

Chapter 51

Vowel harmony in non-Bantu Niger-Congo languages

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51.1 Introduction

A striking property of Niger-Congo is the pronounced role of harmony in governing the distribution of vowels. In this chapter, we summarize the major patterns of vowel harmony within the non-Bantu languages of the Niger-Congo phylum, focusing on advanced tongue root (ATR) harmony (Stewart 1967) where vowels harmonize for tongue root position. We contrast two subtypes, cross-height and mid-height ATR harmony. We exemplify these types with several case studies, especially drawing from Nigerian languages Yoruba, Igbo, Igede, and Degema. In contrast to ATR harmony, other types of vowel harmony such as rounding harmony, height harmony, and identical-vowel harmony occur less frequently. Following our overview of ATR types, we highlight several issues which the Niger-Congo harmony systems bring up. These include which ATR value is dominant, the directionality of ATR harmony, and ATR's antagonistic relationship with interior vowels (i.e. non-peripheral vowels *i y u ə ʌ*, etc.).

For a more complete overview of vowel harmony, see *inter alia* Casali (2003; 2008; 2018), Clements & Rialland (2008), Starwalt (2008), Güldemann (2008), Rose & Walker (2011), Lionnet & Hyman (2018), Hyman et al. (2019), and Rolle et al. (2020). See also Chapter 7, this volume, on ATR generally, and Chapter 49, this volume, for ATR in Nilo-Saharan.

51.2 Types of vowel harmony in non-Bantu Niger-Congo

Our empirical scope is the Niger-Congo phylum, but excluding the massive Bantu family which is discussed separately in Chapter 52, this volume. Moreover, those language families which only controversially belong to the Niger-Congo phylum are also excluded (e.g. families Mande, Dogon, Ijoid, and Kordofanian). We hereafter refer to the remaining core Niger-Congo group with the abbreviation NC*, where the asterisk is a reminder to the reader that this excludes these families.

51.2.1 Cross-height ATR harmony

In ATR systems generally, there are two sets of vowels, one which is [+ATR] (or advanced tongue root) and another which is [-ATR] (or retracted tongue root). Consider the data in (1) from Degema (Kari 2007), where vowels harmonize either for [+ATR] or [-ATR]. (Note the word order is noun possessor.)

(1) Degema ATR harmony

- | | | | |
|----|--------|------------|------------------|
| a. | [+ATR] | [úbi mée] | ‘my palm kernel’ |
| b. | [-ATR] | [ɔ̀bi méɛ] | ‘my book’ |

The size of the pharynx is central to the realization of ATR values. [+ATR] vowels are articulated by advancing the tongue root and simultaneously lowering the larynx, resulting in an expanded pharynx, while [-ATR] vowels are produced by retracting the tongue root and raising the larynx causing a narrowing of the pharynx (Ladefoged 1968; Casali 2008). Acoustically, [+ATR] vowels tend to have a lower first formant frequency (F1) than their [-ATR] counterparts (Starwalt 2008), and the contrast is often transcribed using phones of different heights, e.g. [u] vs. [ɔ̀] in (1).¹

We differentiate two types of ATR harmony. One is cross-height ATR harmony, where there are ATR pairings at both the high and mid heights, with demonstrable harmony across high, mid, and low vowel heights (Stewart 1971: 198). [+ATR] high vowels only occur with [+ATR] mid vowels, [-ATR] high vowels only occur with [-ATR] mid vowels, etc. Consequently, there are no sequences of the type *[u ... ɛ] or *[ɔ̀ ... i].

Many cross-height ATR systems have complete sets of ATR counterparts for all vowel qualities. This is true of the Degema language introduced in (1), which has the 10-vowel system in (2) where /ə/ is low [+ATR] and /a/ is low [-ATR].

¹ In this chapter, we adopt this convention of using distinct phones for the ATR contrasts, rather than the more specialized diacritics for advanced and retracted tongue root, i.e. /u/ versus /ɰ/. In many West African orthographies, [-ATR] vowels are written with a dot under the vowel, e.g. <u> = [ɔ̀].

(2) 10-vowel cross-height ATR system

a.	[+ATR]	i	u	b.	[-ATR]	ɪ	ʊ
		e	o			ɛ	ɔ
		ə				a	

The Degema examples in (3) illustrate mutual exclusivity of ATR values across the three vowel heights (data is from Kari's 2008 dictionary).

(3) Illustration of cross-height ATR harmony in Degema

a.	[+ATR]		b.	[-ATR]	
	úkóβə	‘cowry, cataract’		ɔkəβú	‘saying’
	elú [†] mé	‘land crab’		ɛgbó [†] rá	‘snapper’
	odisə [†] ón	‘afternoon’		ɔsakú	‘ <i>Hepsetus odoe</i> ’ (fish)
	əsínɡo	‘long machete’		atí [†] ré	‘days’

One notable fact, however, is that most cross-height ATR systems do not have a full set of ATR counterparts for all vowel qualities. Two examples of such reduced cross-height ATR systems are in (4), from Igede (Abiodun 1991) and Igbo (Igboid – Welmers 1973).

(4) Reduced cross-height ATR systems

a.	Igede – 9 vowels	b.	Igbo – 8-9 vowels (depending on dialect)
	[+ATR] i u e o		[+ATR] i u e o
	[-ATR] ɪ ʊ ɛ ɔ a		[-ATR] ɪ ʊ (ɛ) ɔ a

The 9-vowel type is much more common than the 8-vowel type, reflected by the fact that Igbo dialects vary between 8 and 9 vowels. Both of these reduced systems are representative of a common asymmetry in NC* harmony: the low series lacks an advanced [+ATR] counterpart.

In Igede (as in Degema), ATR harmony is categorical within roots, i.e. all [+ATR] (e.g. /ugbodzi/ ‘orange’, /egbodu/ ‘okra’, etc.) or [-ATR] (e.g. /ʊvɔhi/ ‘cat’, /adida/ ‘father’, etc.). In addition to static patterns, Igede shows active alternations in larger harmony domains. The

examples in (5) show verbal nouns derived through root reduplication and prefixation of /O-/, whose ATR specification depends on the root.

(5) Igede ATR alternations (tones are omitted)

a.	[+ATR]	Verb root	Reduplicated form
		bi 'lose'	o-bibi 'losing'
		gbu 'die'	o-gbugbu 'dying'
		ho 'fly'	o-hoho 'flying'
		je 'get'	o-jeje 'getting'
b.	[-ATR]	di 'beat'	ɔ-didi 'beating'
		rɔ 'come'	ɔ-rɔrɔ 'coming'
		dʒɛ 'know'	ɔ-dʒɛdʒɛ 'knowing'
		rɔ 'buy'	ɔ-rɔrɔ 'buying'
		wa 'count'	ɔ-wawa 'counting'

Likewise, prefixes marking singularity/plurality harmonize with the root vowel. As shown in (6), the singular prefix /U-/ alternates based on the ATR value of the root, while the plural marker alternates between /e-/ and /a-/.

(6)	a.	[+ATR]	SG	PL		b.	[-ATR]	SG	PL	
			u-do	e-do	'basket'			ɔ-rɔ	a-rɔ	'ear'
			u-bo	e-bo	'room'			ɔ-lɛ	a-lɛ	'hoe'

Unlike high and mid vowels, Igede low vowels do not have a [+ATR] counterpart. In Igede no [+ATR] low vowel [ə] exists, either as a contrastive phoneme or as a conditioned allophone. Data from Abiodun (1991) shows that in morphological contexts where there is an ATR

Another type of harmony is mid-height ATR harmony. Languages of this type typically have a vowel inventory /i e ε (ə) a ɔ o u/, lacking the [−ATR] high counterparts /ɪ ʊ/. One famous example is Yoruba (Awobuluyi & Bamgbose 1967), where mid vowels of different heights do not co-occur, i.e. */e...ɔ/ and */ε...o/. This is shown in (9), taking data from Yai (1996). Both sets can co-occur with high [+ATR] /i u/ vowels, which have no [−ATR] counterparts.

(9) Yoruba mid-height ATR harmony

a.	[oko]	‘farm’	(*okɔ)	b.	[ɔkɔ]	‘husband’	(*ɔko)
	[ètè]	‘lip’	(*etɛ)		[ètè]	‘leprosy’	(*ete)
	[ebi]	‘hunger’			[èbi]	‘guilt’	
	[eku]	‘rat’			[etù]	‘guinea fowl’	
	[ife]	‘cup’			[idɛ]	‘brass’	

Such systems have been called “incomplete” ATR systems (Ladefoged 1968; Rolle et al. 2020), and may simply be called mid-harmony without an ATR label on a case-by-case basis.³

More complicated interactions are found with the sole low [−ATR] vowel /a/. Across dialects, both types of mid vowels may appear after low /a/ (10a-b), but only the [−ATR] vowel may appear before (10c-d).

(10) Yoruba [−ATR] low /a/ triggers regressive harmony

a.	akpé	‘applause’	b.	àkpé	‘beloved’
	abó	‘bowl’		abo	‘female’
c.	èsà	‘ <i>Egúngún</i> genre’	d.	*esa	
	òsà	‘river, lagoon’		*osa	

Here, the /a/ in word-final position triggers regressive [−ATR] harmony, which determines the harmonic value of mid vowels before it (Archangeli & Pulleyblank 1989).

³ Such systems have also been referred to with more precise names, e.g. 4Ht(M) systems (Casali 2003), /1IU/ (Casali 2008), or 1IU-2EO (Rose 2018). See Chapter 15, this volume.

Across Yoruba dialects, the only contrastive high vowels are [+ATR] /i u/; we do not find contrastive [-ATR] /ɪ ʊ/. Consequently, /i u/ are the only high vowels licensed in root-final position, where harmony can spread to preceding vowels. In Standard Yoruba, final [+ATR] high vowels can be preceded by both [+ATR] and [-ATR] non-high vowels. In comparison, in central dialects such as Ife and Ekiti, the root-initial mid vowels preceding root-final high vowels consistently surface as [+ATR], showing harmony from the final vowel (11a). Initial [+ATR] mid vowels remain the same in all dialects (11b).

(11) Regressive [+ATR] harmony triggered by final high vowels in Ife/Ekiti (tone omitted)

	Standard	Ife/Ekiti	
a.	ɛbi	ebi	‘guilt’
	ɛwu	eu	‘garment’
b.	ofu	ofu	‘month’

Related patterns emerge across dialects when a high vowel occurs in non-final position. In cases where all vowels are [+ATR], there are no differences across dialects (compare Standard Yoruba /èbúté/ to Ife and Ekiti /èbúte/ ‘harbor’). In contrast, the three dialects diverge when the high vowel is followed by a [-ATR] vowel /ɛ a ɔ/, shown in (12). In Standard Yoruba, high vowels are opaque and not subject to regressive [-ATR] harmony, producing a new harmonic domain to their left (Orie 2001; 2003). In Ife, medial high vowels also retain their [+ATR] value but are transparent to the transmission of [-ATR] from the final vowel to the initial vowel. Finally, in Ekiti [-ATR] harmony creates high allophones [ɪ ʊ], filling the missing gap in the vowel inventory.

(12) Behavior of medial high vowels

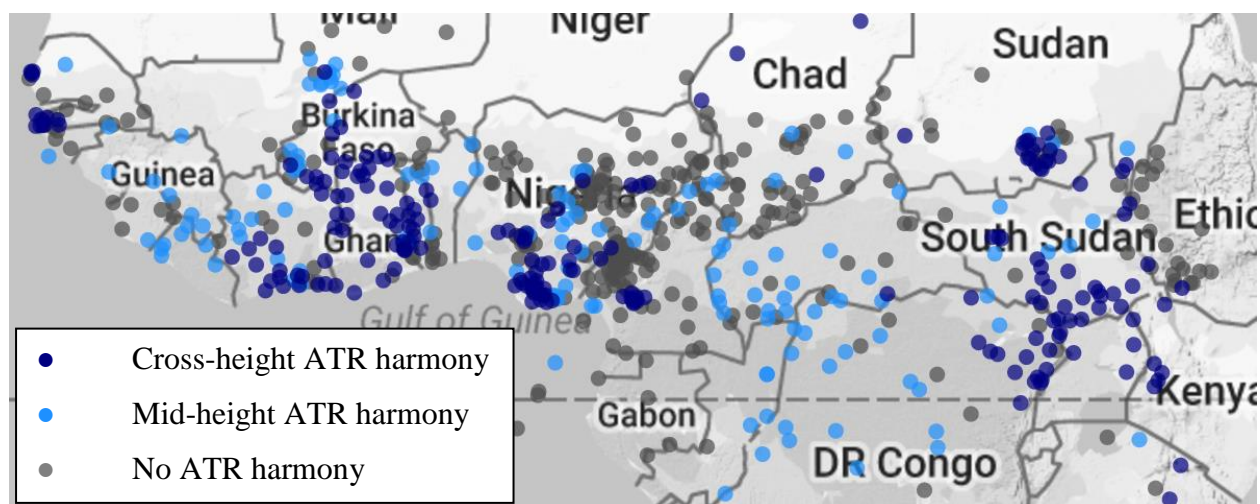
	Standard (opaque)	Ife (transparent)	Ekiti (harmonic)	
a.	odíde	ɔdíde	ɔdíde	‘parrot’
b.	oruko	ɔruko	ɔroko	‘name’
c.	òrìfà	òrisà	òrìfà	‘deity’
d.	òrùka	òrùka	òròka	‘ring’

Having [-ATR] allophones [ɪ ʊ] of /i u/ is rarely reported among NC* languages. More common among African languages are inventories with contrastive vowels /i ɪ ɛ a ɔ u ʊ/, where the sole contrastive mid series /ɛ ɔ/ surface as [e o] in [+ATR] contexts (see also Chapter 15 and 49, this volume). Such systems are fairly common within the Nilo-Saharan phylum (e.g. Central Sudanic and Nilotic), but are not found within NC*.

51.2.3 The distribution of ATR types in NC*

ATR harmony is a defining feature of the linguistic area known as the Macro-Sudan Belt (Güldemann 2008; Clements & Rialland 2008), stretching from Senegal to South Sudan. Map 51.1 shows the distribution of the two ATR types within the Macro-Sudan Belt, based on Rolle et al.'s (2020) *Areal Linguistic Features of Africa* database. This map shows languages from all families in this region, not just NC* languages.

Map 51.1: ATR harmony across the Macro-Sudan Belt



Within this database, there are 357 NC* languages, roughly half of which display ATR harmony ($n=180/357$). This is typical of families Kwa, Gur, Kru, Defoid, Igboid, Delta Cross, and Gbaya. Cross-height harmony is the most common among NC* languages ($n=118/180$), and less common are mid-height systems ($n=62/180$). Other NC* languages do not synchronically show ATR harmony ($n=177/357$) – typical of families Gbe, Kainji, Jukunoid, Platoid, and non-Bantu Bantoid – though may have traces of such systems. Several transitional families are fairly

evenly split between having and not having ATR harmony, e.g. Atlantic (itself controversial as a family), Edoid, Adamawa, and Ubangi. For a complete list of individual languages, see the supplemental materials of Rolle et al. (2020).

51.2.4 Other harmony types

Other types of vowel harmony are rarer among NC* languages. Lionnet & Hyman (2018) emphasize the much more marginal status of other vowel harmonies in Africa compared to world-wide averages, such as rounding harmony (see Chapter 5, this volume) and height harmony (although the latter is common within Bantu NC – see Hyman 1999, and Chapters 6 and 52, this volume).

One example of rounding harmony which Lionnet & Hyman cite is from Nawuri (Casali 1995). In (13a), the prefix surfaces with an unrounded central vowel [ɨ/ɪ] when the stem has an unrounded vowel. In contrast, when the stem has a rounded vowel the prefix harmonizes with this vowel, i.e. [u/ʊ] in (13b).

(13) Nawuri rounding harmony (tone omitted)

- | | | | |
|----|--------------------------|----|--------------------|
| a. | [gi-ni] ‘tooth’ | b. | [gu-ku:] ‘digging’ |
| | [gi-ke:li:] ‘kapok tree’ | | [gu-dʒo] ‘yam’ |
| | [gɨ-sɨbɨtɨ] ‘sandal’ | | [gʊ-lɔ] ‘illness’ |

One noteworthy harmony type that is sometimes encountered in NC* is what we call identical-vowel harmony where all vowels have the same quality (also called “total vowel harmony”). This manifests as a gradient preference in the lexicon of many languages. For example, in Berom (Bouquiaux 1970: 98-99) and C’Lela (Dettweiler 2015: 28), disyllabic stems have identical vowels in approximately 80% and 60% of the time, respectively.

51.3 Issues in NC* vowel harmony

The harmony systems of NC* touch on the core issues of vowel harmony, such as what are the triggers of harmony and issues of opacity and transparency in the target domain. In this section,

we focus on two key issues: directionality and dominance in ATR, and ATR’s antagonistic relationship with interior vowels. Another important issue is the domain of ATR (e.g. stem-level, word-level, or phrase-level harmony), outside the scope of this chapter. Phrase-level ATR harmony often has distinct properties from its word-level counterpart – see Chapter 20, this volume.

51.3.1 Directionality and dominance in ATR

Directionality refers to whether the harmony transmits left-to-right or right-to-left, while dominance refers to what triggers harmony, usually divided into morphological triggers (e.g. a root) and phonological triggers (e.g. a specific phonological position or value). Individual languages may be assessed as to these properties, sometimes with conflicting results across harmony types. For more on directionality in vowel harmony systems, see Chapter 24, this volume.

Consider Tutrugbu (Kwa – McCollum & Essegbey 2020), which has both ATR harmony and rounding harmony.⁴ While [ATR] shows regressive harmony (spreading leftward from the root), [round] shows progressive harmony (spreading rightward from the initial prefix). In (14a) the root /wu/ ‘climb’ is [+ATR] and spreads leftward (changing underlying /a/ to [e]), while in (14b) the root /bá/ ‘come’ is [–ATR]. At the same time, the prefix /ɔ-/ 2s spreads [round] rightward up to but not including the root.

- (14) Tutrugbu – Progressive harmony for [round] but regressive harmony for [ATR]
- | | | | | |
|----|--------|---------------|---|-------------------------------------|
| a. | [+ATR] | /ɔ-kaá-ba-wu/ | → | [o-koó-bo-wu] ‘2S-still-VENT-climb’ |
| | | /a-kaá-ba-wu/ | → | [e-keé-be-wu] ‘3S-still-VENT-climb’ |
| b. | [–ATR] | /ɔ-zaa-bá/ | → | [ó-zɔɔ-bá] ‘2S-not.again.FUT-come’ |
| | | /á-zaa-bá/ | → | [á-zaa-bá] ‘3S-not.again.FUT-come’ |

⁴ Tutrugbu’s vowel inventory is /i e ε a ɔ o u/, with the caveat that there are two sets of lower-mid vowels: /ε ɔ/ vs. /ε^H ɔ^H/. The latter set act phonologically as [+high] despite their surface quality, and could plausibly be rendered /i u/ underlyingly. See McCollum & Essegbey (2020) for details.

In Tutrugbu, [ATR] spreads leftward from the root to prefixes. Such regressive harmony can also be triggered by “dominant suffixes” where the root is targeted. In Diola-Fogny, a minority of suffixes are specified as [+ATR] which spreads leftward (Casali 2018: 207), shown in (15).

(15)	Diola-Fogny	[-ATR] verb		Dominant [+ATR] suffix
	a.	/lɪb/	‘make slices’	Directive form with /-um/: [lɪb-um]
	b.	/bɔŋ/	‘have’	Negative form with /-əti/: [bɔŋ-əti]

With such data, one question is whether a vowel triggers harmony because it is in a specific position (e.g. word initially or finally), or because it bears a specific harmony value regardless of its position (e.g. [+round])? Likewise, is it the ATR value of the root specifically which is the trigger (a morphological trigger), or is the [+ATR] itself (a phonological trigger)? These are issues related to dominance, one of the most notorious issues in ATR studies. Significant progress on these matters has come from Casali (2003; 2008), who correlates vowel inventory with the ATR value which is dominant. Cross-height ATR systems with a contrast in the high vowels are canonically [+ATR] dominant, as evidenced by the fact that the [+ATR] value typically survives intact in phonological processes such as harmony, assimilation, coalescence, *inter alia*. In contrast, mid-height systems are canonically [-ATR] dominant in the same contexts. We refer the reader to Chapter 15, this volume.

51.3.2 Antagonism between ATR and interiority

One striking observations about NC* vowel systems is that the presence of ATR harmony correlates with the absence of interior vowels. Interior vowels refer to non-peripheral vowels centrally located in the vowel space, such as non-low front rounded vowels (i.e. y ʏ ø œ), central vowels (i.e. i ɨ ə ɘ ə ɜ ɛ ɞ), and back unrounded vowels (i.e. u ʊ ʌ). This antagonistic relationship is a major finding of Rolle et al.’s (2020) survey of ATR, and has a clear areal patterning. In Map 51.1, the area in Central Africa between the two prominent zones of cross-height harmony extensively exhibits interior vowels, both contrastively and as allophonic variants.

Since ATR correlates with a distinction along the height dimension (cued by F1) whereas interiority adds additional contrasts along the backness dimension (cued by F2), this antagonistic relationship makes sense from functional perspectives on what forces shape vowel inventories. This does not, however, automatically exclude ATR and interiority co-occurring in a language, which are often found together in Kru languages such as Godie (Marchese 1983), in (16).

(16) Godie vowel inventory

a.	[+ATR]	i	ɨ	u	b.	[-ATR]	ɪ	ʊ	ɔ
		e	ə	o			ɛ	ʌ	ɔ

In languages with both ATR and interiority, do interior vowels pattern as [+ATR], [-ATR], or as neutral? In one language, Anii (Kwa – Morton 2011), the high central vowel /i/ patterns with the [-ATR] series /ɪ ɨ ʊ ɛ ɔ a/, rather than the [+ATR] series /i u e o ə/. The harmonic behavior of the interior vowel /i/ can be seen in (17a), where it appears in a root and triggers the [-ATR] form of the prefix (cf. [+ATR] roots in 17b). Unfortunately, this vowel /i/ does not appear in affixes where we could determine which [+ATR] vowel it alternates with.

(17) Anii harmony with interior vowel

a.	[gí-pil]	‘we cooked’	b.	[gí-pəl]	‘we looked along’
	[gí-tsíŋ]	‘we are good’		[gí-tsəŋ]	‘we stung’
	[gí-ríŋ]	‘we twisted’		[gí-rəŋ]	‘we closed’

51.4 Conclusion

The focus of this chapter has been on vowel harmony in the Niger-Congo phylum, excluding Bantu as well as controversial branches. Approximately half of Niger-Congo languages exhibit advanced tongue root (ATR) harmony which divides the vowel inventory into [+ATR] vowels versus [−ATR] vowels. One subtype was cross-height ATR harmony, involving high and mid height ATR contrasts, with constraints of the type */i...ε/ or */ʊ...o/ banning mixed ATR values across distinct heights. Another subtype was mid-height ATR harmony, where only the mid series participates in ATR harmony due to the absence of a [−ATR] high series, i.e. constraints of the type */e...ε/ or */ɔ...o/. We compared ATR to less common types of harmony within NC*, such as rounding harmony, height harmony, and identical-vowel harmony. Finally, we touched upon several pertinent issues in understanding harmony in these languages, such as the directionality of harmony, which harmony value is dominant, and ATR's antagonistic relationship with interior vowels (e.g. *ɪ y ɯ ʉ ə ʌ*, etc.).

Acknowledgment

Sadly, Olanike Ola Orié passed away in 2021 and was unable to see the final version of this work. Olanike wrote the first draft of this chapter, focusing on the harmonic systems of Yoruba, Igbo, and Igede. In her career, Olanike was a major force in bridging the worlds of theoretical and Africanist linguistics, and we will miss her presence in our field dearly. This chapter is dedicated to her memory.