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CHAPTER 4

SEGMENTAL PHONOLOGY

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INTRODUCTION

As in other parts of the grammar, Bantu segmental phonology can be characterised as a theme and variations: despite the large number of languages and great geographic expanse that they cover, the most noteworthy properties concerning Bantu syllable structure, consonant/vowel inventories and phonological processes are robustly attested throughout the Bantu zone. These shared features, although striking, however mask a wide range of differences which are equally, if not more, important in understanding Bantu phonology in general. It is helpful in this regard to consider both the phonological system inherited from Proto-Bantu, as well as the innovations, often areally diffused, which characterise present-day Bantu subgroups and individual languages.

1 PROTO-BANTU

According to most Bantuists, e.g., Meeussen (1967), Proto-Bantu (PB) had the relatively simple consonant and vowel systems in (1):

(1) a	consonants				b	vowels (long and short)		
	p	t	c	k		i		u
	b	d	j	g		ɩ		ʊ
	m	n	ɲ			ɛ		ɔ
							a	

Of the two series of oral consonants in (1a), all scholars agree that the voiceless series **p*, **t*, **k* were pronounced as stops. There is, however, disagreement as to whether **b *d *g* should be reconstructed as a parallel voiced stop series or as voiced continuants, i.e., **β *l *ɣ*, as they are pronounced in many daughter languages today. It also is not clear whether **c* and **j* should be viewed as palatal stops or affricates – or whether they were palatal at all. Many Bantu languages realise **c* as /s/, and some realise **j* as /z/. Realisations of the latter as /y/ or /j/ (i.e., [*dʒ*]) are, however, probably more common. Although various scholars have occasionally posited additional consonants and series of consonants (e.g., fortis vs. lenis stops) in the proto system, none of these have been demonstrated to the satisfaction of the Bantuist community. On the other hand, much more complex systems have been innovated in the daughter languages as seen in Maddieson (2003) and below (see also chapter 3).

There is, by comparison, more stability in the vowel system, which is reconstructed as in (1b). Most scholars agree that PB had seven distinct vowels (7V). As transcribed in (1b), there would have been an opposition in the high vowels between tense or [+ATR] **i* and **u* and lax or [-ATR] **ɩ* and **ʊ*, which has frequently been transcribed as **i̧ *u̧* vs. **i *u*. The mid vowels **ɛ* and **ɔ* were also lax, although they are often transcribed **e* and **o* for convenience, which I will generally follow here. Such a system, exemplified from Nande JD42 in (2a) (Mutaka 1995), is widely attested, especially in eastern Bantu, where I have changed the *i̧ u̧* transcription of the degree 1 high vowels to be consistent throughout this chapter:

(2)	a	-lím-	'exterminate'	-lúm-	'be animated'
		-lɪ̀m-	'cultivate'	-lʊ́m-	'bite'
		-lɛ̀m-	'fail to carry sth. heavy'	-tɔ́m-	'put aside'
		-làm-	'heal'		
	b	-tìng-	'hook'	-tùng-	'become thin'
		-bèng-	'chase'	-tóng-	'construct'
		-kɛ́ng-	'observe'	-tɔ́ng-	'gather up'
		-tàng-	'flow'		

Other Bantu languages, such as Koyo C24 in (2b) (personal notes), have the 7V system /*i e ɛ u o ɔ a*/, where there is instead a tense/lax or ATR opposition in the mid vowels. Such a system is particularly frequent in Western Bantu. See Stewart (1983, 2000–2001) and Hyman (1999) for further discussion of the reconstructed PB vowel system.

The syllable structures allowed in PB were limited to those in (3).

(3)	a	CV, CVV	b	V, N

Most syllables in PB had one of the two shapes in (3a): a single consonant followed by a vowel that was either short (V) or long (VV), e.g., **-pád-* 'scrape' vs. **-páad-* 'quarrel.' The syllable shapes in (3b) were most likely limited to prefixes, e.g., **à-* 'class 1 subject prefix,' **Ǹ-* 'class 9 noun prefix.' PB roots with non-identical vowels in sequence have also been reconstructed, e.g., **-bàij-* 'carve,' **-gòì* 'leopard,' but may have involved "weak" intervening consonants, e.g., glides, that dropped out in pre-PB (cf. **-bí-ad-* 'give birth'). Many vowel sequences, including some identical ones, e.g., **-tʊ́-ʊd-* 'rest, put down load,' are analysable as heteromorphemic (cf. **-tʊ́-ad-* 'carry on the head'), such that Meeussen (1979) questioned whether PB actually had long vowels at all. Others have subsequently arisen through the loss of PB consonants, e.g., **Ǹ-gòbì*, **Ǹ-jògù* > Kamba E55 *ŋ-goi* 'baby sling,' *n-zou* 'elephant' (Hinnebusch 1974). In many languages this consonant loss is restricted and results in synchronic alternations between C and Ø. For example, while **-dìd-* 'cry' is realised *li-a* (with FV *-a*) in Swahili G42, the final **d* is realised [*l*] before the applicative suffix *-i-*, e.g., *-lil-i-a* 'cry to/for' (from **-dìd-ɪd-a*), since [*l*] does not normally delete before front vowels (Nurse & Hinnebusch 1993: 100). In contrast with PB *VV sequences, which are tautosyllabic, neo-VV sequences typically remain heterosyllabic. On the other hand, many Bantu languages have lost the inherited V/VV opposition, e.g., **-dóot-* 'dream' > Tonga M64 *-lót-*, Chewa N31b *-lót-*, Tswana S31 *-lór-*. Onsetless syllables typically have a short vowel, while CVV may be favored in certain alternations. This is the case in roots such as -(*y*)*ér-* 'sweep' in Ganda JE15, where the initial "unstable-y" is realised in all environments except when preceded by a CV- prefix with which the following vowel fuses, e.g., *tw-éèr-a* 'we sweep' vs. *a-yér-à* 'he sweeps,' *ɲ-jér-à* 'I sweep' (Hyman & Katamba 1999).

The last syllable type, a low tone nasal, is reconstructable in class 9 and 10 noun prefixes, while syllabic nasal reflexes of the first person singular subject and object prefixes derive from earlier **nì-*. The nasal of morpheme-internal NC sequences appears never to be itself syllabic, although it frequently conditions length on a preceding vowel, e.g., **-gènd-* [*-gè:nd-*] 'walk' (Clements 1986). If correctly analysed as two segments, NC constitutes the only consonant cluster in PB. This includes heteromorphemic N+N sequences, although these are subsequently degeminated in many Bantu languages. At the same time, new syllabic nasals often derive from the loss of the vowel of **mV-* prefixes, especially **mu*-CV > m̩-CV > N̩-CV (Bell 1972, Nurse & Hinnebusch 1993: 181–185, Hyman & Ngunga 1997: 139ff, Kadenge 2014, Bostoen & de Schryver 2015, Kadenge 2015).

Some Bantu languages have developed additional syllable structures, typically by the loss of vowels or consonants or through borrowings. Most word-final vowels have been lost in Ruwund L53, whose word-final syllables therefore usually end in a consonant, e.g., **Ǹ-búdà*, **dʊ̀-kʊ́nì > ń-vùl* 'rain,' *rú-kùɲ* 'firewood' (Nash 1992). North-West Bantu languages such as Basaa A43, on the other hand, have not only lost final vowels, e.g., **mʊ̀-dʊ́mè > n-lóm* 'male,' but also create non-final closed syllables by syncopating the medial vowel of CVCVCV stems, e.g., *tiŋil* 'untie' + *a* 'passive suffix' → *tiŋla* (Lemb & de Gastines 1973). Other languages which have closed syllables include the closely related languages Eton A71 (Van de Velde 2008) and Fang A75 (Medjo Mvé 1997), Mbuun B87 (Bostoen & Mundeke 2011), and Nzadi B865 (Crane *et al*. 2011), the last of which often retains the tones when vowels are deleted, e.g., **mʊ̀-(j)ánà > mwàân* 'child.' Closed syllables may also be found in incompletely assimilated borrowings, e.g., Swahili G42 *m-kristo* 'Christian' (Wilson 1985); Yaka H31, *mártóo* 'hammer' (< French *marteau*) (Ruttenberg 2000).

Most Bantu languages maintain a close approximation of the PB situation as far as syllable structure is concerned. The open syllable structure is, in fact, reinforced by the well-known Bantu agglutinative morphology. The typical structures of nouns and verbs are schematised in (4).

(4)	a	Nouns	AUGMENT	PREFIX	STEM
			CV	CV	CV(V)CV
			V	N	CV(V)
				V	VCV

e.g., Bukusu JE31c	kú-mù≠xòò	'arm'	(class 3)
	ó-mù-xàsì	'woman'	(class 1)
	é-ǹ-jùxì	'bee'	(class 9)
	cí-ǹ-jùxì	'bees'	(class 10)
	lí-ì-bèèlè	'breast'	(class 5)

b	Verbs	PI	SP	NEG	TP	AP	OP	STEM
		CV	CV	CV	CV	CV	CV	CV(V)CV . . .
		V	V		V		N	
			N					

e.g., Nande JD42 mó-tù-tétà-yà-mú≠túm-à
PI- SP-NEG-AP-OP-SEND-FV
'we didn't go and send him'

(PI = pre-initial morpheme, including augment; SP = subject prefix; NEG = negative, TP = tense prefix, AP = aspect prefix, OP = object prefix, FV = inflectional final vowel)

c	Verb Stems	ROOT	EXTENSION(S)	FV	
		CVC	VC	V	
		CV	V		
e.g., Chewa N31b		-lìm-ìts-ìl-àn-à			‘cause to cultivate for each other’
		ROOT-CAUS-APPL-RECP-FV			(causative-applicative-reciprocal)

In the above schemas, V stands for any of the seven PB vowels, while C stands for any of the proto-consonants, including, potentially, NC. The most common shape of each morpheme is given in the first row. As seen in (4a,b), pre-stem morphemes (prefixes) are restricted to the shapes CV-, V- and N-. In (4c), on the other hand, we see that post-root morphemes (suffixes) have the shapes -VC- and -V-. Since most roots begin and end with a C, morpheme concatenation provides almost no potential for consonant clusters, but rather a general alternation of consonant-vowel-consonant etc. The one exception to this occurs when Vs meet across a morpheme boundary. In this case specific rules modify the resulting V+V inputs (see Section 3.2). Other assimilatory and dissimilatory alternations occur when morphemes meet, some of which are restricted to specific domains, e.g., the stem (root+suffixes). Many of these alternations produce output segments beyond those in the above V and C inventories. The most widespread phenomena are treated in the following sections, first for vowels (Section 3), then for consonants (Section 4).

2 VOWEL PHONOLOGY

While PB had the 7V system in (1b), the majority of Bantu languages have merged the degree 1 and 2 vowels to achieve the five-vowel (5V) system in (5a).

(5) a Swahili G42

i		u
ɛ		ɔ
	a	

b Budu D332

i		u
ɩ		ʊ
e		o
ɛ		ɔ
	a	

c Bafia A53

i	ɨ	u
e	ə	o
ɛ	ʌ	ɔ
a	ɑ	

A few languages have gone the other direction and developed the nine-vowel system in (5b). While this system appears to be underlying in Budu D332 (Kutsch Lojenga 1994), other languages, such as Nande JD42 and the Sotho-Tswana S30 languages, derive the eighth and ninth vowels [*e*] and [*o*] from the tensing/raising of the degree 3 vowels **ɛ* and **ɔ*, respectively (Mutaka 1995, Creissels 2005). Finally, some of the languages in zone A, such as Bafia A53 in (5c), have developed “rectangular” vowel systems with back unrounded vowels (Guarisma 1969), which also appear in Grassfields Bantu (Watters 2003). B70 and B80 languages have also developed nasalised and fronted (“umlauted”) rounded vowels (Hombert 1986, Bostoen & Koni Muluwa 2014).

3.1 DISTRIBUTIONAL CONSTRAINTS ON UNDERLYING VOWELS

As indicated in Section 2, Bantu phonology is highly sensitive to morphological considerations. Underlying vowel distribution within specific morphological slots and morphological or prosodic domains is thus highly restricted in both seven-vowel and five-vowel languages. Meeussen (1967), for example, allows for the following vowels in each of the indicated positions.

(6) PB vowel reconstructions by position (cf. Hyman 2008, Teil-Dautrey 2008)

	*i	*u	*ɪ	*ʊ	*ɛ	*ɔ	*a
first stem syllable	x	x	x	x	x	x	x
final stem vowel	x	x	x	x	x	x	x
elsewhere	x		x	x			x

The seven vowels of PB contrast in the first and last syllables of a stem, but not in prefixes, extensions or stem-internal position, where only four vowels contrast. In a few cases involving reduplication, the vowel **u* appears in the first two syllables of a verb, e.g., **-dùdum-* 'rumble, thunder,' **-pùpum-* 'boil up, boil over.' The root **-tákun-* 'chew,' on the other hand, appears to be exceptional.

Some languages, particularly five-vowel ones, have further restricted this distribution by position within the stem or word. Thus, Punu B43, which has the underlying system /i u ɛ ɔ a/, restricts /ɛ/ and /ɔ/ to stem-initial syllables only (Kwenzi Mikala 1980). In Bobangi C32 (7V), /u/ may not occur in prefixes, nor may any of the rounded vowels /*u, o, ɔ*/ appear later than the second syllable in stems.

3.2 VOWEL ALTERNATIONS

In addition to underlying constraints on vowel distribution, most Bantu languages severely restrict the sequencing of vowels, particularly within stems. Thus, while Punu B43 allows only /i u a/ in post-root position, /a/ is reduced to schwa in this position, and the expected post-stem sequences [*əCi*] and [*əCu*] surface instead as [*iCi*] and [*uCu*]. Thus, the historical suffix sequences /-am-il-/ (positional-applicative) and /-am-ul-/ (positional-reversive tr.) are realised [*-imin-*] and [*-umun-*]. In addition, a post-stem /a/ ([ə]) assimilates to a FV *-i*, and both post-stem /a/ and /i/ assimilate to a FV *-u* (Fontaney 1980). The Punu B43 case demonstrates two general properties of Bantu vowel systems: (i) There are typically more contrasting underlying vowels in the stem-initial syllable, and (ii) vowels in this position may be exempt from reduction and assimilation processes that post-stem vowels undergo. Ruwund L53 (5V) once had the same vowel distribution as Punu B43, disallowing mid vowels from post-stem position. However, it has since undergone considerable vowel reduction, among other things by dropping most word-final vowels, e.g., **mʊ̀≠(j)ánà > mwáàn* 'child,' **mʊ̀≠kádì > mú≠kàj* 'wife' (Nash 1992). While unusual in tolerating word-final closed syllables, which are analysed with a phantom vowel by Nash, Ruwund L53 is perhaps unique in its overall vowel system in (7a).

(7) a

i		u	ii		uu
			ee		oo
	a			aa	

b *e > i e.g. *-dém- > -lím- 'be lame,' *-dèd- > -lìl- 'raise (child)'
*o > a e.g. *-bón- > -màn 'see,' *-pót- > -pwàt- 'twist'

As seen in (7a), short /e o/ are missing, since they have reduced, respectively, to the peripheral vowels [*i*] and [*a*], as illustrated in (7b). In this atypical case, vowels in the stem-initial syllable were successfully targeted. In Makonde P23 both /e/ and /o/ optionally reduce to [a] in prepenultimate position (Liphola 2001): /ku-pet-il-a/ -> ku-pet-el-a ~ ku-pat-el-a 'to separate for', /ku-pot-il-a/ -> ku-pot-el-a ~ ku-pat-el-a 'to twist for'.

By far the most widely attested assimilatory process is vowel harmony, particularly vowel height harmony (VHH), as indicated in (8) and (9).

(8) Front height harmony (FHH)

a	General	:	*ɪ	→	e	/	/e o/	C ___
b	Extended	:	*ɪ	→	e	/	/e o a/	C ___

(9) Back height harmony (BHH)

a	General	:	*ʊ	→	o	/	/o/	C ___
b	Extended	:	*ʊ	→	o	/	/e o/	C ___

The historical degree-2 vowels (**ɪ *ʊ*) harmonise in height with a preceding mid vowel. The process is frequently different with respect to the front vs. back vowel (Bleek 1862). In a wide range of Central and Eastern Bantu languages, degree-2 /ɪ/ lowers after both /e/ and /o/, while degree-2 /ʊ/ lowers only after /o/. Examples of such "asymmetric" FHH vs. BHH are seen from Nyamwezi F22 in (10), based on Maganga and Schadeberg (1992).

(10)

	Root + Applicative -ɪl-		Root + Separative -ʊl-	
a	βìs-ɪ́l-	'hide for/at'	βìs-ʊ́l-	'find out'
	gùb-ɪ́k-ɪ́l-	'put on lid for/at'	gùb-ʊ́l-	'take off lid'
	pɪ̀ɪ̀nd-ɪ́l-	'bend for/at'	pɪ̀ɪ̀nd-ʊ̀l-	'overturn'
	shʊ̀ʊ̀n-ɪ́l-	'gnaw for/at'	shʊ̀ʊ̀n-ʊ̀l-	'show teeth'
	gàβ-ɪ́l-	'divide for/at'	gàβ-ʊ̀l-	'divide'
b	βòn-èl-	'see for/at'	hòng-ól-	'break off'
c	zèèng-èl-	'build for/at'	zèèng-ʊ̀l-	'build'

There is no harmony in (10a), where the root vowel is either high or low. In (10b) VHH applies to both *-ɪl-* and *-ʊl-* when the root vowel is /o/. However, in (10c), where the root vowel is /e/, *-ɪl-* lowers to *-el-*, but *-ʊl-* remains unchanged. This contrasts with the situation in the JE40 group, e.g., Gusii JE42 (7V), as well as in many North-West Bantu languages. In Mongo-Nkundo C61 (7V), whose vowel system is analysed as /i e ɛ u o ɔ a/, the back degree-2 vowel also harmonises, and FHH and BHH are thus "symmetric."

(11)

	Root + Applicative -el-		Root + Separative -ol-	
a	-íy-èl-	'steal for/at'	-ìs-òl-	'uncover'
	-lúk-èl-	'paddle for/at'	-kùnd-òl-	'dig up'
	-ét-èl-	'call for/at'	-bét-òl-	'wake up'
	-tóm-èl-	'send for/at'	-kòmb-òl-	'open'
	-kamb-èl-	'work for/at'	-bák-òl-	'untie'
b	-kɔ̀t-ɛ̀l-	'cut for/at'	-mɔ̀m-ɔ̀l-	'unglue'
	-kɛ̀nd-ɛ̀l-	'go for/at'	-tɛ́ng-ɔ̀l-	'straighten out'

As indicated in (8b), harmony of the reflex of **ɪ* to [*e*] after /a/ is also attested, particularly in languages towards the Southwest of the Bantu zone, such as Mbundu H21a, Kwangali K33 and Herero R31. While VHH is generally perseverative and limited to the stem domain minus the FV, some languages – particularly those with symmetric FHH/BHH – have extended harmony to the FV and to prefixes. It is important to note that in many 5V Bantu languages, only those /i/ vowels that derive from (degree 2) **ɪ* harmonise, while those that derive from **i* do not. Other languages have modified this original situation and harmonise the perfective ending **-ìd-è* as well (Bastin 1983). In Yaka H31 and certain varieties of Kongo H10, VHH is anticipatory and is triggered primarily by the **-e* of perfective **-ìd-è* (Hyman 1998, 1999). In addition, some of the same languages that have symmetric VHH have extended the process to prefixes, e.g., Mituku D13 (7V) /tú-mú-lòk-é/ → *tó-mó-lòk-é* 'let us bewitch him/her (subjunctive)' (Stappers 1973). For more discussion of variations in Bantu VHH, see Leitch (1996), Hyman (1999) and Goes & Bostoen (2019).

Besides height, other features may also participate in vowel harmony. Closely related Konzo JD41 and Nande JD42 have introduced an advanced tongue root (ATR) harmony, whereby /ɪ ʊ ɛ ɔ/ become [*i u e o*] when followed by /i/ or /u/. They thus have an underlying 7V system (cf. (2)), but introduced two additional, non-contrasting vowels, [*e*] and [*o*], by ATR harmony. /a/ may also be phonetically affected by a following /i/ or /u/ (Gick *et al*. 2006). Clements (1991) provides an overarching framework to treat VHH and ATR harmony in related fashion. Other Bantu languages have innovated rounding harmonies, e.g., perseverative *i* → *u*/*u* ___ in Lengola D12 (Stappers 1971) vs. anticipatory *i* → *u*/___ *u* in Punu B43 (Fontaney 1980). In Maore G44D, regressive rounding harmony even reaches the root vowel: *u≠finiki-a* 'cover,' *u≠funuku-a 'uncover'* (Rombi 1983). Finally, it should be noted that many North-Western 7V languages modify /a/ to [*ɛ*] after /ɛ/ and to [*ɔ*] after /ɔ/, e.g., Mokpwe A22, Tiene B81, Lingala C36d or, in the case of Bembe H11 (5V), to [*e*] and [*o*], respectively.

The above shows the assimilation of one vowel to another across a consonant. When vowels occur in direct sequence, they typically undergo gliding or deletion. Thus, in Ganda JE15, when followed by a non-identical vowel, e.g., the FV *-a*, the front vowels /*i e*/ glide to [*y*], as in (12a), and the back vowels /*u o*/ glide to [*w*], as in (12b) (Hyman & Katamba 1999).

(12)	a	/lí-à/	'eat'	[lyáà . . .]	cf.	a≠lí-dd-è	'he has eaten'
		/ké-à/	'dawn'	[kyáà . . .]		lú≠kè-dd-è	'it has dawned'
	b	/gù-à/	'fall'	[gwaa. . .]		a≠gú-dd-è	'he has fallen'
		/mò-à/	'shave'	[mwaa. . .]		a≠mwé-dd-è	'he has shaved'
	c	/bá-à/	'be'	[báà . . .]		a≠bá-dd-è	'he has been'
		/tá-à/	'let go'	[tâa. . .]		a≠tá-dd-è	'he has let go'
					(SM + Root + PFV + FV)		

As seen in the outputs, gliding of /i e/ and /u o/ is accompanied by compensatory lengthening of the following vowel. In Ganda JE15, this length will be realised if word-internal or if the above verb stems are followed by a clitic. Otherwise it, as well as the length obtained from concatenation of /a/ + /a/ in (12c), will undergo final vowel shortening (FVS), e.g., *kù≠lyáà=kô* 'to eat a little' vs. *kù≠lyâ* 'to eat.'

The details of vowel coalescence may depend on whether the vowels are tautomorphemic vs. heteromorphemic, and whether the vowel sequence is contained within a word or not. Thus, instead of gliding, the Ganda JE15 mid vowels /e o/ join /a/ in undergoing deletion when followed by a non-identical vowel across a word boundary.

(13)	a	mù≠sìbê	+	ò≠mû	→	[mù.sì.bóò.mû]	'one prisoner'
		mù≠wàlâ	+	ò≠mû	→	[mù.wà.lóò.mû]	'one girl'
	b	m≠bògô	+	è≠mû	→	[m.bò.géè.mû]	'one buffalo'
		n≠dígàá	+	è≠mû	→	[n.dì.gèè.mû]	'one sheep'
	c	bà≠sìbê	+	à≠bà-ò	→	[bà.sì.báà.bò]	'those prisoners'
		bà≠kô	+	à≠bà-ò	→	[bà.káà.bò]	'those in-laws'

Deletion, like gliding, is also accompanied by compensatory lengthening. In many cases, the expected glide may not be realised if preceded by a particular consonant or followed by a particular vowel. In Ganda JE15, an expected [*w*] is not realised when preceded by /f v/, e.g., /fu-a/ → *fw-aa* → [*faa*. . .] 'die.' Similarly, an expected [*y*] is "absorbed" into a preceding /s/, /z/ or palatal consonant, e.g., /se-a/ → *sy-aa* → [*saa*. . .] 'grind.' In Ruwund L53, [*w*] is usually absorbed when preceded by an /m/ or /k/ and followed by /o/, e.g., /kù≠òòš-à/ → [*kwòòš*] ~ [*kòòš*] 'to burn' (Nash 1992).

In cases where /a/ is followed by /i/ or /u/ (typically from PB **i* and **u*), a coalescence process can produce [*ee*] and [*oo*], respectively, e.g., Yao P21 /mà≠ísó/ → *méésó* 'eyes' (Ngunga 1997). This coalescence also occurs in the process of "imbrication" (Section 4.2), whereby the [*i*] of the perfective suffix is infixed and fuses with a base vowel, e.g., Bemba M42 *ísàl-ìl-è* → *ísàìl-è* → *ísèèl-è* 'close (tr.) + perfective' (Hyman 1995a).

With these observations, we now can summarise with examples from Ganda JE15 three of the five sources of vowel length in Bantu: (i) from underlying representations (*-lím-* 'cultivate,' *-líím-*(*ís-*) 'spy on'), (ii) from vowel concatenation, e.g., /bá≠àgàl-à/ → [*báàgàlà*] 'they want'; (iii) from gliding + compensatory lengthening, e.g., /tú≠àgàl-à/ → [*twáàgàlà*] 'we want.' A fourth source is the rule of vowel lengthening that occurs before a moraic nasal + consonant, e.g., /kù-ń≠sìb-à/ → [*kúúnsìbà*] 'to tie me' (cf. Section 4.1.5). A fifth source is penultimate vowel lengthening, which occurs in most Eastern and Southern Bantu languages which have lost the lexical vowel length contrast, e.g., Chewa N31b, *t-à≠mèèny-à* 'we have hit,' *t-à≠mèny-èèl-à* 'we have hit for,' *t-à-mèny-èl-ààn≠à* 'we have hit for each other.' Such lengthening typically applies at the phrase level and may be suspended in certain utterance types, e.g., questions or commands (Hyman 2013).

Besides these lengthening processes, vowel shortening may also apply in one of three contexts. First, there may be final vowel shortening (FVS) with languages varying as to whether this occurs at the end of a word or phrase, or "clitic group," as in Ganda JE15 (Hyman & Katamba 1990). Second, there are a number of languages which restrict long vowels to penultimate or antepenultimate position. Thus, any long vowel that precedes phrase-antepenultimate position will be shortened in Mwiini G412 (Kisseberth & Abasheikh 1974): *reeba* 'stop,' *reeb-eɾ-a* 'stop for,' *reb-eɾ-an-a* 'stop for each other.' Similar observations have been made about the Kongo H10 languages and nearby Yaka H31, which also restricts long vowels to occurring within the stem-initial syllable: *zááy-á* 'know,' *zááy-íl-á* 'know+appl,' *zááy-ís-á* 'cause to know'; but: *zá̱y-ákán-á* 'be known,' with shortening. In Safwa M25, the shortening process appears to count the two moras of a CVV penultimate syllable: *à-gàà≠gúz-y-à* 'he can sell,' *à-gà≠bùúz-y-à* 'he can ask' vs. *à-gà≠bùz-y-ààg-à* 'he may ask' (Voorhoeve n.d.). Finally, a few languages have closed syllable shortening, e.g., before geminate consonants in Ganda JE15: /tú-à-èé≠´tt-à/ → [*twéttà*] 'we killed ourselves.'

In addition to length, vowel height may be sensitive to boundaries. In a number of Great Lakes Bantu languages, historical **ɪ* and **ʊ* lower to [*e*] and [*o*] at the beginning of a constituent. This is particularly noticeable in comparing the augment+prefix sequences across languages, e.g., class 3/4 *u-mu-/i-mi-* in Rwanda JD61 vs. *o-mu-/e-mi-* in Haya JE22 (De Blois 1970). In Nyambo JE21 (personal notes), lowering of /i/ and /u/ occurs only initially in a phrase. As a result, the lowered [*o*] of the phrase-initial form, *ò-mù≠kázì* 'woman,' alternates with [*ù*] in *kù-bón'ú-mù≠kázì* 'to see a woman,' where the final *-à* of *kù≠bón-à* 'to see' has been deleted – in this case, without compensatory lengthening. Besides lowering, root-initial vowels are sometimes deleted initially, e.g., PB **-jíb-* > *íb-à* > Chewa N31b [*bà*] 'steal.' Although restructured as a prefix, the original [*i*] appears in the imperative form *ì-bà* 'steal!' (phrase-finally, [*ììbà*]), where it is needed to fill out the bisyllabic minimality condition on Chewa words.

3 CONSONANT PHONOLOGY

As indicated in Section 2, PB is believed to have had a relatively simple consonant system. In addition, all syllables were open in PB, and syllable onsets mostly consisted of a single consonant. The two possible exceptions to this are nasal+consonant and consonant+glide.

4.1 Nasal+consonant

Besides the consonants in (1a), PB and most present-day languages also have nasal complexes (NC), written *mp*, *mb*, *nt*, *nd*, *ŋk*, *ŋg*, etc., and analysed either as clusters of homorganic nasal+consonant or single prenasalised consonants, e.g., **-bʊ́mb-* 'mould,' **-gènd-* 'go,' **-táŋg-* 'read.' The class 9/10 nasal prefix *N-* produces equivalent NCs across morphemes, e.g., Tuki A64 *m̀≠būā* 'dog,' *ǹ≠dòànè* 'cow,' *ŋ̀≠gì* 'fly.' The PB 1sg morpheme is also often realised as a homorganic nasal in present-day languages, e.g., Ganda JE15 *m̀≠bál-á* 'I count,' *ǹ≠dúm-à* 'I bite,' *ŋ̀≠gw-á* 'I fall.' While the prefix is an underspecified homorganic *N-* in 9/10, we know from such forms as Yao P21 *n-áá≠díp-ìl-é* 'I paid,' where the nasal appears before a vocalic tense marker, that the 1sg prefix has an underlying /n/. In some languages where 9/10 is *N-*, the 1sg prefix has a CV shape, e.g., Swahili G42, Chewa N31b *ni-*, Shona S10 *ndi-*, Nande JD42 *ɲi-* (alternating with *n-*). The 9/10 prefix *N-*, on the other hand, rarely occurs directly before a vowel, since PB roots generally begin with a consonant.

In PB, noun and verb roots did not begin with NC. Root-initial NC has subsequently been introduced in Bantu languages which have lost root-initial **ji* or **jɪ*, e.g Kalanga S16 *ngín-à* 'enter' (**-jíngɪd-*), *mb-á* 'sing' (**-jímb-*) (Mathangwane 1999). This is true also of the root *-ntù* 'person, thing, entity,' whose reconstruction may ultimately be **-jìntʊ̀*. In other cases where a stem appears to begin with NC, the nasal may have originally been a prefix, e.g., transferred from 9/10 with the *N-* to another class, which then imposes its own prefix. It is sometimes still possible to analyse such forms as double prefixes, e.g., Chewa N31b *chì-m≠bòmbó* 7/8 'glutton' (cf. *m≠bòmbó* 1/2 'greedy person').

While most Bantu languages preserve NC, many have restrictions either on which N+C combinations are possible, or on where within the word structure NC may occur. Thus, Tiene B81 allows NC across morpheme boundaries, e.g., class 9 *n≠tàbà* 'goat,' but simplifies stem-internal NC, e.g., *mù≠òtò* 'person' (**-(jì)ntʊ̀*) (Ellington 1977). In the same language, stem-internal **mb*/**nd* become [*m*]/[*n*] with compensatory lengthening or diphthongisation of the preceding vowel, while **ŋg* is deleted with no trace, e.g., *-tùùm-à* 'cook' (**-tùmb-*), *-kúón-à* 'desire' (**-kɔ́nd-*), *-tú-à* 'build' (**-tɔ́ng-*). On the other hand, Yao P21 deletes a root-initial voiced consonant after the 1SG prefix *N-*, but not after the 9/10 prefix *N-*. Thus, /ku-n≠gaadil-a/ → *kùù≠ŋáádìlà* 'to stare at me' vs. *ŋ̀≠gùbò* 'cloth' (< PB **Ǹ≠gɔ̀bɔ̀*) (Ngunga 2000).

Where a consonant C is realised differently (C') after N, it is important to note that this may be due to either of two logical possibilities: C is modified to C' after N; or C' becomes C except after N. The latter situation is frequently found with respect to the weakening of **p* to [*h*] or [*w*], which is typically blocked after a homorganic nasal, e.g., Nyambo JE21 *kú≠h-à* 'to give' vs. *ḿ≠p-à* 'give me!.' Through subsequent changes, the relation between C and C' can become quite distant. In Bukusu JE31c, the [*h*] observed in Nyambo has dropped out, and the preserved labial stop becomes voiced after N, such that the alternation is now *úxù≠à* 'to give' vs. *ḿ≠b-à* 'give me!.' See Schadeberg (1989), for a case where [*p*] alternates with [*ŋ*] in Nyole JE35.

Depending on the nature of the post-nasal consonant, N+C inputs can undergo a variety of processes (cf. Kerremans 1980, Hyman 2001).

3.1.1 Nasal + voiceless stop

Perhaps the most widespread process affecting NC is post-nasal voicing, attested in Nande JD42, Gikuyu E51, Bukusu JE31c and Yao P21. Examples from Yao are illustrated in (14) (Ngunga 2000).

(14)	a	kù≠pélék-à	'to send'	b	kùù-m≠bélèk-à	'to send me'
		kù≠túm-á	'to order'		kùù-n≠dúm-à	'to order me'
		kù≠cápíl-à	'to wash'		kùù-ɲ≠jápìl-à	'to wash for me'
		kù≠kwéél-á	'to climb'		kùù-ŋ≠gwéèl-à	'to climb on me'

Another process affecting voiceless stops is aspiration, e.g., in Chewa N31b, Kongo H10, Pokomo E71 and Swahili G42. The illustration in (15) is from Kongo H10 (Carter 1984).

(15)	a	/kù-N≠pùn-á/	→	kú-m≠phùn-á	'to deceive me'
	b	/kù-N≠tál-à/	→	kú-n≠thàl-à	'to look at me'
	c	/kù-N≠kìyílà/	→	kú-ŋ≠khìyíl-à	'to visit me'

The resulting NC^h unit may then undergo nasal effacement (*nt* > *nt*^{h} > *t*^{h}), as in certain varieties of Swahili G42, or de-stopping (*nt* > *nt*^{h} > *n*^{h}), as in Rwanda JD61, Rundi JD62, and Shona S10, where **ʊ́mʊ̀≠(jì)ntʊ̀* 'person' is realised as (*ù*)*mù≠nhù* (cf. Nyamwezi F22 *m≠nhʊ̀*). The resulting N^h may then simplify to N. This is presumably the chain of events that have characterised the southern Tanzanian languages Hehe G62, Pangwa G64 and Kingwa G65, which have *nt* > *n* vs. closely related Vwanji G66, which has *nt* > *n*^{h}.

3.1.2 Nasal + voiceless fricative

Three different strategies are also commonly seen when a nasal is followed by a voiceless fricative. First, the nasal may simply be effaced, even in languages such as Yao P21, which voice post-nasal voiceless stops, e.g., *kù-n≠sóòsà* → *kùù≠sóòsà* 'to look for me.'

The second strategy is seen in Nande JD42, which extends post-nasal voicing to include fricatives, e.g., *ò-lù≠sáŋgá* ‘pearl,’ pl. *è-n≠záŋgá*. A third strategy found in languages such as certain varieties of Kongo H10, Yaka H31 and Venda S21 is affrication. As seen in the Kongo forms in (16), post-nasal affrication can also affect voiced fricatives.

(16) Post-nasal affrication in Kongo (Carter 1984)

a	/kù-N≠fíl-à/	→	kú-m≠pfìl-à	‘to lead me’
	/kù-N≠síb-à/	→	kú-n≠tsìb-à	‘to curse me’
b	/kù-N≠vùn-á/	→	kú-m≠bvùn-á	‘to deceive me’
	/kù-N≠zól-à/	→	kú-n≠dzòl-à	‘to love me’

In Tuki A64, which has nasal effacement before voiceless consonants, /n+s/ becomes [*ts*], as expected, but /n+f/ becomes [*p*], e.g., /à-n≠sèyà-ḿ/ → *à≠tsèyà-ḿ* ‘he abuses me,’ /à-n≠fùnùnà-ḿ/ → *à≠pùnùna-ḿ* ‘he wakes me up’ (Hyman & Biloa 1992). This is presumably because [*f*] comes from earlier **p*. Thus, besides conditioning changes which can be characterised as “strengthening” or “fortition,” a nasal can block the opposite lenition processes (e.g., **p > f*).

3.1.3 Nasal + voiced consonant

As mentioned above and seen in (17a), Yao P21 deletes post-nasal voiced consonants – other than [*d*], e.g., *kù-n≠dípà → kùù-n≠dípà* ‘to pay me’ (Ngunga 2000).

(17)	a	/kù-n≠búúcil-a/	→	kùù≠múúcìl-à	‘to be angry with me’
		/kù-n≠láp-á/	→	kùù≠náp-à	‘to admire me’
		/kù-n≠jíím-à/	→	kùù≠ɲíím-à	‘to begrudge me’
		/kù-n≠gónék-à/	→	kùù≠ŋónèk-à	‘to make me sleep’
	b	/kù-n≠mál-à/	→	kùù≠mál-à	‘to finish me’
		/kù-n≠ném-à/	→	kùù≠náp-à	‘for me to do incorrectly’
		/kù-n≠ɲál-à/	→	kùù≠ɲál-à	‘to cut me in small pieces’
		/kù-n≠ŋáádìl-à/	→	kùù≠ŋáádìl-à	‘to play around with me’

This includes nasal consonants in (17b), since many Bantu languages do not tolerate NN sequences. On the other hand, voiced continuants may alternate with stops (or affricates) after a nasal, e.g., Ganda JE15 /n≠láb-à/ → *n≠dáb-à* ‘I see,’ Tuki A64 /à-n≠ràmà-ḿ/ → *à≠dàmà-ḿ* ‘he pulls me.’

Post-nasal voiced consonants may also be nasalised, in which case a geminate nasal is produced. This is most readily observed in the case of Meinhof’s Law (Meeussen 1962), known also as the Ganda Law and illustrated from that language in (18).

(18)	/n≠bômb-á/	→	m̀≠móòmb-á	‘I escape’
	/n≠límb-á/	→	ǹ≠nîímb-á	‘I lie’
	/n≠júng-á/	→	ɲ̀≠ɲúúng-á	‘I join’
	/n≠génd-á/	→	ŋ̀≠ŋéénd-á	‘I go’

A nasal+voiced consonant becomes a geminate nasal when the next syllable also begins with a nasal. One motivation for this change is the simplification of NCVNC sequences (cf. Section 4.5). However, many of the languages also apply the process when the voiced NC sequence is followed by a simple nasal consonant, e.g., Ganda JE15 /n≠lím-á/ → *n≠ním-á* 'I cultivate.' Interestingly, Yao P21, which fails to delete [*d*] after a nasal in an oral context, will as a result of Meinhof's Law do so if the following syllable is an NC complex, e.g., /kù-n≠dííng-à/ → *kù-n≠níing-à* → *kùù≠níing-à* 'to try me.'

3.1.4 Other processes

The above seems to indicate that Bantu languages prefer that post-nasal consonants be [+voice] rather than [-voice] and [-continuant] rather than [+continuant]. Voiceless stops tend to become aspirated, and voiced stops tend to become nasalised. While these generalisations reflect the common processes affecting post-nasal consonants, it is important to note that opposing "counter-processes," though less common, are also found. For example, voiced stops are devoiced and variably pronounced as ejectives in Tswana S31 and Southern Sotho S33: *bón-á 'see!', m≠pón-á* 'see me!', *dís-á* 'watch,' *n≠tís-á* 'watch me!' Aspirated stops are deaspirated in Nguni S40 languages, e.g., Ndebele S44 *ulu≠thi* 'stick,' pl. *izin≠ti*. Affricates become deaffricated in a number of languages, e.g., Shona S10 *bvum-a* 'agree, admit,' vs. *m≠vum-o* 'permission, agreement.' Finally, and perhaps most unusual, nasal consonants are denasalised after another nasal in Punu B43, Bushong C83, Kongo H10, Yaka H31, e.g., Yaka *m≠bák-íní* 'I carved' (*-mák-* 'carve'), *n≠dúúk-íní* 'I smelt' (*-núúk-* 'smell'). See Hyman (2001) for discussion of the potential theoretical significance of post-nasal processes and counter-processes.

3.1.5 Moricity

In most Bantu languages there is no vowel length opposition before an NC complex. Rather, as seen in many of the cited examples, the preceding vowel is frequently lengthened. The standard interpretation is that this nasal is "moraic," i.e., it contributes a unit of length or "beat," which readily transfers to the preceding vowel (Clements 1986). It also is potentially a tone-bearing unit. This is most transparently seen in languages which allow NN sequences, or when the nasal is syllabic and phrase-initial, e.g., Haya E22 *ḿ-bwà* '(it's a) dog.' However, even when the nasal loses its syllabicity and compensatorily lengthens the preceding vowel, some languages still treat it as a tone-bearing unit, e.g., Ganda JE15, while others do not, e.g., Haya JE22 and Bemba M42.

3.1.6 New cases of NC

While the preceding subsections characterise the phonology of NC complexes inherited from PB, many Bantu languages have introduced new sequences of N+C. The most common source is the loss of [*u*] in *mu-* prefixes, e.g., Swahili G42 *m≠thu* 'person,' *m≠toto* 'child' (Nurse & Hinnebusch 1993: 181–185). The resulting syllabic [*m*] may then undergo homorganic nasal assimilation, as it does in most varieties of Yao P21, e.g., *ŋ̀'≠kúlú* 'elder sibling' 1, *ǹ'≠sééŋgó* 'horn of antelope' 3, *ŋ̀'≠gólógòlò* 'in the weasel' 18 (N' = syllabic). The loss of the [*u*] of *mu-* prefixes also extends to the 2nd person plural SP and the class 1 OP, but will frequently not take place if followed by a vowel or NC, e.g., Yao P21 *mù≠ùsò* 'bow of boat' 3, *mùù≠ndò* 'person' 1, *mw-ìì≠gààsà* 'handful' 18 (cf. (*d*)*ì≠gààsà* 'palm of hand' 5). Vowel deletion can also be blocked if the stem is monosyllabic, e.g., *mù≠sì* ‘village’ 3. The resulting NC may contrast phonetically or phonologically with PB *NC in several ways. First, as the Yao examples illustrate, the nasal from **mʊ̀-* is typically syllabic, while the nasal from *NC loses its syllabicity (Hyman & Ngunga 1997). Second, the nasal from **mʊ̀-* does not condition the same alternations on the following consonant (e.g., voiceless stops do not become voiced after N’- in Yao). In Tswana S31, where *m+b* is normally realised [*mp*] (cf. Section 4.1.4), *mʊ̀-* loses its vowel when followed by stem-initial /b/, which in turn is realised [*m*], e.g., *mʊ̀≠bús-í → m≠músí* ‘governor’ (cf. *-bús-á* ‘to govern’). Contrast this last example with Matumbi P13 (Odden 1996), where class 9/10 N- does not condition changes on voiced stops (*lụ̀≠góị̀* ‘braided rope,’ pl. *N≠góị̀*), but N’- from **mʊ̀-* does (e.g., *mù≠gàálà ~ ŋ≠ŋàálà* ‘in the storage place’). A third difference is that N’- does not condition lengthening on the preceding vowel, cf. Haya JE22 /à-kà-ń-bìŋg-à/ → *à-káá-m-bìŋg-à* ‘he chased me’ vs. /à-kà-mú≠bìŋg-à/ → *à-kà-ḿ≠bìŋg-à* ‘he chased him.’ Finally, there can be a tonal difference, even in cases where there is no difference in syllabicity. Thus, in Basaa A43, class 3 N- (< **mʊ̀-*) is a tone-bearing unit, while class 9 N- is not. The rule of high tone spreading applies in the phrase *púbá m≠bɔ́ndɔ̀* ‘white lion’ (< *m≠bɔ̀ndɔ̀* ‘lion’ 9), but not in *púbá m≠ɓòmgà* ‘white hammer’ (< *m≠ɓòmgà* ‘hammer’ 3), since, although non-syllabic, the *m-* from **mʊ̀-* still functions as a tone-bearing unit to which the high tone spreads. See also Bostoen & de Schryver (2015) for similar developments in Kongo H10 varieties and Kadenge (2014, 2015) for the phenomenon in Shona S10 varieties.

4.2 Consonant + high vowel

Besides the post-nasal environment, consonants are frequently realised differently before high vs. non-high vowels. First and foremost is the process of frication, also known as Bantu spirantisation, which affects consonants when they are followed by *i and *u, producing changes such as those schematised in (19) (Schadeberg 1995, Hyman & Merrill 2016).

(19)	a	*pi	>	p^{H}i	>	pfi			>	fi
		*bi	>	b^{H}i	>	bvi			>	vi
	b				>	psi	>	(tsi)	>	si
					>	bzi	>	(dzi)	>	zi
	c	*ti	>	t^{H}i	>	tsi			>	si
		*di	>	d^{H}i	>	dzi			>	zi
	d	*ci	>	c^{H}i					>	sị
		*ji	>	j^{H}i					>	zi
	e	*ki	>	k^{H}i	>	ksi	>	(tsi)	>	si
		*gi	>	g^{H}i	>	gzi	>	(dzi)	>	zi

As indicated, these changes are first triggered by the development of “noise” in the release of a consonant before the tense high vowels **i* and **u*. Indicated as ^{H} in (19), the present-day reflex can, in fact, be aspiration, as in Makhuwa P31 – cf. Kalanga S16 *-thúm-* ‘sew’ (**-túm-*) vs. *-túm-* ‘send’ (**-tʊ́m-*). Similarly, /t d/ are aspirated before /i/ in Doko C301 (7V): /ká≠tísá/, /í-dínó/ → [*ká≠t^{h}ísá*] ‘traverse,’ [*í≠d^{h}íno*] ‘tooth.’ In most languages, however, C^{H} is further modified either to an affricate or fricative, as indicated, e.g., Ngom

B22b *kfuɓa* 'chicken' (**-kúbà*). Such modifications are found in nearly all five-vowel languages (Lengola D12 is a notable exception), as well as in many seven-vowel systems (Schadeberg 1995), although often with irregularities.

As was seen above in (6), **u* was almost entirely restricted to the first and last stem syllables in PB, although it also occurs in stem-internal position in the PB root **-tákun-*, which has reflexes such as Chewa N31b *-tafun-*, Pende L11 *-táfùn-*, Venda S21 *-ṱáfùn-*, Yao P21 *-táwún-* and (with metathesis), Nkore-Kiga JE13/14 and Nyambo JE21 *-fútàn-*. Synchronic alternations are found in languages which use the **-ú* suffix to derive adjectives or nouns from verbs, e.g., Ganda JE15 *-géjj-* 'become fat' → *-gévv-ù* 'fat'; *-lébél-* 'be loose'→ *-lèbév-ù* 'loose'; *-támíír-* 'become drunk' → *mù≠tàmíìv-ù* 'drunkard.'

**i* also most frequently occurred in the first and last stem syllables in PB, but also in noun class prefixes, e.g., class 8 **bì-* > Shona S10 class 8 *zvi-* with a "whistled" labioalveolar [ẓ]. In many Bantu languages, synchronic alternations are conditioned by one or more of the three suffixes reconstructed with **i* (cf. Chapter 6). The first of these is the causative suffix **-i-* which is almost always followed by a vowel. As seen in the Bemba M42 forms in (20), when followed by causative **-i-*, labial /p b/ become [*f*] and lingual consonants become [*s*], subsequently modified to [*ʃ*] by palatalisation, e.g., /-sít-/ → [*-ʃít-*] 'buy') (Hyman 2003).

(20)	a	-lèèp-	'be long'	→	-lèèf-i-	'lengthen'	[lèèf-y-à]
		-lùb-	'be lost'	→	-lùf-i-	'lose'	[lùuf-y-à]
	b	-fìit-	'be dark'	→	-fìis-i-	'darken'	[fìiʃ-à]
		-cìnd-	'dance'	→	-cìns-i-	'make dance'	[cìnʃ-à]
		-lìl-	'cry'	→	-lìs-i-	'make cry'	[lìʃ-à]
		-bùùk-	'get up (intr)'	→	-bùùs-i-	'get [s.o.] up'	[bùùʃ-à]
		-lúng-	'hunt'	→	-lúns-i-	'make hunt'	[lúnʃ-á]

The second suffix is **-ì*, which derives nouns, often agentives, from verbs, as in Ganda JE15 *ò-mú≠ddùs-ì* 'fugitive' (< *-´ddùk-* 'run (away)'), *ò-mù≠léz-í* 'guardian' (< *-lér-* 'raise (child)'). Finally, the bimorphemic perfective suffix **-ìd-è* also frequently conditions frication (Bastin 1983), e.g., Nkore E13 *-réet-* 'bring,' perfective *-réets-ìr-è*; Rundi JD62 *rìr-* 'cry,' perfective *rìz-è* (< *rìr-y-è* < **-dìd-ìd-è*).

While such frications occur frequently throughout the Bantu zone, there is considerable variation (Bostoen 2008, Hyman & Merrill 2016, Downing 2016). Not only can the exact reflexes differ, but so can the environments in which they occur. In Bemba M42, for instance, only causative **-i-* regularly conditions frication. In Yao P21, frication before causative **-i-* is more widespread than before perfective **-ìd-è*, but will almost always occur before the latter if the preceding consonant is either [*l*] or [*k*], i.e., the two consonants which occur most frequently in extensions (Ngunga 2000). What this indicates is that frication, although originally an across-the-board phonological process, has acquired morphological restrictions and, in some cases, has been levelled out completely. Thus, the [*i*] of Bemba M42 *-il-e* not only fails to condition frication, but has been restructured, on analogy with suffixes such as applicative *-il-*/*-el-*, to undergo vowel height harmony, e.g., *-fik-ìl-è* 'arrive+perfective' vs. *-bèp-èl-è* 'lie+perfective.' The perfective suffix *-il-e* continues to differ from the applicative *-il-* in its ability to fuse or "imbricate" with verb bases that end in a range of consonants, e.g., *-kúngùb-* 'gather' → perfective *kúngwììb-è* vs. applicative *kúngùb-ìl-à* (Bastin 1983, Hyman 1995a).

The vowels **i* and **u* may have effects on preceding consonants other than frication. While nasals are usually exempt from the effects of degree 1 high vowels, in Ganda JE15, **i* palatalises /n/, e.g., *ò-mù-sóɲ-í* 'tailor' (< *-són-* 'sew'). A much more frequent phenomenon concerns the realisation of PB **d*, which may be preserved as [*d*] before [*i*], but realised as [*l*] or [*r*] before other vowels. This occurs both in 7V languages, e.g., Duala A24, Tiene B81, Bobangi C32, as well as in 5V languages, e.g., certain varieties of Kongo H10, Lwena K14, Kwezo L13, Manyo K332, Kete L21 and certain varieties of Yao P21. In the 5V languages **di* is typically realised as [*dzi*] or [*zi*], and **dɪ* is realised [*di*]. Unless preceded by a nasal, **d* is realised as [*l*] or [*r*] before other vowels. The synchronic situation is considerably obscured in Ruwund L53, where **dɪ* is realised [*di*] and **de* is realised as [*li*] (cf. Section 3.2 above). In other languages the effect is extended to the high back vowel **u*, e.g., Tswana S31 (7V). In Kalanga S16 (5V), **du* is realised [*du*], while **dʊ* is realised [*lu*] (Mathangwane 1999). Finally, Chewa N31b exhibits the "hardening" of /l/ to [*d*] only before glides, e.g., *-dy-a* 'eat,' *-bad-w-a* 'be born' (cf. *-bal-a* 'bear (child)'). What this suggests is that the [*d*] realisation is most preferred before glides, then [*i*], then [*u*]. Occurring in both Eastern and Western Bantu – indeed, throughout the zone – there is dialectal evidence in both the Kongo H10 and Sotho-Tswana S30 groups that the [*d*] was originally pronounced as retroflex [*ɻ*] before high vowels. See also much of Chaga E60, where **d* is realised [*r* ~ *ɻ*] before **i* and **u*, elsewhere as [*l*] or Ø.

4.3 Consonant + glide

The post-consonant glides [*y*] and [*w*] are typically derived from underlying vowels. As a result, consonants often show the same alternations before the glides [*y*] and [*w*] as before the corresponding high vowel. Thus, [*y*] and [*w*] from **i* and **u* produce frications, while [*y*] and [*w*] from **ɪ* and **ʊ* or **e* and **o* typically do not. An exception to this is found in the Mongo C60 group (seven-vowel). In some varieties of Mongo, /t/ is realised [*ts*] before the high tense vowels /i/ and /u/, while /l/ (< **d*) is realised as /j/ [*dʒ*]. However, all varieties appear to produce the affricate realisations before [*y*] and [*w*] – even if they derive from /e/ or /o/: *tó≠kàmb-à* 'we work,' *ló≠kàmb-à* 'you pl. work' vs. *tsw-án-à* 'we see,' *jw-án-à* 'you (pl.) see' (Hulstaert 1965).

In many Bantu languages, *ky*/*gy* develop into alveopalatal affricates. This is seen especially in the different realisations of the class 7 **kɪ-* prefix before consonants vs. vowels, e.g., Nyamwezi F22 (7V) *kì≠jíìkò* 'spoon' vs. *c≠èèyò* 'broom'; Swahili G42 (5V) *ki≠kapu* 'basket' vs. *c≠ama* 'society'; Ha JD66 class 7 *ìkì* 'this' vs. *ìcò* 'that (near you).' Other languages front velars with a noticible offglide, i.e., *kʸ*, *gʸ*, first before high front vowels, then before mid-front vowels as well. Thus, Ganda JE15 *èkʸì≠kópò* 'cup,' ultimately *ècì≠kópò*. While different patterns of velar palatalisation are found throughout the Bantu zone (Hyman & Moxley 1992), some languages in the Congo basin show analogous developments with respect to alveolar consonants. Although /li/ is realised [*di*] in both Luba L31a and Pende L11, /ti/ is realised ci [*tʃi*]: Luba *-mác-íl-* 'plaster+appl' (*-mát-*), Pende *shíc-ìl-* (~ *shít-ìl-*) 'close+appl' (*-shít-*).

While a [*y*] offglide can trigger palatalisation, [*w*] is responsible for velarisation, e.g., in the Rundi-Rwanda JD60 and Shona S10 groups. Meeussen (1959) summarises the reflexes of labial+glide and coronal+glide complexes in Rundi JD62 as in (21).

(21)	a	bw [bg]	b
		fw [fk]	fy [f^{s}y]
			vy [v^{z}y]
		mw [mŋ]	my [mɲ]
		tw [tkw]	ty [rtky, r̥^{t}ky]
		rw [rgw (gw)]	rg [rgy]
		sw [skw, s^{k}w]	sy [s^{k}y]
		zw [^{d}z^{g}w]	
		tsw [tskw, ts^{k}w]	
		cw [tʃkw, tʃ^{k}w]	
		jw [^{d}ʒ^{g}w]	
		shw [ʃkw, ʃ^{k}w]	
			nny [ny, n^{i}y]

As seen in (21a), *Cw* hardens to *Ck*/Cg/*Cŋ*, and the labial offglide is lost ("absorbed") when the C is labial. (21b) shows that *Cy* undergoes a comparable hardening process. When the C is velar, one obtains the expected *Cw* sequence. Similar processes occur in the Shona S10 complex. In Kalanga S16, /l/ becomes [*g*] before [*w*], e.g., *-tól-à* 'take,' *-tóg-w-à* 'be taken.' Compare also Basaa A43, where the class 4 *mi-* and class 8 *bi-* prefixes are realised *ŋw-* and *gw-* when directly followed by a vowel, e.g., *bì≠tɔ́ŋ* 'horns' vs. *gw≠ɔ̆m* 'things' (*y≠ɔ̆m* 'thing' 7); cf. the object pronouns *ŋw-ɔ́* (cl. 4) and *gw-ɔ́* (cl. 8) (Lemb & de Gastines 1973). Finally, geminate *w*+*w* and *y*+*y* become, respectively, [*ggw*] and [*ggy*] in Ganda JE15.

(22)	a	/pó-à/	→	wo-a	→	ww-aa	→	ggwaa . . .	'become exhausted'
	b	/pí-à/	→	wi-a	→	yy-aa	→	ggyaa . . .	'get burnt'

As seen, both glides derive from **p*, cf. *m≠pw-êdd-è* 'I have become exhausted' and *m≠pî-dd-è* 'I have gotten burnt' (~ *n≠jî-dd-è*).

4.4 *i + Consonant

Consonants may harden not only after nasals or before glides, but also after PB **i*, particularly when this vowel is either word-initial or preceded by a vowel. Thus, Tswana S31 devoices stops not only after N-, but also after reflexive *i-*: *ì≠pón-é* 'see yourself!,' *ì≠tís-é* 'watch yourself!' (*-bón-* 'see,' *-dís-* 'watch'). In Lega D25, PB **t* normally becomes [*r*], but is preserved as [*t*] after the class 5 prefix **i*, e.g., *ì-támà* 'cheek, pl. *mà-rámà*. Ganda JE15, on the other hand, develops geminates from **iC*. Thus, compare *ò-mù≠sájjà* 'man' and *-bájj-* 'carve' with Haya JE22 *ò-mù≠šáìjà* and *-bàìj-*. This process also produces root-initial geminates, e.g., *-´tt-* 'kill' and *-´bb-* 'steal,' and singular/plural alternations in classes 5/6 such as *è-g≠gùlù* 'sky,' pl. *à-mà≠gùlù* (cf. Haya JE22 *-ít-*, *-íb-*, *è-ì≠gùlù*). While class 5 **i-* typically "strengthens" following consonants, it is known also to condition voicing (and implosion), e.g., Zezuru S12 *ɓáŋgá* 'knife' (pl. *mà≠páŋgá*), *ɗàŋgá* 'cattle enclosure' (pl. *mà≠tàŋgá*), *gáŋgá* 'large helmeted guinea-fowl' (pl. *mà≠káŋgá*) (Hannan 1974).

4.5 Long-distance consonant phonology

In all of the processes discussed thus far, the trigger of the phonological process is adjacent to the targeted consonant. Bantu languages also are known for the ability of a consonant to affect another consonant across a vowel (and beyond). There are several such cases.

The first, Meinhof's Law, was seen already in Section 4.1.3, whereby a nasal+voiced stop is realised NN or N when followed by a second nasal complex (sometimes just N) in the next syllable. Another version of this simplification occurs in Kwanyama R21, where the second nasal+voiced stop loses its prenasalisation (Schadeberg 1987): **N≠gombe* > *oŋ≠gobe* 'cattle,' **N-gandu* > *oŋ≠gadu* 'crocodile.' These dissimilatory changes have the effect of minimising the number of NC complexes in a (prefix+) stem. Another well-known dissimilatory process is Dahl's Law, whereby a voiceless stop becomes voiced if the consonant in the next syllable is also voiceless. This accounts for the initial voiced reflexes in Nyamwezi F22 roots such as *-dàkún-* 'chew' (**-tákun-*), *-gùhí* 'short' (**-kúpì*). Dahl's Law is also responsible for the /t/ or /k/ of prefixes to become voiced and sometimes continuant, e.g., Kuria JE43 /*ko≠tɛma*/ → [*ɣo≠tɛm-a*] 'to beat.' While there is considerable variation (Davy & Nurse 1982), multiple prefixes may be affected, e.g., Southern Gikuyu E51 /ke-ke-ko≠eta/ → [*ɣe-ɣe--ɣw≠eet-a*] 'he (cl. 7) called you.' Alternations are also sometimes found stem-internally, as in Rundi JD62 *-bád-ìk-* 'transplant,' *-bád-ùk-* 'grow well' vs. *-bát-ùr-* 'uproot plants to transplant' (Meeussen 1959).

Other long-distance consonant processes are assimilatory in nature. In Bukusu JE31c, an /l/ will assimilate to a preceding [*r*] across a vowel, e.g., *-fúk-ìl-* 'stir + APPL' vs. *-bír-ìr-* 'pass + APPL.' The process is optional when the trigger [*r*] is separated by an additional syllable, e.g., *-rám-* 'remain,' *-rám-ìl-* ~ *-rám-ìr-* 'remain + APPL.' Several languages in the western Lacustrine area show a process of sibilant harmony which disallows or limits the co-occurrence of alveolar and alveopalatal sibilants, e.g., [*s*] and [*ʃ*]. In Rwanda JD61 and Rundi JD62, /s/ becomes alveopalatal across a vowel, when the following consonant becomes (alveo-)palatal as the result of a *y*-initial suffix, e.g., *-soonz-* 'be hungry' vs. *a-ra≠shoonj-e* 'he was hungry' (< *-soonz-ye*). In Nkore-Kiga JE13/14, the process produces alternations in the opposite (depalatalising) direction, e.g., *-shígìsh-* 'stir,' *ò-mù≠sígìs-ì* 'stirrer.' Finally, a third long-distance assimilation involves nasality. A wide range of Bantu languages nasalise [*l*] or [*d*] to [*n*] after an NV(V) syllable (Greenberg 1951), e.g., Bemba M42 *-cít-ìl-* 'do + APPL' vs. *-lìm-ìn-* 'cultivate + APPL.' While Suku H32 optionally extends this process across additional syllables, creating extension variations such as *-am-ik-il-* ~ *-am-ik-in-*, such long-distance assimilation is obligatory in Kongo H10 – and in nearby Yaka H31, e.g., *-ziik-il-* 'bury + APPL' vs. *-mak-in-* 'climb + APPL,' *-miituk-in-* 'sulk + APPL,' *-nutuk-in-* 'lean + APPL' (Hyman 1995b).

Other forms of apparent long-distance phonology are highly morpheme-specific. Thus, the passive suffix *-w-* (**-ʊ-*) causes the palatalisation of a preceding labial consonant in the Sotho-Tswana S30 and Nguni S40 groups, e.g., Ndebele S45 *-dal-w-* 'be created' (*-dal-*) vs. *-bunj-w-* 'be moulded' (*-bumb-*). In Ndebele and other Nguni languages, this process can actually skip syllables, e.g., *-funjath-w-* 'be clenched' (*-fumbath-*), *-vunjulul-w-* 'be uncovered' (*-vumbulul-*) (Sibanda 2004). In a number of languages where causative **-i-* conditions frication, the effect is sometimes seen on non-adjacent consonants. In Bemba M42, the roots *-lub-* 'be lost' and *-lil-* 'cry' form the causatives *-luf-y-* and *-lis-y-* (> *-liš-*) and the applicatives *-lub-il-* and *-lil-il-*. However, their applicativised causative forms are

-luf-is-y- and *-lis-is-y-*, with frication applying twice. As seen in (23), this is the result of a "cyclic" application of the frication process (Hyman 2003).

(23)

	ROOT		MORPHOLOGY		PHONOLOGY		MORPHOLOGY		PHONOLOGY
a	-lub- 'be lost'	→	-lub-i- 'lose'	→	-luf-i- 'lose for/at'	→	-luf-il-i-	→	-luf-is-i-
b	-lil- 'cry'	→	-lil-i- 'make cry'	→	-lis-i- 'make cry for/at'	→	-lis-il-i-	→	-lis-is-i-

In the second morphology stage, applicative *-il-* is "interfixed" between the fricated root and the causative suffix **-i-* (> y before a vowel). Bemba and certain other Bantu languages show the same multiple frications when the **-id-* of perfective **-ìd-è* is interfixed, e.g., *-luf-is-i-e* [*lufiʃ*e] 'lose + perfective.' In other languages, frication appears to apply non-cyclically, affecting only the applicative consonant, e.g., Mongo C61 /kál-/ 'dry,' /-kál-ì-/ (→ *-káj-à* with FV *-à*) 'make dry,' /-kál-èl-ì-/ → *kál-èj-ì-* 'make dry + APPL' (→ *-kál-èj-à* with FV *-à*). Still others show evidence of cyclicity by "undoing" frication in a fixed (often non-etymological) manner. In Nyamwezi F22 (Maganga & Schadeberg 1992), the verb /-gʊl-/ 'buy' is causativised to /-gʊl-i-/ 'sell,' which undergoes frication to become *-gʊj-i-* (> surface *-gʊj-a* by gliding of *i* to [*y*] and absorption of [*y*] into the preceding alveopalatal affricate). However when *-gʊj-i-* is applicativised, yielding intermediate *-gʊj-ɪl-i-*, the result is *-gʊg-ɪj-i-* (→ *-gʊg-ɪj-a*). The palatal *j* is "undone" as velar [*g*], on analogy with *-og-* 'bathe intr.,' *-oj-i-* 'bathe (s.o.),' *-og-ej-i-* 'bathe + APPL,' not as the [*l*] one would expect if the process were non-cyclic. The most extreme version of this process is seen in languages, such as Nyakyusa M31, which uses a "replacive" [*k*] no matter what the input consonant of an applicativised causative. Thus, *-kees-i-* 'make go by' (the causative of *-keend-* 'go by') is applicativised first to *-kees-el-i-*, which then undergoes frication and de-frication of the *s* to *k*: *-keek-es-i-* 'make go by + APPL' (→ [*-keek-es-y-a*]).

4 FURTHER DISSOLUTION OF THE INHERITED STRUCTURES

The above gives a sketch of some of the phonological properties of syllables, consonants and vowels in Bantu languages. It emphasises languages which have preserved the basic morphological and phonological structure inherited from Proto-Bantu. In order to be complete, it is important to reiterate that quite a few languages in zones A, B and elsewhere have modified this structure significantly, e.g., by allowing closed syllables, developing back unrounded vowels, etc. One striking property of many Northwest Bantu languages is the imposition of prosodic templates on the stem (root + suffixes). Thus, Tiene B81 verb stems can only have the shapes CV, CVV, CVCV, CVVCV and CVCVCV. In the last case the second C must be coronal, while the third must be non-coronal, often requiring infixation, e.g., *-láb-à* 'walk' → *-lásàb-à* 'cause to walk' (Hyman 2010). This stands in stark contrast with Bantu languages to the East and South, where a verb stem can in principle be of any length, cf. Chewa N31b *-mang-its-ir-an-a* 'cause to tie for each other.' By "phonetic erosion" stems have become mostly monosyllabic in Nzadi B865 (Crane *et al*. 2011), e.g., *ò≠kwâ* 'bone' (**-kʊ́pà*), *ì-kěl* 'blood' (**-gìdá*) (see also Chapter 14 on Nsong B85d). The tendency to break down the inherited structure is even more pronounced in groups just outside "Narrow Bantu," e.g., Grassfields Bantu (Watters 2003).

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