi}}$			*		**
b. $[\text{e}^{\text{so}}]_{-hi}$			*!		*

The last item for analysis is that prefixes contribute a reduced set of height contrasts. In order to address this point, we must consider inputs containing [+high] roots. The question is why do these never occur with [-high] prefixes? Given the hierarchy established thus far, for a hypothetical input /o-ri/, the faithful output  $[\text{[o]_{-hi}[ri]_{+hi}}]$  is predicted to be more harmonic than the hypothesized attested output structure  $[\text{[u]_{+hi}[ri]_{+hi}}]$ . This is because both violate  $\text{LIC}(+\text{high})$ , and the attested output also violates  $\text{MAX}_{\text{Aft}}(\text{high})$ . The solution is shown in (28): affixes cannot contribute a [-high] specification to an output, though roots can, a pattern obtained by situating \*[-high] between  $\text{MAX}_{\text{Aft}}(\text{high})$  and  $\text{MAX}_{\text{Aft}}(\text{high})$ . \*[-high] will thus eliminate [-high] that derives from an affix, as in (28b), and the prefix will be correctly realized as [+high] when the input root specification is [+high]. (Another candidate  $[\text{[uri]_{+hi}}]$  is discussed in (29).)

(28)  $\text{MAX}_{\text{Root}}(\text{high}) \gg *[-\text{high}] \gg \text{MAX}_{\text{Aft}}(\text{high})$

/o – ri/	$\text{MAX}_{\text{Rt}}(\text{high})$	*[-high]	$\text{MAX}_{\text{Aft}}(\text{high})$
a. $\text{[u]_{+hi}[ri]_{+hi}}$			*
b. $[\text{[o]_{-hi}[ri]_{+hi}}]$		*!	

In output forms such as (28a), where high prefix vowels match the height of the root, it is reasonable to question whether the prefix [+high] specification is inserted or spread from the root vowel. Both structures correspond to the same vowel qualities. The decision is determined by the ranking of  $\text{CRISP}(\sigma, [\text{high}]) \gg \text{LIC}(+\text{high})$ , established in (27), which favors the insertion candidate, as shown in (29).  $\text{CRISP}(\sigma, [\text{high}])$  also dominates  $\text{DEP}(\text{high})$ , a ranking independently needed for [-high] transfer outcomes like the one in (27). The faithful form

$[\text{ori}]$ , in (29c), is ruled out by \*[-high], which also outranks  $\text{DEP}(\text{high})$ .

(29)  $\text{CRISP}(\sigma, [\text{high}]) \gg \text{LIC}(+\text{high}), \text{DEP}(\text{high}), *[-\text{high}] \gg \text{DEP}(\text{high})$

/o – ri/	$\text{CRISP}(\sigma, [\text{high}])$	*[-high]	$\text{LIC}(+\text{high})$	$\text{DEP}(\text{high})$
a. $\text{[u]_{+hi}[ri]_{+hi}}$			*	*
b. $[\text{uri}]_{+hi}$		*!		
c. $[\text{[o]_{-hi}[ri]_{+hi}}]$		*!		*

The ranking summary for Esimbi is given in (30). In broad strokes the failure of marked height features to remain in situ results from the domination of  $\text{IDENT-IO}(\text{high})$  and  $\text{LIC}(+\text{high})$  by  $\text{LIC}(-\text{high})$  and  $\text{CRISP}(\sigma, [\text{high}])$ , and the feature mobility stems from the supercedence of  $\text{IDENT}(\text{F})$  by  $\text{MAX}(\text{F})$ . The top tier of constraints also outranks  $\text{MAX}_{\text{Aft}}(\text{high})$  to produce the asymmetrical preservation of root features over affix ones. The reduced set of height contrasts in prefixes emerges from ranking \*[-high] between  $\text{MAX}_{\text{Rt}}(\text{high})$  and  $\text{MAX}_{\text{Aft}}(\text{high})$ . \*[-high] also dominates  $\text{DEP}(\text{high})$ , as does  $\text{CRISP}(\sigma, [\text{high}])$ .<sup>12</sup>

(30) Ranking summary

$\text{MAX}_{\text{Rt}}(\text{high})$	$\text{CRISP}(\sigma, [\text{hi}])$	$\text{LIC}(-\text{high})$
*[-high]	$\text{IDENT-IO}(\text{high})$	$\text{LIC}(+\text{high})$
$\text{DEP}(\text{high})$	$\text{MAX}_{\text{Aft}}(\text{high})$	

#### 4. Some typological consequences of $\text{IDENT}(\text{F})$ and $\text{MAX}(\text{F})$

The analysis developed in this work makes use of  $\text{IDENT}(\text{F})$  and  $\text{MAX}(\text{F})$  constraints. In this section I briefly examine some typological consequences for a theory that admits both types of featural faithfulness.

Let us consider the factorial ranking of  $\text{IDENT}(\text{F})$  and  $\text{MAX}(\text{F})$  together with a context-free markedness constraint \* $\alpha\text{F}$ . As sketched in (31), three kinds of outcomes result for an input containing two segments each linked to their own  $[\alpha\text{F}]$  specification. (Segment roots are symbolized by “S”.) First, if  $\text{MAX}(\text{F})$  outranks \* $\alpha\text{F}$ , a fully faithful mapping is optimal, as in (31a). There is reason to believe that this kind of structure occurs in language: a plausible instance is the case of articulatory trough patterns where contiguous identical vowel articulation are produced as separate events (e.g. English; Gafos 1996). A second outcome arises under the ranking  $\text{IDENT}(\text{F}) \gg * \alpha\text{F} \gg \text{MAX}(\text{F})$ . This hierarchy produces the cross-segmental feature linkage shown in (31b). In this configuration, output segments must be identical to their input specifications, but autosegments are minimized. This structure is frequent under OCP conditions and

<sup>12</sup> Because of space limits I do not address details of multiply-prefixed forms, multiple vowel roots and rare unprefixed forms here. See Walker (1997b) for discussion and analysis.

spreading. The third outcome arises under prioritization of \* $\alpha F$ . In this circumstance the result is neutralization to the least marked feature specification, labelled [βF] in (31c). This pattern is motivated for any (hypothetical) input that contains a marked feature specification not tolerated in outputs of the language.

- (31)
- a. Fully faithful mapping:  $\text{MAX}(F) \gg * \alpha F$  (IDENT(F) ranked anywhere)
- $$\begin{array}{c} S \\ | \\ \alpha F \end{array} \Rightarrow \begin{array}{c} S \\ | \\ \alpha F \end{array} \quad \begin{array}{c} S \\ | \\ \alpha F \end{array}$$
- b. Feature linkage/spreading:  $\text{IDENT}(F) \gg * \alpha F \gg \text{MAX}(F)$
- $$\begin{array}{c} S \\ | \\ \alpha F \end{array} \Rightarrow \begin{array}{c} S \\ | \\ \beta F \end{array} \quad \begin{array}{c} S \\ | \\ \alpha F \end{array}$$
- c. Neutralization to least marked specification: \* $\alpha F \gg \text{MAX}(F)$ , IDENT(F)
- $$\begin{array}{c} S \\ | \\ \alpha F \end{array} \Rightarrow \begin{array}{c} S \\ | \\ \beta F \end{array} \quad \begin{array}{c} S \\ | \\ \beta F \end{array} \quad \text{where } \alpha \neq \beta$$

The essential contribution of MAX(F) becomes apparent when faithfulness is combined with some kind of positional markedness constraint, such as \* $\alpha F/Y$ , which prohibits [αF] in position Y. If \* $\alpha F/Y$  and MAX(F) together outrank IDENT(F), the result is a feature shift, as in (32). This resembles the case of Esimbi, where αF is preserved to satisfy MAX, but it relocates to position X.

- (32) Featural shift:  $\text{MAX}(F)$ , \* $\alpha F/Y \gg \text{IDENT}(F)$
- $$\begin{array}{c} X \\ | \\ \alpha F \end{array} \Rightarrow \begin{array}{c} X \\ | \\ \alpha F \end{array} \quad \begin{array}{c} Y \\ | \\ \alpha F \end{array}$$

The following is a short assessment of the issues. MAX(F) is well-recognized as necessary for floating features. It is also motivated for cases involving feature transfer.<sup>13</sup> These are both instances where features are preserved independent of faithfulness to an input sponsoring node. (See also other work supporting featural faithfulness cited in §3.2.) The work of IDENT(F) is rather different: it mandates featural identity in corresponding segments and contributes to the avoidance of featural scrambling in outputs. The existence of two kinds of featural faithfulness is connected to the dual nature of features. On the one hand they are autosegmental elements with potential for independent manipulation, and on the other, they must be contained under a sponsoring root node in order to be properly incorporated into phonological structure. The outcomes illustrated in (31–32) suggest that admitting both IDENT(F) and MAX(F) in the theory does not produce outrageous results, though a more thorough typology

<sup>13</sup> In addition, MAX(F) obviates any need for covert structure in feature transfer languages (e.g. turbid representations; Goldrick & Smolensky 1999).

logical study is needed to verify this conclusion. A related interesting issue is the general rarity of featural transfer in language. While the potential for features to function independent of their root sponsor is evident from the cases noted above, feature shifts tend to be quite restricted. Further research in this area, taking into consideration limits on locality, will surely bring more insight to these matters.

## 5. Conclusion and issues for further research

In this paper I have argued that licensing requirements expressed as positional markedness constraints determine the special status of privileged positions in harmonies that guide features to strong targets—positional faithfulness is not sufficient to characterize these alternations. Such cases add to the accruing set of phenomena that necessitate positional markedness constraints (Zoll 1996, 1998). The account does not, however, deny the existence of positional faithfulness constraints. Indeed, a faithfulness constraint specific to roots is necessary for the analysis of Esimbi, and additional studies cited above have identified other patterns that support positional faithfulness. The conclusion that appears to be emerging from various threads of research is that both positional markedness constraints and positional faithfulness are warranted in the theory.

In the arena of featural faithfulness, this work has identified that MAX(F) plays a pivotal role in Esimbi height transfer—providing further evidence for the activity of [F]-correspondence constraints beyond cases of floating features. In Esimbi, the domination of IDENT(F) by MAX(F) and a licensing constraint is essential to producing the feature shift from root vowels to prefixes. The nature of the licensing condition contributes to what appear to be unusual root-affix asymmetries in the harmonies studied here. The word-initial site for licensing in Esimbi together with feature mobility and the language's prefixing structure obscures the fact that Root-Faith is prioritized. Yet preservation of root features is in fact emphasized in Esimbi, confirming the precedence of Root-Faith over Affix-Faith. In Veneto, the apparent preferential treatment of suffix features emerges in part from the need to license [high] affiliated with a weak position combined with a system that does not display root/stem dominance.

With respect to typology, this research has identified two kinds of height harmony involving licensing: one in which [-high] alone spreads and one in which licensing for [-high] is witnessed. In the latter case, the status of [+high] licensing is perhaps ambiguous; the analysis developed here suggests that licensing of [+high] is violable in Esimbi, and prefixal agreement with high-vowel roots is by default rather than spreading. To the best of my knowledge there yet remains to be identified a metaphony-type pattern in which a range of height contrasts originate in a strong target position in a root, and only marked non-high (affix) vowels trigger alternations. Such a harmony would resemble Veneto, except that mid vowels would induce lowering and be the sole triggers. Given that vowel harmonies targeting a strong position are not numerous, it is

difficult to assess whether the lack of this type of pattern is significant or represents an accidental gap. A related issue concerns the nature of the licensing condition in Veneto metaphony. The analysis developed here explores the possibility that this harmony involves an assimilation to the unmarked. The extent to which assimilations of this kind are observed across the feature spectrum has yet to be determined. It is interesting that despite their singular activity in assimilations of certain languages, unmarked features are often noted to be less active in various other assimilations. The theoretical understanding of these observations remains to be fully integrated. It might be the case that the concept of (un)markedness needs to be better elaborated (see Rice 1999a, b, Kager 2001). For example, in the case of metaphony, it could be explored whether any basis exists to suggest that [+high] in fact stands as a marked specification in final vowels. This may or may not prove viable. Nevertheless the issues surrounding markedness and the topology of licensing will surely continue to provide fruitful material for study.

#### Acknowledgments

For comments on this research thanks to Eric Baković, René Kager, Bruce Hayes, Joe Pater, Cathie Ringen, Donca Steriade, Christian Uffmann, Colin Wilson, Kie Zuraw, audiences at HILP 5 and UCLA, and students in the fall 2000 phonology seminar at USC.

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