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Domains and directionality in Kinande vowel harmony: a Correspondence approach

Laura J. Downing, University of Gothenburg, SE, laura.downing@sprak.gu.se
Martin Krämer, UiT The Arctic University of Norway, NO, martin.kramer@uit.no

The ATR vowel harmony patterns observed in Kinande have received persistent attention for their combination of stem control and dominance, as well as less familiar phenomena such as dominance reversal and cross-word harmony. This paper provides a Syntagmatic Correspondence analysis of the Kinande vowel harmony system and demonstrates that it straightforwardly accounts for the intricate interaction of featural, directional and morpho-prosodic domain restrictions that define the occurring harmony patterns. The analysis obviates an appeal to dominance reversal, and cross-word harmony is shown to be phonological, not phonetic (contra Archangeli & Pulleyblank 2002; Kaisse 2019), yielding to a non-stratal analysis in the approach adopted. The analysis thus provides additional evidence for incorporating directionality into the formalization of Syntagmatic Correspondence constraints and for morpho-prosodic domain limitations on these and other OT constraints.

1 Issues in Kinande vowel harmony

The Kinande (Bantu JD.42, Democratic Republic of the Congo) advanced tongue root (ATR) vowel harmony system has regularly attracted the interest of phonologists (e.g., Archangeli & Pulleyblank 1994; 2002; Hyman 2002; Kenstowicz 2009; Mutaka 1990; 1995; 2007; Schlindwein 1987), as it shows an intricate combination of several of the properties that define variation in the typology of vowel harmony systems in surveys like Baković (2000), Casali (2002; 2008; 2016), Hyman (2002), Krämer (2003), Rose & Walker (2011) and Walker (2011). In many harmony systems, the harmony trigger is in a strong position (stem(-initial) or stressed vowel) and the target is in a weak position (affix or unstressed). While prominence control systems usually seem unidirectional, they can show bidirectionality under certain circumstances (Krämer 2003), even though, according to Hyman (2002), vowel harmony is by default regressive. Kinande has both unidirectional and bidirectional ATR vowel harmony. Bidirectional harmony is stem-controlled and is restricted to high vowels, while unidirectional regressive harmony, triggered by vowels in non-prominent positions, targets both high and non-high vowels. In ATR harmony systems with an ATR contrast among high vowels, [+ATR] is canonically the dominant value (Casali 2002; 2008; 2016). Hyman (2002) and Kenstowicz (2009) argue that Kinande shows what Baković (2000) terms "dominance reversal": [–ATR] can exceptionally trigger harmony in certain morphological contexts. Finally, vowel harmony is canonically word-bound (Kaisse 2017; 2019 and references therein). In Kinande, however, unidirectional regressive vowel harmony can optionally cross word boundaries under certain phonological and syntactic conditions.

This paper adopts a Syntagmatic Correspondence approach to the Kinande vowel harmony system and demonstrates that it straightforwardly accounts for the intricate interaction of featural, directional and morpho-prosodic domain restrictions that define the occurring harmony patterns. The paper is structured as follows. Section 2 presents an overview of the ATR vowel harmony patterns in Kinande to be analyzed in this paper, and sections 3–6 develop a Syntagmatic Correspondence Theory analysis of the patterns. Section 7 takes up alternative approaches to theoretical issues raised by our analysis, in particular debates on how best to formalize dominance, domain restrictions and directionality in harmony processes, to highlight the advantages of the Syntagmatic Correspondence approach. Section 8 concludes.

2 Background on Kinande and its ATR vowel harmony patterns

We begin with an introductory sketch of Kinande morphology and its vowel inventory, followed by an overview of the ATR vowel harmony (ATR VH) patterns to be analyzed in this paper.

2.1 Background on Kinande morphology and vowel phoneme inventory

Kinande nominals have the morphologically complex structure schematized in (1):

(1) Kinande/Bantu nominal word structure (Archangeli & Pulleyblank 2002: 141)
augment $_{\mathbf{PWord}}$[dim./augmentative prefixes $_{\text{Macro-stem}}$[class prefixes [$_{\mathbf{Stem}}$[$_{\text{Root}}$ …] …]]]

The domains that will play an important role in our analysis are Stem[1] and (P)Word. It is important to note that the augment is outside the PWord constituent that includes the other class prefixes and the stem. As we shall see, this prefix can optionally be excluded from the regressive ATR VH domain.

Kinande has a seven-vowel phoneme inventory (Archangeli & Pulleyblank 2002; Hyman 2002; Kenstowicz 2009). Only high vowels are contrastive for [ATR], while non-high vowels are [–ATR]:

(2) Kinande vowel phonemes

i	u
ɪ	ʊ
ɛ	ɔ
	a

The nominal forms in (3) illustrate these phonemic contrasts. (Note that infinitives are nominals, beginning with the noun class prefix /ɛ-rɪ-/.) The root-initial vowel (which is also the stem-initial vowel, as shown in (1), above) is the locus of maximal phonemic contrast in Kinande, as in other Bantu languages (Beckman 1997; Hyman 1999). '[' indicates the left stem edge in all of the data in the paper:

(3) Infinitives illustrating stem-initial vowel contrasts (Archangeli & Pulleyblank 2002: 148); we do not transcribe phrasal vowel length

a.	+high, ATR	ɛ-ri-[líb-a	'to cover'
		ɛ-rí-[húk-a	'to cook'
b.	+high, not ATR	ɛ-rɪ-[lɪ́m-a	'to cultivate'
		ɛ-rɪ-[hʊ́m-a	'to beat'
c.	–high, not ATR	ɛ-rɪ-[hɛ́k-a	'to carry'
		ɛ-rɪ-[kár-a	'to force'
		ɛ-rí-[bɔ́h-a	'to tie'

2.2 ATR vowel harmony patterns

Three distinct ATR VH patterns affect the realization of vowel quality in Kinande: stem-controlled, word level, and phrasal harmony. Stem-controlled vowel harmony affecting both the height and

[1] See Downing & Kadenge (2020) and references therein for detailed arguments in favor of Stem as a phonological domain.

the ATR value of vowels is found in many Bantu languages. It is canonically controlled by the root-/stem-initial vowel and applies within a domain that Hyman (1999) characterizes as follows:

(4) "Canonical" Bantu VH, morphological conditioning (Hyman 1999: 238)

a. It does not apply to the inflectional final vowel.

b. It does not apply to prefixes.
That is, it applies roughly within the derivational stem (bolded):
[[Prefixes] [[**Root + Derivational Suffixes**] IFV]

The data in (5) illustrate stem-controlled ATR VH in Kinande. In this data set, the infinitive forms provide evidence for the underlying ATR quality of the stem-initial vowel. The applicative suffix (-ir-/-ɪr-/-ɛr-), which is within the stem, harmonizes for [+ATR] with an immediately adjacent [+high] vowel, as shown in (5d–f).[2,3]

(5) Stem-controlled ATR VH (Archangeli & Pulleyblank 2002; Mutaka 1990; 1995; 2007; Kenstowicz 2009)

	Infinitive	*Applicative*	*Gloss*
a.	ɛ-rɪ-[hɛ́k-a	ɛ-rɪ-[hɛ́k-ɛ́r-a	'carry'
b.	ɛ-rɪ-[lɔ́g-a	ɛ-rɪ-[lɔg-ɛ́r-a	'bewitch'
c.	ɛ-rí-[hák-a	ɛ-rí-[hak-ír-a	'smear'
d.	ɛ-rí-[tʊ́m-a	ɛ-rí-[tʊm-ír-a	'send'
e.	e-ri-[hímb-a	e-ri-[himb-ír-a	'build'
f.	e-rí-[húm-a	e-rí-[hum-ír-a	'move'
g.	e-ri-[liban-a	e-ri-[liban-ír-a	'disappear'

The example in (5g), cited from Mutaka (1995: 49), shows that stem-controlled ATR VH only affects the applicative suffix if it is adjacent to a [+high, +ATR] (stem-initial) vowel. That is, only [+high] vowels can be targets for this ATR VH pattern, and the [+low, –ATR] vowel [a] blocks stem-controlled VH. An analysis of this pattern is developed in section 3.

Besides stem-controlled ATR VH, there are two types of regressive ATR VH in Kinande: word-internal and phrasal. Both patterns are triggered by contrastive [+ATR, +high] vowels in non-stem-initial position. In contrast to stem-controlled ATR VH, regressive word-internal ATR VH – discussed in detail in section 4 – targets both high and non-high vowels, deriving an [ATR]

[2] In this paper, data taken from earlier sources are adjusted to reflect the findings of Gick et al. (2006) and Kenstowicz (2009), which established that the low vowel undergoes ATR harmony in regressive contexts but not in progressive contexts.

[3] As we can see in (5), the applicative suffix also harmonizes for height. Accounting for height harmony is outside the scope of this paper, which focuses on ATR VH. See Mutaka (1990; 1995) for discussion and analysis, and see Hyman (1999) for a detailed survey of Bantu height-based VH systems.

contrast for all vowels on the surface. For example, the causative suffix, which is contrastively [+ATR], triggers ATR VH on all preceding vowels in the word, as shown in (6):

(6) Regressive word-internal ATR VH (Archangeli & Pulleyblank 2002; Mutaka 1990, 1995, 2007; Kenstowicz 2009)

	Infinitive	*Causative*	*Gloss*
a.	ɛ-rɪ-[hɛ́k-a	e-ri-[hek-es-i-a	‘carry’
b.	ɛ-rɪ-[lɔ́g-a	e-ri-[log-es-i-a	‘bewitch’
c.	ɛ-rí-[hák-a	e-rí-[hək-is-i-a	‘smear’
d.	ɛ-rí-[tʊ́m-a	e-rí-[tum-is-i-a	‘send’
e.	e-ri-[lim-a	e-ri-[lim-is-í-a	‘exterminate’
f.	e-rí-[húm-a	e-rí-[hum-is-í-a	‘move’

Strikingly, the low vowel /a/, which blocks stem-controlled ATR VH (compare (5g) with (6c)), undergoes regressive ATR VH. Regressive ATR VH can also optionally cross word boundaries, under syntactic and phonological conditions discussed in detail in section 6, on phrasal harmony.

While [+ATR] is the dominant feature for vowel harmony in most Kinande ATR VH patterns, Hyman (1999) and Kenstowicz (2009) argue that there is a morphologically-conditioned form of dominance reversal in Kinande, where [–ATR] seems to be the trigger of vowel harmony. In section 5 we show this seemingly anomalous pattern can be accounted for with only a minor modification of the analysis of ATR VH developed in sections 3 and 4.

3 Stem-controlled ATR VH: a Correspondence analysis

We begin our analysis of vowel harmony in Kinande with the stem-controlled ATR VH pattern illustrated in (5), above. The generalization that emerges from the data in (5) is that adjacent vowels that are [+high] must also agree in their value for [±ATR]. That is, as observed by Mutaka (1995), this pattern targets a sequence of immediately adjacent [+high] vowels within the (macro-)stem. This meets the definition of parasitic harmony: only neighboring vowels that already share a particular feature, [+high], harmonize for another feature, [ATR]. Note that [+high] prefix vowels also harmonize for [ATR] with the stem-initial vowel, showing that this harmony pattern is not unidirectional.

We formalize the relation between harmonizing vowels in terms of Syntagmatic Correspondence. Syntagmatic Correspondence Theory (Krämer 1998; 2001; 2003) and Agreement by Correspondence (ABC) theory (Walker 2000a, b; Hansson 2001; Rose & Walker 2004) are further developments of OT’s Agree constraints (e.g., Baković 2000 for vowel harmony), inspired by a proposal by Pulleyblank (1997) to account for local assimilation between consonants. Correspondence relations are not only assumed between representations, as in IO-Correspondence and the correlating faithfulness constraints (McCarthy & Prince 1995), such as IO-IDENT, but also between adjacent units of the same type within representations. While in Syntagmatic Correspondence every vowel in an output candidate is automatically in correspondence with every neighboring vowel, this relation between units of the same type is optional in candidates in ABC theory (which was first developed to account for long-distance assimilation between consonants only) and regulated by a specific set of CORRESPONDENCE (CORR) constraints. However, Hansson (2014) argues for a slimmed down version of ABC theory without CORR constraints, and Bennett (2019) shows that the presence or absence of CORR constraints from CON does not change the extensional properties of typologies. (See, too, Bennett & DelBusso (2018) for a systematic comparison of minimally different versions of surface correspondence constraint systems.) Accordingly, we opt for the simpler candidate and constraint sets of Syntagmatic Correspondence here.

We propose that the Syntagmatic CORRESPONDENCE constraint in (7) best formalizes parasitic, stem-controlled ATR VH. The constraint is restricted to [+high] vowels, since [ATR] correspondence is observed to affect only adjacent [+high] vowels in this harmony pattern.

(7) Constraint formalizing stem-controlled ATR VH
S-IDENT$^{\mathrm{HI}}$(±ATR): Given a correspondence relation R between the members of each pair of adjacent vowels within a (surface) string S, assign one violation mark for every pair of correspondent [+high] vowels V1 and V2 in S that are not identical with respect to [±ATR].

In order for vowel harmony to be optimal, this CORRESPONDENCE constraint must outrank the IO-FAITHFULNESS constraint DEP(+ATR) in (8a), which penalizes any [+ATR] specification in the output which is not found in the input. A second generalization to account for is that [+ATR] specifications in the input are not deleted to satisfy the CORRESPONDENCE constraint in (7). This generalization is formalized by the IO-FAITHFULNESS constraint MAX$^{\mathrm{HI}}$ in (8b), which crucially is restricted to high vowels, since only they have contrastive [ATR] values in the input.[4]

(8) (a) IO-DEP(+ATR): Assign one violation mark for every [+ATR] that is present on a segment in the output but not present on the correspondent of that segment in the input.
(b) IO-MAX$^{\mathrm{HI}}$(+ATR): Assign one violation mark for every [+ATR] that is present on a [+high] segment in the input but not present on the correspondent of that segment in the output.

The analysis so far is exemplified in (9). In the tableaux in this section, we ignore the prefixes, in order to focus on stem-internal ATR VH.

[4] This constraint might be decomposed as a local conjunction of MAX(ATR) and *[+high] (as proposed in Baković 2000). Since constraints have domains as their restricting variables, as we will see as the analysis progresses, they might also be restricted to certain segment classes. The same holds for the S-IDENTITY constraints.

(9) Adjacent high vowels agree in ATR to satisfy Syntagmatic Correspondence

/ɛ-rɪ-[himb-ír-a/ ‘to build for’	S-Ident^{HI}(± ATR)	Max^{HI}(+ ATR)	DEP(+ ATR)
a. …-[himb-ír-a	*!		
☞ b. …-[himb-ír-a			*
c. …-[hɪmb-ír-a		*!	

Crucial constraint rankings:
S-Ident^{HI}(± ATR) ≫ DEP(+ ATR): optimizes ATR VH
Max^{HI}(+ ATR) is high-ranked, as it is not violated to achieve ATR VH
Max^{HI}(+ ATR) ≫ DEP(+ ATR): optimizes + ATR dominance (reranking would optimize (c))

The majority of OT work on vowel harmony appeals to IO-Identity constraints. Asymmetrical IO-Ident and OI-Ident constraints as well as IO-Ident constraints referring only to one feature value have been proposed in several analyses (e.g., Pater 1999; Walker 2015). However, other work, such as Butska (1998), Brown (2016) argues in favor of decomposing IO-Identity into Max and Dep(feature). We will give further empirical arguments from Kinande for our choice of Max/Dep(feature) constraints such as those in (8) in the discussion of regressive, word-internal VH in section 4.

To model the dominance of ATR, Archangeli & Pulleyblank (1994; 2002) propose grounded constraints formalizing the typological generalization that [+ high] vowels are optimally not [–ATR] and nonhigh vowels are optimally not [+ ATR], which we recast as simple OT markedness constraints in (9a, b). Note that we already account for [+ ATR] dominance by using Max(+ ATR) rather than IO-Identity(± ATR). Nevertheless, these markedness constraints still play a minor role in the analysis.

(10) a. *[+ Hi,–ATR]: Assign one violation mark for every [+ high] V that is specified as [–ATR]. (= Archangeli & Pulleyblank’s (1994; 2002) Hi/Atr)

b. *[–Hi, + ATR]: Assign one violation mark for every [–high] V that is specified as [+ ATR]. (= Archangeli & Pulleyblank’s (1994; 2002) Atr/Hi)

c. Ranking for contrast among high vowels and neutralisation among low vowels
Max^{HI}(+ ATR), DEP(+ ATR) ≫ *[+ Hi,–ATR], *[–Hi, + ATR] ≫ Max(+ ATR)

To capture the fact that only the high vowels are contrastive for ATR, the two IO-Faithfulness constraints in (8) have to dominate *[+ Hi,–ATR], and *[–Hi, + ATR] has to dominate other IO-Faithfulness constraints, since non-high vowels are predictably [–ATR], except when targeted by regressive ATR VH, to be discussed in section 4.

The MARKEDNESS constraints in (10) also play a role in accounting for why Kinande ATR VH optimizes strings of [+ATR, +high] vowels and affects only [+high] vowels. For example, in (8), above, a candidate with a final low [+ATR] vowel was not considered, since non-high vowels are not in the scope of the S-CORRESPONDENCE constraint in (7). A [+ATR] low vowel would not even be an optimal output for a hypothetical input [+ATR] low vowel because such an output violates (10b), crucially ranked above more general IO-FAITHFULNESS constraints on [+ATR], such as MAX(+ATR), the unrestricted version of the MAX^{HI}(+ATR) constraint in (8b). This point is exemplified in the tableau in (11).[5]

(11) Low vowels to the right are not targeted

/ɛ-rɪ-[himb-ír-ə/	S-IDENT^{HI} (±ATR)	MAX^{HI} (+ATR)	*–HI, +ATR	MAX (+ATR)
a. …-[himb-ír-ə	*!		*	
b. …-[himb-ír-ə			*!	
☞ c. …-[himb-ír-a				*

Crucial constraint rankings:
*[–HI, +ATR] ≫ MAX(+ATR): penalizes output non-high [+ATR] vowels
Non-crucial, low-ranked constraints have been omitted to simplify the presentation

In (11) we assume for the sake of argument a hypothetical input [+ATR] low vowel in final position. The [+ATR] low vowel is not realized faithfully in the output because the faithful and harmonic candidate (b) violates the MARKEDNESS constraint (10b) penalizing non-high [+ATR] vowels. The winning candidate (c) only violates MAX(+ATR), the general FAITHFULNESS constraint on [+ATR], which is ranked lowest, to account for the fact that non-high vowels are not contrastive for ATR. Since the S-CORRESPONDENCE constraint (7) optimizing ATR VH only scans adjacent pairs of high vowels for ATR identity, the marked [+ATR] final low vowel in (b) does not improve satisfaction of this CORRESPONDENCE constraint, even though candidate (b) appears to be more harmonic than the optimal candidate since all of its vowels are [+ATR].

A final property of stem-controlled ATR VH is that if a low vowel separates two high vowels that are not identical with regard to ATR, harmony is blocked. (See (5g), above). Since the CORRESPONDENCE constraint in (7) only evaluates adjacent pairs of high vowels, inserting an [+ATR] feature on non-adjacent high vowels gratuitously violates IO-DEP(+ATR) (7a), as

[5] Note that, even though the CORRESPONDENCE constraint in (7) optimizing ATR VH is non-directional, we do not consider candidates containing vowels to the left of the trigger yet. This is because the non-high vowels behave differently when they occur to the left of triggers than when they occur to the right. We return to this point in section 4.

in candidate (12d). If an intervening non-high vowel is changed to [+ATR] this violates the Markedness constraint against non-high ATR vowels, as shown in candidates (12b, c). We put the violation of IO-DEP(+ATR) by the non-high vowel of candidate (12b) in parentheses, because it is only violated if this vowel is underlyingly underspecified for [+ATR].

(12) Stem-controlled ATR VH blocked by nonhigh Vs

/ɛ-rɪ-[liban-ír-a/ 'to disappear for'	S-IDENT^{HI} (±ATR)	MAX^{HI} (+ATR)	DEP (+ATR)	*–HI, +ATR	*+HI, –ATR	MAX (+ATR)
☞ a. …-[liban-ír-a					*	
b. …-[libən-ír-a			*!	*	*	
c. …-[libən-ír-a			*!	*		
d. …-[liban-ír-a			*!			
e. …-[lɪban-ír-a		*!			**	*

Crucial constraint ranking:
MAX^{HI}(+ATR) ≫ DEP(+ATR) ≫ *+HI,–ATR

To sum up this section, we have accounted for the following properties of stem-controlled ATR VH. First, it is parasitic, applying only to adjacent high vowels within the stem – (9) and (11). Second, only [+high] vowels are contrastive for ATR – (11); and high vowels are targets of harmony to the exclusion of non-high vowels – (11) and (12). We have shown that the MARKEDNESS constraints in (10) that are central to Archangeli & Pulleyblank's (2002) analysis play only a minor role in our analysis. Higher ranked CORRESPONDENCE and FAITHFULNESS constraints partially incorporate some of the same markedness generalizations that enforce a restriction of ATR VH to high vowels.

(13) Interim summary of crucial constraint rankings

a. S-IDENT^{HI}(±ATR) ≫ IO-DEP(+ATR): accounts for the basic parasitic harmony pattern
b. IO-MAX^{HI}(+ATR) ≫ IO-DEP(+ATR) accounts for +ATR dominance
c. {IO-MAX^{HI}(+ATR), IO-DEP(+ATR)} ≫ *+HI,–ATR: ATR contrast in high vowels
d. *–HI,+ATR ≫ MAX(+ATR): penalizes output non-high [+ATR] vowels

(14) Ranking diagrams

S-IDENT^{HI}(±ATR) IO-MAX^{HI}(+ATR)
IO-DEP(+ATR)
*+HI,–ATR

*–HI,+ATR
MAX(+ATR)

4 Extending the analysis to regressive word-internal ATR VH

4.1 The data to be accounted for

As shown in section 2.2, above, besides having stem-controlled ATR VH, Kinande has regressive word-internal ATR VH, triggered by contrastive [+ATR, +high] vowels in non-stem-initial position. Unlike stem-controlled ATR VH discussed in the preceding section, regressive ATR VH targets both high and non-high vowels. The forms in (15), which partially repeat the data in (6), illustrate word-internal regressive ATR VH triggered by causative and agentive suffixes. These two [+high] suffixes are contrastively [+ATR] and trigger ATR VH on all preceding vowels in the word, not just [+high] vowels. (Recall the infinitive form shows the input [ATR] value of the stem-initial vowel.):

(15) Word-internal regressive ATR VH (Archangeli & Pulleyblank 2002; Mutaka 1990; 1995; 2007; Kenstowicz 2009); note that ‘j’ indicates the glide ‘y’ in (b), below

	Infinitive	*Causative*	*Agentive*	*Gloss*
a.	ɛ-rɪ-[hɛ́k-a	e-ri-[hek-es-i-a	o-mu-[hék-i	‘carry’
b.	ɛ-rɪ-[lɔ́g-a	e-ri-[log-es-i-a	o-mu-[lój-i	‘bewitch’
c.	ɛ-rí-[hák-a	e-rí-[hək-is-i-a	o-mú-[hə́k-i	‘smear’
d.	ɛ-rí-[tʊ́m-a	e-rí-[tum-is-i-a		‘send’
e.	e-ri-[lim-a	e-ri-[lim-is-í-a	o-mu-[lím-i	‘exterminate’
f.	e-rí-[húm-a	e-rí-[hum-is-í-a	o-mú-[húm-i	‘move’

Strikingly, even the low vowel /a/, which blocks stem-controlled ATR VH (see analysis in (12)), undergoes regressive ATR VH, as shown in (15c). Since [+ATR] non-high vowels can be the output of regressive ATR VH, the process is not structure-preserving, yielding the surface vowel inventory in (16), which has an [ATR] contrast for all vowels on the surface, as Gick et al.’s (2006) and Kenstowicz’s (2009) phonetic studies demonstrate:

(16) Kinande surface vowel inventory (cf. the vowel phoneme inventory in (2))

Advanced	i, e, ə, o, u
Retracted	ɪ, ɛ, a, ɔ, ʊ

Regressive word-internal ATR VH is also triggered in other morphological contexts, such as by the *-irɛ* past tense verbal suffix, as shown in (17); and in nouns with a contrastive [+ATR, +high] vowel in non-stem-initial position, as shown in (18b).

(17) Regressive harmony within verb words triggered by *-irɛ* (Archangeli & Pulleyblank 2002: 176)

	Infinitive	*Past tense*	*Gloss*
a.	e-rí-[lím-a	mó-twə́-kí-[lím-irɛ	‘we exterminated it’
b.	e-rí-[húk-a	mó-twə́-ki-[huk-irɛ	‘we cooked it’

c.	ɛ-rɪ-[hʊ́m-a	mó-twə́-kí-[hum-irɛ	'we beat him/her'
d.	ɛ-rɪ-[lím-a	mó-twə́-kí-[lím-irɛ	'we cultivated it'
e.	ɛ-rɪ-[hɛ́k-a	mó-twə́-kí-[hék-irɛ	'we carried it'
f.	ɛ-rí-[bɔ́h-a	mó-twə́-kí-[bóh-irɛ	'we tied it'
g.	ɛ-rɪ-[kára	mó-twə́-kí-[kə́r-irɛ	'we forced him/her'

(18) Regressive harmony within nouns triggered by a non-stem initial [+ ATR] vowel (Kenstowicz 2009: 260)

	Singular	*Plural*	*Gloss*
a.	ɔ-mʊ́-[lʊ́mɛ	abá-[lʊ́mɛ	'man/men'
	ɔ-mʊ-[hʊ́lɪ	ɛ-mɪ-[hʊ́lɪ	'nostril/nostrils'
	ɛ-n-[gɔnɪ	ɛ-syɔ-n-[gɔnɪ	'cane/canes'
b.	o-mú-[kəli	ə-bə́-[kəli	'woman/women'
	é-m-[búli	e-syó-m-[búli	'sheep/pl.'

4.2 Extending the Correspondence analysis

We begin our analysis of regressive word-internal ATR VH by accounting for how it targets [+ high] vowels in, for example, (17c) 'we beat him/her'. In fact, the regressive ATR VH pattern illustrated by the high vowels in this form is captured by the grammar so far, as the CORRESPONDENCE constraint in (7) has no intrinsic directionality. This is illustrated in the tableau in (19); low-ranking, non-crucial constraints have been omitted to simplify the presentation:

(19) Regressive ATR VH; cf. (9), above

/mó-twə́-kí-[hʊm-irɛ/ 'we beat him/her'	S-IDENT^{HI}(± ATR)	MAX^{HI} (+ ATR)	DEP(+ ATR)
a. …-kí-[hʊm-irɛ	*!		
☞ b. …-kí-[hum-irɛ			**
c. …-kí-[hʊm-ɪrɛ		*!	

At this point it is instructive to make a short excursus to more carefully motivate the choice of appealing to the asymmetrical MAX/DEP(+ ATR) constraints in (8), following Archangeli & Pulleyblank (2002), rather than the symmetrical IO-IDENTITY(F) constraints used in most of the OT literature on VH (see, e.g., Baković 2000; Beckman 1997; Krämer 2003). Given an input with several high [–ATR] vowels and only one [+ ATR] vowel, a symmetrical IO-IDENT^{HI}(ATR) constraint (replacing asymmetrical MAX/DEP constraints) would incorrectly select a "majority rules" candidate as the winner, as shown in (20):

(20) Majority should not rule; the correct output is bolded

/ɛ-rí-[tʊ́m-ɪs-i-a/ 'send-CAUS'	S-IDENT$^{\text{HI}}$ (±ATR)	**IDENT$^{\text{HI}}$ (ATR)**	*–HI, +ATR	*+HI, –ATR
a. …-[tʊ́m-ɪs-i-a	*!			**
b. **…-[tum-is-i-a**		**!		
💣c. …-[tʊ́m-ɪs-ɪ-a		*		***

Candidate (b) is the actual output (see (15d)). However, it is non-optimal in this alternative analysis, since changing the one input [+ATR] vowel to the majority's [–ATR], as in candidate (c), incurs just one IDENT-ATR violation rather than several. If we compare this tableau to the one in (19), we see that an analysis which appeals to asymmetrical MAX/DEP(+ATR) does not face this problem: (c) is the "majority rules" candidate in (19), correctly evaluated as non-optimal.

To account for the fact that regressive ATR VH also affects non-high vowels, we need a new CORRESPONDENCE constraint, given in (21). This constraint is asymmetric, like MAX/DEP, but it applies to correspondent vowels within a representation rather than correspondent segments in different representations. It is asymmetric both in its directionality and also with regard to the specified feature value, in parallel with MAX/DEP constraints. Recall that MAX/DEP only refers to [+ATR], not [±ATR].

(21) Vowel harmony correspondence constraint 2: S-IDENT-$V_R V_L^{PWd}$(+ATR) / S-MAX$^{\text{PWD}}$(+ATR)
For every pair of correspondent vowels, V_L and V_R, within a prosodic word, assign one violation mark for every V_R that is [+ATR] if V_L is not identical with regard to [+ATR].

Note that we are departing from Krämer's (2003) approach to Correspondence by building directionality into the constraint.[6] The order of the corresponding vowels is specified, following a proposal in Rose & Walker (2004), yielding an asymmetric triggering condition. The directionality restriction is needed to capture the generalization that regressive ATR VH applies more generally than stem-controlled ATR VH. Following Krämer (2001), the constraint is restricted to the prosodic word (PWord) since regressive ATR VH only crosses word boundaries under restricted conditions, discussed in section 6. The following tableaux exemplify the analysis of word-internal regressive ATR VH, showing how it optimizes targeting all vowels, both high and non-high:

[6] See Mahanta (2008) for a similar formulation of directional vowel harmony in a different theoretical framework. See McCollum & Essegbey (2020) for recent thoughtful comparison of prominence driven and direct directionality analyses of vowel harmony.

(22) Regressive ATR VH with nonhigh interveners

/ɔ-mʊ-[hɛk-i/ ‘carrier – Agentive’	S-MAX^{PWd} (+ATR)	S-IDENT^{Hi} (±ATR)	MAX^{Hi} (+ATR)	DEP (+ATR)	*–HI, +ATR
a. ɔmʊ-[hɛk-i	*!				
b. ɔmu-[hɛk-i	*!			*	
☞ c. omu-[hék-i				***	**
d. ɔmʊ-[hɛk-ɪ			*!		

As we can see, the optimal candidate in (22c) displays severe violations of structure preservation, since it contains [+ATR] non-high vowels, even though they are not part of the Kinande phoneme inventory – cf. (2). An alert reader will notice that a candidate in which the mid vowels in candidate (c) are substituted with the corresponding high vowels (e.g., *umu-[híki*) would win against (c), given this set of constraints and rankings, for it avoids violations of *–HI, +ATR. We assume that faithfulness to [±high] outranks all the constraints motivating ATR harmony, and thus we will not consider this kind of candidate in tableaux in the remainder of the paper.

Lack of structure preservation for ATR contrasts in the output of regressive harmony is emphasized by a word like, *e-rí-hək-is-i-a* ‘to smear-CAUS’, where we see that the low vowel /a/, which blocks stem-controlled ATR VH, undergoes regressive ATR VH. The MARKEDNESS constraints (10) are, crucially, ranked too low to make this output non-optimal:

(23) Regressive harmony can target /a/, which was a blocker for progressive harmony

/ɛ-rɪ-[hak-ɪs-i-a/ ‘to smear-CAUS’	S-MAX^{PWd} (+ATR)	S-IDENT^{Hi} (±ATR)	MAX^{Hi} (+ATR)	DEP (+ATR)	*–HI, +ATR	*+HI, –ATR
a. ɛ-rɪ-[hak-ɪs-i-a	*!	*				**
☞ b. e-rí-[hək-is-i-a				****	**	
c. ɛ-rɪ-[hak-is-i-a	*!			*		*
d. ɛ-ri-[hak-is-i-a	*!			**		
e. ɛ-rɪ-[hak-ɪs-ɪ-a			*!			***

The example evaluated in (23) contains the sequence of prefixes we omitted in the previous section for ease of exposition.[7] As shown in (23), the directional CORRESPONDENCE constraint (21) selects the candidate in which the initial vowel (augment) harmonizes as well, along with

[7] Note that the high vowel in the second prefix (*-ri-*) is also affected by the CORRESPONDENCE constraint on high vowels (7) in forms with a stem-initial high vowel. This point is crucial to our analysis of apparent “dominance reversal,” taken up in section 5.

the other high and non-high vowels preceding the harmony trigger. While Mutaka (1995) and Archangeli & Pulleyblank (2002) mainly transcribe the augment as [–ATR], they note some variability in the ATR quality of the initial vowel. We assume this variable pronunciation to be caused by variable prosodification of the vowel inside or outside the PWord (see (1), above) and thus either inside or outside the domain of regressive, word-internal ATR VH. In the optimal candidate in (23), the augment is prosodified inside the PWord. In (24), it is prosodified outside the PWord, thus outside the domain of word-internal ATR VH.

(24) Non-harmonizing initial vowel, parsed outside PWord (indicated with left parenthesis)

/ ɛ-rɪ-[hak-ɪs-i-a/ ‘smear-CAUS’	S-Max^{PWd} (+ATR)	S-Ident^{Hi} (±ATR)	Max^{Hi} (+ATR)	Dep (+ATR)	*–Hi, +ATR	*+Hi, –ATR
a. ɛ-(rɪ-[hak-ɪs-i-a	*!	*				**
☞ b. ɛ-(rí-[hək-is-i-a				****	*	
c. ɛ-(rɪ-[hak-is-i-a	*!			*		*
d. e-(rí-[hək-is-i-a				*****!		

We will return to the issue of variability in section 6. Unless noted otherwise, we assume optimal candidates where the augment is prosodified inside the PWord.

Because we assume – in contrast to Archangeli & Pulleyblank (2002) – that [ATR] contrasts are the property of vowels, not morphemes, the analysis has no trouble accounting for regressive ATR VH in nouns like (18b) [o-mú-kəli] ‘woman’ and the absence of complete harmonization in forms like [e-ri-liban-ír-a] ‘to disappear for’, which were problematic for Archangeli & Pulleyblank’s (2002) account. The crucial portion of the tableau in (12) is repeated below for ease of comparison:

(25) Regressive harmony in nouns

i. /ɔ-mʊ́-[kali/ ‘woman’	S-Max^{PWd} (+ATR)	S-Ident^{Hi} (±ATR)	Max^{Hi} (+ATR)	Dep (+ATR)	*–Hi, +ATR	*+Hi, –ATR
a. ɔ-mʊ́-[kali	*!					*
☞ b. o-mú-[kəli				***	**	
c. ɔ-mʊ́-[kalɪ			*!			**

ii. /ɛ-rɪ-[liban-ír-a/	S-Max^{PWd} (+ATR)	S-Ident^{Hi} (±ATR)	Max^{Hi} (+ATR)	Dep (+ATR)	*–Hi, +ATR	*+Hi, –ATR
☞ a. e-ri-[liban-ír-a						*
b. e-ri-[libən-ír-a				*!		

As can be seen from comparing the two tableaux in (25), assuming that the final high vowel in /-kali/ is specified [+ATR] in the input optimizes an output that satisfies regressive ATR VH under this constraint grammar. However, the ATR associated with the initial high vowel in /-liban-/ cannot trigger stem-controlled ATR VH on the applicative suffix. In Archangeli & Pulleyblank's (2002) account, the ATR feature is not associated with any vowel, and HI/ATR (our *+HI, –ATR), the constraint driving harmony in their analysis, erroneously picks (24ii.b) as the winner.[8]

To sum up the analysis so far, by appealing to two distinct CORRESPONDENCE constraints, (7) and (21), to formalize the distinct featural, directional and domain restrictions on stem-controlled and regressive ATR VH, our analysis straightforwardly captures the fact that low vowels do not block regressive word-internal ATR VH, while they do block stem-controlled ATR VH. Note this is a type of harmony system that Baković (2000) claimed should not exist. (See, too, discussion in Rose & Walker 2011: 280.)

5 Dominance reversal in the class 5 prefix?

In our analysis, [+ATR] dominance is explicitly encoded in the CORRESPONDENCE constraint in (21) and implicitly encoded in the MAX/DEP constraints (8a,b) which refer asymmetrically to [+ATR]. Hyman (2002) and Kenstowicz (2009) claim that the dominance of [+ATR] is reversed with the class 5 prefix. However, as we will see in this section, our analysis extends with minor modification to account for the data without invoking dominance reversal.

The class 5 prefix /ɛ-ri-/, is realized [ɛ-rɪ-] in the context of a [–ATR, +high] stem-initial vowel; it is realized [e-ri-] elsewhere. The data in (26) compares the realization of the infinitive prefix with the near-identical class 5 prefix to illustrate this point. Notice that the infinitive prefix undergoes regressive ATR VH, as expected and surfaces as [–ATR] in the absence of an ATR trigger. The class 5 prefix, in contrast, is consistently [+ATR], except in (26c, d, bolded), where it is [–ATR] to match the [+high, –ATR] stem-initial vowel; recall that '[' indicates a left stem edge:

(26) "Dominance reversal" with the class 5 prefix (Hyman 2002; Kenstowicz 2009: 261–263)

	infinitive prefix	*gloss*	*class 5 prefix*	*gloss*
a.	e-ri-[líba	'to cover'	e-ri-[ríba	'eddy'
b.	e-ri-[húka	'to cook'	e-rí-[bú	'ember'
c.	ɛ-rɪ-[líma	'to cultivate'	**ɛ-rí-[hɪrɪ**	'crab'
d.	ɛ-rɪ-[hʊ́m-a	'to beat'	**ɛ-rí-[bʊgʊ**	'plantain'
e.	ɛ-rɪ-[hɛ́k-a	'to carry'	e-rí-[hɛmbɛ	'horn'
f.	ɛ-rí-[bɔ́h-a	'to tie'	e-rí-[lɔ́lɔ	'sin'
g.	ɛ-rɪ-[kára	'to force'	e-ri-[sanza	'branch'

[8] For this reason, they prematurely conclude that the morphosyntactic domain of root must play a role in the phonological grammar. See discussion of domains relevant to our analysis in sections 6 and 7, below.

Hyman (2002) and Kenstowicz (2009) analyze the class 5 prefix with an underlying [+ATR, +high] vowel, contra Archangeli & Pulleyblank (2002), who propose that all class 5 nouns have a floating [+ATR] feature. We follow Hyman and Kenstowicz, for reasons taken up in detail below.[9]

Our analysis can account for this pattern with only minor modifications to the constraint set developed so far. What we propose is, first, a more specific MAX$^{\text{HI}}$(+ATR) constraint that is localized to the domain of the Stem (just as constraint (21) is localized to the domain of PWord). The new constraint is defined in (27):

(27) IO-MAX$^{\text{HI,STEM}}$ (+ATR):
Assign one violation mark for every [+ATR] that is present on a [+high] segment in the Stem in the input but not present on the correspondent of that segment in the output.

In addition, we have to specify DEP(+ATR) to the same domain and rank it above general MAX$^{\text{HI}}$(+ATR), but below the domain-specific MAX(+ATR) constraint in (27), to maintain the results of the analysis in the previous sections:

(28) IO-DEP$^{\text{HI,STEM}}$ (+ATR):
Assign one violation mark for every [+ATR] that is present on a high vowel in the output but not present on the correspondent of that segment in the stem in the input.

These two constraints crucially distinguish high vowels in stems from other high vowels that are contrastively specified for ATR. Both constraints must be ranked above MAX$^{\text{HI}}$(+ATR) to have an effect. Informally, the proposal is that being faithful to the ATR specification is more important for vowels in stems than those in other morphological domains.

As demonstrated in the tableau in (29), below, adding these constraints to the analysis straightforwardly accounts for apparent dominance reversal, recasting it as a process that reinforces the stem as the asymmetric source of harmony triggers. Note that non-crucial, low-ranked constraints have been omitted from this tableau to simplify the presentation:

(29) Class 5 prefix harmonizes with [+high, –ATR] vowel in stem-initial position

/ɛ-rí-[hɪrɪ/ ‘crab’	S-MAX$^{\text{PWD}}$ (+ATR)	S-IDENT$^{\text{HI}}$ (±ATR)	MAX$^{\text{HI,STEM}}$ (+ATR)	DEP$^{\text{HI,STEM}}$ (+ATR)	MAX$^{\text{HI}}$ (+ATR)	*+HI, –ATR
a. ɛ-rí-[hɪrɪ	*!	*				**
b. e-rí-[hɪrɪ		*!				**
☞ c. ɛ-rɪ-[hɪrɪ					*	***
d. e-rí-[hiri				*!*		

9 See Kenstowicz (2009) for additional data illustrating ATR harmony in nouns with class 5 prefixes.

In (29), the disharmonic faithful candidate (a) is excluded because it violates the CORRESPONDENCE constraints optimizing parasitic ATR VH between adjacent high vowels (7) and regressive ATR VH (21). All other candidates satisfy (21). However, candidate (b) has a high [+ATR] vowel followed by a high [–ATR] vowel, which violates S-IDENT$^{\text{HI}}$(±ATR). Candidates (c) and (d) contain only [+ATR] vowels or only [–ATR] vowels and thus are more harmonic than candidates (a) and (b). Candidate (c) is superior to candidate (d) because it satisfies DEP$^{\text{HI,STEM}}$. As we can see, it is crucial here that the high-ranking MAX$^{\text{HI,STEM}}$(+ATR) constraint (28) is limited to the stem domain. We have included the wide-domain MAX$^{\text{HI}}$(+ATR) constraint (8b) in the tableau, even though it is low ranked, to make this point clear.

The tableau in (30) illustrates how our analysis accounts for the lack of harmony between the high [+ATR] vowel in the prefix and [–ATR] non-high vowels following it. (Again, non-crucial, low-ranking constraints have been omitted to simplify the presentation.)

(30) Class 5 prefix does not harmonize with [–high, –ATR] vowel in stem-initial position

/ɛ-rí-[hɛmbɛ/ ‘horn’	S-MAX$^{\text{PWD}}$ (+ATR)	S-IDENT$^{\text{HI}}$ (±ATR)	MAX$^{\text{HI,STEM}}$ (+ATR)	DEP$^{\text{HI,STEM}}$ (+ATR)	MAX$^{\text{HI}}$ (+ATR)	*–HI, +ATR
a. ɛ-rí-[hɛmbɛ	*!					
b. ɛ-rɪ-[hɛmbɛ					*!	
c. e-rí-[hembe						**!*
☞ d. e-rí-[hɛmbɛ						*

Crucially, none of the Syntagmatic CORRESPONDENCE constraints are violated by this apparent disharmony. Recall that S-MAX (S-IDENT-$V_RV_L^{PWd}$) (21) is only violated by a sequence of a [–ATR] vowel followed by a [+ATR] vowel, not the reverse order. This is exemplified by the first candidate in (30). Even though all the FAITHFULNESS constraints refer to high vowels only, candidate (d), with mid [–ATR] vowels to the right of the [+ATR] high prefix vowel, is preferred over the fully harmonic candidate (c). No harmony constraint decides between the two forms, leaving the decision to the MARKEDNESS constraint penalizing [–high, +ATR] vowels. Given the absence of pressure from harmony-inducing CORRESPONDENCE constraints, there is also no reason to select the fully harmonic form, (b), with all [–ATR] vowels, over the winning candidate. Note that (b) violates the lowest ranked FAITHFULNESS constraint, which optimizes preserving input [+ATR] in output high vowels.

It is important to note that our analysis follows Hyman (2002) and Kenstowicz (2009) in assuming that the exceptional [+ATR] properties of the class 5 prefix are due to an input [+ATR] specification on the [+high] vowel of the prefix. This contrasts with the analysis of Archangeli & Pulleyblank (1994; 2002), who assume that an input floating [+ATR] specification on all class

5 noun stems with [–ATR] root vowels is responsible for the [+ATR] realization of the class 5 prefix vowel(s). Both Hyman (2002) and Kenstowicz (2009) provide several arguments against this alternative. One of the more telling arguments they put forward is that, if a class 5 noun stem has a [+ATR] floating feature, it should surface also with other prefixes to the same noun stem, such as the class 6 plural prefix or the diminutive prefix, but it does not. Another strong argument is that the floating [+ATR] autosegment associated with [–high] stem-initial vowels has no plausible diachronic source, since only [+high] vowels contrast for [ATR] in Proto-Bantu. (See Hyman 2002 and Kenstowicz 2009 for more detailed discussion of these points.) Our analysis deviates substantially from Kenstowicz's in that we specify IO-Faithfulness to a prominent domain, i.e., Stem, and we use a positive directional harmony constraint instead of Kenstowicz's negative constraint against progressive VH. The right-to-left bias diagnosed by Hyman is thus, in our analysis, a direct effect of S-Max. This is in line with the general treatment of VH here and in the majority of the literature, in which some specific VH constraint (Agreement, S-Correspondence or Alignment) favors VH, while IO-Faithfulness blocks VH.

Finally, as a reviewer points out, the class 4/10 numeral prefixes are also exceptional in that they trigger progressive ATR harmony (Hyman 2002; Kenstowicz 2009). Noun class prefixes normally harmonize for ATR with their bases: e.g., the class 4 nouns, ***ɛmí**-hólɪ* 'nostrils' vs. ***emí**-líki* 'ropes' All the data thus far has illustrated this generalization. However, the prefix for a class 4 numeral, which has a distinct form from the prefix found with other class 4 words, triggers ATR harmony on the numeral stem: *ba-**bɪrɪ*** 'two, class 2' vs. *i-**biri*** 'two, class 4' (Kenstowicz 2009: 260; Hyman 2002: 21). While these data are clearly problematic for any analysis of Kinande harmony, they also clearly form a small, multiply exceptional set. We propose that since numerals are a closed class, they do not have stem status and therefore behave like other functional items, such as suffixes. This data thus does not constitute the same kind of stem dominance reversal as is found with the class 5 prefix, where apparent "reversal" is quite general for words in this class, not confined to a single closed class of modifiers. For a general discussion of why prefixes so rarely act as triggers in vowel harmony, we direct the reader to Fábregas & Krämer (2020).[10]

To sum up this section, we have shown that "dominance reversal" emerges from our Syntagmatic Correspondence analysis of ATR VH without having to propose a constraint specific to the class 5 prefix context that optimizes [–ATR] harmony. On the contrary, the Correspondence constraint in (7) optimizing parasitic [+ATR] VH between adjacent [+high] vowels also optimizes stem-controlled [–ATR] harmony in the context of the class 5 prefix, due to its interaction with two constraints ((27) and (28)) that have the effect of restricting harmony triggers to the stem domain. The Hasse diagram in (31) summarizes the Kinande grammar developed so far.

[10] See Hyman (2002) and Kenstowicz (2009) for alternative accounts of the exceptionality of the class 4/10 numeral prefixes in Kinande.

(31) Kinande harmony grammar

$\text{S-Max}^{\text{PWd}}(+\text{ATR})$ $\text{S-Ident}^{\text{Hi}}(\pm\text{ATR})$ $\text{IO-Max}^{\text{Hi,Stem}}(+\text{ATR})$

$\text{IO-Dep}^{\text{Hi,Stem}}(+\text{ATR})$

$\text{IO-Max}^{\text{Hi}}(+\text{ATR})$

IO-Dep(+ATR)

*+Hi,–ATR *–Hi,+ATR

Max(+ATR)

6 Regressive ATR VH across word boundaries

It is regularly asserted in surveys of vowel harmony systems that the domain of vowel harmony typically is the word. (See, e.g., Archangeli & Pulleyblank 2007; Hyman 2002; Kaisse 2017; 2019; Krämer 2003; Rose & Walker 2011; van der Hulst & van de Weijer 1995.) The "word" is usually taken to refer to the phonological word (PWord), not the grammatical word, since compounds are often disharmonic. Indeed, vowel harmony is said to rarely cross lexical word boundaries, either within compounds or within phrases.

However, work like Casali (2002; 2008), Downing (2018), Downing & Krämer (to appear), Hyman (2002), Kaisse (2019), Krämer (2003), Kügler (2015) and Obiri-Yeboah & Rose (2022) demonstrates that it is, in fact, not uncommon for vowel harmony to extend beyond a word boundary. Kinande regressive ATR VH, as described in Mutaka (1990; 1995), is of interest for theories of the domain of vowel harmony, as it represents an additional case where vowel harmony can apply across morphological word boundaries. As shown in (32), its application is, though, both variable and gradient. Regressive phrasal ATR VH (PVH) applies only optionally across a word boundary, only within noun-modifier collocations, and then it can have a 'domino effect,' taking as its domain one or more contiguous syllables within the target word:

(32) Kinande phrasal vowel harmony (Schlindwein 1987; Mutaka 1990; 1995);
V = vowel; harmonizing vowels are italicized

	Input	*Potential outputs*		*Domain of PVH*
a.	e-mi-[ti mi̧-[ku̧hi̧ trees short	ɛ̀mítí míkù:hì	'short trees'	PWord
b.	e-mi-[ti̧ mi̧-[ku̧hi̧	ɛ̀mít*í* míkù:hì		V + PWord
c.	e-mi̧-[ti̧ mi̧-[ku̧hi̧	ɛ̀m*ítí* míkù:hì		V + V + PWord
d.	ȩ-mi̧-[ti̧ mi̧-[ku̧hi̧	*èmítí* míkù:hì		$\{\text{PWord PWord}\}_{\text{DP}}$

While earlier work on Kinande had characterized PVH as phonological, Archangeli & Pulleyblank (2002) argue that Kinande PVH is a phonetic anticipatory effect, because: "The impressionistic evidence is that phrasal ATR harmony is gradient both in how far it goes in a word and in how strongly each vowel is affected" (p. 180). For this reason, Kinande would not be a true exception to the claim that vowel harmony is word bound. Kaisse (2019) argues, furthermore, that since Kinande, like other Bantu languages, has only a small number of adjectives, noun-adjective collocations can be considered lexicalized, i.e., PWord-like.

We argue that Kinande PVH must be considered phonological and extend our Correspondence analysis of ATR VH to account for the phonological constraints on this harmony pattern. In section 6.2 we justify our phonological approach to PVH by critiquing Archangeli & Pulleyblank's proposal that gradience and variability in PVH are sufficient criteria for considering it a phonetic process.

6.1 Kinande PVH as a phonological process

This section provides arguments for why PVH must be considered a phonological process, based on the detailed discussion in Mutaka (1995). Section 6.1.2 extends our analysis of word-internal ATR VH to the phrasal domain.

6.1.1 PVH is morphosyntactically conditioned

If PVH were a purely phonetic phenomenon, we would expect it to either always apply or not in the same phonetic and phonological contexts. Morphosyntactic information should not be available to condition postlexical or phonetic processes (Coetzee & Pater 2011). However, as Mutaka (1995) demonstrates, PVH is subject to morphosyntactic conditioning: it only applies within DPs. This is illustrated by the data in (33), which partially repeats the data in (32), for convenience. Note that the data where PVH applies are DPs consisting of a noun followed by a modifier:

(33) Kinande PVH applies in DPs (Mutaka 1995:52)

a. ɛ̀-mí-tí mí-kù:hì — 'short trees'
[literally, *trees short*]
ɛ̀-mí-t*í* mí-kù:hì
ɛ̀-m*í-tí* mí-kù:hì
è-mí-tí mí-kù:hì

b. ɛ-βɪ-tsʊngʊ́ βí-kù:hì — 'short potatoes'
[literally, *potatoes short*]
ɛ-βɪ-tsʊng*ú* βí-kù:hì
ɛ-βɪ-ts*ungú* βí-kù:hì
e-βi-tsungú βí-kù:hì

Mutaka (1995) demonstrates that PVH is not found in phrases consisting of a noun + verb. As shown by the data in (34), regressive VH stops at the first syllable of the second word, the one containing the triggering vowel. The first word is not affected:

(34) PVH not found in non-DPs (Mutaka 1995: 54)
ɛ-kɪ-tsʊngʊ 'potato' ki-némundí-húk-u-a '(it) will be cooked'
→ ɛ-kɪ-tsʊngʊ ki-némundí-húk-u-a 'the potato will be cooked'

We propose that this restriction is related to the fact that DP is the smallest Phase (Kratzer & Selkirk 2007; Kahnemuyipour 2009).[11] We can then define the domain for ATR VH and PVH as the PWord and the smallest Phase, respectively. Kinande PVH is thus grammatically conditioned, which is not the case for phonetic processes (Kiparsky 1985).

Kaisse (2019) discusses other languages where the DP provides a domain for processes which are usually considered to be canonically word-bound, and Obiri-Yeboah & Rose (2022) mentions other cases of cross-word harmony restricted to DP, so Kinande is not alone in this regard. Kaisse proposes that, because of the small number of adjectives in Kinande, noun-adjective sequences are not to be considered as loosely juxtaposed as other phrasal collocations. Our counterargument is that the adjective and the noun within the DP each has word morphology: each consists of a stem plus agreement class prefix and augment, and the prefixes have identical phonological properties, unlike the exceptional numeral prefixes discussed in the preceding section. Kaisse alludes to the frequency of collocations in her argument. We suspect that a collocation like 'the potatoes will be cooked' (34) has a higher frequency than 'short potato' (33), unless 'short' has a broader meaning in Kinande or 'short potato' is some popular local dish (as for example shortbread in Scotland). Indeed, even though adjectives are a restricted class, nouns are not, and so the number of different noun + adjective collocations would necessarily include some less frequent ones. Finally, Kaisse (2019: 235) mentions, without citing much data, that, according to her personal communication with Mutaka, non-iterative PVH also can occur between verb-object collocations. (Mutaka's data showing that PVH does not occur in subject-verb sequences, as shown in (34), is not challenged by Kaisse.) Thus, we can conclude that we are looking at two different processes: variably iterative PVH occurring regularly within the DP, and non-iterative PVH optionally occurring within the VP. Both are clearly syntactically conditioned, a property that is not expected for phonetic processes.

[11] We thank our colleagues, Peter Svenonius and Antonio Fábregas, for their help in defining this syntactically-conditioned domain.

6.1.2 PVH is phonologically conditioned

If PVH were a purely phonetic phenomenon, we would not expect its application to be subject to phonological restrictions. As Mutaka (1995) demonstrates, however, phonological restrictions apply to regressive PVH that do not apply to regressive word-internal ATR VH.

One phonological restriction on PVH is that it does not apply if the first word in the DP, the potential target for PVH, does not end in a high vowel. Recall that regressive ATR VH within the PWord applies to any vowel preceding the trigger, with no restrictions on its height. The height restriction on PVH is illustrated in the noun + modifier DPs in (35):

(35) Non-high vowels block PVH (Mutaka 1995: 52; Hyman 2002)

a.	ɛ-mɪ-hámbá mí-kù:hì	'short knives'	*e-mi-hə́mbə́ mí-kù:hì
b.	ɛ-mí-twɛrɔ́ mí-kù:hì	'short nails'	* e-mí-tweró mí-kù:hì
c.	ɛ-bí-sɛkɛ́ mí-kù:hì	'short sugar canes'	* e-bí-seké mí-kù:hì

A second restriction, as Mutaka (1995) shows, is that PVH is only regressive. A non-ATR word which begins with a high vowel does not undergo harmony with a final [+ATR, +high] vowel in the preceding word. This restriction is illustrated in the noun + modifier DPs in (36):

(36) Directionality in PVH (Mutaka 1995: 53)

ɛ/e-kí-kalì	'cl.7 woman'	kí-rɪ	'tall'	ɛ/e-kí-kalì kí-rɪ
ɛ/e-njunju	'cl 9 bird'	njí-rɪ	'long'	ɛ/e-njunju njí-rɪ
ɔ/o-mú-kalì	'cl.1 woman'	mʊ́-lɪ-mʊ́-lɪ	'very tall'	ɔ/o-mú-kalì mʊ́-lɪ-mʊ́-lɪ
ɛ/e-kí-síki	'cl. 7 log'	kɪ-βʊja	'pretty'	ɛ/e-kí-síki kɪ-βʊja

Recall that, if parasitic ATR VH as defined in (7) had scope across word boundaries, one would expect harmony in this phonological context. PVH clearly applies subject to different restrictions than either stem-controlled or word-internal regressive VH.

To account for the fact that word-internal and phrasal regressive ATR VH are subject to different phonological conditions, we propose, first, to revise the constraint in (7) to restrict its domain to the prosodic word, matching the domain of the regressive ATR VH constraint in (21). The revised constraint is given in (37):

(37) Stem-controlled harmony constraint, revised
S-IDENT$^{\text{HI,PWD}}$(ATR): Assign one violation mark for every pair of adjacent [high] vowels *within a prosodic word* that are not identical with respect to [ATR].

To account for the different phonological restrictions holding of regressive ATR VH across word boundaries (PVH), we need an additional constraint, one that is a fusion of the two S-IDENT CORRESPONDENCE constraints introduced before. It has to be directionally asymmetric, like (21), and restricted to targeting high vowels, like (7), BUT not restricted to the domain of the PWord. This new constraint is formalized in (38):

(38) PVH CORRESPONDENCE constraint: S-MAX$^{\text{HI}}$(+ATR)
For every pair of correspondent vowels, V_L and V_R, within a string, if V_R is [+ATR] and V_L is [+high], assign one violation mark if V_L is not [+ATR].

Tableau (39) exemplifies the analysis. Note that in the tableaux in this section, parentheses indicate PWord edges; '[' indicates a left stem edge.

(39) Crossing the word boundary I

/ɛ̀-mí-[tí mí-[kʊ̀:hì/ 'tree short'	S-MAX$^{\text{PWd}}$ (+ATR)	S-IDENT$^{\text{HI,PWd}}$ (±ATR)	MAX$^{\text{HI,STEM}}$ (+ATR)	S-MAX$^{\text{HI}}$ (+ATR)	DEP$^{\text{HI,STEM}}$ (+ATR)	*+HI, –ATR]
a. ɛ̀(mí[tí) (mí[kʊ̀:hì)	*!	*				****
b. ɛ̀(mí[tí) (mí[kù:hì)				*!		**
☞ c. ɛ̀(mí[tí) (mí[kù:hì)					***	
d. ɛ̀(mí[tí) (mí[kʊ̀:hì)			*!		*	*****

Candidate (a) is ruled out by its violation of the CORRESPONDENCE constraints we have seen at work before: note that the [+ATR] feature present on the last vowel in the second word is not reproduced on preceding vowels. Candidate (b) consists of two harmonic domains, each spanning a prosodic word. Across this PWord boundary we see a [–ATR] high vowel followed by a [+ATR] vowel, which violates the constraint in (38). Candidate (c), the optimal candidate, does not have this flaw. While all vowels in the first word are [+ATR], in blatant violation of DEP$^{\text{HI,STEM}}$(+ATR), these violations are not fatal. All other candidates violate higher-ranked constraints. Even candidate (d), which is completely harmonic by virtue of the absence of any output [+ATR] specification, fatally violates MAX$^{\text{HI,STEM}}$(+ATR).

In tableau (40) we show that the grammar correctly optimizes disharmonic sequences of words within DP if the ATR feature originates in the word to the left, even though the word to the left is itself harmonic. Non-crucial, low-ranking constraints have been omitted for ease of presentation:

(40) PVH is regressive, not progressive

/ɛ-[njʊnju njí-[rɪ/ 'bird long'	S-MAX$^{\text{PWd}}$ (+ATR)	S-IDENT$^{\text{HI,PWd}}$ (±ATR)	MAX$^{\text{HI,STEM}}$ (+ATR)	S-MAX$^{\text{HI}}$ (+ATR)	DEP$^{\text{HI,STEM}}$ (+ATR)
a. ɛ-[njʊnju) (njí-[rɪ	*!	*		*	
b. e-[njunju) (njí-[ri					**!*
☞ c. e-[njunju) (njí-[rɪ					*
d. ɛ-[njʊnjʊ) (njí-[rɪ			*!		

Candidate (b), which undergoes progressive PVH, is not optimal, compared to candidate (c) with one harmonic domain in each word, since the relevant CORRESPONDENCE constraint (38) does not "look to the right." A sequence of a [+ATR] high vowel and a [–ATR] high vowel therefore does not violate it. As a result, candidate (b) incurs more IO-FAITHFULNESS violations than the winning candidate (c).

Since constraint (38) is restricted to high vowels, the grammar also does not optimize PVH if the vowel at the end of the first word is non-high, even if it is followed by a [+ATR] vowel. This point is exemplified in (41):

(41) No PVH to non-high vowels

/ɛ-mɪ-[hámbá mí-[kʊ̀ːhì/ 'knives short'	S-MAX^{PWd} (+ATR)	S-IDENT^{Hi,PWd} (±ATR)	MAX^{Hi,Stem} (+ATR)	S-MAX^{Hi} (+ATR)	DEP^{Hi,Stem} (+ATR)	*–HI, +ATR
☞ a. (ɛ-mɪ-[hámbá) (mí-[kù:hì)					*	
b. (ɛ-mi-[hámbá) (mí-[kù:hì)	*!				*	
c. (ɛ-mɪ-[hámbá) (mí-[kʊ̀:hì)	*	*		*!		
d. (ɛ-mɪ-[hámbá) (mí-[kʊ̀:hì)			*!		*	*
e. (e-mi-[hə́mbə́) (mí-[kù:hì)					*	*!**

A final phonological restriction on PVH is that, while we find variability when PVH is motivated by markedness reduction, from Mutaka's (1995) discussion it appears to be exceptionless within the DP if the final vowel of the first word glides or deletes in a vowel hiatus context, leading to resyllabification of the first word (a noun) with the second (a nominal modifier). ATR VH overspill is optional only for the initial vowel (the augment) if the noun is followed by a determiner or a numeral (noun + modifier):[12]

(42) Gliding/vowel deletion I (Mutaka 1995: 52–53)

a.	ɛkɪ-[hɪndɪ	'log'	ekì	'this'	ɛ/eki-hindjekì
	ɛmí-[tɪ	'trees'	ejì	'these'	ɛ/emítjejì
	ɔmʊ́-[tɪ	'tree'	ojù	'this'	ɔ/omútjejì
	ɛ́-[mbɛnɛ̀	'goat'	ejì	'this'	ɛ́/émbenjejì
	ɛ-[mbasa	'axe'	ejì	'this'	ɛ/embasejì (ɛ/embəsejì

[12] See Archangeli & Pulleyblank (2002) and Jones (2012) for discussion of ATR patterns resulting from word-internal vowel coalescence and glide formation.

b.	ɔmʊ-[mbɛsa	‘girl’	ojù	‘this’	ɔ/omumbesojù
	ɛsj-[ɔ́mbasa	‘axes’	esì	‘these’	ɛ/esjómbasesì (ɛ/esjómbəsesì)
c.	ɛsj-[ɔ́mbɛnɛ̀	‘goats’	íβirì	‘two’	ɛ/esjómbeniβirì
	aβa-[mbɛsa	‘girls’	íkumi	‘ten’	aβambesíkumi (a/əβəmbesíkumi)
	ɛsj-[ɔmbʊndʊ	‘rifles’	íni	‘four’	ɛ/esjombundwíni

To account for this pattern, Mutaka (1995) proposes (citing a suggestion from John McCarthy) that: “gliding or vowel deletion destroys the morphological boundary between the two words.” That is, PVH is perhaps not truly phrasal in examples like this, where resyllabification destroys the crisp alignment of morphological words and syllable edges. The data in (43) further illustrate PVH triggered by resyllabification within the DP:

(43) ATR VH overspill optional only for initial V with N + Adj (lex + lex)

a.	ɛmí-[tɪ + emí-[kùhì	ɛmítjemíkùhì	‘trees that are short’
b.	ɔlʊ́-[tɪ + olú-[kùhì	ɔlútjolúkùhì	‘a big tree that is short’
c.	ɛmɪ-[hámbá + emí-[kùhì	ɛmihámbemíkùhì (ɛ/emihə́mbemíkùhì)	‘knives that are short’
d.	ɔlʊ-[hámbá + olú-[kùhì	ɔluhámbolúkùhì (ɔ/oluhə́mbolúkùhì)	‘a big knife that is short’
e.	ɛmí-[twɛrɔ́ + emí-[kùhì	ɛmítwɛrwemíkùhì	‘nails that are short’
f.	ɔmʊ́-[twɛrɔ́ + omú-[kùhì	ɔmútwerwomúkùhì	‘a nail that is short’

Glide formation and vowel deletion are common phonological strategies to avoid hiatus, and the resulting resyllabification is what extends the domain of PVH. As shown in (44), below, the DP restriction on PVH holds, however, even if resyllabification occurs:

(44) PVH not found in non-DPs in spite of gliding (Mutaka 1995: 54)

a.	ʊ́-hʊ́m-ɛ ‘hit’	ɛ-kí-síki	‘log’ →	ʊ́-hʊ́m-j ɛ/ekí-síki	‘hit the log’
b.	ʊ́-m-bɛ ‘give me’	ɛ-kí-síki	‘log’ →	ʊ́-m-bj ɛ/ekí-síki	‘give me the log’
c.	ɛ-rɪ-hɛr-a ‘to plant’	ɛ-kí-síki	‘log’ →	ɛ-rɪ-hɛr ɛ/ekí-síki	‘to plant the log’

In our analysis, we adopt Mutaka’s (1995) basic proposal, namely, that vowel hiatus resolution leads to resyllabification, which in turn leads to prosodic reorganization, which in turn extends the domain of regressive ATR VH within the DP. To formalize this generalization, we appeal to the *Consistency of Exponence Hypothesis* (Prince & Smolensky 1993): while a phonological process cannot destroy a morphological boundary, it can lead to prosodic reorganization. The proposal is schematized in (45) for example (43e):

(45) Prosodic reorganization due to resyllabification to resolve vowel hiatus across a word boundary in Noun + adjective DPs

{ɛmítwɛrɔ́}$_{\text{PWord1}}$ + (emíkùhì)$_{\text{PWord2}}$ → e.mí.twe.rwe.mí.kù.hì

a. Overlapping PWords: {e.mí.twe.(rwe}$_{\text{PWord1}}$.mí.kù.hì)$_{\text{PWord2}}$

b. Merged PWord: (e.mí.twe.rwe.mí.kù.hì)$_{\text{PWord}}$

Resyllabification applies systematically when a noun is followed by a function word modifier. Since function words (fnc) are not commonly parsed into an independent PWord (Selkirk 1995), the function word status of some nominal modifiers provides an additional motivation for prosodic reorganization in this context:

(46) Hiatus resolution/fnc incorporation results in prosodic reorganization in Noun + fnc

(ɛkɪhɪndɪ)$_{\text{PWord}}$ + ekì

a. Partial parse: (ɛ/e.ki.hin.dje.)$_{\text{PWord}}$ kì

b. Full parse: (ɛ/e.ki.hin.dje.kì)$_{\text{PWord}}$

Additional constraints are needed to account for vowel hiatus and its effect on re-prosodification. First, hiatus avoidance is triggered by some MARKEDNESS constraint, like the requirement for every syllable to have an onset or a constraint penalizing two adjacent vowels, *VV. Violation of this constraint can be avoided in various ways. A mapping in which one of the two input vowels is deleted violates MAX-IO to satisfy *VV. Alternatively, one of the vowels could be turned into a consonant (glide), in violation of a faithfulness constraint like IDENT(vocalic). The latter solution is the one that is observed in most instances in Kinande. The three relevant constraints are ranked as shown in (47d).

(47) Constraints penalizing hiatus

a. *VV: 'Assign one violation mark for every pair of adjacent vowels.'

b. MAX-IO: 'Assign one violation mark for every segment in the input that is not present in the output.'

c. IDENT(vocalic): 'Assign one violation mark for every V realized as a G.'

d. *VV, MAX-IO >> IDENT(vocalic)

Glide formation has further consequences for higher level prosodic organization, as now the glide, the preceding consonant and the following vowel are parsed in the same syllable. The resulting syllable contains segmental material from two otherwise distinct words and has to be integrated into one, the other or both. Any of these solutions will violate some constraint on prosodic organization. We propose that overlapping PWords violate the CRISPEDGE constraint (Ito & Mester 1999) in (48):

(48) CRISPEDGEPWD: Assign a violation mark for Prosodic Words that overlap.

CRISPEDGEPWD must be dominated by *VV, since hiatus resolution is what leads to a potential overlap in PWords.

Once CRISPEDGEPWD comes into play, there is no constraint in our grammar that would favor a candidate with overlapping PWords over one with both words parsed as a single PWord. A constraint to this effect, i.e., (MWORD ≈ PWD) is also ranked below the constraints favouring gliding. We thus assume that ATR VH propagates beyond the left word edge in these cases because the syllable resulting from glide formation results in parsing the two words involved as one PWord, in violation of MWD ≈ PWD. If there is a [+ATR] feature at the right edge of the PWord into which the first word is integrated, regressive ATR VH optimally proceeds as usual through the whole PWord domain to satisfy the CORRESPONDENCE constraint in (21). The tableau in (49) exemplifies the analysis; curly brackets delimit PWord1 and parentheses delimit PWord2 or a merged PWord, as in (45), above:

(49) Phrasal VH as a by-product of hiatus avoidance

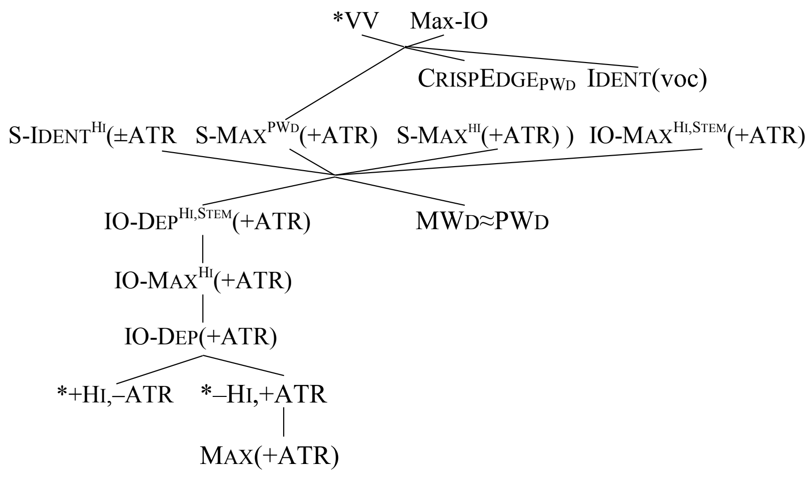
//ɛmbɛnɛ ɛji//	*VV	MAX-IO	CRISPEDGE$_{PWD}$	IDENT(voc)	S-MAX^{PWD} (+ATR)	MWD ≈ PWD
a. {ɛmbɛnɛ} (ɛji)	*!				*	
b. {ɛmbɛnɛ} (eji)	*!					
c. {ɛmbɛnɛ}(ji)		*!				
d. (ɛmbɛneji)		*!			*	*
e. {ɛmbɛn(je}ji)			*!	*	*	
f. {ɛmben(je}ji)			*!	*	*	
g. {emben(je}ji)			*!	*		
h. (ɛmbɛnjeji)				*	*!	*
☞ i. (embenjeji)				*		*
j. (ɛmbenjeji)				*	*!	*

Candidates (a) and (b) both violate *VV (47a), as they each contain a sequence of two vowels not separated by a consonant. Candidate (b) universally bounds (a) since the vowels in each PWord satisfy S-IDENT (21). All other candidates are more optimal than (a) and (b) since they all avoid vowel hiatus and so satisfy *VV. Candidates (c) and (d) are non-optimal, as they have avoided hiatus by deleting one of the two vowels, in violation of high-ranked MAX. Candidates (e) to (g) all violate CRISPEDGE-PWD, as they have overlapping PWords: the syllable formed with segments from both words is integrated in two overlapping PWords. Candidates (h-k) have resolved the hiatus by glide formation, and they have resolved the resulting prosodification problem by parsing the whole string as a single PWord. Candidate (h) has the same ATR specifications as the two words would have in isolation, thus displaying disharmony between the last vowel of the first word and the first vowel of the last word, in violation of S-IDENT (21). Candidate (j) is non-optimal, as it has an augment with the unmarked ATR value for a non-high vowel, leading to disharmony with the next (and remaining) vowels in the PWord in which it is integrated. This leaves candidate (i) as the optimal output.[13]

To sum up this section, we conclude that the morphosyntactic and phonological restrictions on PVH discussed in Mutaka (1995) clearly demonstrate that it must be considered a phonological process, rather than a phonetic one (contra Archangeli & Pulleyblank 2002). Purely phonetic processes should be blind to these kinds of grammatical restrictions. As we have shown, the CORRESPONDENCE analysis developed to account for word-internal regressive ATR VH extends, with minor adaptation, to account for PVH. It is worth noting that the phonological and morphological restrictions on PVH contradict Archangeli & Pulleyblank's (2002) proposal that postlexical phonological processes should be subject to fewer restrictions than word-internal processes. In fact, Obiri-Yeboah & Rose's (2022) survey of cross-word harmony shows that it is fairly common for more restrictions to apply to cross-word than to word-internal harmony. It is an advantage of the CORRESPONDENCE approach adopted here that the different restrictions holding on Kinande regressive vowel harmony in these two different domains can be captured, in a parallel fashion, through the interaction of distinct CORRESPONDENCE constraints.

The diagram in (50) summarizes the constraint system for Kinande ATR vowel harmony and hiatus avoidance.

(50) Kinande harmony and hiatus grammar



[13] Note that the S-CORRESPONDENCE constraint without domain restriction in (38) must be unranked with regard to an additional CRISPEDGE constraint which bans [+ATR] from crossing prosodic word boundaries (Kügler 2015). When S-MAX dominates CRISPEDGE, it still is in conflict with FAITHFULNESS constraints against changes in the ATR specifications of word 1, plus changing the last vowel to [+ATR] causes violations of the other S-CORRESPONDENCE constraints. It is outside the scope of this paper to further develop this aspect of the analysis.

6.2 Gradience and variability in phonological processes

Before concluding our discussing of PVH, we would like to briefly address Archangeli & Pulleyblank's (2002) argument that gradience allows PVH to be ignored in a phonological analysis of Kinande ATR VH because gradience automatically classifies PVH as a purely phonetic process. Mutaka (1995: 52), following Douglas Pulleyblank's suggestion (p.c.), identifies two dimensions of gradience in Kinande PVH:

i. Degree of advancement: "vowels getting gradually less and less advanced, in a nondiscrete fashion, as a vowel gets further and further from the source of harmony."
ii. Spreading domain: "The harmonic domain may optionally extend one, two, three, etc. vowels away from the source."

In reaching the conclusion that gradience is a property of phonetic processes, not phonological ones, Archangeli & Pulleyblank (2002) follow a tradition of work in phonology beginning with *SPE* (Chomsky & Halle 1968), which defines gradience and variability as criteria distinguishing phonology (competence) from phonetics (performance). Indeed, gradience is highlighted as a key property distinguishing phonetic phenomena from phonological ones in papers such as Keating (1996) and Myers (2000), which are roughly contemporary to Archangeli & Pulleyblank (2002). (See Cohn 2006 for discussion.)

However, a growing body of work on the phonetics-phonology interface beginning with Browman & Goldstein (1992) shows that many classic phonological processes, like place assimilation and final devoicing, are gradient in the sense that they are not entirely neutralizing, phonetically. In fact, gradient realization of an anticipatory assimilation is not particularly unexpected of phonological assimilation. (See, e.g., Ernestus 2011 for an overview; Hallé & Adda-Decker 2011 on incomplete voicing assimilation in French; and Krämer 2018 on gradient regressive nasal assimilation.) Even if there were phonetic studies corroborating Mutaka's (1995) and Archangeli & Pulleyblank's (2002) claim that "vowels [are] gradually less and less advanced, in a non-discrete fashion, as a vowel gets further and further from the source of harmony" (Mutaka 1995:52), this kind of gradience in the degree of ATR advancement cannot be considered a motivation for regarding PVH as phonetic, since the vowels are still perceived as either [+ATR] or [–ATR]. Moreover, this kind of petering out effect is not atypical of vowel harmony systems, as shown by work like McPherson & Hayes (2016).[14] McCollum (2019) provides an in-depth study and argumentation that vowel harmony is still phonological despite the gradient reduction of the harmonizing effect as the distance from the trigger increases.

[14] For other examples of petering out effects, see Downing's (2010) analysis of vowel reduction in a vowel harmony domain, and Martínez-Paricio's (2013) analysis of Dutch schwa reduction conditioned by distance from a stressed vowel.

The variability in the extent of PVH also does not provide an argument that it is a phonetic process, as it shows an interesting locality effect. Vowels assimilate to ATR like domino bricks falling in a row. There are no gaps in ATR quality. This is expected if syntagmatic correspondence constraints require harmonic identity of adjacent vowels. Moreover, even vowels which do not contrast in ATR, i.e., the non-high vowels intervening between a high trigger and target are not skipped, as attested in vowel harmony patterns with neutral vowels (e.g., Finnish palatal harmony). In languages with neutral vowels, we observe a similar kind of variability: the more neutral vowels intervene between trigger and target the more variable the process and the less likely it is to apply (Hayes & Londe 2006; Kimper 2011; Zymet 2014). Accordingly, even CORRESPONDENCE constraints that are restricted to a particular class of vowels, e.g., high vowels, as in Kinande, scan adjacent pairs of vowels, not just adjacent pairs of high vowels. If one of two adjacent vowels is not a high vowel, there is no identity requirement and the CORRESPONDENCE constraint is vacuously satisfied. The alternative would be that the constraint ignores non-high vowels in the same way it ignores intervening consonants. It is this locality property of the Correspondence approach to vowel harmony that actually predicts that ATR VH might 'peter out,' leading to the gradiency claimed for Kinande PVH.

Finally, there is a growing tradition of formalizing variability in phonological theory, beginning with work like Anttila (1997) and Boersma (1997). McPherson & Hayes (2016) and Kaplan (2016) provide representative recent examples. For example, Anttila (1997, 2007) proposes that optionality arises from partially ordered constraints which are ranked in random order whenever evaluation takes place. These random orders each produce a different candidate as optimal, in our case a fully harmonic one or one with two consecutive words with their respective harmonic domains as well as candidates with some of the vowels in the first word harmonized with respect to the first vowel in the second word. It is beyond the scope of this paper to develop the details of a formal analysis of the gradience and variability that Archangeli & Pulleyblank (2002) suggest are found in PVH in Kinande. The variation is not documented well enough to support a detailed analysis, in any case. Our main goal is to argue that PVH is a phonological process and to show how Correspondence theory can formalize the distinct phonological restrictions holding on word-internal vs. cross-word regressive harmony.

To sum up this section, gradience and variability are no longer the key properties dividing phonetic and phonological processes. They certainly do not trump the phonological and morphosyntactic restrictions on PVH discussed in section 6.1 which strongly argue for considering it a phonological process, as we have done in this paper.

7 Issues for alternative approaches to (Kinande) VH

In this section we survey issues raised by the Kinande VH patterns, and discuss why these issues are more straightforwardly handled in the Correspondence approach we have adopted than by alternative approaches. Because Kinande has not been analyzed in all the approaches we critique, as far as we know, we focus our attention on the issues, rather than taking up alternative analyses in detail.

A central issue in accounting for Kinande ATR VH concerns directionality and its relation to featural dominance or positional prominence. ATR VH patterns in Kinande are not all prominence-controlled, radiating out from an easily identifiable position of strength as in other systems where the lexical root, the stem-initial vowel or the stressed vowel exclusively acts as a VH trigger. We identified the locus of control as the Bantu (macro-)stem, and within this domain ATR VH is of the dominant-recessive type, with [+ATR] as the dominant value. The apparent dominance reversal at the prefix-stem boundary in class 5 nouns shows, however, that stem control is more important than [+ATR] dominance for the parasitic ATR VH pattern.

The only vowels that display a phonemic ATR contrast in Kinande are the high vowels. All [+ATR] non-high vowels are derived by regressive ATR VH. In many other harmony systems, neutral vowels (ones for which the harmony feature is not contrastive) act as blockers or they are transparent. In Kinande, neutral vowels only act as blockers in parasitic ATR VH, discussed in section 3, when the triggering feature is to the left of a target vowel. The contrasting behavior of neutral vowels in parasitic (bidirectional) versus regressive ATR VH is of interest as it provides a clear counterexample to Baković's (2000) claim that neutral vowel blocking should not vary depending on directionality.

Baković analyzes dominance as a Local Constraint Conjunction (LCC) of the respective Markedness constraint and the Faithfulness constraint involved. In the case of ATR dominance, *[–ATR] has to be conjoined with IO-IDENT(±ATR). While we do not have objections against LCCs in general, this particular LCC is equivalent to a feature value-specific directional Identity constraint, which is technically identical to framing the same in MAX(F) and DEP(F) constraints, which thus offer a more straightforward explanation of dominance effects in vowel harmony patterns.

The asymmetric behavior of non-high vowels also motivated a diagnosis of two distinct ATR VH processes at work, one bidirectional and parasitic, affecting only [+high] vowels, and the other regressive, affecting all vowels. Archangeli & Pulleyblank model this observation by attributing the regressive harmonization of non-high vowels to an ALIGNMENT constraint and the harmonization of high vowels to the reduction of markedness. Kenstowicz uses McCarthy's (2004) Span Theory and proposes a constraint against adjacent conflicting ATR spans as well as a negative constraint against left-to-right harmony (*LR). He motivates the latter with Hyman's (2002) aforementioned observation of an anticipatory bias in vowel harmony patterns. This raises two issues: the choice of formalism to account for harmony, and the way in which the regressive bias is theoretically captured. The problems with alignment have been discussed at length over the years (see, e.g., Krämer 2003), and we will not comment on this here. Span

Theory is also an intrinsically non-directional account of harmony. The constraint against two spans with conflicting feature specifications does not determine which span or segment has to change. The theory crucially relies on the notion of a head for each span and one could add a constraint that prefers spans with the head at the right edge, just as there are constraints on the alignment of the head or prominence in prosodic feet. However, the introduction of heads of domains in the context of syntagmatic interaction of segmental features seems to be poorly motivated, since directionality effects can presumably be accounted for by reference to simple IO-Faithfulness or Faithfulness in combination with phonotactic, prosodic or morphosyntactic properties of the segments involved. For instance, regressivity of many consonantal assimilation processes can be attributed to the coda-onset asymmetry, while most cases of progressive vowel harmony easily yield to an analysis that takes the stem-affix (or lexical-functional) asymmetry into account, etc.

Is there any difference between Kenstowicz' ad hoc directionality constraint and our S-MAX (21)? And why is there no mirror image constraint? The anticipatory bias of vowel harmony attested by Hyman (2002) could have its grounding in speech planning and contrast enhancement. Since speakers are planning ahead in time while producing parts of a planned utterance already, anticipatory effects are not surprising. Kaun (1995) for example provides a functional grounding argument for her EXTEND constraint that draws on contrast enhancement. Perception of a contrastive feature specification presumably improves with every additional feature bearing unit it is realized on. This argument holds for any positive non-directional harmony constraint. In the same spirit one can argue that for contrastive features originating in weak positions, such as the end of the word (see, e.g., Beckman's 1999 seminal work on strong and weak positions), there is a natural drive to extend to a perceptually more salient position, such as the left edge of the word. This drive has also been formalized in terms of Positional Licensing (Walker 2011). A constraint that prefers regressive assimilation is thus functionally grounded, a constraint penalizing progressive assimilation, such as Kenstowicz' *LR, is not. Parsimony also dictates that, in theory construction, a constraint that is integrated into an existing family should be preferred to one that constitutes a constraint category of its own to avoid proliferation of constraint types. Syntagmatic Correspondence constraints of the type S-IDENT(F) are members of the family of Correspondence constraints, as are directional Syntagmatic Correspondence constraints like S-MAX (21).

The integration of directionality into surface correspondence constraints was first proposed within ABC Theory. The current analysis could probably have been done in this approach as well. The major difference lies in the formalization of the cooccurrence condition. The restriction of stem or bidirectional harmony to high vowels would be due to a CORR constraint demanding a correspondence relation for ATR between high vowels rather than a variable in the harmony constraint itself. If there is no Correspondence relation between vowels of different heights, the surface identity constraint preferring harmonic candidates is also not violated. To account for the harmonization of non-high vowels to a high trigger to their right, however, such a correspondence relation is necessary. We do not see an alternative way to exclude this correspondence relation between a non-high vowel and a high vowel to its left other than by assigning the different harmony processes to different levels or strata. And even if a more general CORR constraint dominated IO-Faithfulness at the word level, it would still have the unwanted effect of incorrectly penalizing a non-high vowel preceded by a high vowel within a stem.

We analyzed stem control as a domain restriction holding for FAITHFULNESS constraints. This move deserves two remarks. First, the most extensive OT analysis of Kinande harmony so far (Archangeli & Pulleyblank 2002) also restricts constraints to morphological domains: root, (macro-)stem and word. In contrast, our analysis refers only to stem vs. word domains, in line with proposals that the stem-word distinction is a central one in Bantu and many other languages. (See, e.g., Downing 1999; Downing & Kadenge 2015; 2020; Hyman 2008; Jurgec & Bjorkman 2018; Mutaka 1990.)

Our analysis improves on Archangeli & Pulleyblank's formalization of grounded conditions on Kinande VH. They introduce a hybrid of MARKEDNESS and FAITHFULNESS constraints, i.e., HI/ATR$_{domain}$. They turn their grounded conditions, such as HI/ATR ([+high] vowels are [+ATR]), which are MARKEDNESS constraints, into FAITHFULNESS constraints with a MARKEDNESS component by restricting them to the morphological domains of root, stem and macro-stem, rather than using plain FAITHFULNESS constraints. Their definition, e.g., of HI/ATR$_{\text{ROOT}}$, (p. 157), reads "*For specifications morphologically affiliated with a root*, if [+high] then [+ATR]." (our emphasis) This is a MARKEDNESS constraint penalizing [+high][–ATR] vowels which is active only if the respective [+high] is situated within a root that is specified as [+ATR]. At the same time, it optimizes realizing the underlying ATR feature (on a high vowel) and is thus violated if the ATR feature is not realized on that vowel or not at all, and thus a FAITHFULNESS constraint. It is vacuously satisfied if there is either no high vowel or no ATR specification in the input. As we have shown, this hybridization of constraints is unwarranted. Our analysis decomposes this complex set of conditions into pure MARKEDNESS constraints and pure FAITHFULNESS constraints.

Indeed, it has been argued since McCarthy & Prince (1995) that placing domain restrictions on MARKEDNESS constraints potentially defines a pathological grammar in which ATR is contrastive in affixes and other functional items but not in the root morphemes of lexical words like nouns, verbs and adjectives.

(51) Pathological contrast in functional but not in lexical morphemes
*[+High, –ATR]/root ≫ Faith ≫ *[+High, –ATR]

In our analysis, we thus opted to restrict the domains of FAITHFULNESS, rather than MARKEDNESS, constraints.

A second issue arises from our proposal that FAITHFULNESS constraints – which include Syntagmatic CORRESPONDENCE constraints – are restricted to domains. (Recall that two Syntagmatic CORRESPONDENCE constraints are restricted to the domain of the Prosodic Word in our analysis.) This proposal allows processes to be restricted to the stem or word domain in a non-derivational, non-stratal way. While constraint indexation and a stratal approach might provide equivalent analyses for most of the Kinande ATR VH system, the case of PVH triggered by syllabification across morphosyntactic word boundaries, which we have analyzed as a single Prosodic Word incorporating two morphosyntactic words, would present a problem for a stratal approach. In a stratal approach, resyllabification would apply at the post-lexical level, at which point PWord-bound vowel harmony would presumably be inactive. The particulars of phrasal harmony in Kinande can thus be considered an argument against a stratal organization of the phonological grammar and in favor of domain restricted constraints. The restriction of PVH to the DP, however, suggests that modular architecture plays a role here, as it illustrates the sensitivity of phonology to phases. This aspect of the pattern clearly needs further investigation.

A final point is that since Archangeli & Pulleyblank (2002) consider PVH phonetic, they do not discuss or analyze its properties, and thus miss the opportunity to investigate the implications of PVH for the phonology-syntax interface. As we have shown, Kinande PVH is of typological and theoretical interest since it is subject to phonological restrictions that do not hold of word-internal ATR VH. This contradicts a common assumption (see work since Kiparsky 1985) that phrasal processes are less restricted than word-internal processes. It is also of typological interest since it is restricted to DPs, confirming a cross-linguistic pattern, identified by Kaisse (2019), showing that phrasal phonological processes are often restricted to the DP context (see as well Downing & Krämer, to appear, for a discussion of cross-linguistic variation in PVH).

8 Conclusion

In this paper, we have adopted a Syntagmatic Correspondence approach to the Kinande vowel harmony system and demonstrated that it straightforwardly accounts for the intricate interaction of featural, directional and morpho-prosodic domain restrictions that define the occurring ATR harmony patterns. Even though it has been demonstrated since Krämer (1998; 2001; 2002; 2003; see, too, Rhodes 2012) that Correspondence theory is well suited to the analysis of vowel harmony systems, there is still some controversy about whether vowel harmony can be handled as well as consonant harmony in Correspondence theory. Bennett & Delbusso (2018), for example, only evaluate CORRESPONDENCE constraints accounting for consonantal harmony and dissimilation. This paper therefore adds to the body of work showing that Correspondence Theory provides a viable general approach to harmony systems.

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Competing Interests

The authors have no competing interests to declare.

References

Anttila, Arto. 1997. Deriving variation from grammar: A study of Finnish genitives. In Frans Hinskens, Roeland van Hout & Leo Wetzels (eds.), *Variation, Change and Phonological Theory*, 35–68. Amsterdam: John Benjamins. DOI: https://doi.org/10.1075/cilt.146.04ant

Anttila, Arto. 2007. Variation and optionality. In Paul de Lacy (ed.), *The Cambridge Handbook of Phonology,* 519–536. Cambridge: Cambridge University Press. DOI: https://doi.org/10.1017/CBO9780511486371.023

Archangeli, Diana & Pulleyblank, Douglas. 1994. *Grounded Phonology*. Cambridge, MA: The MIT Press.

Archangeli, Diana & Pulleyblank, Douglas. 2002. Kinande vowel harmony: domains, grounded conditions and one-sided alignment. *Phonology* 19. 139–188. DOI: https://doi.org/10.1017/S095267570200430X

Archangeli Diana & Pulleyblank, Douglas. 2007. Harmony. In de Lacy, Paul (ed.), *The Cambridge Handbook of Phonology*, 353–378. Cambridge: Cambridge University Press. DOI: https://doi.org/10.1017/CBO9780511486371.016

Baković, Eric. 2000. *Harmony, dominance and control*. New Brunswick: Rutgers University dissertation.

Beckman, Jill N. 1997. Positional faithfulness, positional neutralisation and Shona vowel harmony. *Phonology* 14. 1–46. DOI: https://doi.org/10.1017/S0952675797003308

Beckman, Jill N. 1999. *Positional faithfulness: An Optimality Theoretic Treatment of Phonological Asymmetries*. London: Routledge.

Bennett, William G. 2019. When 'better coverage' isn't enough: comparing theories of agreement & correspondence. Keynote address presented at the Old World Conference on Phonology 19, 16–18 January 2019, University of Verona.

Bennett, William G. & DelBusso, Natalie. 2018. The typological effects of ABC constraint definitions. *Phonology* 35. 1–37. DOI: https://doi.org/10.1017/S0952675717000367

Boersma, Paul. 1997. How we learn variation, optionality and probability. *Proceedings of the Institute of Phonetic Sciences of the University of Amsterdam* 21. 43–58.

Browman, Catherine P. & Goldstein, Louis. 1992. Articulatory phonology: an overview. *Phonetica* 49. 155–180. DOI: https://doi.org/10.1159/000261913

Brown, Jason 2016. Laryngeal assimilation, markedness and typology. *Phonology* 33: 393-423.

Butska, Luba. 1998. Faithfulness to [voice] in Ukrainian: an analysis of voicing alternations within Optimality Theory. *RuLing Pa*pers 1, 59-73. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.53.1541&rep=rep1&type=pdf

Casali, Roderic F. 2002. Nawuri ATR harmony in typological perspective. *Journal of West African Languages* 29(1). 3–43. DOI: https://doi.org/10.1017/S0952675716000191

Casali, Roderic F. 2008. ATR harmony in African languages. *Language and Linguistics Compass* 2/3. 496–549. DOI: https://doi.org/10.1111/j.1749-818X.2008.00064.x

Casali, Roderic F. 2016. Some inventory-related asymmetries in the patterning of tongue root harmony systems. *Studies in African Linguistics* 45. 95–140. DOI: https://doi.org/10.32473/sal.v45i1.107254

Chomsky, Noam & Halle, Morris. 1968. *Sound pattern of English*. New York: Harper and Row.

Coetzee, Andries & Pater, Joe. 2011. The place of variation in phonological theory. In Goldsmith, John A., Riggle, Jason & Yu, Alan C.L. (eds.), *The Handbook of Phonological Theory* (2nd ed.), 401–431. Malden, MA: Wiley-Blackwell. DOI: https://doi.org/10.1002/9781444343069.ch13

Cohn, Abigail C. 2006. Is there gradient phonology? In Fanselow, Gisbert, Féry, Caroline, Vogel, Ralf & Schlesewsky, Matthias (eds.), *Gradience in Grammar*, 25–44. Oxford: Oxford University Press. DOI: https://doi.org/10.1093/acprof:oso/9780199274796.003.0002

Downing, Laura J. 1999. Prosodic stem ≠ Prosodic word in Bantu. In Hall, T. Alan & Kleinhenz, Ursula (eds.), *Studies on the Phonological Word*, 73–98. Amsterdam: John Benjamins. DOI: https://doi.org/10.1075/cilt.174.05dow

Downing, Laura J. 2010. Opacity is a matter of representation: Shimakonde vowel harmony and vowel reduction. *ZAS Papers in Linguistics* 52. 159–191. DOI: https://doi.org/10.21248/zaspil.52.2010.387

Downing, Laura J. 2018. Is Vowel Harmony canonically (P)Word bound?: An Africanist perspective on vowel harmony domains. Paper presented at GLOW41, Budapest, Hungary.

Downing, Laura J. & Kadenge, Maxwell. 2015. Prosodic stems in Zezuru Shona. *Southern African Linguistics and Applied Language Studies* 33. 291–305. DOI: https://doi.org/10.2989/16073614.2015.1108766

Downing, Laura J. & Kadenge, Maxwell. 2020. Re-placing PStem in the Prosodic Hierarchy. *The Linguistic Review* 37. 433-461. DOI: https://doi.org/10.1515/tlr-2020-2050

Downing, Laura & Krämer, Martin. To appear. Phrasal Vowel Harmony. In van der Hulst, Harry & Ritter, Nancy (eds.), *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press.

Ernestus, Mirjam. 2011. Gradience and categoricality in phonological theory. In van Oostendorp, Marc, Ewen, Colin J., Hume, Elizabeth & Rice, Keren (eds.), *The Blackwell Companion to Phonology*, chapter 89. DOI: https://doi.org/10.1002/9781444335262.wbctp0089

Fábregas, Antonio & Krämer, Martin. 2020. Why prefixes (almost) never participate in vowel harmony. *Evolutionary Linguistic Theory* 2. 84–111. DOI: https://doi.org/10.1075/elt.00016.fab

Gick, Bryan, Pulleyblank, Douglas, Campbell, Fiona & Mutaka, Ngessimo. 2006. Low vowels and transparency in Kinande vowel harmony. *Phonology* 23. 1–20. DOI: https://doi.org/10.1017/S0952675706000741

Hallé, Pierre & Adda-Decker, Martine. 2011. Voice assimilation in French obstruents: A gradient or a categorical process? In Goldsmith, John A., Hume, Elizabeth & Wetzels, Leo (eds.), *Tones and features: Phonetic and phonological perspectives*, 149–175. Berlin: De Gruyter. DOI: https://doi.org/10.1515/9783110246223.149

Hansson, Gunnar Ólafur. 2001. *Theoretical and typological issues in consonant harmony*. Berkeley: University of California dissertation.

Hansson, Gunnar Ólafur. 2014. (Dis)agreement by (non)correspondence: inspecting the foundations. *UC Berkeley Phonology Lab Annual Report: ABC Conference Archive*. Slides available (April 2020) at http://linguistics.berkeley.edu/phonlab/documents/2014/ABCC/Hansson.pdf

Hayes, Bruce & Londe, Zsuzsa Cziráky. 2006. Stochastic knowledge: the case of Hungarian vowel harmony. *Phonology* 23. 59–104. DOI: https://doi.org/10.1017/S0952675706000765

Hyman, Larry M. 1999. The historical interpretation of vowel harmony in Bantu. In Hombert, Jean-Marie & Hyman, Larry M. (eds.), *Bantu historical linguistics: Theoretical and empirical perspectives*, 235–295. Stanford: CSLI.

Hyman, Larry M. 2002. Is there a right to left bias in vowel harmony? Paper presented at the 9th International Phonology Meeting, Vienna, November 1, 2002. http://linguistics.berkeley.edu/~hyman/Hyman_Vienna_VH_paper_forma.pdf

Hyman, Larry M. 2008. Directional asymmetries in the morphology and phonology of words, with special reference to Bantu. *Linguistics* 46. 309–350. DOI: https://doi.org/10.1515/LING.2008.012

Ito, Junko & Mester, Armin. 1999. Realignment. In Kager, René, van der Hulst, Harry & Zonneveld, Wim (eds.), *The prosody-morphology interface*, 188–217. Cambridge, U.K.: Cambridge University Press. DOI: https://doi.org/10.1017/CBO9780511627729.007

Jones, Patrick. 2012. Glide formation in Kinande does not neutralize an underlying [ATR] contrast. In Connell, Bruce & Rolle, Nicholas (eds.), *Selected Proceedings of the 41st Annual Conference on African Linguistics*, 10–17. Somerville, MA: Cascadilla Proceedings Project.

Jurgec, Peter & Bjorkman, Bronwyn M. 2018. Indexation to stems and words. *Phonology* 35. 577–615. DOI: https://doi.org/10.1017/S0952675718000210

Kahnemuyipour, Arsalan. 2009. *The Syntax of Sentential Stress*. Oxford: Oxford University Press. DOI: https://doi.org/10.1093/acprof:oso/9780199219230.001.0001

Kaisse, Ellen M. 2017. The domain of stress assignment: Word-boundedness and frequent collocation. In Bowern, Claire, Horn, Laurence & Zanuttini, Raffaella (eds.), *On looking into words (and beyond)*, 17–41. Berlin: Language Science Press. DOI: https://doi.org/10.5281/zenodo.495437

Kaisse, Ellen M. 2019. What kinds of processes are postlexical? And how powerful are they? In Zhang, Hongming & Qian, Youyong (eds.), *Prosodic studies: Challenges and prospects*, 227–251. London: Routledge. DOI: https://doi.org/10.4324/9781351212878-9

Kaplan, Aaron. 2016. Local optionality with partial orders. *Phonology* 33. 285–324. DOI: https://doi.org/10.1017/S0952675716000130

Kaun, Abigail Rhoades. 1995. *The Typology of Rounding Harmony: An Optimality Theoretic Approach*. PhD dissertation, UCLA.

Keating, Patricia. 1996. The phonology-phonetics interface. *UCLA Working Papers in Phonetics* 92. 45–60.

Kenstowicz, Michael. 2009. Two Notes on Kinande Vowel Harmony. *Language Sciences* 31(2–3). 248–270. DOI: https://doi.org/10.1016/j.langsci.2008.12.011

Kimper, Wendell A. 2011. *Competing triggers: Transparency and opacity in vowel harmony*. Ph. dissertation, University of Massachusetts, Amherst.

Kiparsky, Paul. 1985. Some consequences of Lexical Phonology. *Phonology Yearbook* 2. 85–138. DOI: https://doi.org/10.1017/S0952675700000397

Krämer, Martin. 1998. A Correspondence Approach to Vowel Harmony and Disharmony. *SFB 282 Working Paper* Nr. 107. Heinrich-Heine-Universität Düsseldorf.

Krämer, Martin. 2001. Yucatec Maya Vowel Alternations – Harmony as Syntagmatic Identity. *Zeitschrift für Sprachwissenschaft* 20. 175–217. DOI: https://doi.org/10.1515/zfsw.2001.20.2.175

Krämer, Martin 2002. Local constraint conjunction and neutral vowels in Finnish harmony. In Brunger, Karen (ed.), *Belfast Working Papers in Language and Linguistics* 15. 38-64. Belfast: University of Ulster.

Krämer, Martin. 2003. *Vowel Harmony and Correspondence Theory*. Studies in Generative Grammar 66. Berlin: Mouton de Gruyter. DOI: https://doi.org/10.1515/9783110197310

Krämer, Martin. 2018. Is vowel nasalisation phonological in English? A systematic review. *English Language and Linguistics* 23. 405–437. DOI: https://doi.org/10.1017/S1360674317000442

Kratzer, Angelika & Selkirk, Elisabeth. 2007. Phase Theory and Prosodic Spellout: The Case of Verbs. *The Linguistic Review* 24. 93–135. DOI: https://doi.org/10.1515/TLR.2007.005

Kügler, Frank. 2015. Phonological phrasing and ATR vowel harmony in Akan. *Phonology* 32. 177–204. DOI: https://doi.org/10.1017/S0952675715000081

Mahanta, Shakuntala. 2008. *Directionality and locality in vowel harmony*. Utrecht: LOT Publications.

Martínez-Paricio, Violeta. 2013. *An exploration of minimal and maximal metrical feet.* Tromsø: Arctic University of Norway dissertation.

McCarthy, John J. 2004. Headed spans and autosegmental spreading. Rutgers Optimality Archive 685.

McCarthy, John J. & Prince, Alan. 1995. Faithfulness and reduplicative identity. *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory*. Retrieved April 2020 from https://scholarworks.umass.edu/linguist_faculty_pubs/10

McCollum, Adam. 2019. *Gradience and locality in phonology: Case studies from Turkic vowel harmony*. PhD Dissertation, UC-San Diego.

McCollum, Adam & Essegbey, James. 2020. Initial prominence and progressive vowel harmony in Tutrugbu. *Phonological Data & Analysis 2(3)*. DOI: https://doi.org/10.3765/pda.v2art3.14

McPherson, Laura & Hayes, Bruce. 2016. Relating application frequency to morphological structure: the case of Tommo So vowel harmony. *Phonology* 33. 125–167. DOI: https://doi.org/10.1017/S0952675716000051

Mutaka, Ngessimo M. 1990. *The lexical tonology of Kinande*. PhD Dissertation, USC. Published 1994, Munich: LINCOM Europa.

Mutaka, Ngessimo M. 1995. Vowel harmony in Kinande. *Journal of West African Languages* 25. 41–55.

Mutaka, Ngessimo M. 2007. *Kinande: A grammar sketch (Version 1.0)*. Retrieved April 2020 http://www.africananaphora.rutgers.edu/images/stories/downloads/casefiles/KinandeGS.pdf

Myers, Scott. 2000. Boundary disputes: the distinction between phonetic and phonological sound patterns. In Burton-Roberts, Noel, Carr, Philip & Docherty, Gerard (eds.), *Phonological knowledge: Conceptual and empirical issues*, 245–272. Oxford: Oxford University Press.

Obiri-Yeboah, Michael & Rose, Sharon. 2022. Vowel harmony and phonological phrasing in Gua. *Natural Language and Linguistic Theory* 40. 159–193. DOI: https://doi.org/10.1007/s11049-021-09509-y

Pater, Joe 1999. Austronesian nasal substitution and other NC effects. In Kager, René, van der Hulst, Harry & Zonneveld, Wim (eds.), *The Prosody–Morphology Interface*, 310–343. Cambridge: Cambridge University Press. DOI: https://doi.org/10.1017/CBO9780511627729.009

Pulleyblank, Douglas. 1997. Optimality Theory and Features. In Archangeli, Diana & Langendoen, D. Terence (eds.), *Optimality Theory*, 59–10. Oxford: Blackwell Publishers.

Rhodes, Russell. 2012. Vowel Harmony as Agreement by Correspondence. *UC Berkeley Phonology Lab Annual Report*, 138–168. http://linguistics.berkeley.edu/phonlab/annual_report/annual_report_2012.html. DOI: https://doi.org/10.5070/P79NS2K90J

Rose, Sharon & Walker, Rachel. 2004. A typology of consonant agreement as correspondence. *Language* 80. 475–531. DOI: https://doi.org/10.1353/lan.2004.0144

Rose, Sharon & Walker, Rachel. 2011. Harmony systems. In Goldsmith, John A., Riggle, Jason & Yu, Alan C.L. (eds.), *The Handbook of Phonological Theory*, 2nd edition, 240–290. Malden, MA: Blackwell. DOI: https://doi.org/10.1002/9781444343069.ch8

Schlindwein, Deborah. 1987. P-bearing units: a study of Kinande vowel harmony. *Proceedings of NELS* 17. 551–567.

van der Hulst, Harry & van de Weijer, Jeroen. 1995. Vowel harmony. In Goldsmith, John A. (ed.), *The Handbook of Phonological Theory*, 495–534. Cambridge, MA: Blackwell.

Walker, Rachel. 2000a. Long-distance consonantal identity effects. *WCCFL 19*. 532–545.

Walker, Rachel. 2000b. Yaka nasal harmony: Spreading or segmental correspondence? *BLS 26*. 321–332. DOI: https://doi.org/10.3765/bls.v26i1.1164

Walker, Rachel. 2011. *Vowel patterns in language*. Cambridge: Cambridge University Press.

Walker, Rachel. 2015. Surface correspondence and discrete harmony triggers. *Proceedings of AMP 2014*. https://pdfs.semanticscholar.org/3d7f/a78a5386422e101a44e3a5e3638c211e4745.pdf

Zymet, Jesse. 2014. *Distance-based decay in long-distance phonological processes: probabilistic models for Malagasy, Latin, English, and Hungarian*. PhD dissertation, UCLA.