Vowel harmony in non-Bantu Niger-Congo languages

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51.1 Introduction

A striking property of Niger-Congo phonology is the pronounced role of vowel 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) whereby vowels harmonize for tongue root position. We contrast two subtypes, cross-height and mid-height ATR harmony, both of which are widespread across Niger-Congo. We exemplify these types with several case studies, especially drawing from Nigerian languages Yoruba, Igbo, Igede, and Degema. We show in contrast to ATR harmony, other types of vowel harmony such as rounding harmony, height harmony, and identical-vowel harmony occur far less frequently. Following our overview of ATR types, we highlight several important issues which the NC* harmony systems bring up. These include which ATR value is dominant, the directionality of ATR harmony, the (prosodic) domain of harmony, and ATR's antagonistic relationship with interior vowels (i.e. non-peripheral vowels ɨ y ʉ ɯ ə ʌ, etc.).

Our discussion of vowel harmony in Niger-Congo is necessarily brief. For a more complete overview, see *inter alia* Casali (2003; 2008; 2016; 2018), Clements & Rialland (2008), Starwalt (2008), Güldemann (2008; 2018), Rose & Walker (2011), Lionnet & Hyman (2018), Hyman et al. (2019), and Rolle et al. (2020). Within this volume, see also {chapter 7} on ATR generally, and discussion of ATR in Nilo-Saharan in {chapter 49}.

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

The empirical scope of this chapter is on the Niger-Congo phylum, but excluding the massive Bantu family which is discussed separately in this volume ({chapter 52}). Moreover, those language families which only controversially belong to the Niger-Congo phylum are excluded as well (e.g. families Mande, Dogon, Ijoid, and Kordofanian), all of which also commonly display types of vowel harmony. 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 the Bantu family as well as these controversial branches.

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 (Edoid – Elugbe 1976; Kari 2007), where all vowels in the phrase 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]	[ʊɓɪ mɛ́ɛ]	'my book'

In terms of articulation, 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; Lindau 1975, 1976; 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. [ʊ] in (1).[1]

We differentiate two types of ATR harmony. The most common types 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). In other words, [+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 *[ɔ … 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. /u̟/ versus /u̠/. In many West African orthographies, [-ATR] vowels are written with a dot under the vowel, e.g. <ụ> = [ʊ].

(2) Common 10-vowel 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]	
	ikpəpú˩ú	'padlock'		ɪdʒá˩lám	'blood'
	úkóɓə	'cowry, cataract'		ʊkaɓʊ́	'saying, slogan'
	elú˩mə́	'land crab'		ɛgbʊ́˩rá	'snapper'
	odisə́˩ə́n	'afternoon'		ɔsakʊ́	'*Hepsetus odoe*' (fish)
	əsíŋgo	'long narrow machete'		atí˩rɛ́	'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 (Idomoid – 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. vowels are all either [+ATR] (e.g. /ugbodʒi/ 'orange', /egbodu/ 'okra', etc.) or [-ATR] (e.g. /ʊvəhɪ/ 'cat', /adɪda/ 'father', etc.). In addition to such 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 is determined by the root.

(5) Igede ATR alternations (tones are omitted)

		Verb root		Reduplicated form	
a. [+ATR]	bi	‘to lose’	o-bibi	‘losing’
	gbu	‘to die’	o-gbugbu	‘dying’
	ho	‘to fly’	o-hoho	‘flying’
	je	‘to get’	o-jeje	‘getting’
b. [-ATR]	dɪ	‘to beat’	ɔ-dɪdɪ	‘beating’
	rʊ	‘to come’	ɔ-rʊrʊ	‘coming’
	dʒɛ	‘to know’	ɔ-dʒɛdʒɛ	‘knowing’
	rɔ	‘to buy’	ɔ-rɔrɔ	‘buying’
	wa	‘to 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’		ʊ-rʊ	a-rʊ	‘ear’
	u-bo	e-bo	‘room’		ʊ-lɛ	a-lɛ	‘hoe’

Unlike high and mid vowels, Igede low vowels do not have a [+ATR] counterpart. Further data from Abiodun (1991) shows that in morphological contexts where there is an ATR alternation involving a low vowel affix, the [+ATR] counterpart is either /e/ as in the plural forms in (6), or /o/ as in the third person singular pronoun in (7).[2]

(7)

a. [-ATR]		b. [+ATR]	
a rʲɪ idʒu	‘he ate yam’	o mile ide	‘he swallowed saliva’

In Igede no [+ATR] low vowel [ə] exists, neither as a contrastive phoneme nor as a conditioned allophone. In such reduced systems, the phonological patterning of the sole low vowel /a/ is one of the focal points in theoretical work on vowel harmony, for example whether it behaves as [-

[2] A reviewer adds that in 9-vowel ATR languages although it is quite common for a [-ATR] /a/ to alternate with a [+ATR] /e/ or to alternate with a [+ATR] /o/, it is quite rare to find both types of alternations co-occurring within a single language in different morphological contexts.

ATR] (as in Igede), or is neutral and may occur with either set. For theoretical discussion, see van der Hulst & Smith (1986), Bakovic (2000), *inter alia*.

Another kind of reduced cross-height ATR harmony is found in Igbo, whose many dialects have been extensively studied for their ATR patterns. All dialects appear to show a harmony contrast among high vowels, but vary in the mid/low series. Southern dialects such as Owere and Ngwa have eight vowels /i ɪ u ʊ e a o ɔ/, all of which can appear in roots and in affixes. This is exemplified in (8). In such dialects, [+ATR] /e/ and [-ATR] /a/ are in a harmonic relationship; there is no [-ATR] /ɛ/.

(8) Igbo ATR harmony (tone omitted)

a. [+ATR]		b. [-ATR]	
isi	‘head’	ʊkwʊ	‘leg’
ise	‘five’	ʊzɔ	‘way’
olu	‘neck’	ahɪa	‘market’
ewu	‘goat’	ɔgba	‘fence’
oke	‘rat’	afɔ	‘year’

In contrast, in dialects such as Ohaozara and Ekpeye (Clark & Williamson 2013) the [-ATR] mid vowel /ɛ/ is contrastive, resulting in the more common 9-vowel ATR system. This is demonstrated by minimal pairs /yɛ́/ ‘he/she’ versus /yé/ ‘fry’, and /méɛ́/ ‘wine’ versus /méɛ̄/ ‘blood’ and /máá/ ‘spirit’. Disyllabic nouns in Ekpeye illustrating /ɛ/ with other [-ATR] vowels of all heights are in (9) (tone omitted).

(9) Ekpeye [-ATR] /ɛ/

a.	ɛzɪ	‘head pad’	ɛsʊ	‘thigh’
b.	ɛlɛ	‘earth, land’	ɛbɔ	‘kingdom’
c.	ɛkpa	‘bag’		

In still other (Northern) dialects such as Imilike (Nweya 2013), two centralized allophones exist, one [+ATR] transcribed as [ə] and one [-ATR] transcribed as [ə̣] (distinct from fellow [-ATR] low vowel /a/). Examples include [+ATR] [obəʃi] ‘cat’ and [-ATR] [ɛgə̣rə̣] ‘blacksmith’. We will return to the relationship between ATR and such centralized vowels in section 51.3.3.

51.2.2 Mid-height ATR harmony

Another type of harmony is mid-height ATR harmony. Languages of this type typically have a vowel inventory /i e ɛ (ə) a ɔ o u/, lacking the [−ATR] high counterparts /ɪ ʊ/. Only the mid series participates in ATR harmony, i.e. constraints of the type */e…ɛ/ or /ɔ…o/. One famous

example is Yoruba (Awobuluyi 1967; Bamgbose 1967; Oyelaran 1973), where mid vowels of different heights do not co-occur. This is shown in (10), taking data from Yai (1996). Both sets can co-occur with [+ATR] /i u/, which have no [-ATR] counterparts.

(10) Yoruba mid-height ATR harmony

a.	[oko]	'farm'	(*okɔ)	b.	[ɔkɔ]	'husband'	(*ɔko)
	[ètè]	'lip'	(*etɛ)		[ètɛ̀]	'leprosy'	(*ɛte)
	[ebi]	'hunger'			[èbi]	'guilt'	
	[eku]	'rat'			[ɛtù]	'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/ as shown in (11a.)-(11b.), but only the [-ATR] vowel may appear before, as in (11c.)-(11d.).

(11) Yoruba [-ATR] low /a/ triggers regressive harmony

a.	akpɛ́	'applause'	b.	àkpé	'beloved'
	abɔ́	'bowl'		abo	'female'
c.	èsà	'*Egúngún* genre'	d.	*esa	
	ɔ̀sà	'river, lagoon'		*osa	

We interpret these data as the /a/ in word-final position triggering regressive [-ATR] harmony, which determines the harmonic value of mid vowels before it (Archangeli & Pulleyblank 1989).

As stated, across Yoruba dialects it is only in the high series that [+ATR] /i u/ are contrastive, and we do not find contrastive [-ATR] /ɪ ʊ/. Consequently, they are the only high vowels licensed in root-final position, where harmony can spread to preceding vowels as in (11). Consider the dialect comparison in (12). 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

[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).

as [+ATR], showing harmony from the final vowel (12a.). Initial [+ATR] mid vowels remain the same in all dialects (12b.).

(12) Yoruba – Regressive [+ATR] harmony triggered by final high vowels (tone omitted)

	Standard	Ife/Ekiti	Gloss
a.	ɛbi	ebi	'guilt'
	ɛwu	eu	'garment'
b.	oʃu	oʃu	'month'

Related patterns emerge across dialects when a high vowel occurs in non-final position. In cases where all of the vowels are [+ATR] there are no differences across dialects, e.g. 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/. Examples with a medial high vowel in trisyllabic roots are shown in (13).

(13) Yoruba dialects showing regressive [-ATR] harmony

	Standard (opaque)	Ife (transparent)	Ekiti (harmonic)	Gloss
a.	odídɛ	ɔdídɛ	ɔdídɛ	'parrot'
b.	orukɔ	ɔrukɔ	ɔrʊkɔ	'name'
c.	òrìʃà	ɔ̀rìsà	ɔ̀rìʃà	'deity'
d.	òrùka	ɔ̀rùka	ɔ̀rʊ̀ka	'ring'

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. This allophony is equally found with high vowels in initial position, shown in (14).

(14)

	Standard	Ekiti	Gloss
a.	idɛ	ʊdɛ	'brass'
b.	iyɔ̀	ʊyɔ̀	'salt'
c.	igbá	ʊgbá	'calabash'

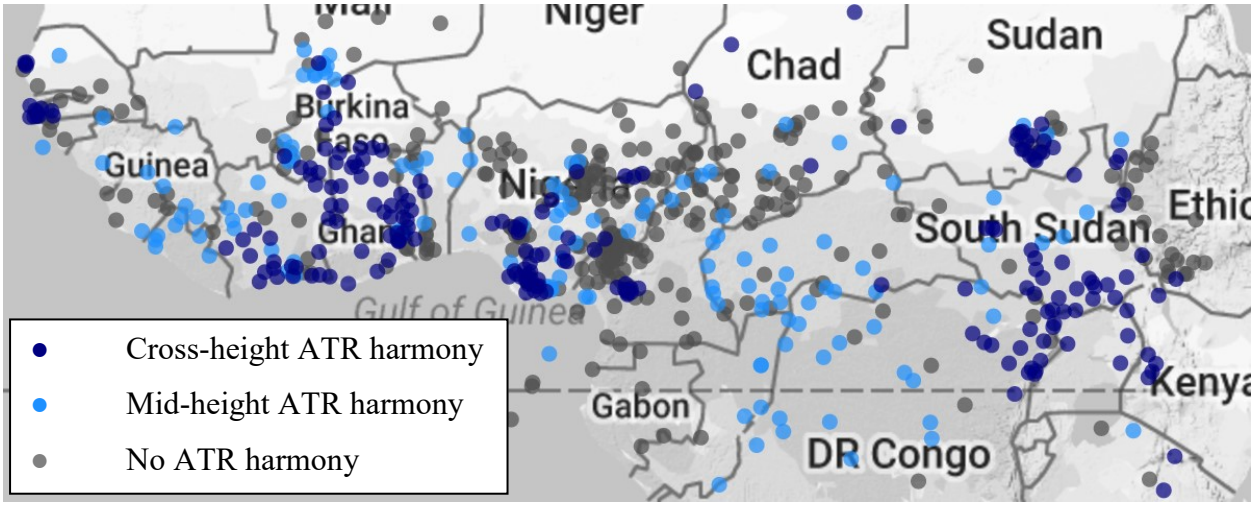
Having [-ATR] allophones [ɪ ʊ] of /i u/ is rarely reported among NC* languages. Much more common among African languages are inventories with contrastive vowels /i ɪ ɛ a ɔ u ʊ/, where the sole contrastive mid series /ɛ ɔ/ surface as [e o] in [+ATR] contexts. Such systems are

fairly common within the more easterly-located Nilo-Saharan phylum (e.g. Central Sudanic and Nilotic families), but they 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 roughly from Senegal in the west to South Sudan in the east. Map 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 1: ATR harmony across the Macro-Sudan Belt



Within this database, there are 357 NC* languages. Of these NC* languages, roughly half display ATR harmony (*n*=180/357). This is typical of families Kwa (e.g. famously, Akan), Gur (e.g. Dagbani and Dagaare), Kru, Defoid, Igboid, Delta Cross, and Gbaya. Cross-height harmony is the most common among these NC* languages (*n*=118/180), and less frequent but still 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

Compared to ATR harmony, other types of vowel harmony are rarer among NC* languages and are not areally widespread (cf. Map 1). In fact, Lionnet & Hyman (2018) emphasize the much

more marginal status of other vowel harmonies in Africa generally compared to world-wide averages, such as rounding harmony (see {chapter 5}) and height harmony (although the latter is common within Bantu NC – see Hyman 1999, {chapter 6}, and {chapter 52}). When individual languages exhibit such harmonies, they tend to be less central to the phonologies of these languages compared to ATR.

One example of rounding harmony which Lionnet & Hyman cite is from Nawuri (Kwa – Casali 1995). In (15a.), the prefix surfaces with an unrounded central vowel [ɨ] (or its [-ATR] counterpart [ɪ] depending on the stem [ATR] value) when the stem has an unrounded vowel. In contrast, (15b.) shows that when the stem has a rounded vowel the prefix harmonizes with this vowel, becoming /u/ (or /ʊ/).

(15) Nawuri rounding harmony (tone omitted)

a.	[gɨ-ɲi] 'tooth'	b.	[gu-kuː] 'digging'
	[gɨ-keːliː] 'kapok tree'		[gu-dʒo] 'yam'
	[gɪ-baː] 'hand'		[gʊ-sʊ] 'ear'
	[gɪ-sɪbɪta] 'sandal'		[gʊ-lɔ] 'illness'

Further, one noteworthy type that is sometimes encountered in NC* is what we call identical-vowel harmony where all vowels have the same quality. This manifests as a gradient preference in the lexicon of many languages. For example, in Nigerian languages Berom (Platoid – Bouquiaux 1970: 98-99) and C'Lela (Kainji – Dettweiler 2015: 28), disyllabic stems have identical vowels in approximately 80% and 60% of the time, respectively. Similar facts are seen in various Gbaya and Ubangi languages, e.g. 47% of CVCV words show identical-vowel harmony in Banda-Ndele (Sampson 1985: 141).

Sometimes identical-vowel harmony only affects a subset of the vowel inventory. In Salka Kambari (Kainji – Stark 2010: 208ff) there are two sets of vowels: high vowels /i u/ versus non-high vowels /ɛ ə ɔ a/. Table 1 shows that while high vowels have no restrictions, non-high vowels must be identical if more than one co-occur in a domain.

Table 1: Identical-vowel harmony among non-high vowels in Salka Kambari

V1 / V2	i	u	ɛ	ə	ɔ	a
i	✓	✓	✓	✓	✓	✓
u	✓	✓	✓	✓	✓	✓
ɛ	✓	✓	✓	*	*	*
ə	✓	✓	*	✓	*	*
ɔ	✓	✓	*	*	✓	*
a	✓	✓	*	*	*	✓

Unlike many of the gradient patterns of identical-vowel harmony cited above which largely hold over the static lexicon, Salka Kambari shows active alternations to comply with this constraint. In (16), the third plural marker harmonizes with the non-high vowel of the root; high vowels here are transparent to the harmony process.

(16) Salka Kambari harmony (Stark 2010: 215)

a. a ciga ‘they want’ a guɓa ‘they herd’

b. ə cipə ‘they come down’ ə luwə ‘they drive’

c. o rito ‘they learn’ o puro ‘they wait’

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 will examine three key issues brought up by harmony in NC* in particular: (i) directionality and dominance in ATR, (ii) the domain of ATR, and (iii) ATR’s antagonistic relationship with interior vowels.

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 phonological 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}.

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 (17a.) the root /wu/ 'climb' is [+ATR] and spreads leftward (changing underlyingly /a/ to [e]), while in (17b.) the root /bá/ 'come' is [-ATR]. At the same time, the prefix /ɔ-/ 2S spreads [ROUND] rightward up to but not including the root.

(17) 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]	/ɔ́-zaa-bá/	→	[ɔ́-zɔɔ-bá]	'2S-not.again.FUT-come'
		/á-zaa-bá/	→	[á-zaa-bá]	'3S-not.again.FUT-come'

In the Tutrugbu case, [ATR] spreads backward from the root to prefixes. Such regressive harmony can also be triggered by so called 'dominant suffixes' where it is the root which is targeted (and shows active alternations). In Diola-Fogny, a Bak language traditionally classified within Northern Atlantic, a minority of suffixes are specified as [+ATR] which spreads backward (Casali 2018: 207). This is shown in (18).

(18) Diola-Fogny

	[-ATR] verb		Dominant [+ATR] suffix	
a.	/lɪb/	'to make slices'	Directive form with /-um/:	[lib-um]
b.	/baɟ/	'to have'	Negative form with /-əti/:	[bəɟ-əti]

Casali (2018) makes the interesting observation that all dominant suffixes are derivational, while all inflectional suffixes (and all prefixes) are uniformly recessive.

From data like Tutrugbu, Diola-Fogny, and others, we can ask whether it is the rounding value of the word-initial vowel which triggers spreading, or is it triggered by the presence of [+ROUND] itself (regardless of its position in the word)? Likewise, is it the ATR value of the root 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 famous issues in ATR studies. Significant progress on these matters has come from Casali (2003; 2008; 2016), who correlates

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

the type ATR harmony and inventory (i.e. cross-height vs. mid-height) with the ATR value which is dominant. In short, 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} in this volume for more details.

51.3.2 The domain of ATR harmony

The domain of ATR harmony also varies across NC* languages. In some languages it is only the root which is subject to harmony, therefore manifesting only static patterns. In most harmonic NC* languages, however, ATR harmony creates alternations in morphemes of the types we have seen already. What the exact domain is though – e.g. the prosodic stem, the phonological word, the clitic group, etc. – is often difficult to clearly ascertain and can vary across dialects.

This is exemplified in (19) using Yoruba (Akinlabi & Liberman 2000; Rose & Walker 2011). In the standard dialect, subject markers do not harmonize with the root and are inherently either [+ATR] or [-ATR]. In contrast, in the Oyo dialect the subject markers harmonize with a [-ATR] root (19a.), illustrating an expansion of the harmony domain. At the same time, note that even in Oyo these markers never harmonize with a [+ATR] root (19b.).

(19) Yoruba harmony domain:

		Standard	Oyo	Gloss
a.	[-ATR] root	ó wá	ɔ́ wá	‘he/she came’
		ɛ wá	ɛ wá	‘you-all came’
b.	[+ATR] root	ó dé	ó dé	‘he/she came’
		ɛ dé	ɛ dé	‘you-all came’

In many cases, harmony does not apply the same even within a morpheme class in a single morphological position. Returning to Degema (Kari 2007), (20a.) shows that the first singular post-nominal possessive pronoun harmonizes with the root. In contrast, the third singular pronoun /nɔ́ɔŋʷ/ is consistently [-ATR] in both contexts (20b.), while first plural /néni/ is consistently [+ATR] (20c.).

(20) Degema

	[+ATR] root		[-ATR] root	
a.	[úbi mée]	‘my palm kernel’	[ʊɓɪ méɛ]	‘my book’
b.	[esen nɔ́ɔŋʷ]	‘his fish’	[aβɪ nɔ́ɔŋʷ]	‘his leg’
c.	[íɓə néni]	‘our oysters’	[ɛɓʊɲ néni]	‘our goat’

In such cases, either harmony applies on a morpheme-by-morpheme basis, or there is a lurking phonological factor which governs harmony application.

The ATR domain can sometimes be quite large, approaching the phonological phrase. Such phrase-level ATR has distinct properties from its word-level counterpart, especially with regard to the target, trigger, directionality, and iterability. See {chapter 20} in this volume and the references therein.

51.3.3 Antagonism between ATR and interiority

One striking observations about NC* vowel systems (and those in its vicinity) is that the presence of ATR harmony correlates with the absence of interior vowels. Interior vowels refer to non-peripheral vowels more centrally located in the vowel space, such as non-low front rounded vowels (i.e. y ʏ ø œ), central vowels (i.e. ɨ ʉ ɘ ɵ ə ɜ ɞ ɐ), and back unrounded vowels (i.e. ɯ ɤ 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 1 above, 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. For example, several Kru languages have developed interior vowels with ATR distinctions. The inventory of Godie (Marchese 1983; Williamson 2004) is given in (21), with ATR contrasts in front, central, and back vowels (note that /a/ exists but it is neutral).

(21) Godie vowel inventory

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

One question which arises in languages with both ATR and interiority is whether the interior vowels pattern as [+ATR], [-ATR], or as neutral. For example, in Anii (Kwa – Morton 2011) a high central vowel [ɨ] exists which patterns as [-ATR], shown in are in (22).

(22) Anii vowel inventory a. [+ATR] /i u e o ə/ b. [-ATR] /ɪ ɨ ʊ ɛ ɔ a/

When these vowels occur in roots, affixes harmonize based on the root's ATR value, shown with a collection of noun class prefixes in (23) (the label for the noun classes derive from letters in the Anii alphabet).

(23) Noun class harmony: [-ATR] root [+ATR] root

a.	Class Ǝ	[a-bɔrí]	'sheep/animal'	[ə-kutú]	'orange'
b.	Class Y	[ba-fʊmɪ]	'farmers'	[bə-pi]	'children'
c.	Class Ð	[gɪ-bɔ]	'very short shorts'	[gi-ʤe]	'yam'

The harmonic behavior of the interior vowel /ɨ/ can be seen in (24a.), where it appears in a root and triggers the [-ATR] form of the prefix. Roots with /ə/ are shown triggering [+ATR] in (24b.) for comparison.

(24)

a.	[gí-pɨl]	'we cooked'	b.	[gí-pəl]	'we looked along'
	[gí-tsɨŋ]	'we are good'		[gí-tsəŋ]	'we stung'
	[gí-rɨŋ]	'we twisted'		[gí-rəŋ]	'we closed'

Unfortunately, this vowel /ɨ/ does not appear in affixes where we could determine which [+ATR] vowel it alternates with. See Morton (2011: §3) for more details on the origin and behavior of interior vowels in Anii.

51.4 Conclusion

The focus of this chapter has been on vowel harmony in the Niger-Congo phylum, but excluding Bantu as well as controversial branches of Niger-Congo (e.g. families Mande, Dogon, Ijoid, and Kordofanian). We referred to this as NC*. Approximately half of NC* languages exhibit tongue root harmony which divides the vowel inventory into [+ATR] vowels (or advanced tongue root) versus [-ATR] vowels (or retracted tongue root). We established two subtypes of ATR harmony. Cross-height ATR harmony involves high and mid height ATR contrasts, with constraints of the type */i…ɛ/ or */ʊ…o/ banning mixed ATR values across distinct heights. In contrast, in mid-height ATR harmony only the mid series participates in ATR harmony due to the absence of a [-ATR] high series, i.e. constraints of the type */e…ɛ/ 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, from this overview we touched upon several pertinent issues in understanding harmony in NC* languages. These included the directionality of harmony (L-to-R or R-to-L), dominance (does [+ATR] trigger, [-ATR], or both), the domain of vowel

harmony (e.g. root, stem, word, phrase), and ATR's antagonistic relationship with interior vowels (e.g. vowels ɨ y ʉ ɯ ə ʌ, etc.).[5]

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[5] Sadly, Olanike Ola Orie 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. 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.

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