Relational Markedness in Bantu Vowel Height Harmony

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1 Introduction

The idea that phonological grammars are sensitive to functional drives such as the minimization of articulatory effort and the maximization of acoustic contrastiveness has been advanced by numerous researchers (Lindblom 1986, 1990, Martinet 1952, 1955, to name a few). Flemming (1995) illustrates the interplay of these drives in deriving segmental inventories using constraints which make direct reference to contrastiveness and articulatory ease framed within Optimality Theory (Prince and Smolensky 1993). The central issue to be addressed in this paper is how these drives might be formalized so as to provide insight into the syntagmatic properties of active phonological processes in languages. I will provide an analysis of vowel harmonic phenomena in Bantu, claiming that the harmonic patterns can be derived via Correspondence Theoretic (McCarthy and Prince 1995, McCarthy 1996) instantiations of these drives. The crucial insight to be developed here is that the syntagmatic formalization of these drives represents a kind of 'relational markedness' which is quite distinct from more standard 'discrete' notions of markedness. In other words, relational markedness (RM) constraints will delimit the combinatory possibilities among various elements rather than describe the markedness of individual elements.

I will examine Vowel Height Harmony (VHH) in two Bantu languages: Shona, spoken in Zimbabwe, and Yaka, spoken in ex-Zaire. Beckman's (1998) positional faithfulness analysis of Shona VHH represents an archetypical instance of a discrete markedness approach in that she derives Shona VHH using a markedness hierarchy for individual vowel heights. I will argue that, while positional faithfulness does indeed play a role in Bantu VHH, the utilization of universal markedness hierarchies for individual vowel heights should be supplanted by a set of RM constraints on contrastiveness and ease of articulation. Utilization of RM constraints in the derivation of Bantu VHH will yield two prime advantages. First, utilization of RM constraints provides an explanation of *why* certain cross-linguistically marked or rare vowels should be dispreferred in some contexts. Second, and most crucially, a RM analysis will succeed in deriving VHH in Yaka where an analysis based on universal height markedness hierarchies fails. Furthermore, the RM analysis will account for the contrast between the VHH in Shona

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and Yaka through minimal constraint reranking, thus providing a unified analysis of two different types of vowel height harmony in Bantu.

In section 2 I give data illustrating the properties of VHH in Shona. Section 3 reviews Beckman's (1998) analysis of Shona VHH. Section 4 contains a discussion of the explanatory inadequacy of universal height markedness scales. In section 5 I propose an alternative, RM-based approach to VHH. In section 6 I apply the constraints introduced in section 5 to Shona VHH. Section 7 shows that feature markedness hierarchies are incapable of capturing VHH in Yaka while relational markedness constraints are capable of capturing the differences between Shona and Yaka through minimal re-ranking. Finally, in section 8, I conclude with some remarks on the value of relational rather than discrete notions of markedness.

2 Bantu vowel height harmony

Vowel height harmony is ubiquitous among Bantu languages. Hyman (1997) states: "[T]he majority of an estimated 500+ Bantu languages exhibit some variant of a progressive harmony process by which vowels lower when preceded by an appropriate (lower) trigger." Most eastern Bantu languages, including Shona and Yaka, evidence an asymmetric form of VHH where round high vowels only lower to mid following round mid vowels.[1]

(1) VHH in Shona[2]: i → e / {e, o} __ u → o / o __

a.	son-er-a	'sew for'
	per-er-a	'end in'
	ip-ir-a	'be evil for'
	bvum-is-a	'make agree'
	vav-ir-a	'itch at'
b.	gobor	'uproot'
	bover	'collapse inwards'
	svetuk	'jump'

(2) VHH in polysyllabic roots:

tonhor-	'be cold'
kumbir-	'ask for'
pofomar-	'be blind'
fungat-	'embrace'
simuk-	'stand up'
nonok-	'dally, delay'
buruk-	'dismount'
findam-	'tangle (intr.)'

Vowel height harmony is evidenced in verbal extensions and suffixes combined with roots.

(3) Root + applicative extension:

pera	'end'	per-era	'end in'
tsveta	'stick'	tsvet-era	'stick to'
sona	'sew'	son-era	'sew for'
pona	'give birth'	pon-era	'give birth at'
ipa	'be evil'	ip-ira	'be evil for'
bata	'hold'	bat-ira	'hold for'

(4) Root + neuter extension:

gona	'be able'	gon-eka	'be feasible'
vereŋga	'count'	vereŋg-eka	'be numerable'
cheŋgeta	'keep'	cheŋget-eka	'get kept'
kiwira	'climb'	kiwir-ika	'easy to climb'
bvisa	'remove'	bvis-ika	'easy to remove'
tarisa	'look at'	taris-ika	'easy to look at'

[1] Throughout this paper I will essentially ignore the color asymmetry in the harmonic process. For a detailed analysis of this aspect of Bantu VHH see Riggle (1999).
[2] Data in this section from Beckman (1998); see references therein.

(5) <u>Root + perfective suffix</u>:

pota	'go round'	pot-erera	'go right round'
cheka	'cut'	chek-erera	'cut up small'
seka	'laugh'	sek-erera	'laugh on and on'
pinda	'pass'	pind-irira	'to pass right through'
ɓuɗa	'come out'	ɓuɗ-irira	'to come out well'

(6) <u>Root + causative suffix:</u>

tonda	'face'	tond-esa	'make to face'
shoŋga	'adorn self'	shoŋg-esa	'make adorn'
oma	'be dry'	om-esa	'cause to get dry
bvuma	'agree'	bvum-isa	'make agree'
shamba	'wash'	shamb-isa	'make wash'

3 A brief review of Beckman's analysis

Beckman makes numerous generalizations about Shona VHH, the following of which are relevant to the analysis at hand:

(7) a. The full range of vowels may occur in the initial syllable of the root.
b. The vowel [a] is inert with respect to harmony; all and only input [a] surface as [a].
c. Mid vowels may appear non-initially only if preceded by a mid vowel.
d. High vowels may appear non-initially if the vowel of the preceding syllable is high or low, but never if the preceding vowel is mid.

As one can see the generalizations given in (7) hold over the data presented in (2)-(6). Beckman derives these generalizations through several theoretical mechanisms. The central insight of Beckman's analysis is positional faithfulness, the principle that some faithfulness constraints indexed to prominent positions may be elevated in the constraint hierarchy of a given grammar. To capture generalization (7a), Beckman uses the following positional faithfulness constraint.

(8) **IDENT -σ_1 (high)**

Let β be an output segment in the root initial syllable, and α its input correspondent. If β is [γhigh], then α must be [γhigh].

"An output segment in -σ_1 and the input correspondent of that segment must have identical specifications for the feature [high]." (Beckman 1998: 66)

Beckman derives generalization (7b), the basic inert quality of low vowels, with the following:

(9) **IDENT (low)**

Let α be an input segment and β its output correspondent. If α is [γlow] then β must be [γlow].

"An input segment and its output correspondent must have identical specifications for the feature [low]." (Beckman 1998: 66)

The second major theoretical device that Beckman employs in her analysis of Shona is a set of markedness constraints on individual height features and the assumption that these markedness constraints form a universal scale. Through these mechanisms she derives generalizations (7c) and (7d). These constraints and their ranking are presented below:

(10) ***Mid:** Vowels specified as [-high, -low] are marked.
***Low:** Vowels specified as [-high, +low] are marked.
***High:** Vowels specified as [+high, -low] are marked.

(11) <u>Universal Height Markedness Hierarchy:</u> *MID >> *HIGH, *LOW

Ranking the positional faithfulness constraint above of the universal height markedness hierarchy yields the following results: mid vowels are highly marked and thus only surface when they can be linked to a mid vowel in the protected initial position. In other words, unless a medial vowel can link to the initial vowel, thereby avoiding markedness violations, only the relatively unmarked high vowels will surface. This is, in essence, an 'emergence of the unmarked' effect. The application of these constraints is presented in the following tableaux: (*HIGH, *MID, and *LOW are abbreviated *H, *M, *L.)

(12) Mid goes to high after an initial high.

ip + era	ID-σ_1 (high)	ID (low)	*M	*H	*L	ID (high)
a. i p i r a +hi +hi -lo -lo				**!	*	*
b. ☞ i p i r a Aperture +hi -lo				*	*	*
c. i p e r a +hi -hi -lo -lo			*!	*	*	
d. i p a r a +hi -hi -lo +lo		*!		*	**	
e. e p e r a Aperture -hi -lo	*!		*		*	*

(13) High goes to mid after an initial mid.

per + ira	ID-σ_1 (high)	ID (low)	*M	*H	*L	ID (high)
a. p e r a r a -hi -hi -lo +lo		*!	*		**	*
b. ☞ p e r e r a Aperture -hi -lo			*		*	*
c. p e r i r a -hi +hi -lo -lo			*	*!	*	
d. p e r e r a -hi -hi -lo -lo			**!		*	*
e. p i r i r a Aperture +hi -lo	*!			*	*	*

This analysis generates the observed pattern of VHH in Shona. We are, however, left with some questions. First, while this analysis does provide a description of Shona VHH, does it provide an explanation of the general phonological drives responsible for the harmony? And second, does the analysis extend to other similar patterns of VHH in Bantu? I will address these questions in sections 4 and 6 respectively. I will conclude that replacement of the universal height markedness hierarchy with a set of RM constraints not only yields an analysis with superior explanatory power but crucially allows extension of an analysis of Shona VHH to other Bantu languages.

4 On the explanatory inadequacy of universal height markedness hierarchies

Prince and Smolensky (1993) introduce the notion of capturing typological generalizations through universal constraint subhierarchies in OT, e.g. ONS >> NOCODA. Following this tactic, Beckman cites Crothers' (1978) and Disner's (1984) observations that the presence of mid vowels in an inventory implicates the presence of high and low vowels, while the converse is not true. It is this implicational relationship that leads Beckman to posit the markedness hierarchy in (11). While the markedness hierarchy *****MID>>*****HIGH,*LOW is surely an accurate description of a typological generalization it seems to lack much subtlety in dealing with active phonological processes. For example, given this markedness hierarchy the numerous cases of vowel reduction to schwa seem quite mysterious. Moreover, if we accept the premise that hesitation or default (epenthetic) vowels are selected from the least marked in the inventory of a given language we would incorrectly predict that mid vowels should never occur cross-linguistically as such. Most crucially given that this markedness ranking simply describes the observation that the presence of mid vowels implicates the presence of high/low vowels this ranking yields no *explanation* of the typological generalization on which it is based.

Looking at cross-linguistic typological distribution of vowel inventories in a framework such as Dispersion Theory (DT; Flemming 1995), the entailment of high/low vowels in the presence of mid vowels is attributed to competing constraints on dispersion of the inventory in the vowel space. That is, if there are only two vowel heights in a language they will be as far apart as possible. Within DT this typological distribution is not attributed to some inherent markedness of mid vowels but rather to the idea that *systems* composed of high and mid or low and mid are marked due to a lack of contrast in the inventory. In fact, we might assert that in terms of articulation mid vowels are the least marked in that they involve less effort. Conversely, in terms of contrastiveness, we might assert that mid vowels are the most marked due to their lack of distinctiveness from high and low vowels, but this markedness is fundamentally relational rather than discrete. Whether or not the dispersion theoretical analysis of vowel inventories is correct, the point stands that the entailment relation between the presence of mid and high/low vowels can be generated by a more articulated set of markedness constraints than those in the ranking *****MID>>*****HIGH,*LOW.

In the following section I will propose a set of relational markedness constraints designed to yield a more subtle and articulated explanation of the cross-linguistic markedness of mid vowels.

5 Relational Markedness

In this section I will develop an analysis of Shona VHH which does not utilize individual markedness for height features. Instead, I will attribute the harmonic patterns to the interaction of two competing drives. These are:

(14) a. Minimize the articulatory distinctiveness of the nuclei of adjacent syllables.
b. Maximize acoustic contrast or contour between the nuclei of adjacent syllables.

These drives are both quite plausibly grounded. First, the drive towards acoustic contour might be attributed to a basic perceptual drive towards contrastiveness and seen as an instantiation of the Obligatory Contour Principle (OCP; Leben 1973, Goldsmith 1976, McCarthy 1986). Second, the antagonistic drive towards featural similarity can be seen as a basic drive towards articulatory ease. Grounding phonological processes in functional drives is at the heart of Flemming's dispersion theoretical analysis of vowel inventories. The question at hand is how to apply these concepts such that they derive the combinatory possibilities evidenced in Bantu VHH. To this end I will use a correspondence theoretic set of constraints to delimit the possible relationship between elements. The basic idea is that the nuclei of adjacent syllables stand in a kind of correspondence relationship and as such grammars may impose constraints on how similar or dissimilar they must be.

Minimization of articulatory distinctiveness between the nuclei of adjacent syllables can be accomplished in several ways. Beckman's system achieves this effect in a tacit fashion by virtue of the fact that multiply linked representations will always fare better with respect to her discrete markedness constraints on vowel heights. Alternatively, Generalized Alignment-based analyses (McCarthy 1995) of harmony utilizing feature spreading like the one presented by Ní Chiosáin and Padgett (1995) achieve the minimization of articulatory distinctiveness by virtue of constraints like SPREAD which directly demand the multiple linking of features. For the purposes of this analysis I utilize a constraint I call EASE which simply demands that the nuclei of adjacent syllables have identical feature specifications.

(15) **EASE^{HT}** EASE OF HEIGHT TRANSITION-NUCLEUS
Let α be the feature specifications of the nucleus of some σ_x and β be the feature specifications of the nucleus of some σ_y, adjacent to σ_x. For each feature [F] $\in$ HEIGHT [3] if α is specified [γF] then β must be specified [γF].

Conversely, the drive towards perceptual contrastiveness yields a constraint which demands that contours between the nuclei of adjacent syllables be as large as possible. I call this constraint CONTOUR^{HT}.

(16) **CONTOUR^{HT}** HEIGHT-CONTOUR-NUCLEUS
Let α be the feature specifications of the nucleus of some σ_x and β be the feature specifications of the nucleus of some σ_y, adjacent to σ_x. For each feature [F] $\in$ HEIGHT if α is specified [γF] then β must **not** be specified [γF].

It is interesting to note that while EASE^{HT} and CONTOUR^{HT} are strictly antagonistic they are not each other's anti-constraints. Consider the hypothetical candidates in tableau (17). Illustrated are all possible pairs of vowels in a typical five vowel system.

[3] Note that the set of tongue height features and the set of features that make up the acoustic dimension of height are the same : {high, low, ATR}. I am using Padgett's (1995) formalization of Feature Class Theory (FCT) to make reference to these sets of features in the constraints above; cf. Padgett (1995) for detailed exposition of FCT.

(17)

$\sigma_x . \sigma_y$	CONTOUR^{HT}	EASE^{HT}
a . i		*
a . u		*
i . a		*
u . a		*
a . e	*	*
a . o	*	*
e . a	*	*
e . i	*	*
e. u	*	*
o . a	*	*
o . i	*	*
o . u	*	*
i . e	*	*
i . o	*	*
u . e	*	*
u . o	*	*
a . a	*	
e . e	*	
o . e	*	
e . o	*	
o . o	*	
i . i	*	
i . u	*	
u . i	*	
u . u	*	

Here we see that while every possible sequence of vowels violates either CONTOUR^{HT} or EASE^{HT} it is also the case that numerous possible candidates violate both. Considering the relationship between one of the oft-cited undesirable pairs of anti-constraints, IDENT and ANTI-IDENT, we see that the relationship between CONTOUR^{HT} and EASE^{HT} is importantly different. With constraints like IDENT and ANTI-IDENT it is the case that every possible input → output mapping violates one or the other, but it is impossible to simultaneously violate both. As such the set of candidates which violate IDENT is complementary to the set of candidates which violate ANTI-IDENT and thus they are true anti-constraints. Since there are candidates which violate both CONTOUR^{HT} and EASE^{HT} the sets of possible candidates which violate them are non-complementary. Thus CONTOUR^{HT} and EASE^{HT} are not each other's anti-constraints.

Examining the candidates in (17) we see that the interaction of these RM constraints will have many of the same effects as classical formulations of the OCP. That is, in order to generate more harmonious surface strings we will see both assimilation and dissimilation. Like the assimilation generated by the multiple linking of candidates in autosegmental OCP analyses, we will generate assimilation simply through the dominance of EASE^{HT}. On the other hand, CONTOUR^{HT} simply bans identically specified nuclei in adjacent syllables and thus forces dissimilation. This is quite in line with proposals that the OCP might be formalized as a constraint under which "a sequence of identical elements within a tier is prohibited"(Pulleyblank 1996:330). In this sense this pair of RM constraints might be seen as a correspondence theoretic instantiation of the OCP. Worth noting here is that assimilation and dissimilation are achieved via exactly the same mechanisms and for the same reasons. Thus, it is no surprise that we should see harmonic patterns such as those in Shona which seem to vary between assimilation and dissimilation depending on the context of harmony. In other words, cases where we see both assimilation and dissimilation will arise from the interaction of CONTOUR^{HT} and EASE^{HT} with other constraints.

The prime advantage of deriving these patterns via relational rather than discrete markedness constraints is that this approach supplants the purely descriptive assertion of markedness of features as ubiquitous as [high] and [low] with an explanation of why certain feature combinations should be dispreferred in certain contexts. In other words, derivation of OCP effects by constraints which demand contrastiveness or contour between elements explains the drives behind these processes. The incorporation of a relational notion of markedness represents a departure from the classical discrete markedness constraints of Optimality Theory. However, it is worth noting that relational faithfulness constraints have been in use for some time. For example, the constraints CONTIGUITY and LINEARITY are concerned with preserving relationships (adjacency and precedence respectively) between the input and the output without regard to the specific elements participating in these relationships.

6 A relational markedness based account of Shona VHH

Examining tableau (17) we see that any pair of nuclei in adjacent syllables that differ by exactly one height feature will violate both EASE^{HT} and CONTOUR^{HT}. Hyman (1997), in his analysis of Yaka, proposes a constraint called PLATEAU which marks some of the same height sequences.

(18) PLATEAU: *HM, *LM
Subsequent syllables with nuclei that are high then mid, or low then mid are marked.

In terms of the analysis presented here PLATEAU can be seen as a descriptive generalization of the effects of the interaction of the constraints CONTOUR^{HT} and EASE^{HT}.

One further theoretical refinement can be made before turning to the analysis of Shona. Rather than using IDENT(low) to ensure the inert quality of low vowels I will use the following constraint:

(19) IDENT (COLOR)
Let α be an input segment and β its output correspondent. For each [F] which is an element of the feature class denoted by COLOR, if α is [γF] then β must be [γF].

Since the feature class of COLOR is taken to be composed of the features {round, back} it is the case that [a] is distinct with respect to its color specifications form all other vowels in Shona and Yaka. In essence [a] is central, and given a highly ranked IDENT (COLOR) no input / output mapping will be permitted between the central [a] and the other vowels.

Shona vowel height harmony may be captured by ranking the RM constraints presented in (15) and (16) below the positional faithfulness constraint IDENT-σ_1 and the standard faithfulness type constraint IDENT (COLOR). This ranking is presented below:

(20) IDENT -σ_1 , IDENT (COLOR) >> EASE^{HT} >> CONTOUR^{HT} >> IDENT

Shona VHH is thus seen as the maximal satisfaction of the drive towards articulatory ease while remaining faithful to the initial syllable and input avoiding any input-output mapping between central and front/back vowels. Just in cases where all candidates which satisfy the highly ranked faithfulness constraints fare equally badly with respect to EASE^{HT} will we see the activity of the lower ranked antagonistic drive towards acoustic distinctiveness in the nuclei of adjacent syllables (CONTOUR^{HT}).

Given an input sequence with adjacent high and low vowels there will be no way to satisfy EASE^{HT} without violating the highly ranked IDENT (COLOR). Thus, in these cases the lower ranked CONTOUR^{HT} will choose the winner. Since adjacent high and low vowels do not violate CONTOUR^{HT}, input sequences /high, low/ or /low, high/ will always emerge as maximally faithful. This is exemplified in the following tableaux. (CONTOUR is abbreviated CNTR.)

(21) /ip+a/ ‘ be evil’

High followed by low.

ip-a	ID -σ_1	ID (CLR)	EASE^{HT}	CNTR^{HT}	ID
a. ☞ ipa			*		
b. ipi		*!		*	*
c. ipe		*!	*	*	*
d. api	*!	**	*		**
e. epe	*!	*		*	**

(22) /vav+ir+a/ ‘itch at’

Low followed by high.

vav-ir-a	ID -σ_1	ID (CLR)	EASE^{HT}	CNTR^{HT}	ID
a. ☞vavira			-*-*-	---	
b. vavara		*!	---	-*-*-	*
c. vavera			-*-*-	-*!-*-	*
d. vivira	*!	*	--*-	-*--	*
e. vevera	*!	*	--*-	-*-*-	**

In tableau (22) candidates (b), (d), and (e) all violate IDENT(COLOR) due to a change in the feature [back]; in the case of candidate (b) [i] has become [a], and in the cases of (d) and (e) [a] has become [i] and [e] respectively. Candidates (d) and (e) have also changed the feature specifications of the vowel in the initial syllable of the root thus violating IDENT-σ_1. The interesting comparison is between candidates (a) and (c) which obey the highly ranked faithfulness constraints. Since EASE^{HT} is violated by any pair of adjacent vowels which do not have identical height specifications, /a . i . a/ and /a . e . a/ both incur two violations, one for each relationship of non-identity. Thus, in this case the lower ranked CONTOUR^{HT} crucially determines the output. To make it easier to read the violations of the relational constraints I have used dashes to represent vowels in the candidates. Thus the space between each pair of dashes represents the relationship between a pair of nuclei. Each of these spaces may contain one violation if the relationship violates one of the relational markedness constraints.

Since any pair of vowels in the nuclei of adjacent syllables with the same height specifications satisfies the highly ranked EASE^{HT}, input sequences /high, high/, /low, low/ and /mid, mid/ will emerge as fully faithful. This is illustrated in the following tableaux:

(23) /simuk-/ ‘stand up’ High followed by high.

simuk	ID -σ_1	ID (CLR)	EASE^{HT}	CONTOUR^{HT}	ID
a. ☞ simuk			--	-*-	
b. simik		*!	--	-*-	*
c. simok			-*!-	-*-	*
d. samak	*!	**	--	-*-	**
e. simak		*!	-*-	--	*

(24) /bat+a/ ‘hold’

Low followed by low.

bat-a	ID -σ_1	ID (CLR)	EASE^{HT}	CNTR^{HT}	ID
a. ☞bata			--	-*-	
b. bati		*!	-*-	--	*
c. bate		*!	-*-	-*-	*
d. bita	*!	*	-*-	--	*

(25) /verer/ ‘move stealthily’

Mid followed by mid.

verer	ID -σ_1	ID (CLR)	EASE^{HT}	CNTR^{HT}	ID
a. ☞ verer			--	-*-	
b. virer	*!		-*-	-*-	*
c. varir	*!	*	-*-	--	**
d. verir			-*!-	-*-	*

Interesting cases arise when we consider input strings containing nuclei which differ in exactly one height feature and thus violate both CONTOUR[HT] and EASE[HT]. Considering the input sequence [mid, low] we see that IDENT (COLOR) and IDENT-σ_1 must dominate EASE[HT] because violations of the latter will be tolerated rather than changing the vowel of the root initial syllable or the color specifications of [a]. Unlike the forms considered in (21)-(25) perfect satisfaction of either RM constraint is simply not possible in (26) due to the high ranking of the faithfulness constraints.

(26) /per+a/ 'end'

Mid followed by low.

per-a	ID -σ_1	ID (CLR)	EASE[HT]	CONTOUR[HT]	ID
a. ☞ pera			-*-	-*-	
b. pere		*!	--	-*-	*
c. para	*!	*	--	-*-	*
d. peri		*!	-*-	-*-	*
e. pira	*!		-*-	--	*

In the following tableaux I will consider hypothetical inputs where the suffixes are assumed to contain underlying mid vowels. I make this assumption in order to capture the robust generalization that mid vowels may not follow high or low vowels.[4] This is necessary following the Richness of the Base Hypothesis (Smolensky, 1997). The successful derivation of attested outputs in (27) and (28) nicely illustrates an important aspect of this analysis, namely that any attested output variant of a given suffix can be considered underlying and still yield the correct harmonic patterns.

(27) High followed by mid is not possible.

pind-erer-a	ID -σ_1	ID (CLR)	EASE[HT]	CNTR[HT]	ID
pinderera			-*!--*-	-*-*-*-	
pindirera			--*!-*-	-*-*-*-	*
☞pindirira			---*-	-*-*--	**
pindiriri		*!	----	-*-*-*-	***
penderera	*!		---*-	-*-*-*-	*

(28) Low followed by mid is not possible.

vav-erer-a	ID -σ_1	ID (CLR)	EASE[HT]	CNTR[HT]	ID
vaverera			-*--*-	-*-*!-*-	
vavirera			-*-*-*!-	--*-*-	*
☞vavirira			-*--*-	--*--	**
vavarara		*!*	----	-*-*-*-	**
veverera	*!		---*-	-*-*-*-	*

Consideration of trisyllabic inputs with an initial mid vowel and a final low vowel illustrates the crucial conflict between EASE[HT] and CONTOUR[HT]. In Shona the dominance of EASE[HT] results in harmony between the nuclei of the initial and medial syllable at the expense of good contrast (CONTOUR[HT]) with the nucleus of the final syllable. This crucial dominance relationship is boxed in the tableau below and will become relevant in the following section.

[4] Beckman (1998) claims that {e,o} following [i] are simply unattested in Shona. Hyman (1997) makes the same claim about Yaka.

(29)

per-ir-a	ID -σ_1	ID (CLR)	EASE^{HT}	CONTOUR^{HT}	ID
perira			-*-*!-	-*--	
☞perera			--*-	-*-*-	*
pirira	*!		--*-	-*--	*
perere		*!	---	-*-*-	**

The typologies predicted by these constraints are fairly straightforward. If we inverted the rankings of CONTOUR^{HT} and EASE^{HT} while keeping fixed the high ranked IDENT(COLOR), vowels surrounding the 'inert' [a] would become [e] rather than [i]. On the other hand, in grammars without a highly ranked IDENT(COLOR), inversion of CONTOUR^{HT} and EASE^{HT} would generate systems with total assimilation.

In this section I have illustrated that a RM analysis is capable of capturing all the descriptive generalizations about Shona VHH while offering a more articulated explanation of the harmonic patterns. The improvement in explanatory adequacy alone might not be reason enough to adopt the RM analysis. I will, however, show in the following section that a relational markedness analysis is desirable on empirical grounds as well as it will readily account for the VHH system of Yaka and the contrast between Shona and Yaka VHH through minimal re-ranking of constraints.

7 The empirical failure of universal height markedness hierarchies

Vowel height harmony in Shona shows an interesting contrast with the VHH evidenced in Yaka. In both Shona and Yaka the full range of vowels may occur in the initial syllable of the root while the range of vowels that may occur in subsequent syllables is subject to restrictions. However, the conditions that permit mid vowels word medially in Yaka are somewhat different from those present in Shona. Yaka is similar to Shona with respect to the behavior of root + perfective suffix in that, with the perfective suffix, medial mid vowels occur if and only if there is a mid vowel in the preceding syllable. This is illustrated in (30b.):

(30) a.	kik-idi	'barrer'	kin-ini	'danser'
	kud-idi	'chasser qqn'	kún-ini	'planter'
	kas-idi	'lier'	kan-ini	'proposer'
b.	keb-ele	'faire attention'	kém-ene	'gémir'
	sol-ele	'débioser'	són-ene	'colorer'

On the other hand VHH in Yaka departs from Shona VHH with respect to the common applicative, causative, and reversive verbal extensions. In these cases a mid vowel in the initial syllable will **not** license a mid vowel in subsequent syllables. This is illustrated in (31), which contrasts with the Shona forms in (32).

(31) Yaka: root + verbal extension + final vowel

a. Applicative -*il*-		b. Causative -*is*-	
kik-il-a	'barrer pour'	kik-is-a	'faire barrer'
kud-il-a	'chasser pour'	kud-is-a	'faire chasser'
kas-il-a	'lier pour'	kas-is-a	'faire lier'
keb-il-a	'faire attention pour'	keb-is-a	'faire attention'
sol-il-a	'déboiser pour'	sol-is-a	'fare déboiser'

c. Reversive intransitive -*uk*-		d. Reversive intransitive -*ul*-	
zib-uk-a	'être ouvert'	zib-ul-a	'ouvrir'
hul-uk-a	'être sauvé'	hul-ul-a	'sauver'
bal-uk-a	'être renversé'	bal-ul-a	'renverser'
yek-uk-a	'être séparé'	yek-ul-a	'séparer'
tob-uk-a	'être percé'	tob-ul-a	'percer'

(32) Shona: root + causative

om-es-a	'cause to get dry'
bvum-is-a	'make agree'
shamb-is-a	'make wash'
pamk-is-a	'make do again'
cheyam-is-a	'make be twisted'
tond-es-a	'make to face'
shoŋg-es-a	'make adorn'

Unfortunately, derivation of the attested output pattern in Yaka is all but impossible under a system relying on universal height markedness hierarchies. Consider the form /keb-is-a/ in Beckman's system:

(33)

keb-is-a	ID-σ_1 (high)	ID (low)	*M	*H	*L	ID (high)
a. ☹ k e b i s a -hi +hi -hi -lo -lo +lo			*!	*	*	
b. 💣 k e b e s a Aperture -hi -hi -lo +lo			*		*	*
c. k e b e s e -hi -hi -hi -lo -lo -lo		*!	***			*
d. k i b i s a +hi +hi -hi -lo -lo +lo	*!			**	*	*

☹Desired winner fails.

💣Incorrectly generated form.

The problem in tableau (33) is that no reranking of the markedness constraints will yield the attested output.[5] We could 'morphologize' the constraints such that they apply differently to the different suffixes. However, avoidance of this tactic will produce a more unified account of VHH in Yaka.

A system employing relational markedness is capable of generating the contrast between Yaka and Shona through minimal re-ranking of constraints without recourse to morphological 'tagging' of constraints within Yaka. In tableau (34) I have applied the RM ranking for Shona to data from Yaka. We see that the Shona ranking incorrectly

[5] Elevating the faithfulness IDENT(high) above the markedness constraints would predict the correct winner in this form. This would, however, render the analysis crucially dependent on assumptions about the input at odds with the Richness of the Base hypothesis.

predicts candidate (b) as the winner. However, inverting the ranking of EASE^{HT} and CONTOUR^{HT} generates the correct output for Yaka, as illustrated in (35).

(34)

keb-is-a	ID -σ_1	ID (CLR)	EASE^{HT}	CNTR^{HT}	ID
a. ☹kebisa			-*-*!-	-*--	
b. 💣kebesa			--*-	-*-*-	*
c. kibisa	*!		--*-	-*--	*
d. kebese		*!	---	-*-*-	**

(35)

keb-is-a	ID -σ_1	ID (CLR)	CNTR^{HT}	EASE^{HT}	ID
a. ☞kebisa			-*--	-*-*-	
b. kebesa			-*-*!-	--*-	*
c. kibisa	*!		-*--	--*-	*
d. kebese		*!	-*-*-	---	**

In the case of the perfective suffix there is no final [-a] to drive CONTOUR^{HT}. Thus, with no motivation to satisfy CONTOUR^{HT} the effects of EASE^{HT} will generate the same pattern of harmony in both languages regardless of the relative rankings of the RM constraints. For example /keb-ile/ will emerge as [kebele] in both Shona and Yaka.

There is one further set of forms which bears consideration. Interestingly, although the perfective and applicative suffixes systematically fail to harmonize when preceding the final vowel morpheme [-a], when they appear between a root and the perfective suffix they harmonize in the typical pattern.(Hyman 1997) For example we see input-output mappings like: /kel-um-uk-ine/ $\rightarrow$ [kelomokene]. Felicitously, this is exactly what is expected under the RM analysis given. Since these forms begin with a mid vowel there will be no way to satisfy CONTOUR^{HT} without violating both highly ranked faithfulness constraints. Furthermore, since there is no immutable final [-a], perfect satisfaction of EASE^{HT} will be possible without violating either highly ranked faithfulness constraint. Thus, in just this case EASE^{HT} will crucially select as optimal the form with total height harmony throughout. This is illustrated in (36).

(36) /kel-umuk-ine/ 'faire volteface'

kel-um-uk-ine	IDENT -σ_1	ID(COLOR)	CONTOUR^{HT}	EASE^{HT}	IDENT
a. kelumukine			-*-*-*-*-	-*!---*-	
b. kelomukine			-*-*-*-*-	--*!--*-	*
c. kelomokine			-*-*-*-*-	---*!-*-	**
d. ☞kelomokene			-*-*-*-*-	-----	***
e. kilamukani	*!	**	-----	-*-*-*-*-	****
f. kilumukini	*!		-*-*-*-*-	-----	**

This is certainly the *coup de grace* for the hypothesis that harmony in Yaka is simply morphologically conditioned so as to apply only to the perfective suffix. It illustrates quite nicely the flexibility and subtlety of analysis that is afforded by RM .

8 Conclusions

In this paper I have argued for the utility of Relational Markedness constraints. I have shown that interaction of the RM constraints CONTOUR^{HT} and EASE^{HT} yields a more articulated explanation of the cross-linguistic typological markedness of mid vowels. Furthermore, I have shown that CONTOUR^{HT} and EASE^{HT} succeed where universal height markedness hierarchies fail. Not only are they capable of capturing Yaka VHH but they will also generate the contrast between Shona and Yaka through minimal re-ranking. Finally, RM provides a unified analysis of assimilatory and dissimilatory processes as the means of satisfying basic phonological drives.

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