Balantak metathesis and theories of possible repair in Optimality Theory

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Joe Pater, University of Massachusetts, Amherst

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1. Introduction

The second person singular possessive suffix in Balantak (Busenitz and Busenitz 1991) displays total vowel assimilation between adjacent vowels, and across a glottal stop:

(1)	a. /tama + Vm/	→	[tamaam]	'your father'
	b. /tambu + Vm/	→	[tambuum]	'your green beans'
	c. /aleʔ + Vm/	→	[aleʔem]	'your garden'
	d. /bakokoʔ + Vm/	→	[bakokoʔom]	'your knife'

When an oral stop occurs stem finally, it metathesizes with the suffixal vowel, and assimilation occurs between adjacent elements. The nasal of the suffix is concomitantly lost due to a prohibition against coda clusters.

(2)	a. /sarat + Vm/	→	[saraat]	'your foot'
	b. /popurun + Vm/	→	[popuruun]	'your sago'

Given that oral consonants often block total vowel assimilation (Aoki 1968, Steriade 1987), this case of metathesis can be analyzed as serving to allow assimilation to apply unimpeded (cf. Broselow 2001). In terms of Optimality Theory, both the constraint driving assimilation and the constraint blocking assimilation across an oral consonant are satisfied, at the cost of violating faithfulness constraints against segmental metathesis and deletion. With the relevant assimilation constraint (expositorily ASSIM) and the constraint against trans-oral assimilation (BLOCK) ranked above the anti-metathesis and anti-deletion constraints (SEGFAITH), this pattern is produced. Failed candidate (3b) is an instance of trans-oral assimilation, and candidate (3c) is an instance of non-assimilation, with a default vowel surfacing (here schwa) instead of an assimilated one.

(3)

/sarat + Vm/	ASSIM	BLOCK	SEGFAITH
a. ☞ saraat			* *
b. saratam		*!	
c. saratəm	*!		

Systems like that of Balantak are in fact expected under factorial typology. Analyses of vowel assimilation in Optimality Theory have focused on candidates like those in (3b) and (3c), showing how permuting the ranking of instantiations of 'ASSIM' and 'BLOCK' yields various patterns of assimilation and blocking (e.g. McCarthy 1994, Gafos 1996, Ní Chiosáin and Padgett 1997, Walker 1998, Gafos and Lombardi 1999, Bakovic and Wilson 2001). Implicit in these analyses is that the faithfulness constraints against rearrangement of the segmental string cannot be violated to satisfy ASSIM and BLOCK, presumably because SEGFAITH ranks above those constraints. Under standard assumptions, this ranking is a language particular choice, and we would expect to find systems in which SEGFAITH falls beneath ASSIM and BLOCK, as in Balantak.

This is a good result, but it also points to a serious problem. While we now have one attested instance of SEGFAITH being violated to allow total vowel assimilation, there are no reports of parallel phenomena involving partial vowel assimilation, such as nasal harmony, rounding harmony or ATR harmony. In all of these cases, we find patterns of blocking and assimilation that can be, and have been, analyzed in terms of rankings of instantiations of ASSIM and BLOCK. Yet despite the sustained attention that partial vowel assimilation has received since the emergence of autosegmental phonology, not one case of a potential blocking segment being deleted or moved has been reported.

The challenge this raises for a restrictive theory of phonology is to allow total vowel assimilation to trigger metathesis and deletion, but to deprive partial vowel assimilation of the ability to do the same. This challenge is part of the more general problem of limiting the set of repairs that can be used to satisfy a given markedness constraint. Here I adopt perhaps the most obvious approach within an Optimality Theoretic framework, but one that has yet to receive much attention: that some faithfulness constraints are fixed in rank above some markedness constraints. Specifically, I claim that all constraints on segmental correspondence ("SEGCOR", which is intended to denote McCarthy and Prince's 1995, 1999 MAX, DEP, LINEARITY, UNIFORMITY, and INTEGRITY, but not IDENT) universally dominate all constraints driving vowel assimilation ("ASSIM", which is intended to denote the AGREE, SPREAD or ALIGNFEAT constraints):

(4) *Universal meta-ranking*
SEGCOR >> ASSIM

To produce movement or deletion of blockers, ASSIM must dominate SEGCOR as in (3), in contravention of this universal meta-ranking.

Under this view, total vowel assimilation in Balantak cannot be due to the same constraints that drive partial assimilation. In line with this, the analysis that I provide in section 2 treats Balantak vowel assimilation as filling an underlyingly empty prosodic position, rather than as satisfying constraints demanding featural identity between successive vowels. Treating Balantak total vowel assimilation as essentially a type of epenthesis receives support from the fact that truly epenthetic vowels also exhibit total assimilation. The analysis also deals with two related complications. First, blocking of trans-oral assimilation is not categorical in Balantak, since it occurs across stem-initial oral consonants (e.g. /mVŋ+bala/ → [mambala]). This is dealt with as an instance of positional faithfulness: a stem-initial LINEARITY constraint blocks metathesis across the left edge. Second, nasal-sonorant sequences, banned throughout Balantak, are resolved by deletion when the prefix has a fixed vowel (e.g. /saŋ+wuras/ → [sawuras]), but by epenthesis when the prefix has an assimilating vowel (e.g. /mVŋ+wawau/ → [maŋawawau]). The initially puzzling limitation of epenthesis to assimilating prefixes falls out straightforwardly from the analysis of prefixal trans-oral vowel copy.

Following the analysis of Balantak, I flesh out the fixed ranking analysis of the typology of possible repairs. I use this approach to deal with two instances of impossible repair: the absence of segmental movement and deletion as repairs for violations of constraints causing partial assimilation, and for the absence of epenthesis as a repair for *NC̥, a constraint against nasal-voiceless obstruent sequences. I then discuss an alternative approach to the typology of possible repair in OT: targeted constraints (Wilson 2001), and show that it faces difficulties in capturing these typological gaps.

2. Balantak vowel assimilation

2.1 Analytic preliminaries

In this analysis, total vowel assimilation in Balantak results from the need to fill a prosodic position that has no underlying segmental content. I will assume that the position is a bare mora, unspecified for segmental content. Underlying representations for a suffix and a prefix with assimilating vowels are as in (5a) and (5b).

(5) a. /μm/ b. /mμŋ/

I will further assume that an unfilled mora is universally ill-formed at surface structure; for MAX-μ (6a) to be satisfied the mora must be linked to a vowel.[1] The adoption of an adjacent vowel's features, rather than default features, is forced by DEP-V (6b), a constraint that bans the insertion of a non-underlying vowel melody. These and all other faithfulness constraints are based on the correspondence theory of McCarthy and Prince (1995, 1999).

(6) a. MAX-μ Input moras must have Output correspondents
b. DEP-V Output vowels must have Input correspondents

I take the constraints in (6) to be undominated in Balantak. There are two ways that they can be satisfied, through analogues of spreading and copying (cf. Kitto and de Lacy 2000). In (7a), a "spreading" Input-Output mapping appears; here two prosodic positions share a single segmental melody. In a "copying" mapping (7b), on the other hand, the underlying segmental melody has two output correspondents.

(7) **'Spreading' and 'copying' mappings**

```
a. /μ + μ/ →  [μ    μ]
    |          \   /
    a            a

b. /μ + μ/ →  [μ    μ]
    |          |    |
    a1         a1   a1
```

The mapping in (7b) violates the following constraint (McCarthy and Prince 1995, 1999), and will thus be chosen over (7a) only under compulsion of higher ranked constraints:

(8) INTEGRITY: No Input element has multiple Output correspondents

In the sections that follow, I will argue for an analysis of Balantak in which the melodic material is provided to the suffix through spreading, and to the prefix through copying.

2.2 Suffixal alternations

The following is a fuller set of data to illustrate the alternations involving the suffix -*Vm*. Its basic form occurs with stems ending in vowels (9a-e) or glottals (9f-h). When the

stem-final consonant has an oral place of articulation (9i-m), it metathesizes with the vowel of the suffix. The nasal is lost in these cases as well, presumably in order to avoid creating a coda cluster, which are not allowed in Balantak.

(9)	a. /tama+Vm/	→	[tamaam]	'your father'
	b. /tambue+Vm/	→	[tambueem]	'your green beans'
	c. /kopi+Vm/	→	[kopiim]	'your coffee'
	d. /tigo+Vm/	→	[tigoom]	'your tobacco'
	e. /apu+Vm/	→	[apuum]	'your fire'
	f. /aleʔ+Vm/	→	[aleʔem]	'your garden'
	g. /bakokoʔ+Vm/	→	[bakokoʔom]	'your knife'
	h. /oriiʔ+Vm/	→	[oriiʔim]	'your poles'
	i. /sarat+Vm/	→	[saraat]	'your foot'
	j. /popurun+Vm/	→	[popuruun]	'your sago'
	k. /wewer+Vm/	→	[weweer]	'your lips'
	l. /witis+Vm/	→	[witiis]	'your calf-of-leg'
	m. /suap+on+Vm/	→	[suapoon]	'burned by you'

A cross-linguistically common pattern is for total vowel assimilation to apply only across glottals, and for it to be blocked by intervening oral consonants (Aoki 1968, Steriade 1987, Gafos and Lombardi 1999). Following Gafos and Lombardi (1999) (see also McCarthy 1994, Gafos 1996, Ní Chiosáin and Padgett 1997), I derive blocking by assuming that the intervening consonant participates in V-to-V linkage, so that a featural co-occurrence constraint can be invoked to determine which consonants can intervene.[2]

(10) **Cross-consonantal spreading configurations**

a. o k o b. o ʔ o

V-FEAT V-FEAT

In (10a), an oral consonant bears vowel features, in contravention of the following constraint (see Gafos and Lombardi 1999 for a more fine-grained approach that derives a typology of possible blockers):

(11) *C/VFEAT
Oral consonants are not specified for vocalic features

With this much in hand, the Balantak pattern of metathesis and deletion can be straightforwardly produced by having *C/VFEAT rank above the faithfulness constraints LINEARITY ("no metathesis") and MAX-C ("no deletion"). The constraints are defined in (12) and (13), and (14) provides a tableau showing the outcome of this ranking for a root ending in an oral consonant.[3]

(12) LINEARITY
The precedence relation of Input elements must be maintained in the Output

(13) MAX-C
Input consonants must have Output correspondents

(14)

	$sara_1t_2+\mu_3m_4$	*C/VFEAT	LINEARITY	MAX-C
a. ☞	$sara_1a_3t_2$		*	*
b.	$sara_1t_2a_3m_4$	*!		

When the root ends in a glottal or a vowel, *C/VFEAT is not at issue, and the lower ranked faithfulness constraints choose ordinary suffixation:

(15)

	$ale_1ʔ_2+\mu_3m_4$	*C/VFEAT	LINEARITY	MAX-C
a.	$ale_1e_3ʔ_2$		* !	* (!)
b. ☞	$ale_1ʔ_2e_3m_4$			

Violation of *C/VFEAT, as well as LINEARITY and MAX-C, would be avoided if copying, rather than spreading were employed. This would lead to the wrong outcome for roots ending in an oral consonant; the tableau in (16) shows that INTEGRITY must dominate LINEARITY and MAX-C. The subscripting '$a_{1,3}$' on the assimilating vowel in (16b) indicates that it is in correspondence with the underlying suffixal mora, and with the melodic content of the stem-final vowel. That is, it indicates copying, as in (7b).

(16)

	$sara_1t_2+\mu_3m_4$	INTEGRITY	LINEARITY	MAX-C
a. ☞	$sara_1a_3t_2$		*	*
b.	$sara_1t_2a_{1,3}m_4$	*!		

2.3 Prefixation

The verbal prefixes *mVŋ-, nVŋ-*, and *pVŋ-* also undergo total vowel assimilation, which in this case does regularly traverse oral consonants:

(17)	a. /mVŋ+bala/	→	[mambala]	'to fence'
	b. /mVŋ+keke/	→	[meŋkeke]	'to dig'
	c. /mVŋ+goop/	→	[moŋgoop]	'to suck'
	d. /nVŋ+tete/	→	[nentete]	'to signal'
	e. /nVŋ+tuluŋ/	→	[nuntuluŋ]	'to help'

Broselow (2001) points to examples like these to argue that a ban on trans-oral spreading cannot be responsible for suffixal metathesis. In the context of Optimality Theory, in which constraint ranking leads to nonuniform constraint activity, this argument is not conclusive. There is no reason that the constraint against trans-oral spreading could not be active in driving metathesis in the context of suffixation, yet be violated in the context of prefixation. However, it does remain to be shown that the intervention of well-motivated constraints can derive the prefix/suffix difference.

Root-initial position is a psycholinguistically prominent position and hence regularly a target of positional faithfulness constraints (see e.g. Casali 1997, Beckman 1998, Smith 2002). Thus, positional faithfulness is a likely cause of the prefix/suffix asymmetry. I assume the following constraint is at work:

(18) LINEARITY(ROOT-INITIAL)
The Input precedence relation between the root initial segment and other segments must be maintained in the Output

If metathesis applied between the prefix and root, this constraint would be violated. In (19a), we have the failed candidate Input-Output mapping that undergoes root-initial metathesis to satisfy *C/VFEAT. If we examine the ordering of the numeric subscripts indicating the Input-Output correspondence relation, 1 precedes 3 in the Input, but 1 does not precede 3 in the Output. In the optimal Input-Output mapping, shown in (19b), all Input precedence relations are maintained (new ones are also added, but I take this to be irrelevant for LINEARITY)

(19) a. /mμ$_1$ŋ$_2$+b$_3$a$_4$la/ → *[m$_2$b$_3$a$_1$a$_4$la]
b. /mμ$_1$ŋ$_2$+b$_3$a$_4$la/ → [ma$_{1,4}$ŋ$_2$b$_3$a$_4$la]

With this constraint ranked above INTEGRITY, vowel copy is chosen for prefixes instead of metathesis and strictly local spreading:

(20)

	mμ$_1$ŋ$_2$+b$_3$a$_4$la	LIN(ROOT-INI)	INTEGRITY	LINEARITY
a. ☞	ma$_{1,4}$m$_2$b$_3$a$_4$la		*	
b.	m$_2$b$_3$a$_1$a$_4$la	*!		*

Spreading across the oral consonant is ruled out by *C/VFEAT being ranked above INTEGRITY (*C/VFEAT is violated by both of the intervening consonants):

(21)

	mμ$_1$ŋ$_2$+b$_3$a$_4$la	*C/VFEAT	INTEGRITY
a. ☞	ma$_{1,4}$m$_2$b$_3$a$_4$la		*
b.	ma$_1$m$_2$b$_3$a$_4$la	* *!	

As this completes the analysis of assimilation, in (22) I combine all of the rankings motivated above into a single hierarchy:

(22) MAX-μ, DEP-V, *C/VFEAT, LINEARITY(ROOT-INITIAL) >> INTEGRITY >> MAX-C, LINEARITY

Before moving on to consider an alternative approach, I will briefly recap the analysis. Empty moras must receive an adjacent vowel's features due to undominated MAX-μ and DEP-V. Spreading generally occurs rather than copying due to the activity of INTEGRITY. Spreading across oral consonants, however, runs afoul of undominated *C/VFEAT. For suffixes, metathesis and deletion serve to allow spreading, since MAX-C and LINEARITY are dominated by the other constraints. For prefixes, the ranking of LINEARITY(ROOT-INITIAL) and *C/VFEAT above INTEGRITY leads to copying rather than spreading.

Given the data we have seen thus far, there is no reason that one could not assume that all vowel assimilation in Balantak is spreading, and that root-initial LINEARITY (STEM-INI) forces a violation of *C/VFEAT in initial position, rather than of INTEGRITY. In the next section, however, I show that the copy analysis of prefixal assimilation allows for an account of facts that seem recalcitrant under such a spreading account.

2.4 Assimilation licenses epenthesis

In section 2.2, we saw that total vowel assimilation plays a role in triggering metathesis and deletion. In this section, we see that it also is involved in triggering epenthesis. Morpheme-internally, Balantak has no nasal-sonorant sequences, and when these arise at a prefix-stem boundary, nasal deletion results:

(23)	a. /miŋ+noa/	→	[minoa]	'to breath'
	b. /niŋ+ŋoap/	→	[niŋoap]	'yawned'
	c. /toŋ+yooŋ/	→	[toyooŋ]	'unintentionally shake'
	d. /saŋ+wuras/	→	[sawuras]	'one seed'
	e. /saŋ+loloon/	→	[saloloon]	'one thousand'

When an assimilating prefix is added to a sonorant-initial stem, however, epenthesis occurs instead of deletion:

(24)	a. /mVŋ+wawau/	→	[maŋawawau]	'to do'
	b. /mVŋ+memel/	→	[meŋememel]	'to cool'
	c. /mVŋ+limbaŋ/	→	[miŋilimaŋ]	'to move'
	d. /mVŋ+roŋor/	→	[moŋoroŋor]	'to hear'
	e. /mVŋ+yuŋgot/	→	[muŋuyuŋgot]	'to shake'

Here we have an instance of a conspiracy between two processes in the satisfaction of a single target constraint (Kisseberth 1970), which is usually straightforwardly handled in Optimality Theory (see e.g. McCarthy 2002a: 95). It is not immediately apparent, however, why the occurrence of assimilation should license the presence of the epenthetic vowel. It is a nice outcome, therefore, that an account of the distribution of these two repairs falls out from the analysis of vowel assimilation provided above.

The prohibition against nasal-sonorant sequences is likely the result of a syllable contact restriction, which I state in terms of the relatively parochial constraint *N/SON:

(25) *N/SON
No nasal/sonorant sequences

The default preference for deletion over epenthesis is what our current hierarchy predicts. Like the assimilating vowels, epenthetic vowels will necessarily violate INTEGRITY in order to receive featural specification. Default feature insertion is ruled out by higher ranked DEP–V, and spreading by *C/VFEAT. Since deletion violates only MAX-C, it is the chosen repair:

(26)

	$sa_1ŋ_2+w_3u_4ras$	*N/SON	INTEGRITY	MAX-C
a.	$sa_1ŋ_2u_4w_3u_4ras$		*!	
b.	$sa_1ŋ_2w_3u_4ras$	*!		
c. ☞	$sa_1w_3u_4ras$			*

In the case of assimilating prefixes, violation of INTEGRITY with respect to the root-initial vowel is already forced by higher ranked constraints (DEP-V and root-initial LINEARITY; see (20)). Epenthesis incurs no extra violation of INTEGRITY since no additional underlying vowel has multiple correspondents, and it is therefore optimal:

(27)

	$mμ_1ŋ_2+w_3a_4wau$	*N/SON	INTEGRITY	MAX-C
a.	$ma_{1,4}w_3a_4wau$		*	* !
b.	$ma_{1,4}ŋ_2w_3a_4wau$	*!	*	
c. ☞	$ma_{1,4}ŋ_2a_4w_3a_4wau$		*	

It is unlikely that copying a vowel or consonant to satisfy one constraint always licenses extra copies of that vowel to satisfy another constraint, as it does here. This is due, presumably, to the fact that copying violates constraints other than INTEGRITY. For example, DEP-μ, a constraint against inserting prosodic positions, would be violated by the candidate in (27c), but not by the one in (27a) (note that neither candidate violates DEP-V, since the melodies are in correspondence with the underlying root-initial vowel). With DEP-μ ranked beneath MAX–C, candidate (27c) is optimal, as in Balantak. With the ranking reversed, parasitic copying would be banned, as it likely is in other languages.[4]

A similar analysis of the Balantak case is impossible if prefixal assimilation is ‘spreading’, since deletion would avoid accumulating violations of *C/VFEAT. In the

tableau in (28), a bomb appears beside the candidate that such an analysis would wrongly prefer. Both the nasal of the prefix and the root-initial consonant violate *C/VFEAT in (28c), while only the root-initial consonant violates the constraint in (28a). That *C/VFEAT is violated twice (28c) does not require it to be gradiently violable; a violation is incurred for each locus of violation (see McCarthy 2002b on the distinction between multiple loci of violation and gradience).

(28)

	$m\mu_1ŋ_2$+$w_3a_4$wau	*N/SON	*C/VFEAT	MAX-C
a. 💣	$ma_1w_3a_4$wau		*	*
b.	$ma_1ŋ_2w_3a_4$wau	*!	**	
c.	$ma_1ŋ_2a_5w_3a_4$wau		**!	

Besides supporting the specific proposal that prefixal assimilation is copying, rather than spreading, these cases of epenthesis lend credence to the general approach of treating total assimilation in Balantak as being due to the filling of a segmentally unspecified position, since the truly epenthetic vowels are also copies of the root-initial vowel.

2.5 Is Balantak metathesis really driven by assimilation?

There are of course other ways one might analyze the metathesis pattern in Balantak. The chief advantage of the present analysis is that metathesis is derived from constraints that are independently needed to produce the assimilation and blocking pattern across glottal and oral consonants in other languages. In Broselow's (2001) analysis, metathesis is driven by a constraint that requires the right edge of a stem to align with the right edge of a syllable, which prefers [saraat] to [sarataam] for underlying /sarat+Vm/. In addition, a syllable contact constraint is used to stop intervocalic consonants from being syllabified as codas, since if the stem-final [t] of [saraatam] were a coda, it would satisfy alignment. Glottals pattern differently in this account because they are prohibited from being onsets, which is in line with their absence word-initially, and with Busenitz and Busenitz's (1991) impressions of their syllabification. One argument against this analysis is that it requires a novel interpretation of syllable contact, which is usually held to apply between consonants, and not between a vowel and a subsequent consonant (see e.g. Hooper 1976, Murray and Vennemann 1983, Baertsch 2002, Gouskova 2002). Ultimately, however, the best way to decide between these analyses would be to study closely related languages, to see if the metathesis pattern is always accompanied by total vowel assimilation, or by

syllabification of glottals as codas. Unfortunately, according to Busenitz and Busenitz (1991), Balantak is the only member of its immediate language family that has been well described, and as far as I know, no other languages of Sulawesi have this pattern of metathesis.

3. Implications for theories of possible repair

3.1 The problem

In Balantak suffixal vowel assimilation, assimilation and blocking constraints are satisfied by changing the segmental makeup of the Input string through metathesis and deletion. This way of avoiding the violation of assimilation and blocking constraints is unattested, however, when assimilation is partial, rather than total. In this section, I discuss one particular example of such an unattested repair, deletion of opaque segments in nasal harmony, and consider how it can be accounted for in Optimality Theory.

Like total vowel assimilation, nasal harmony is also often blocked by a subset of intervening consonants. Walker (1998) analyzes the blocking patterns in terms of the interaction of a 'SPREAD' constraint, whose formulation is paraphrased in (29), with the fixed ranking of co-occurrence constraints in (30):

(29) SPREAD([+NASAL])
For any segment linked to a feature [+nasal], all other segments in the domain must be linked to that same instance of [+nasal] (violated by every unassociated segment)

(30) *NASOBSSTOP >> *NASFRICATIVE >> *NASLIQUID >> *NASGLIDE >> *NASVOWEL >> *NASSONSTOP

The tableau in (31) shows how the ranking of one of the blocking constraints, *NASGLIDE, above the assimilation constraint SPREAD([+NASAL]) stops assimilation from proceeding through a glide (as in Sundanese; Robins 1957):

(31)

¨ mawa	*NASGLIDE	SPREAD(NAS)
a. mãw̃ã	*!	
b. ☞ mãwa		**

The reverse ranking would yield a language in which glides participate in harmony, as in Malay (Onn 1976). However, both of these constraints could be satisfied by deleting the intervening consonant. This is the predicted outcome if MAX-C ranked beneath them:

(32)

¨ mawa	*NASGLIDE	SPREAD(NAS)	MAX-C
a. mãw̃ã	*!		
b. mãwa		**!	
c. ☞ mãã			*

Despite the considerable attention that the typology of nasal harmony has received in the phonological literature (e.g. Schourup 1973, Cohn 1987, Piggott 1992, Walker 1998), not a single case of this type has emerged. Similarly, other types of partial vowel harmony, such as ATR harmony and rounding harmony, never seem to dispose of blocking consonants or vowels through metathesis or deletion. One indication of the robustness of this generalization is that Walker's (1998) typological survey of nasal assimilation included 75 languages, and not one of these had a process like the one predicted by the ranking in (32) (Rachel Walker, p.c.).

To capture this asymmetry between total and partial vowel assimilation, the markedness constraint(s) driving total assimilation must be differentiated from those causing partial assimilation so that only the former can be satisfied when segmental movement or deletion occurs. The first step towards this goal has already been taken by providing an analysis of Balantak total vowel assimilation that relies on constraints demanding that a prosodic position be segmentally filled, rather than on the constraints demanding feature sharing or agreement that are responsible for other types of vowel assimilation. The second step is to deprive the feature sharing or agreement constraints of the ability to force deletion, as one of them does in (32), as well of the ability to force any other change to the number of segments or their order. In this section I will consider two approaches to this problem: imposition of a universally fixed ranking amongst constraints (cf. Prince and Smolensky 1993), and reformulation of the markedness constraints within the targeted constraint framework of Wilson (2001).

3.2 Fixed ranking of markedness and faithfulness constraints

When factorial typology overgenerates, one way to rein it in is through the imposition of universally fixed rankings, first introduced by Prince and Smolensky (1993) in their account of Berber syllabification. Some fixed rankings, like Prince and Smolensky's Peak/Margin sonority hierarchies, and Walker's (1998) nasal co-occurrence hierarchy in (30), involve rankings between markedness constraints, while others involve rankings between faithfulness constraints, as in McCarthy and Prince's (1994) Root-Faith >> Affix-Faith schema, and Kiparsky's (1994) ranking of faithfulness to non-coronals above faithfulness to coronals. Fixed rankings of both types are well-represented in the OT literature, along with constraints in stringency relationships, which cover similar, but not identical empirical ground (see e.g. Prince 1997, de Lacy 2002).[5]

For the case at hand, however, it is the ranking between a markedness constraint and a faithfulness constraint that must not be allowed to vary cross-linguistically. Such rankings have only been proposed in passing (Pater 1999: 319, Steriade 2001a: 242; see also Piggott 2002 in a somewhat different framework). Taking our example of nasal harmony, (33) provides the full factorial typology produced by the free ranking of representative assimilation, blocking, and segmental faithfulness constraints, along with the Output they would select for underlying /mawa/:

(33)

	Ranking	I: mawa	*Attested?*
a.	MAX-C >> *NASGLIDE >> SPREAD([+NASAL])	O: mãwa	Yes
b.	MAX-C >> SPREAD([+NASAL]) >> *NASGLIDE	O: mãw̃ã	Yes
c.	SPREAD([+NASAL]) >> MAX-C >> *NASGLIDE	O: mãw̃ã	Yes
d.	*NASGLIDE >> MAX-C >> SPREAD([+NASAL])	O: mãwa	Yes
e.	SPREAD([+NASAL]) >> *NASGLIDE >> MAX-C	O: mãã	No
f.	*NASGLIDE >> SPREAD([+NASAL]) >> MAX-C	O: mãã	No

Rankings (33a-d) produce the attested patterns in which glides either block or participate in harmony, while the rankings producing unattested results are those in (33e) and (33f). What these have in common is that MAX-C falls to the bottom of the hierarchy. To rule them out, MAX-C must universally dominate either SPREAD(+NASAL) or *NAS-GLIDE.[6] Fixed ranking of the markedness constraints will not help, since they are in opposite orders in (33e) and (33f). A fixed ranking of faithfulness constraints, which Steriade (2001b) uses to limit the set of possible repairs is also of no avail. Even with MAX-C

fixed in rank above IDENT(+NAS), if they both fell beneath the markedness constraints, deletion would still result:

(34)

¨ mawa	*NASGLIDE	SPREAD(NAS)	MAX-C	IDENT(NAS)
a. mãw̃ã	*!			***
b. mãwa		**!		*
c. ☞ mãã			*	**

Thus, it seems that a fixed faithfulness over markedness ranking, such as the one between SPREAD(+NASAL) and MAX-C in (35), is required:

(35) Fixed ranking: MAX-C >> SPREAD(+NASAL)

Since it appears that no partial vowel assimilation process ever leads to a disruption of the segmental (as opposed to featural) makeup of the Input string, this universal ranking should be generalized.

Constraints motivating vowel assimilation have been proposed to either require feature sharing between segments, as in Walker's (1998) SPREAD(+NASAL) constraint, or for adjacent segments to have the same value, as in Bakovic's (2000) AGREE formulation.[7] A choice between these is tangential to the present undertaking, so I will use "ASSIM" to stand for either one.[8]

For the faithfulness constraints, what is required is a rubric that includes the constraints on segmental correspondence in McCarthy and Prince's (1995, 1999) theory of faithfulness. I take SEGCOR to denote MAX, DEP, LINEARITY, UNIFORMITY, and INTEGRITY. Crucially, IDENT constraints, which require that segments in correspondence have identical featural values, fall outside the scope of this denotation.

(36) Generalized fixed ranking: SEGCOR >> ASSIM

With this ranking schema limiting factorial typology, only featural changes, and not segmental ones, can be commanded by the constraints driving partial assimilation processes.

Total vowel assimilation, which copies an entire segment, can use segmental deletion and metathesis to allow it to apply unimpeded, while partial vowel assimilation, which applies at the featural level, cannot force such changes. This suggests a

relationship between the representational level that the markedness constraint evaluates, and the type of change it can affect to the Input string. This observation, however, is unlikely to form the basis of a workable account of possible repairs, because there are instances in which the typology of possible repairs for a given constraint often crosscuts the segmental/featural divide. For instance, *NC̥, which militates against nasal/voiceless obstruent clusters, can be satisfied through deletion of the nasal or voicing of the obstruent, but not through epenthesis (Pater 1996, 1999, see further Myers 2002).[9] That is, one segmental change is allowed, but not another; a theory that limits repairs to a given representational level would have nothing to say about this. For nasal assimilation it seems that some featural changes, but not others, are allowed. Obviously, changing the nasal specification is possible, but as Piggott (2002) points out, debucallization is never used to render an opaque segment amenable to nasal spreading. Even though there are many languages in which glottal, but not oral stops, undergo nasalization, no language debuccalizes stops to permit spreading.[10]

In terms of the fixed ranking approach, cases like these can be handled by placing particular faithfulness constraints above markedness constraints: DEP-μ above *NC̥,[11] and IDENT-PLACE above NASASSIM. Thus, not only are there broad schemas like the one in (36), but there are also more parochial fixed rankings between particular markedness and faithfulness constraints.

3.3 Targeted constraints

Targeted constraints (Wilson 2001, see also Bakovic and Wilson 2000) have recently been proposed as a solution to the “too many repairs” problem. As such, they would appear to offer an alternative to fixed rankings as an account of the typological gaps addressed here.

Standard markedness constraints in Optimality Theory penalize a particular structure, and are satisfied by all candidates lacking that structure. Targeted constraints also penalize marked structures. However, they do so by placing a harmonic ordering between a candidate bearing that structure, and one specified candidate that lacks that structure (hypothesized to be the one that is the most perceptually similar to the dispreferred candidate). Returning to our example of nasal harmony, what we want is a constraint that compares only candidates in which the segmental string has been preserved intact. The constraint in (37) has that property.

(37) →NASASSIM
Candidate x' is preferred over x (x' > x) iff x' is exactly like x except that a segment adjacent to and to the right of a nasal segment has been changed from [-nasal] to [+nasal]

For an input like /mawa/, this constraint will place the harmonic orderings in (39a) on output candidates displaying varying degrees of assimilation. When combined, these yield harmonic ordering in (38b):

(38) a. mãw̃ã > mãw̃a, mãw̃a > mãwa, mãwa > mawa
b. mãw̃ã > mãw̃a > mãwa > mawa

As desired, →NASASSIM is silent on the candidate [mãã̃], which was problematic because it satisfied the SPREAD[+NASAL] constraint.

However, for [mãã̃] to be ruled out universally as a response to →NASASSIM, it must be the case that no constraint orders it above [mãw̃ã] (or above any of the other candidates displaying assimilation, if the ones higher in the ordering in (38b) are dispreferred by some other constraint). To see this, consider a putative constraint X, that does prefer [mãã̃] over [mãw̃ã]. Combining the ordering imposed by constraint X and the one in (38b) will result in that of (39):

(39) mãã̃ > mãw̃ã > mãw̃a > mãwa > mawa

The co-occurrence constraint *NASGLIDE would have exactly this effect, unless it is targeted as well (cf. Bakovic and Wilson 2000 on a targeted (+HI, -ATR) co-occurrence constraint):

(40) →*NASGLIDE
Candidate x' is preferred over x (x' > x) iff x' is exactly like x except that a glide is changed from [+nas] to [-nas]

This constraint will impose the following orderings:

(41) mãwã > mãw̃ã, mãwa > mãw̃a

Here we have introduced another candidate [mãwã], which is the one preferred over the fully assimilated [mãw̃ã] by a targeted *NASGLIDE constraint.

The orderings imposed by →*NASGLIDE and →NASASSIM conflict. →*NASGLIDE prefers [mãwã] over [mãw̃ã], while →NASASSIM will place the candidates in the reverse order; the same applies to [mãwa] and [mãw̃a]. As in standard Optimality Theory, ranking resolves conflict between constraints. A harmonic ordering is placed on the candidate set starting with the highest ranked constraint. Each subsequent constraint in the hierarchy also places its ordering on the candidate set, insofar as it does not conflict with orderings already imposed by higher ranked constraints. If →NASASSIM dominates →*NASGLIDE a fully assimilated candidate is chosen as optimal (e.g. mãw̃ã). As shown in (42), →NASASSIM first imposes its ordering on the candidate set, and →*NASGLIDE is blocked from imposing its own:

(42) →NASASSIM >> →*NASGLIDE

1. →NASASSIM:	mãw̃ã > mãw̃a > mãwa > mawa
	mãw̃ã > mãwã
2. →*NASGLIDE:	–
Cumulative ordering:	mãw̃ã > mãw̃a > mãwa > mawa
	mãw̃ã > mãwã

With the reverse ranking, [mãwã] and [mãwa] are at the top of their respective orderings, but nothing chooses between them:

(43) →*NASGLIDE >> →NASASSIM

1. →*NASGLIDE:	mãwã > mãw̃ã, mãwa > mãw̃a
2. →NASASSIM:	mãw̃ã > mãw̃a, mãwa > mawa
Cumulative ordering:	mãwã > mãw̃ã > mãw̃a
	mãwa > mãw̃a, mãwa > mawa

To produce the blocking pattern (e.g. [mãwa]), we need a constraint that will choose blocking over “transparency” (e.g. [mãwã]). The following “doubly conditioned assimilation” constraint can serve that purpose (see Bakovic and Wilson 2000 for a similar approach to blocking of ATR harmony):

(44) *NASORNAS
No Nasal-Oral-Nasal sequences

This constraint will prefer everything, including [mãwa], over [mãwã]. To get blocking to beat full assimilation, →*NASGLIDE must dominate *NASORNAS and →*NASASSIM, so that [mãwã] is ordered above [mãw̃ã] (either of the other constraints would prefer the reverse). *NASORNAS can then place the blocking candidate [mãwa] above [mãwã], which results in the blocking candidate being transitively ordered above [mãw̃ã]. The ranking between →NASASSIM and *NASORNAS appears to be indeterminate, but I have placed the constraints in a total order in (45) to illustrate one of the rankings that chooses the correct outcome:

(45) →*NASGLIDE >> →*NASASSIM >> *NASORNAS

1. →*NASGLIDE: mãwã > mãw̃ã, mãwa > mãw̃a
2. →NASASSIM: mãw̃ã > mãw̃a, mãwa > mawa
3. *NASORNAS mãwa > mãwã

Cumulative ordering: mãwa > mãwã > mãw̃ã > mãw̃a
mãwa > mawa

By creating targeted versions of *NASASSIM and *NASGLIDE, and by adding the *NASORNAS constraint, we have an account of nasal assimilation and blocking that does not produce the unattested deletion candidate through ranking permutation. There are some outstanding issues, however.

First, this approach makes the prediction that every assimilation process that has a set of opaque segments should have a related doubly conditioned assimilation process. Whether this is the case can only be substantiated through further research. Bakovic and Wilson (2000) do list a set of doubly conditioned assimilation processes, but conspicuously absent from that list is the one that would be produced by their constraint. Furthermore, the relationship between transparency and blocking is potentially problematic. Targeting the *NASGLIDE constraint as in (40) leads to the prediction that transparency should be optimal in some language, with that constraint ranked above *NASORNAS. This works well for the parallel *[+HI, -ATR] constraint in Bakovic and Wilson (2000), but glides and liquids are never transparent to nasal harmony, even though they can block or undergo it (Walker 1998: 21 ff.).

A more general, and serious, issue is the one raised for targeted constraint theory by McCarthy (to appear), and alluded to above. If [mãã] is never to be rendered optimal as an output for /mawa/ by →NASASSIM, then there must be no constraint in the universal

constraint set that prefers [mãã] to [mãw̃ã]. If there is, then →NASASSIM can be used to order [mãw̃ã] over the more faithful [mawa], and this other constraint can place [mãã] at the top of the ordering. For the small set of constraints under consideration, we eluded this difficulty by targeting the *NASGLIDE constraint, so that it did not prefer [mãã] over [mãw̃ã]. Another obvious worry is IDENT[NASAL] (McCarthy and Prince 1995, 1999), which is violated three times in [mãw̃ã], but only twice in [mãã]. If IDENT[NASAL] outranks MAX, [mãã] will be harmonically ordered above [mãw̃ã]:

(46) →NASASSIM >> IDENT[NASAL] >> MAX

1. →NASASSIM:	mãw̃ã > mãw̃a > mãwa > mawa
	mãw̃ã > mãwã
2. IDENT[NASAL]	mãã > mãw̃ã
3. MAX	–
Cumulative ordering:	mãã > mãw̃ã > mãw̃a > mãwa > mawa
	mãã > mãw̃ã > mãwã

It is perhaps conceivable that IDENT[NASAL] and other constraints could be formulated so that that they do not prefer the unattested outcome for this case, as well as for cluster reduction as discussed by Wilson (2001) and McCarthy (to appear). However, attempting to deal with the *NC̥ repair typology in this way points up some serious difficulties in pursuing this line of attack.[12]

Recall that *NC̥ is satisfied by post-nasal voicing and by nasal deletion, but not by epenthesis. That post-nasal voicing and nasal deletion are caused by the same constraint is highlighted by the fact that they can conspire to rid a language of NC̥ clusters. In Modern Greek (Newton 1972), post-nasal voicing (48a,c) applies except when the post-nasal obstruent is itself followed by a voiceless obstruent (a fricative). In this situation, nasal deletion applies instead (48b,d), thus avoiding voicing disagreement between obstruents, which is generally prohibited in Greek:[13]

(47)	a. /pemp+o/	[pembo]	'I send'
	b. /e+pemp+s+a/	[epepsa]	-aorist
	c. /ton#topo/	[tondopo]	'the place'
	d. /ton#psefti/	[topsefti]	'the liar' (Cypriot)

Conversely, the epenthesis gap is highlighted by the fact that epenthesis is well attested as a way of avoiding other types of marked cluster. In Balantak, we saw epenthesis used in concert with deletion to avoid nasal/sonorant clusters. Epenthesis can also be the sole repair in this circumstance, as in Begak, another western Austronesian language (Goudsward in prep.; see also Blust 1997 on Mukah Melanau). Similar to the well-known Indonesian/Malay paradigm, the Begak /məŋ-/ prefix fuses with voiceless obstruents (48a), and assimilates to voiced ones (48b). However, before sonorants, Begak employs epenthesis (48c), instead of deletion as in Indonesian:[14]

(48)	a.	/məŋ + tunu/	[mənunu]
		/məŋ + tinam/	[məninam]
		/məŋ + sawo/	[mənawo]
	b.	/məŋ + dippan/	[məndippan]
	c.	/məŋ + litoŋ/	[məŋəlitoŋ]
		/məŋ + riksaʔ/	[məŋəriksaʔ]

The challenge, then, is to allow *NC̥ to participate in driving post-nasal voicing and nasal deletion, but not epenthesis. Let us assume that post-nasal voicing is the repair picked out by the targeted constraint (cf. Steriade 2001b):

(49) →*NC̥

Candidate x' is preferred over x (x' > x) iff x' is exactly like x except that a segment following a nasal is changed from [-voice] to [+voice]

Given an Input /ampa/, this constraint places the following ordering on a candidate set that includes deletion, epenthesis, and post-nasal voicing as repairs:

(50) amba > ampa
aməpa, apa

Only [amba] and [ampa] are ordered with respect to each other; neither is ordered with respect to [aməpa] or [apa], and these last two are also unordered with respect to each other.

To get deletion as an outcome, we can invoke IDENT[VOICE] (McCarthy and Prince 1995, 1999):

(51) IDENT[VOICE]
Segments in correspondence are identical in [voice] specification

This constraint will order all other candidates over [amba]:

(52) aməpa, apa, ampa > amba

For →*NC̥ to have any effect, it must rank above IDENT[VOICE], since IDENT[VOICE] asserts the opposite ordering [ampa] > [amba]. IDENT[VOICE], however, does have an effect when ranked below →*NC̥, since it imposes orderings other than the one inconsistent with →*NC̥. In particular, it will order the deletion candidate and the epenthesis candidate above the post-nasal voicing candidate:

(53) →*NC̥ >> IDENT[VOICE]

1. →*NC̥:	amba > ampa
2. IDENT[VOICE]	aməpa, apa > amba
Cumulative ordering:	aməpa, apa > amba > ampa

For the deletion candidate [apa] to emerge as optimal, the anti-epenthesis constraint DEP must dominate the anti-deletion constraint MAX. In addition, MAX must rank beneath IDENT[VOICE], in order to maintain the preference for deletion over post-nasal voicing.

While we now have an account of deletion as a response to →*NC̥, the problem is that simple reranking of MAX and DEP will produce the unattested epenthetic outcome. Here, it is very difficult to see how one could reformulate the constraint so that it does not prefer the unattested repair: why should IDENT[VOICE] apply when the preceding consonant is deleted (so as to prefer [apa] over [amba]) but not when a preceding vowel is inserted (so as not to prefer [aməpa] over [amba])?

One might consider a targeted version of IDENT[VOICE] that only prefers an unaltered candidate (e.g. [ampa]) over one with a voicing change (e.g. [amba]). The result of targeting IDENT[VOICE] in this way is that the set of possible repairs becomes extremely limited; given the constraints we have considered, only post-nasal voicing is possible. →*NC̥ and →IDENT[VOICE] assert the opposite harmonic ordering of the two candidates [amba] and [ampa]. If →IDENT[VOICE] is ranked beneath →*NC̥, which it must be if an unfaithful mapping is to be produced, it will have no effect itself, as shown

in (54). Now, no matter where DEP and MAX are ranked, they will place [aməpa] and [apa] beneath [amba].

(54) →*NC̥ >> →IDENT[VOICE]

1. →*NC̥:	amba > ampa
2. →IDENT[VOICE]	-
Cumulative ordering:	amba > ampa
	aməpa, apa

Thus, if →IDENT[VOICE] is targeted in this way, post-nasal voicing will be the only repair for →*NC̥, which is not the result we want.

At this point, the theory begins to resemble that of Steriade (2001b), in which IDENT[VOICE] is placed in a fixed ranking beneath other faithfulness constraints. Both of these approaches seem to contend rather well with the observed typology for voicing assimilation between adjacent obstruents. As Steriade (2001b) emphasizes, change in voicing specification is the only repair for the constraint against voicing disagreement. AGREE[VOICE] (see e.g. Lombardi 1999) seems never to force deletion, epenthesis, or any featural change besides voice assimilation. Targeted IDENT[VOICE], along with a targeted AGREE[VOICE] constraint, would produce just this effect, as we have just seen it does with targeted *NC̥. Similarly, placing IDENT[VOICE] in a fixed ranking beneath all other faithfulness constraints results in voicing change being always preferred to any other faithfulness violation. These theories would also be successful in dealing with other cases in which only a single repair is used, such as nasal harmony.

The problem of course is how to account for cases of what McCarthy (2002a) calls heterogeneity of process, which form a fundamental argument for a constraint-based approach to phonology. The various ways that *NC̥ clusters can be avoided form a prototypical instance of this phenomenon. To deal with the range of repairs for *NC̥, Steriade (2001b) suggests that language learners can create lexically specific versions of faithfulness constraints that can subvert the fixed ranking, when prompted by evidence from the language being learned. For instance, in acquiring a language with deletion of nasals before voiceless obstruents, learners would create a lexically specific IDENT[VOICE] constraint that they would rank above MAX. This makes the interesting prediction that only the default repair will occur in the absence of such overt evidence, such as in language change and in loanword phonology, as well as in early stages of language learning. Steriade (2001b) in fact does provide loanword and language change

evidence for the default status of post-nasal voicing as a repair (though cf. Pater 1999 for a list of cases of *NC̥ nasal deletion in child language).

This account could be translated into targeted constraint theory by allowing learners to create language-particular constraints that place the required ordering on the candidate set (for instance, by ordering deletion over post-nasal voicing). However, there are two problems with the lexically-specific constraint approach to multiple repairs, and these would apply equally to this attempt to rescue the targeted constraints analysis constructed here. First, for constraints like *NC̥ that have multiple repairs, it fails to distinguish between possible and impossible repairs. If lexically specific IDENT[VOICE] can rank above MAX to produce *NC̥ deletion, then it should be able to rank above DEP to produce *NC̥ epenthesis. Second, it fails to distinguish between constraints that have multiple repairs, and those that only have a single repair, like AGREE[VOICE]. If a lexically specific IDENT[VOICE] constraint can produce *NC̥ deletion, then it should also be able to produce deletion as a response to AGREE[VOICE].

To sum up the discussion of targeted constraints, we have seen that it may be possible to account for the absence of deletion as a response to a constraint causing partial vowel assimilation by targeting constraints like NASASSIM. However, the success of this account relies on ensuring that no other constraints favor deletion over assimilation. To do so, we would need to target constraints like *NASGLIDE and IDENT[NASAL]. While this approach may work for markedness constraints that have but a single repair, it fails to deal with the *NC̥ repair typology, since there seems to be no way to target IDENT[VOICE] so that it favors deletion, but not epenthesis, over post-nasal voicing.

3.4 Fixed F>>M rankings: further issues

The discussion of the targeted constraint approach to repair typology raises several issues for fixed Faithfulness over Markedness rankings. First, one might wonder whether fixed rankings are also vulnerable to the effects of other constraints that prefer the unattested repair. For example, an anonymous reviewer suggests that a constraint demanding that words be minimally bisyllabic could produce epenthesis to avoid NC̥ clusters, even if DEP is fixed above *NC̥. However, the required sort of constraint interaction is impossible in standard OT with strict domination. If a MINWORD constraint ranks above DEP, epenthesis applies to all sub-minimal words, regardless of whether *NC̥ is also at issue. If DEP ranks above MINWORD, epenthesis is blocked across the board. No ranking

will produce epenthesis only when both *NC̥ and MINWORD are at stake. To do so would require a locally conjoined version of *NC̥ and MINWORD that is violated when both constraints are violated (Smolensky 1995), which could be ranked above DEP. Therefore, insofar as local conjunctions are permitted (cf. Padgett 2002), any fixed rankings referring to the component constraints must be preserved, so that, for example, DEP remains above "*NC̥&MINWORD".

Second, one might wonder whether fixed rankings can capture Wilson's (2001) generalization about the outcome of cluster reduction. Wilson (2001) points out that when an intervocalic cluster C_1C_2 is reduced to a singleton, the default pattern is for C_2 to be retained. Furthermore, while this pattern can be disrupted by differences in sonority or morphological affiliation of the two consonants, C_1 cannot be chosen over C_2 due to its being less marked in terms of its place of articulation or voicing (or any other context-free measure).

The basic default pattern can be straightforwardly captured by positional faithfulness, despite Wilson's arguments to the contrary. In all of the examples that Wilson considers, C_2 is in morpheme-initial position.[15] Thus, a positional MAX constraint, relativized to morpheme-initial position (Casali 1997), will prefer C_2 retention. Alternatively, CONTIGUITY (McCarthy and Prince 1999), relativized to the syllable (Lamontagne 1996, Pater 1997), would prefer C_2 retention for clusters between and within morphemes. The generalization that the pattern is not disrupted by preferences for unmarked voicing or place specification then requires that this positional faithfulness constraint be fixed in rank above context-free markedness constraints like *VOICE and *LABIAL.

A final issue concerns the functional grounding of FAITHFULNESS >> MARKEDNESS rankings. Here, it may be possible to borrow aspects of the proposals in Steriade (2001a,b) and Wilson (2001). McCarthy (2002a: 21) suggests that all universal hierarchies might be derived from natural scales of relative prominence, like sonority. The Faithfulness and Markedness constraints that have been placed in fixed rankings seem to stand in no inherent relationship, and certainly not one of prominence. A different sort of grounding for these fixed rankings, however, may be derived from the considerations of perceptual distance that Steriade (2001a,b) and Wilson (2001) invoke. In these approaches, a particular repair is preferred because it is closest perceptually to the unchanged input string. Instead of stating what is close enough perceptually, the fixed F >> M ranking could be taken to define what is *too far* perceptually to be considered as an alternative to violation of a given constraint.

4. Conclusions

Balantak provides a unique case in which assimilation and blocking constraints are satisfied by rearrangement of the segmental string. This can be captured straightforwardly by ranking segmental correspondence constraints beneath the assimilation and blocking constraints. The challenge this raises is to limit such repairs to total vowel assimilation, since partial vowel assimilation does not seem to be capable of driving a change to the segmental makeup of the string. Here I have considered two approaches to the problem: imposing a universal ranking of the segmental correspondence constraints above the constraints driving partial assimilation, and creating targeted versions of the assimilation constraints, and have argued that only the fixed ranking account seems to be adequate. However, regardless of whether one adopts fixed rankings, targeted constraints, or some other approach to repair typology, total vowel assimilation in Balantak must be formally distinguished from partial assimilation. This was accomplished in the analysis of Balantak by treating it as a means of providing a vocalic melody to an underlyingly unfilled prosodic slot.

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Notes

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[1] The mora could presumably also be attached to coda position in the Output. There appears to be no evidence for moraic codas in Balantak, so an undominated constraint could be invoked to rule out this possibility.

[2] Most the cited work forces the participation of the intervening consonant by stipulating that all spreading is strictly local. This view faces the challenge of accounting for transparency, and other apparent cases on non-locality. On transparency, see Walker (1998), Bakovic (2000), and Bakovic and Wilson (2001), and on long-distance assimilation, see Hannson (2001) and Rose and Walker (2001). The issue of whether all spreading is strictly local is ultimately somewhat tangential to this approach to blocking; one could also employ a violable constraint against non-local spreading to get the desired result that the intervening consonant participates.

[3] Under the present ranking, a candidate in which only the root-final consonant deletes would emerge as optimal. This candidate could be ruled out by invoking a root-specific version of MAX-C, which demands that all root consonants be preserved (see e.g. McCarthy and Prince 1995, Beckman 1998, Pater 1999 on root-specific faithfulness).

[4] Another approach would be to have gradient and non-gradient versions of INTEGRITY (see Buckley 1997 on gradient INTEGRITY; though cf. McCarthy 2002).

[5] Fixed rankings between markedness and faithfulness constraints, as proposed here, appear to resist a reformulation in terms of stringency.

[6] One advantage of having the assimilation constraint SPREAD(+NASAL), rather than the co-occurrence constraint *NAS-GLIDE, universally dominated by MAX-C, is that the latter would not rule out deletion of the triggering nasal (e.g. /mawa/ → [awa]).

[7] The literature on assimilation in Optimality Theory is quite large; Walker (1998) and Bakovic (2000) have extensive citations of earlier invocations of these types of constraint.

[8] Constraints requiring homorganicity between adjacent consonants do seem to induce segmental deletion, as well as assimilation, as de Lacy (2002) emphasizes. This could entail that such constraints are of a different formal family than the vowel assimilation constraints; it is also possible that a coda condition is at work (Ito 1989).

[9] The further unattested repairs Myers cites are metathesis and changing the voiceless obstruent to a sonorant. While these do remain to be dealt with, they seem somewhat less worrisome than the epenthesis gap. First, it is possible that these repairs are a sort of "overkill" (McCarthy 2002a:113); metathesis may be harmonically bound by fusion, and sonorantization by post-nasal voicing. Second, these repairs are themselves rare, so their absence from the NC̥ typology is less unexpected than that of epenthesis. And finally, allomorphic NC̥ metathesis is documented in Steriade (2001b).

[10] Further research is needed to determine exactly which featural changes are allowed. Segments can be altered in some ways to allow assimilation. For example, in vowel harmony, languages with inventory gaps will often change another feature to allow assimilation (e.g. by raising low vowels to allow ATR harmony, or changing rounding to allow backness harmony, or vice versa; see Bakovic 2000 on "re–pairing"). Similarly, fricatives can be produced as frictionless continuants under nasalization (see e.g. Ohala 1983, Walker 1998).

[11] The constraint here is DEP-μ, rather than DEP-V, because it is possible to have epenthesis that satisfies DEP-V: vowel copying, as in Balantak (thanks to an anonymous reviewer for pointing this out).

[12] This section owes much to discussion with John McCarthy, as well as Paul de Lacy.

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[13] In all dialects, the nasal is deleted within the word (47b), and in most dialects, including Cypriot, it is deleted in an article preceding a noun (47d), except in 'slow, deliberate speech'.

[14] Unfortunately, for various reasons, roots beginning with labials, nasals, and voiced stops are not well represented in this Begak paradigm, so it is somewhat unclear whether all and only sonorant-initial stems trigger epenthesis. In any case, the main point of this example holds: that nasal-initial clusters are often broken up by epenthesis, except when *NÇ̥ is the motivating constraint.

[15] Thanks to Monica Sieh for pointing this out.