NOMINAL ATR HARMONY IN NATA: AN ASSESSMENT OF ROOT FAITHFULNESS*

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1. Introduction

Within Optimality Theory (OT), (vowel) harmony is canonically an assimilatory process where a particular feature is distributed throughout some domain such as a word, (Beckman 1998, Bakovic 2000, Archangeli and Pulleyblank 2002, among others). Nata, (E45, Guthrie: (1967-71)), a lacustrine Bantu language spoken in Northwest Tanzania, demonstrates an [ATR] vowel harmony situation where different roots exhibit incompatible ways of achieving harmony with respect to prefixes. Crucially, Nata harmony motivates morphological domains such as root/stem and word, which restrict the domain of application of harmonic constraints (Beckman 1998; Archangeli and Pulleyblank 2002; Downing 2007 among others). The interaction between harmony and nominal morphological domains in Nata presents evidence for morphology-phonology mapping (Akinlabi 1996; Beckman 1998, Archangeli and Pulleyblank 2002).

Another aspect of Nata [ATR] harmony is the variation of harmony between derived nouns and underived nouns. Specifically, while underived nouns exhibit root faithfulness conditions, certain nominalizing suffixes in derived nouns present a case of dominant-recessive [ATR] vowel harmony (Bakovic, 2000), which overrides root faithfulness conditions. The nature of these alternations motivates sequential markedness constraints discussed in the No-disagreement Account (Pulleyblank 2002) where such constraints are ranked above word positional faithfulness to prohibit disallowed vowel sequences. I show that the conflict between root faithfulness conditions and dominant-recessive harmony in Nata results into two phonological processes namely: dissimilation and assimilation. Since assimilation and dissimilation are opposite phonological processes, cannot be accounted for by a single constraint ranking, hence two Co-phonologies.

This paper divides into 3 sections. In Section 1 I give a brief introduction of the inventory and the morphology of Nata nouns. In Section 2, I present the data, generalization and OT constraints interaction. In Section 3 I conclude.

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1.1 The Phonology of Nata

Nata has a 7-vowel inventory (cf. Johannes 2007) in which one set of vowels is associated with a [+ATR] value, (1a), and the other set is associated with a [-ATR] value, (1b)[1].

(1) a. Set I [+ATR] b. Set II [-ATR]

[i, u] [e,o] [ɛ,ɔ] [a]

In (1) only mid vowels are lexically contrastive for [ATR] value. That is, high vowels and the low vowel have no [ATR] counterparts.

1.2 The Nata Noun Morphology

For the analysis of Nata nominal [ATR] harmony, I claim that vowel harmony functions differently in different morphological domains. I adopt the morphological domain distinctions and/or terminology such as *root*, *stem*, *macrostem*, and *word* **(**Downing 1997, Archangeli and Pulleblank 2002, Mudzingwa 2010 too mention a few). These constituents are schematically represented in (2), for underived nouns, and (3) for derived nouns.

(2) PPF $_{WD}$[PF [STEM/ROOT]]]

(3) PPF $_{WD}$[PF [MST(OM)STEM[ROOT-(EXT)-FV]]]]

In (2), the nominal root in underived nouns is coextensive with the nominal stem; hence either label would be okay to refer to either of them (cf. Mudzingwa 2010). In (3), the Object Marker (OM) that forms part of the Macrostem in derived nouns is optional in some deverbal nouns. Where OM is absent, both (2) and (3) allow the PF to attach directly to the root. In (3) the stem is formed of the VRoot and at least on suffix (for example the Extensional suffixes (EXTs) and/or the final vowel, which is also known as *the nominalizing suffix.* EXTs add a wide range of meanings to the verb root, such as applicative, intensive, reciprocal etc. As I argued in Gambarage (2012), in Nata, the pre-prefix (PPF), also known as the *augment* in Bantu attaches at the syntactic level, to the DP rather than a word level[2]. For that matter, I leave out the analysis of PPFs. I will make references to PPFs only where necessary. These domains map phonology to morphology and crucially specify the domains of application of harmonic constraints (cf. Beckman 1998; Archangeli and Pulleyblank 2002).

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[1] I am assuming bivalence of features [±ATR]; contrastively an analysis assuming that features are monovalent [ATR or RTR] will achieve similar results.

[2] PPFs in Nata are argued to be weak determiners (Ds) (Gambarage 2012). In Nata, Class 5 nouns are not marked with overt PPFs, due to some prosodic evidence (i.e., word minimality condition).

2. Vowel Harmony Phonotactics and Domains

I start with an argument that only two harmonic domains exist in Nata: the root/stem and the word. I argue that vowel harmony phonotactics that hold within stems also hold within roots. Generally, I show that root/stem internal harmony is restricted to mid vowel sequences, and that such harmony phonotactics hold across the word domain.

2.1 The Root or Stem Harmonic Domain: Underived Nouns

In underived nouns, roots and stems exhibit similar harmony alternations. First, high vowels are advanced in all events and a low vowel is retracted always. Additionally, roots do not alternate in either tongue height or [ATR] features. Crucially, root/stem internal [ATR] harmony is restricted to mid vowel sequences, hence mid vowels with different ATR values such as ***eCɛ, *ɛCe, *eCɔ, *ɔCe, *oCɛ, *ɛCo, *oCɔ,** and ***ɔCo** are unattested. Other than these sequences, vowels within roots may appear advanced (4), retracted (5), or both advanced and retracted, (6). Throughout, domains are marked with square brackets for exposition. H-tone is marked but assume it does not affect harmony.

(4) a. C8 e-βé-[tore] 'cucumbers'.
b. C3 o-mo-[ríɣo] 'load'

(5) a. C6 a-má-[sa:hɛ] 'blood'
b. C8 o-βú-[sɛra] 'porridge'

(6) a. C3 e-me-[kéra] 'wild fruits'
b. C11 o-βo-[róma] 'scarcity of meat'
b. C7 o-mo-[súkɔ] 'pocket'
c. C3 a-ma-[sɔ́hi] 'sisal'

2.1.1 Constraint Interaction

To ensure that high vowels are advanced and a low vowel is retracted in Nata, the universal grounded conditions in (7) are crucial, Archangeli and Pulleyblank's (1994). The constraint in (7)a prefers [+HI] vowels be associated articulatorily with tongue root advancement, and the one in (7)b prefers that a [+LO] vowel be associated with tongue root retraction.

(7) a *+HI/-ATR: If [+HI] then not [-ATR]

b. *+LO/+ATR: If +LOW then not [+ATR]

Within OT (Prince and Smolensky, 1993), the grounded constraints potentially conflict with faithfulness to featural changes in (8).

(8) IDENT-IO[ATR]$_{ROOT}$: Within a root, let X be a segment in the input and Y be a correspondent of X in the output. If X is [αATR], then Y is [αATR] (McCarthy and Prince, 1995, Beckman 1998).

For the analysis of Nata, the markedness grounded conditions in (7) must be ranked above root faithfulness to prohibit retraction in high vowels and advancement in a low vowel, (9).

(9) *+HI/-ATR, *+LO/-ATR >> IDENT-IO[ATR]$_{ROOT}$

The effect of imposing such conditions is that a [-ATR] high vowel will incur a violation mark on (7)a, while [+ATR] high advanced vowels will survive this condition. Also, a [+ATR] low vowel will violate constraint (7)b while a [-ATR] low vowel will satisfy this condition.

2.2 The Root or Stem Harmonic Domain: Derived Nouns

Derived noun roots/stems pattern differently with respect to the nominalizing suffixes, as we shall see in 2.2.1. However, some generalizations for underived noun roots/stems also hold for derived noun roots: high vowels are advanced in all cases and a low vowel is always retracted. Stem/root internal harmony is restricted to mid vowels only; thus mid vowels with different [ATR] qualities are not allowed. Vowels within roots may appear advanced (10)a, retracted (10)b, or both advanced and retracted, (10)c-d.

(10)	a.	C1	sikera (V)	o-mó-[siker]-i	‘enterer’
	b.	C7	tɔ́ɔndɔra (V)	e-ɣi-[tɔ́ɔ́ndɔɔr]-i	‘pair of tongs’
	c.	C14	sínɔɔra (V)	o-βo-[sínɔɔr]-i	‘bed wetting’
	d.	C15	ráɣora (V)	a-βa-[ráɣor]-i	‘healers’

Since these cases are not different from those found in underived nouns, the constraint ranking proposed for underived noun roots can account for the derived noun root cases as well.

2.2.1 Stem Harmony with Suffixes

Harmony with nominalizing suffixes is of particular interest. First, recall the morphology of derived noun stems in (3), […[…STEM[ROOT[(EXT)-FV]]]]. The nominalizing suffixes are either [-ATR] mid vowel [ɔ] or high vowels [i, u]. The suffix (**ɔ**) can co-occur with any vowel within a stem, except [+ATR] mid vowels, (11). [+ATR] mid vowels [e,o] in roots appear as [-ATR] before the suffix [ɔ] (see examples (11)d, (13)), as well as in forms where a low vowel intervenes between roots and [ɔ], (14). High vowel suffixes can co-occur with any vowel (12). Note that here too a low vowel is retracted in all cases and high vowels are always advanced.

(11)	a.	ɣana (V)	C6	a-má-[ɣan-**ɔ**]	‘stories’
	b.	tɔ́ɔsa (V)	C3	o-mú-[tɔɔs-**ɔ**]	‘an abuse’
	c.	súuŋga (V)	C11	o-ro-[súuŋg-**ɔ**]	‘hanger’
	d.	iɣóta (V)	C3	o-mw-[iɣɔ́t-**ɔ**]	‘satisfaction’

(12)	a.	sɛ́ka (V)	C1	o-mú-[sɛk-**i**]	'laugher'
	b.	sɔ́ɔha (V)	C14	o-βu-[sɔ́ɔh-**u**]	'greediness
	c.	tuka (V)	C1	o-mo-[tuk-**i**]	'digger'
	d.	saβa (V)	C1	o-mu-[[saβ-**i**]	'beggar'
(13)	a.	tóoŋga (V)	C3	ɔ-mɔ́-[tɔɔŋg-**ɔ**]	'string'
	c.	méra (V)	C7	ɛ-kɛ́-[mɛr-**ɔ**]	'throat'.
(14)	a.	hetaera (V)	C3	ɔ-mɔ́-[hɛtɛɛr-an-**ɔ**]	'a wake'
	b.	hoora (V)	C3	ɔ-mɔ́-[hɔɔr-an-**ɔ**]	'pounding'

The following observations are crucial for the analysis of stems in (11-14): First, roots with [+ATR] mid vowels assimilate to the [-ATR] value of the suffix [ɔ], which seems to be underlyingly specified as [-ATR], (11)d, (13). This may suggest that the [-ATR] value of mid vowels is a dominant value (cf. Casali 2003, Hume 2011). High vowel suffixes do not spread their [+ATR] feature to roots, (12). Crucially, a low vowel seems to be transparent to the propagation of the [-ATR] feature of the nominalizer [-ɔ] in (14). It is not plausible to assume that a low vowel (of the applicative morpheme (-an-)) spreads a [-ATR] feature leftward in (14), as the same effect is observed even where a low vowel is absent, (13). Moreover, verbs in (14) show clearly that a low vowel does not trigger retrogressive harmony. This presents further evidence that mid vowel harmony occurring in stems takes the root as its domain, and hence applies to both root and stem material.

2.2.2 Accounting for Suffix Harmony in Stems

To enforce Nata harmony for stem cases in (11-14), one needs to prohibit disagreeing sequences of mid vowels. My analysis follows the spirit of the No-disagreement account, Pulleyblank (2002) who proposes the sequential markedness constraints to prohibit disharmony. For the analysis of Nata the constraints in (15) become crucial[3].

(15) a. *[-HI, +ATR] C_0[-LO, -ATR]$_{WORD}$: Ignoring consonants, within a word, a [-ATR] non-low vowel may not immediately be preceded by a [+ATR] non-high vowel.

b. *[-LO, -ATR]C_0[-HI,+ATR]$_{WORD}$: Ignoring consonants, within a word, a [-ATR] non-low vowel may not be followed by a [+ATR] non-high vowel.

(16) a. IDENT-IO[-ATR]$_{WORD}$: Let X be a segment in the input and Y be a correspondent of X in the output. If X is [-ATR], then Y is [-ATR], (ID[-A]$_{WD}$) (cf. McCarthy and Prince, 1995).

[3] In the No-disagreement Account Pulleyblank uses sequential markedness constraints with different levels of proximity as in Suzuki (2000): close, *[+ATR][-ATR]; intermediate, *[+ATR]C_0[-ATR], and distal proximity, *[-ATR]∞[+ATR]. Since such constraints are not restricted to mid vowel sequences they will overapply in Nata.

b. IDENT-IO[+ATR]$_{WORD}$: Let X be a segment in the input and Y be a correspondent of X in the output. If X is [+ATR], then Y is [+ATR], (ID[+A]$_{WD}$) (cf. McCarthy and Prince, 1995).

The constraints in (15) and (16)a are undominated, hence are ranked above faithfulness to [+ATR] value, (16)b. ID[ATR]$_{RT}$ must be ranked below ID[ATR], because [+ATR] value of root mid vowels assimilate to [-ɔ]. The ranking in (17) is illustrated in tableau (18) with ɛ-kέ-mɛr-ɔ 'throat'.

(17) GROUND, MID V. HARMONY, ID[-A]$_{WD}$>>ID[A]$_{RT}$>> ID[+A]$_{WD}$

(18) ɛ-kέ-mɛr-ɔ 'throat' from méra 'swallow'.

/-mer-ɔ/	*[-HI, +A] [-LO, -A]	*[-LO, -A] [-HI,+A]	ID[-A]	ID[A]$_{RT}$	ID[+A]
a. ɛ-kέ-[mer-ɔ]	*!				
b. ɛ-kέ-[mɛr-ɔ] ☜				*	*
c. ɛ-kέ-[mer-o]			*!		*

In (18), candidate (a) fatally violates the mid vowel harmonic constraint. The [ATR] value cannot be changed, hence (c) is out.

Now, take stem cases with both [+ATR] and [-ATR] value such as o-βo-[sínɔɔr-i] 'bed wetting'.

(19) o-βo-[sínɔɔr-i] 'bed wetting' from *sínɔɔra* 'pee'.

/[sínɔɔr]-i /	*HI/-ATR	*[-HI, +A] [-LO, -A]	*[-LO, -A] [-HI,+A]	ID[ATR]$_{RT}$
a. o-βo-[sínɔɔr-i] ☜				
b. o-βo-[sínoor-i]				*!
c. o-βo-[sınɔɔr-ı]	*!*			

In (19) where the stem has both [+ATR] and [-ATR] values, and (c) is penalized by the grounded constraint that prohibits high vowel retraction. Since changing tongue root features is prohibited by IDENT candidate (b) is out.

2.2.3 Harmony with Extension Suffixes

The stem is comprised of a verbal root and the extensions such as applicative extensions *–er- or -εr,* or intensive extensions *–er-er-* or *-εr-εr-*. Roots with [ATR] mid vowels select for [-ATR] extensions (20), and roots with [+ATR] vowels select for [+ATR] extensions (21). Surprisingly, a low vowel selects for the [+ATR] extensions suffixes, (22). Apparently, the nominalizing suffix [i] does not affect the [-ATR] value of extensions or roots, (20).

(20) a. tɛma (V) C1 o-mo-tu-[tɛm-**ɛr**-i] 'one who beats for us'
b. βɔha (V) C1 o-mo-tu-[βɔh-**ɛr-ɛr**-i] 'one who ties for us'

(21) a. tuma (V) C1 o-mó-to-[tum-**er**-i] 'one who sews for us'
b. βooka (V) C1 o-mó-[βook-**er-er**-i] 'one who never plans ahead'

(22) a. sama (V) C1 o-mó-tu-[sam-**er**-i] 'one who taste things for us'
b. ɣamba (V) C1 o-mú-[ɣamb-**er-er**-i] 'slacker'/'jobless person'

Similar to [+ATR] mid vowels, the nominalizing suffix [i] follows from the analysis that a [+ATR] feature is a dormant value in Nata. This accounts for the fact that [+ATR] vowels in the suffixes cannot extend their features either to extensions or to roots as in (20). As we shall see below, Nata data, in fact, appeal for the analysis that a [+ATR] value is default and a [-ATR] feature is a dominant value (cf. Casali 2003 and references therein). Thus, it is plausible to posit that extensions in (20) surfaced with a [-ATR] value in order to satisfy mid vowel harmony. I argue that [+ATR] extensions occurring after [+ATR] mid and high vowels in (21) receive the [+ATR] value by default feature assignment. Nata data suggest that only [-ATR] mid vowel spreads their [ATR] value but not a low vowel. The reason for this may be that a low vowel does not have its [ATR] counterpart (cf. Archangeli and Pulleyblank (in prep) for selectional vs. default allomorphy in feature assignment). This accounts for the data in (22) in which [a] fails to spread its feature to the extensions yielding prefixes with a default [+ATR] value.

2.2.3.1 Accounting for Extensions Harmony

The constraint ranking for the OT analysis must be one that allows retracted extensions [**ɛr**] to follow stems with [-ATR] mid vowels, and default extensions (extensions with advanced mid vowels) [**er],** in elsewhere cases. Assume that any of the alternating extensions /**ɛr/~/er/** can be our underlying representation[4]. For that matter to achieve desirable results one needs to rank featural prohibition markedness [*FG] above faithfulness, (23)c.

(23) a. *[-ATR, -LO]$_{AFFIX}$: There are non-low [-ATR] affixes.
b. *[+ATR, -HI]$_{AFFIX}$: There are no [+ATR] non-high affixes.
c. *[-LO, -A][-HI,+A]*[-HI,+A][-LO, -A]>>*[-ATR,-LO]$_{AFFIX}$ >>*[+ATR, HI]$_{AFFIX}$ >> ID[ATR]$_{ST}$

Ranking *[+ATR, -HI]$_{AFFIX}$ below *[-ATR, -LO]$_{AFFIX}$ allows default values in the grammar (cf. tableau 24-25). Assume /er/ is the input.

[4] Richness of the base is the concept that places the lexicon as the source of all contrastive properties at all language levels (see Prince and Smolensky, 1993 and others). In OT it is the lexicon that provides underlying form specification.

(24) o-mo-tu–[tɛm-**ɛr**-i] (19)a

/-tɛm-er –i/	*[-LO, -A] [-HI,+A]$_{ST}$	*[-A,-LO]$_{AF}$	*[+A,-HI]$_{AF}$	ID[A]$_{ST}$
a. o-mo-tu-[tɛm-**er**-i]	*!		*	
b. o-mo-tu-[tɛm-**ɛr**-i] ☜		*		*

(25) o-mó-to-[tum]-er-i (20)a

/-tum-er-i/	*[-LO, -A] [-HI,+A]$_{ST}$	*[-A,-LO]$_{AF}$	*[+A,-HI]$_{AF}$	ID[A]$_{ST}$
a. o-mó-to-[tum-ɛr-i]		*!		*
b. o-mó-to-[tum-er-i] ☜			**	

(26) o-mó-tu-[sam-**er**-i]

/-sam-er-i/	*[-LO, -A] [-HI,+A]$_{ST}$	*[-A,-LO]$_{AF}$	*[+A,-HI]$_{AF}$	ID[A]$_{ST}$
a. o-mó-tu-[sam]-ɛr-i]		*!		*
b.o-mó-tu-[[sam]-er-i] ☜			*	

Extensions with [-ATR] non-low value in such stems as (20) are not default values. For that matter such extensions are permissible in the grammar only because mid vowel harmony phonotactics (harmonic constraints) outrank featural prohibition markedness as illustrated by the tableaux in (24). In this ranking since faithfulness is ranked low in tableaux (24-26), it does not matter whether we have /er/ or /**ɛr**/ as our input; desirable results are guaranteed.

2.3 Harmony with Prefixes: Word Level Harmony

Harmony between PFs and nominal roots or verbal roots is different in several respects from the one we saw occurring in roots/stems. First, note that while it is possible to find [+ATR] mid vowel preceding a low vowel (e…a, o…a) within both underived noun roots/stems, (27) and derived noun roots/stems, (28), mid vowel PFs cannot precede roots beginning with a low vowel.

(27) a. C3 o-mo-[k**er**a] ‘tail’.
b. C11 o-ro-[ɣ**o**m**a**] ‘wound’ (usu. found on a head).

(28) a. C15 tenani (V) o-ɣo-[t**en**a**n**]-i ‘putting Xs diagonal’
b. C6 hóoŋga (V) a-βá-[hooŋg]-**er**-**a**n-i ‘people who sieve’

If roots begin with a low vowel as in examples (29-30) prefixes consistently surface as high vowels.

(29)	a.	C1	o-**mu**-[kári]	*o-**mo**-[kári]	‘woman’
	b.	C11	o-**rú**-[**β**aru]	*o-**rú**-[**β**aru]	‘ribs’
(30)	a.	C1	o-**mú**-[ɣan]-i	*o-**mó**-[ɣan]-i	‘story teller’
	b.	C1	o-**mú**-[raɣor]-i	*o-**mú**-[raɣor]-i	‘healer’

Additionally, [+ATR] mid vowel prefixes cannot immediately precede roots beginning with a [-ATR] mid vowel. Thus, prefixes are high vowels if the first syllable of the root contains a [-ATR] mid vowel as in (31), and are [+ATR] non-high vowels where roots start with a [+ATR] value as in (32).

(31)	a.	C14	o-**βu**-[sɔ́ɔhu]	*o-**βo**-[sɔ́ɔhu]	‘greediness’
	b.	C7	e-**ki**-[ɣérɔ]	*e-**ke**-[ɣérɔ]	‘thing’
(32)	a.	C1	o-**mó**-[sukɔ]	* o-**mú**-[sukɔ]	‘pocket’
	b.	C4.	e-**me**-[kéra]	*e-**mi**-[kéra]	‘tails’

In derived nouns, too, prefixes with high vowels can only feature if the first syllable of the root has a [-ATR] vowel, (33); but where roots do not start with a [-ATR] vowel, prefixes appear with [+ATR] mid vowels, (34).

(33)	a.	C7	e-βi-[rɛɛŋgɛ]	*e-βe-[rɛɛŋgɛ]	‘feet’
	b.	C1	o-**mu**-[sɔ́ɔh]-u	*o-**mó**-[sɔ́ɔh]-u	‘greedy person’
(34)	a.	C1	o-**mó**-[rem]-i	*o-**mu**-rem-i	‘farmer’
	b.	C7	e-**ke**-[ríβ]-ɔ	*e-**ki**-[ríβ]-ɔ	‘lid’

Recall that within roots/stems mid vowels with different [ATR] values cannot completely occur. Contrastively, at a word level mid vowels of different tongue root qualities are tolerated when not adjacent, (35).

(35)	a.	C1	o-**mó**-[sukɔ]	*o-**mú**-[sukɔ]	‘pocket’
	b.	C7	e-**ke**-[ríβ]-ɔ	*e-**ki**-[ríβ]-ɔ	‘lid’

As we shall see below, except for derived noun cases involving assimilation, in Nata, there are no underived nouns with [-ATR] mid vowel PFs, thus sequences such as ***Cɔ-[C**V..**]**, ***Cɛ-[CV..]**, ***Cɔ-[C**V..], ***Cɛ-[C**V..] are not found[5]. I argue that in such nouns, roots do not spread the [-ATR] feature leftward because spreading is blocked by another phonological process, namely dissimilation.

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[5] There are a few exceptional forms in Nata where prefixes appear with a [-ATR] mid vowel before a [-ATR] root initial syllable, (i). Such forms are doubted to be deverbal but their source verbs cannot be traced. Such patterns are common in derived nouns (i)c because of leftward spreading of a [-ATR] feature by suffix. I treat the forms as exceptional, unless further evidence is presented to the contrary.

(i)	a.	C3	ɔ-mɔ́-[rɔr-ʔɔ]	‘fire’
	b.	C7	ɛ-βɛ-[séɣ-ʔɔ]	‘miracles’.
	c.	C7	ɛ-kɛ-[réɛr]-**ɔ**	‘relish’ from *réera* ‘use as a relish’

2.3.1 Accounting for prefix dissimilation harmony

To account for prefixes that dissimilate before a low vowel in roots, I assume that there is a constraint such as the one in (36) which prohibits [+ATR] mid vowel prefixes to immediately precede roots starting with a low vowel. Recall that such a constraint does not hold in stem/root internal harmony hence provides evidence for the instantiation of the word domain. I maintain that the [-ATR] value is an active value while the [+ATR] value is the default. I refer to the process that forces mid vowel PFs surface as high vowels before [-ATR] roots initial syllables as "prefix dissimilation" (see also Higgins 2011 similar process in Ikoma– a sister dialect to Nata). Based on the fact that underived noun roots/stems do not alternate in both tongue height and [ATR] values, it is plausible to consider root faithfulness constraints, IDENT[HEIGHT]$_{ROOT}$, and IDENT[ATR]$_{ROOT}$. In addition to the grounded constraints, featural prohibition markedness, and stem mid-vowel harmonic constraints, the following constraints are crucial for the analysis of Nata harmony at the word domain:

(36) *[+ATR, -HI]C$_0$[+LO]$_{WORD}$: Ignoring consonants, a mid vowel may not immediately precede a low vowel.

(37) a. IDENT[HEIGHT]$_{ROOT}$: Within the root, let X be a segment in the input and Y be a correspondent of X in the output. If X is [αhigh], then Y is [αhigh], (ID[HE]$_{RT}$), (Adopted from Baković, 2000, Pulleyblank 2002).

b. IDENT[HEIGHT]$_{WORD}$: If an input segment is [αhigh] then its output correspondent is [αhigh], (ID[HE]$_{WD}$), (Adopted from Baković, 2000, Pulleyblank, 2002).

In order to allow for PFs dissimilation, we need to rank ID[HE] very low. The constraints in (37)b is undominated and this accounts for mid vowel harmony between PFs and roots. Ranking *[+ATR, -HI]$_{AF}$ below *[-ATR, -LO]$_{AF}$ but above ID[ATR]$_{WORD}$ may rule out undesirable candidates with retracted non-low vowels which may otherwise surface as false winners. We know that due to the nature of prefix dissimilation, ID[HEIGHT]$_{WD}$ is violable hence needs to be ranked low, possibly below ID[ATR]$_{WD}$. I adopt the ranking in (38) to account for prefix dissimilation cases:

(38) MID. V. HARMONY, GROUNDED >> ID[ATR]$_{RT}$>> *[ATR] >>ID[+ATR]$_{WD}$ >> ID[HE]$_{WD}$

Now consider cases with prefix dissimilation such *o-rú-βaru* 'ribs', *o-βu-sɔ́ɔhu* 'greediness' also any form in (29-31). Assume the prefix /βo/ in the input.

(39) o-βo-sɔɔhu ‘greediness’ (30)a

/o-βo-sɔɔhu/	*[-HI,+ATR]C_0 [-LO, -ATR]	*[-A, LO]$_{AF}$	*[+A, -HI]$_{AF}$	ID[+A]$_{WD}$	ID[HE]$_{WD}$
a. o-[βɔ-sɔ́ɔh-u]		*!		*	
b. o-[βu-sɔ́ɔh-u] ☜					*
c. o-[βo-sɔɔh-u]	*!		*		

This ranking disfavours any candidate with non-low [-ATR] value in the affix at the expense of harmony.

For cases involving PFs dissimilation before roots beginning with a low vowel, the constraint *[+ATR, -HI]C_0[+LO] introduced in (36) needs to be ranked above ID[ATR]$_{WD}$ for correct results. The reason is, as it will be evident, such a constraint is violable in stems. I illustrate this ranking in tableau (40) using (29)b *o-ru-[βaru]* ‘rib’. Assume that the PF is /rɔ/ in the input.

(40) o-rɔ-[βaru] ‘rib’

/o-rɔ-[βaru]/	*[-A, -LO]$_{AF}$	*[+A, -HI] C_0[+LO]	*[+A, -HI]$_{AF}$	ID[A]$_{WD}$	ID[HE]$_{WD}$
a. ɔ-[**rɔ́**-βaru]	*!				
b. o-[**rú**-βaru] ☜				*	*
c. o-[**ró**-βaru]		*!	*	*	

In tableau (40) the winner violates the last two constraints but this does not make it worse than candidate (a) who violates featural prohibition and candidate (b) who violates harmony.

Cases involving default prefixes in (41) are not problematic. They straightforwardly follow from the analysis of the default affixes we proposed in 2.2.3.1. That is, we should maintain ranking *[-A, -LO]$_{AF}$ above word faithfulness to prohibit prefix retraction. However, as I will argue in detail in 2.4, there is no motivation to re-rank ID[HE]$_{WD}$.

(41) a. C1 o-[mó-sukɔ] *o-[mú-sukɔ] ‘pocket’
b. C4. e-[me-kéra] *e-[mi-kéra] ‘tails’
c. C7 e-[ke-ríβ-ɔ] *e-[ki-ríβ-ɔ] ‘lid’.

I demonstrate this case using (41)a o-mó-sukɔ ‘pocket’.

(42) C1 o-mó-sukɔ ‘pocket’ (41)a

/mo-sukɔ/	HARM ONY	ID[A]$_{RT}$	*[-A, -LO]$_{AF}$	ID[+A]$_{WD}$	ID[HE]$_{WD}$
a. o-[mo-sukɔ] ☜					
b. ɔ-[mɔ-sukɔ]			*!	*	
c. o-[mu-sukɔ]					*!
d. o-[mo-suko]		*!			

Candidate (b) violates featural prohibition markedness for having a retracted PF. Candidate (c) violates ID[HE]$_{WD}$, left in the last column hence candidate (a), wins without violating any constraint.

2.3.2 Accounting for Retrogressive Harmony Cases

We now turn to PF cases involving retrogressive harmony, (43)-(44) repeated partially from (13)-(14) above. These cases require ID[HE]$_{WD}$ to be undominated in order to rule out candidates with high vowel prefixes. Note also that in these examples only [+ATR] non-high vowels assimilate to the suffix [ɔ]. This follows from the analysis of the dominant [-ATR] value in Nata. Although it is clear that prefix dissimilation occurs where roots begin with a [-ATR] value, (31&33), it is not clear to me why prefix dissimilation is not attested in cases where the suffix [ɔ] triggers retrogressive assimilation to roots as in (43)-(44). Recall roots beginning with a [-ATR] vowel forced PF raising in cases like (31’). One explanation might be that the suffix [ɔ] takes the word as its domain where PFs assimilate to the suffix instead of raising[6]. I do not have a concrete answer to this problem. This situation necessitates a separate Co-phonology, Inkelas (1998). This is because ID[HE]$_{WD}$, which was ranked very low in dissimilatory cases, needs to be undominated in these cases in order to prohibit PF dissimilation.

(43) a. héta (V) C3 ɔ-mɔ́-[hɛt]-ɔ ‘strap’
b. méra (V) C7 ɛ-kɛ́-[mɛr]-ɔ ‘throat’

(44) a. hetaera (V) C3 ɔ-mɔ́-[hɛtɛɛr]-an-ɔ ‘a wake’
b. hoora (V) C3 ɔ-mɔ́-[hɔɔr]-an-ɔ ‘pounding’

If we apply the ranking for dissimilation cases to retrogressive assimilation cases such as in (43)-(44), ID[+ATR] would conspire with ID[ATR]$_{RT}$ against the correct winner who appear to have two violations on ID[+ATR], as demonstrated in tableau (46).

[6] There is no nominalizing suffix as [**ɛ**]. However, in subjunctive mood where verbs take the suffix [**ɛ**], the suffix triggers harmony in the same way as the suffix [**ɔ**], i.e. ɣora ‘buy’ n-ɔɔ-mɔ-ɣɔ́r-ɛr-ɛ ‘just buy for him/her’. This provides further evidence that the [-ATR] value is systematically dominant in Nata.

(46) o-mɔ́-hɛt-ɔ ‘trap’ from héta ‘pass’

/o-mo-het-ɔ/	*[+A,-HI]C_0[-A,-LO]/ *[-A,-LO]C_0[+A,-HI]	ID[-A]	ID[+A]	ID[HE]$_{WD}$
a. o-mó-[hɛt]-ɔ	*!		*	
b. o-mɔ́-[hɛt]-ɔ ☹			*!*	
c. o-mó-[het]-o		*!	*	
d. o-mú-[hɛt]-ɔ ☜			*	*
e. o-mú-[het]-o		*!		*
f. o-mo-[het]-ɔ	*!			

To correctly account for retrogressive harmony, we to employ IDENT[+ATR] to prevent roots from spreading a [-ATR] to PFs. Thus, ID works similarly to DEP[-ATR] (cf. Leitch, 1997; also Higgins, 2011). This constraint must be ranked very low because of unfaithfulness of [+ATR] value in mid vowels. ID[HE] must be undominated to prevent prefix dissimilation. Since [-ATR] mid vowels never trade their [-ATR] feature, I have no evidence for ranking ID[-ATR] with respect to ID[HE]$_{WD}$. However, as we shall see below, ID[ATR]$_{RT}$ needs to be ranked below ID[-ATR] because of instances of the unfaithfulness of [+ATR] mid vowels in derived noun stems. IDENT[ATR]$_{RT}$ needs to outrank IDENT[+ATR]$_{WD}$ since faithfulness to roots is more important than faithfulness to affixes (i.e., in extensions), hence the master ranking in (48).

(48) GROUNDED, MID V. HARMONY, ID[HE]$_{WD}$, ID[-ATR] >> MID VOWEL HARMONY >> ID[ATR]$_{RT}$ >> ID[+ATR][7].

Now observe the case that the first co-phonology left unresolved in tableau (46).

[7] I do not have reason to invoke constraints such as *[$\underline{\text{-ATR}}$]$_{AF}$ or *[+ATR]$_{AF}$ for retrogressive harmony as such constraints are irrelevant here.

(49) ɔ-mɔ́-[hɛt-ɔ] 'trap' from héta 'pass'

/mo-het-ɔ/	*[-HI,+A]C_0 [-LO, -A]	ID[HE]$_{WD}$	ID[A]$_{WD}$	ID[A]$_{RT}$	ID[+A]$_{WD}$
a. o-[mó-hɛt-ɔ]	*!			*	*
b. ɔ-[mɔ́-hɛt-ɔ] ☜				*	***
c. o-[mó-het-o]			*!		*
d. o-[mú-hɛt-ɔ]		*		*!	**
e. o-[mú-het-o]		*	*!		*
f. o-[mo-het-ɔ]	*!				

In this tableau, ID[ATR]$_{RT}$ conspires with ID[+ATR] and rules out candidate (d) because of PF dissimilation. This gives us desirable results as (b) wins over d. I argue that this ranking is also crucial for cases involving transparency of a low vowel in stems. A low vowel allows the propagation of [-ATR] feature of the nominalizer as in (44). Note that the harmonic constraint for mid vowel harmony *[+A, -HI][+LO, -A] is ranked appropriately low as sequences of mid vowel preceding a [+LO] low vowel are attested if they occur non-adjacent, i.e., a word. I illustrate this ranking using *ɔ-mɔ́-[hɛtɛɛr]-an-ɔ* 'a wake' in (50).

(50) *ɔ-[mɔ́-hɛtɛɛr-an-ɔ]* 'a wake' (43)a

/o-*mo-heteer-an-ɔ*/	*[+A,-HI]C_0 [-A,-LO],	ID [HE]$_{WD}$	ID [-A]$_{WD}$	*[+A,-HI] [+LO]	ID [A]$_{RT}$
a. o-[mó-hɛtɛɛr-an-**ɔ**]	*!				**
b. ɔ-[mɔ́-hɛtɛɛr-an-**ɔ**] ☜					**
c. o-[mó-heteer-an-**o**]			*!		
d. o-[mó-heteer-an-**ɔ**]				*!	
e. o-[mú-hɛtɛɛr-an-**ɔ**]		*!			

Candidate (d) loses the race as she fatally violates the constraint that bans the co-occurances of mid vowels with different [ATR] values. Candidate (c) is out due to changing the suffix [ATR] value for unknown course.

3. Conclusion

This paper presented harmony cases involving root faithfulness, suffix-controlled harmony, and morphological domains. An interesting case is the one, which [-ATR] feature is a dominant feature spreading leftward from the nominalizing suffix (**ɔ**) in derived nouns across the board (if not blocked by high

vowels). This process overrides root faithfulness conditions and affects [+ATR] mid vowels to the left of the nominal domain. Based on the analysis of Nata harmony presented in this work, I submit that the [-ATR] feature is the systematic dominant value while the [+ATR] value is the default. Nata is consistent with the System-Dependent [ATR] Dominance Hypothesis (Casali, 2003: 356) which argues that 'the dominant [ATR] value in a language is strongly correlated with underlying inventory structure and that the [-ATR] value is regularly dominant in languages in which [ATR] is contrastive only for non-high vowels'. I have argued that within OT, Nata harmony can be studied within two separate Co-phonologies: one accounting for assimilation cases and the other one for default feature assignment and prefixes dissimilation.

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