

Chapter 2

On the Ngbugu vowel system

Kenneth S. Olson

SIL International

Previous researchers have posited asymmetric oral vowel systems for Ngbugu and other Banda languages. The present analysis shows that Ngbugu has a symmetric ten-vowel system which includes one interior vowel /ə/ and lacks vowel harmony. It also supports and refines Boyeldieu & Cloarec-Heiss's (2001) proposed Proto-Banda vowel system. The affinities of the resulting proto vowel system to those of nearby languages could facilitate the comparison of vowel systems across the region in order to test hypotheses about shared inheritance or borrowing. Possible explanations for the lack of vowel harmony are suggested.

1 Introduction

Authors of previous studies have proposed various oral vowel systems for Ngbugu (ISO 639-3 code=lnl), a language of the Banda group, Ubangian family, spoken in southcentral Central African Republic by about 95,000 people (Simons & Fennig 2018). These proposed systems are shown in Tables 1, 2, and 3.¹

Table 1: Ngbugu oral vowels (Cloarec-Heiss 1978: 13–14)

	front	central	back
high	i	ɨ	u
mid	e	ə	o
low		a	ɔ

¹I use standard IPA transcriptions for segments and tone in this paper.



The system in Table 1 contradicts a universal put forth by Crothers (1978: 122): “The number of height distinctions in front vowels is equal to or greater than the number in back vowels.” Yet, the majority of Banda languages appear to exhibit it. Cloarec-Heiss (1978: 13–16) posits this same system for seven other Banda speech varieties: Langbasi [lna], Ngundu [nue], Kpagua [kuw], Gubu [gox], Gbi [bbp], Linda [liy], and Yakpa [bjo]. It is also the system posited for Mono [mnh] by both Kamanda-Kola (2003) and Olson (2005) independently of each other.

Table 2: Ngbugu oral vowels (Théret-Kieschke 1998: 43)

	front	central	back
high	i	ɨ	u
mid	e	ə	o
low	ɛ	a	(ɔ)
diphthongs	iɛ		oa

Théret-Kieschke’s proposed system in Table 2 is more symmetric. In addition to monophthongs, she posits two diphthongs. She considers /ɔ/ to be a marginal phoneme (p. 9).

Table 3: Ngbugu oral vowels (Boyeldieu & Cloarec-Heiss 2001: 191)

	front	central	back
high	i	ɨ	u
mid	e	ə	ɔ
low	(i)ɛ	a	

Boyeldieu & Cloarec-Heiss propose the system shown in Table 3. They transcribe the low front vowel as /(i)ɛ/, capturing the generalization – according to their data – that the phoneme is usually realized as [iɛ], yet surfaces as [ɛ] in initial position and immediately following /w/. The vowel /ɔ/ is positioned as a mid vowel in their chart, along with /e/ and /ə/ (p. 192).²

Comparison of these three proposed systems raises questions about the phonemic status of /ɛ/, /o/, and /ɔ/. To address these questions, I worked with a team of three native Ngbugu speakers during three visits to Bangui from 2015 to 2017

²Boyeldieu (pers. comm.) considers /ɔ/ to be phonetically halfway between [o] and [ɔ] when it does not follow a /w/.

(a total of five weeks) to re-evaluate the oral vowel system, employing the participatory research methodology elucidated in Kutsch Lojenga (1996).³ I do not address diphthongs or nasal vowels, which are both also part of the Ngbugu vowel system.

Prior to our consultations, the team had collected a corpus of about 2000 lexical items. We removed compound words, borrowings, derived words, etc., after which we had a corpus of about 700 words to work with.

In §2, I provide evidence for the phonemic status of /ɛ/, /o/, and /ɔ/, as well as an in-progress merger between /o/ and /ɔ/. I also provide evidence for the existence of an additional vowel /ʊ/ not reported by the previous researchers. In §3, I provide acoustic evidence for my transcription of the vowels and show that /i/ is best reinterpreted as the front vowel /ɪ/. In §4, I discuss possible implications for the historical development of vowels in the Banda group.

2 Phonology

Several arguments support the phonemic status of /ɛ/. First, contrasts between /ɛ/ and its phonetically similar segment /e/ are common in Ngbugu. A sampling of these contrasts is shown in Table 4.

Table 4: Contrasts between /ɛ/ and /e/

/ɛ/	gloss	/e/	gloss
ʃé.ʃɛ̄	bifurcation	ʃē.ʃē	root
ɲé	all, together	ɲé	2PL-object
ɛ̄	small	ʔē	call
húɛ̄	sweat	hùè	open

Second, my language consultants had no difficulty distinguishing /ɛ/ and /e/, and the orthography testing they conducted in the Ngbugu community suggested that this is true among Ngbugu speakers in general. Third, /ɛ/ is not rare, occurring in more than 20 words in our corpus. This count does not include word-initial [ɛ̄], which may be a relic of an historical prefix denoting animals (Greenberg 1970: 13). Fourth, /ɛ/ occurs in word-initial, word-medial, and word-final positions, as shown in Table 5.

³The three language consultants conducted extensive orthography testing in the Ngbugu region during this period of time.

Table 5: Distribution of /ɛ/

	/ɛ/	gloss
initial	ē.vkó	dog
medial	ɲgó.lè.fò	earthworm
final	fé.fē	bifurcation

While the phonetic sequence [iɛ] does occur in a substantial number of words, it is also true that [ɛ] is attested immediately following more consonants than just /w/, e.g. [ɲgó.lè.fò] ‘earthworm’, [fé.fē] ‘bifurcation’, [gbé] ‘all’, [ndè.rə] ‘sticky’. Additional examples are found in Boyeldieu’s Ngbugu wordlist in *RefLex* (Segerer & Flavier 2011). There are also cases where [iɛ] and [ɛ] both occur after the same consonant, e.g. [gbīē] ‘king’ vs. [gbé] ‘all’. These considerations bolster the view that /ɛ/ is a phoneme in its own right, distinct from the diphthong /iɛ/.

Finally, there is a clear acoustic distinction between /ɛ/ and /e/, as discussed below in §3.

Several arguments support the phonemic status of both /o/ and /ɔ/. First, there is contrast between these two phonetically similar segments, as shown in Table 6.

Table 6: Contrasts between /o/ and /ɔ/ (Théret-Kieschke 1998: 9)

/o/	gloss	/ɔ/	gloss
kpò.tò	hat	kpò.tò	skin
ko	(to) distribute	kɔ	(to) oil

Second, many native speakers have no difficulty distinguishing the two sounds. Third, both sounds are common, each occurring in more than 30 words in my corpus. Fourth, there is a clear acoustic distinction between the two sounds, as discussed below in §3.

Despite this evidence, the case of /o/ and /ɔ/ is complicated by a couple of factors. First, for apparently all speakers of Ngbugu – even those for whom the two sounds are contrastive – free variation occurs between /o/ and /ɔ/ for certain lexical items, as exemplified in Table 7.

Second, while all three of my language consultants recognize the distinctiveness of /o/ and /ɔ/, they indicate that some Ngbugu speakers do not distinguish the two sounds, opting to produce /o/ in all cases. Théret-Kieschke (1998: 9) noted

Table 7: Free variation between /o/ and /ɔ/ in some lexical items

/o/ ~ /ɔ/	gloss
kò.tò ~ kò.tò	hill
kò.kò.lò ~ kò.kò.lò	duck

this pattern among younger speakers and suggested that a merger is currently underway between /o/ and /ɔ/: *o, *ɔ > o. Robust contrast exists between /o/ and /ɔ/ in most other Banda varieties, e.g. Linda (Boyeldieu & Cloarec-Heiss 2001) and Mono (Olson 2005), which harmonizes well with this claim.

During the course of our research, we encountered an additional synchronic vowel phoneme, /ʊ/, not attested by previous researchers. Several factors support the existence of this additional phoneme. First, there is contrast between /ʊ/ and all of the other back vowels, as shown in Table 8.

Table 8: Contrast between /ʊ/ and other back vowels

/u/	gloss	/ʊ/	gloss	/o/	gloss	/ɔ/	gloss
kū	thigh	k̄	war	kō	male	kò	type of termite
–		ɸ̄	stroll	ɸò	roll, pass	–	
tū	ear	t̄.ɸ̄	in vain	dò	divert	tò	marry
–		ḡ	hole	ḡó	white	–	

Second, native speakers readily distinguish /ʊ/ from other back vowels. Third, /ʊ/ is not rare, occurring in over 40 lexical items in my corpus. Fourth, /ʊ/ occurs both medially and finally, e.g. [s̄.ḡ] ‘pillar’. Finally, /ʊ/ is distinct acoustically from the other back vowels, as discussed in §3.

While /ʊ/ does not occur as such in any of the previous research, it does show up indirectly in Boyeldieu & Cloarec-Heiss (2001), where the sequence transcribed there as /wɔ/ corresponds to my /ʊ/, as shown in Table 9.⁴

Though Boyeldieu & Cloarec-Heiss do not document extant /ʊ/ per se, their comparative study of Ngbugu and Linda leads them to reconstruct the high back [–ATR] vowel *ʊ for Proto-Banda (pp. 199, 202–203). One of the key findings of the current paper is that the reflex /ʊ/ of the proto phoneme *ʊ is present in Ngbugu today.

⁴Most of the occurrences of [ʊ] in Table 9 occur after [ɸ], but most cases of [ʊ] in my corpus follow other consonants. The difference between my data and that of Boyeldieu and Cloarec-Heiss could be due in part to dialectal variation. More research is necessary on this.

Table 9: Samples of /ʊ/ transcribed as /wɔ/ by Boyeldieu & Cloarec-Heiss (2001)

Boyeldieu and Cloarec-Heiss	page	my transcription	gloss
jɔ̄kwɔ̀	216	dʒɔ̄.kɔ̀	sorghum
gkwɔ̀	218	gkɔ̀	to touch
gwɔ̀gwɔ̀	218	gɔ̀	hunger
kwɔ̀	218	kɔ̀	to stop
ngkwɔ̀	195, 218	ŋgkɔ̀	to scratch
kwɔ̀	213	kɔ̀	to walk
tɔ̀kwɔ̀	212	tɔ̀.kɔ̀	in vain

This finding suggests a possible novel use of the comparative method – as an aid to linguistic fieldwork. The comparison of the sound systems of related languages can be used not only to reconstruct proto phonemes, but it can also lead to hypotheses about the structure of the synchronic sound systems and hence serve as a diagnostic for examining them more closely. In the current case, Boyeldieu & Cloarec-Heiss’s positing of *ʊ led my language consultants and me to examine more carefully the high back vowels of Ngbugu, eventually unearthing /ʊ/.

3 Acoustic properties

An acoustic study was undertaken in order to verify the transcription of the Ngbugu vowels. The subject was a male native speaker of Ngbugu in his late 40s at the time of the recordings. He grew up in the Ngbugu region, and both of his parents speak Ngbugu as their first language. He has obtained his *baccalauréat* and has taken some university courses. He moved to Bangui in 2014. The recordings were made in 2015 and 2016 in Yaoundé and Bangui, respectively. Besides Ngbugu, he is also fluent in Sango [sag] and French [fra].

The set of data was recorded at 48k, 24-bit, using a Zoom H2 recorder, and saved as WAV files. The 2015 recording session took place at the SIL center in Yaoundé, and the 2016 recording session took place at the ACATBA (Association Centrafricaine pour la Traduction de la Bible et l’Alphabétisation) center in Bangui. Twelve tokens of each vowel were chosen for analysis. This included two tokens of each vowel spoken in isolation. In most of the words selected, the vowel followed a coronal consonant.

Acoustic analysis was performed using Praat v. 6.0.37 (Boersma & Weenink 2018). I first visually inspected a wide-band spectrogram of each token to verify that there was a steady state period of the vowel. I then visually identified the midpoint of the steady state. The window of analysis was centered on this midpoint. The formant measurements were made using the LPC analysis feature in Praat, employing its default parameters, except that the “Maximum formant (Hz)” setting was changed from 5500Hz to 5000Hz, the latter being more appropriate for a male speaker (Boersma & Weenink 2018). Because LPC calculations of F_1 can potentially be influenced by a high f_0 , I verified the formant measurements by visual inspection on a wide-band spectrogram and spectral slices, when appropriate. The F_1 vs. F_2 plot is shown in Figure 1.

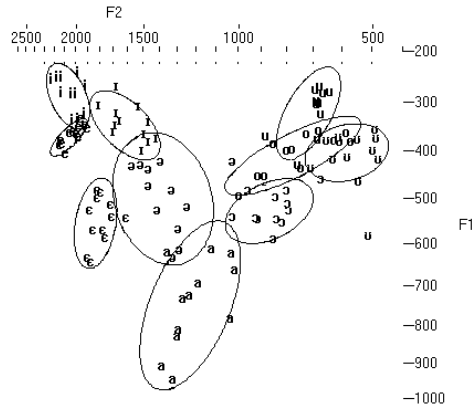


Figure 1: Formant plot of Ngbu vowels (12 tokens each)

Several observations can be made about this plot. First, the F_2 of what I have been transcribing as /i/ is generally higher (~1600Hz) than the F_2 of /ɐ/ (~1400Hz), approaching the front vowels /i/ and /e/. This suggests that /i/ may best be construed as a front vowel. I will transcribe it as /ɪ/ for reasons that will soon become apparent.

Second, the positioning of /ɪ/ and /ʊ/ in the plot generally corresponds to what we expect for high [-ATR] vowels. In Starwalt’s (2008) crosslinguistic study of the acoustics of ATR vowel harmony systems, she found that the F_2 of /ʊ/ is consistently lower than the F_2 of /o/ for the African languages she studied (although this was not always statistically significant) – *Kwa*: Foodo [fod] and Ikposo [kpo] – *Bantu*: Kinande [nnb] and LuBwisi [tlj] – *Defoid*: Ekiti-Yoruba [yor]. The positioning of /ʊ/ vis-à-vis /o/ in Figure 1 is consistent with this.

With respect to front vowels, Starwalt found some variation: for some speakers of Foodo (p. 105), Kinande (p. 128), and LuBwisi (p. 136), the F_2 of /ɪ/ is lower than the F_2 of /e/. This is consistent with what I found for Ngbugu. For the rest of Starwalt’s speakers, the F_2 of /ɪ/ was higher than the F_2 of /e/.

This acoustic study is preliminary. Testing additional subjects would help confirm that our data are indicative of the larger Ngbugu-speaking population. Ladefoged (2003) suggests testing a half-dozen speakers of each sex.

4 Discussion

4.1 Vowel system symmetry

If /i/ is reinterpreted as /ɪ/, as proposed in §3, the resulting Ngbugu vowel system becomes symmetric, as shown in Table 10.

Table 10: Reanalyzed Ngbugu oral vowel system

	front	central	back
high	i		u
mid-high	ɪ		ʊ
mid-low	e	ə	o
low	ɛ	a	(ɔ)

Not only is symmetry what is generally expected for vowel systems (Pike 1947: 59), it is also what is found in most languages of the region, as shown in Table 11. The languages of all of the Ubangian subgroups except Banda exhibit symmetric vowel systems, as do many of the languages from the nearby Central Sudanic group Bongo-Bagirmi.

In fact, the reanalyzed Ngbugu vowel system is similar to the set of Proto-Banda monophthongs reconstructed by Boyeldieu & Cloarec-Heiss 2001 shown in Table 12. The differences are (1) the presence of a high central vowel *ɨ, and (2) the absence of the front vowels *ɪ and *ɛ.

It is not surprising that Boyeldieu and Cloarec-Heiss posited the proto phoneme *ɨ. At the time of their study, it was thought that all Banda languages had a high central vowel. The finding that Ngbugu has extant /ɪ/ instead opens up the option of positing the proto phoneme *ɪ (rather than *ɨ) with a corresponding sound change *ɪ > i to account for the presence of /i/ in the other Banda varieties

Table 11: Vowel systems of sample languages in geographic proximity (“cross” = cross-height harmony)

sample lg	group	oral vowels	VH	source
Gbeya	Gbaya	/i e ε a ɔ o u/	mid	(Samarin 1966)
Sango	Ngbandi	/i e ε a ɔ o u/	mid	(Samarin 2000)
Ngbaka Ma’bo	Sere-Ngb.-Mba	/i e ε a ɔ o u/	mid	(Thomas 1963)
Zande	Zande	/i ɪ ε ə a ɔ ʊ u/	cross	(Boyd 1997)
Nzakara	Zande	/i ɪ ε a ɔ ʊ u/	cross	(Landi 2005)
Bagiro	Bongo-Bagirmi	/i e ε a ɔ o u/	mid	(Boyeldieu 2000)
Yulu	Bongo-Bagirmi	/i e ε (ə) a ɔ o u/	none	(Boyeldieu 1987)
Lutos	Bongo-Bagirmi	/i e ε (ə) a ɔ o u/	none	(Olson 2013)

Table 12: Proto-Banda vowel system (Boyeldieu & Cloarec-Heiss 2001)

	front	central	back
high	*i	*ɪ	*u
mid-high			*ʊ
mid-low	*e	*ə	*o
low		*a	*ɔ

(subject to confirmation via the comparative method). This also leads to a more typologically common proto vowel system.

As for the absence of *ε, Boyeldieu & Cloarec-Heiss posit instead the proto diphthong *ia (pp. 198–199). In their analysis, occurrences of [iε] in Ngbugu following labial, alveolar, and velar consonants are combined with occurrences of [ia] in Ngbugu following palatal consonants in order to reconstruct the proto diphthong. The corresponding Linda forms are [eya] following labials, [ia] following alveolars and velars, and [a] following palatals. Given their data, an equally valid reconstructed form would be *iε. Absent from their correspondence sets are occurrences of [ε].⁵

If we examine cases of [ε], we see that Ngbugu [ε] corresponds with Linda [ja] (Moñino 1988) in word-initial position, as shown in Table 13.

⁵There are some residual items in Boyeldieu & Cloarec-Heiss’s data: [iε] and [ia] contrast in [gia] ‘tourner la pâte’ vs. [giè] ‘animal, viande’; and [ε] and [iε] contrast in [ɲgàè] ~ [ɲgè] ‘canne à sucre’ vs. [ɲgié] ‘noyau de la noix de palme’ (pp. 192–193).

Table 13: Correspondences between Ngbugu [ɛ] and Linda [ja]

Ngbugu	Linda	gloss
ē.bɔ̀ò	jā.bù.rù	goat
ē.vɔ̀ó	jā.vó.ró	dog
ē.fē	jā.fē	woman

I was not able to identify cognates in Linda that correspond to the Ngbugu words in which [ɛ] is word-medial or word-final. Hence, more research is necessary. That being said, the distinction between the two correspondence sets (Ngbugu iɛ~ia vs. Linda ia~eja and Ngbugu ɛ vs. Linda ja) leads me to propose two proto phonemes, *iɛ and *ɛ, with a possible merger *iɛ, *ɛ > ja in Linda. The choice of *ɛ leads to the Proto-Banda system in Table 14 that is not only typologically more common but is also nearly identical to the extant Ngbugu one.

Table 14: Reanalyzed Proto-Banda vowel system

	front	central	back
high	*i		*u
mid-high	*ɪ		*ʊ
mid-low	*e	*ə	*o
low	*ɛ	*a	*ɔ

One mystery of the Banda group has been its unusual inventory of vowels (cf. Table 1). The revised symmetric Ngbugu vowel system – and the comparable Proto-Banda system proposed here – are much more in line with those found in the surrounding languages. Of particular comparative interest are the vowel systems of Nzakara and Zande, since Nzakara is the immediate neighbor of Ngbugu to the northeast. Ngbugu, Nzakara, and Zande all have identical inventories of *phonetic* vowels: [i ɪ e ɛ a ɔ o ʊ u]. These similarities allow for the straightforward comparison of vowels between groups, something that was very difficult given our previous understanding of the vowel systems in the Banda group. This makes it more believable that the Banda group could be related to other language groups in the vicinity.

4.2 Vowel harmony

Boyeldieu & Cloarec-Heiss suggest that there are traces of a Proto-Banda ATR harmony system in extant Linda (p. 189), and to a lesser degree in extant Ngbugu (pp. 196–197, 202). The existence in the current-day Ngbugu vowel system of contrasts between [+ATR] and [−ATR] vowels lends credence to the hypothesis of this earlier ATR harmony system.

Indeed, the revised Ngbugu vowel inventory bears a remarkable resemblance to inventories that exhibit ATR harmony. It is the same inventory as the ten-vowel systems that exhibit the “most straightforward” cases of ATR harmony in Africa, where the vowels are divided into two groups: the [+ATR] vowels /i e ə o u/ and the [−ATR] vowels /ɪ ɛ a ɔ ʊ/ (Casali 2008: 499).

Yet, it is relatively clear that the current Ngbugu system does not exhibit vowel harmony, for two reasons. First, there are many cases in Ngbugu of monomorphemic words containing both [+ATR] and [−ATR] vowels, shown in Table 15.

Table 15: Monomorphemic words with both [+ATR] and [−ATR] vowels

lexical item	gloss
kó.lí.ɲgɔ̃	millipede
ʃé.ʃē	bifurcation
ɲgèé	central vein of the palm leaf
ɲgó.lè.ʃò	earthworm
kóé.ló	bitter plant
ɲgó.wò	smoke
zō.ɲgō	rainy season
à.gɔ̃.mè	midnight
húē	sweat
míē	twin
tʃá.nó	hand
là.fó	standing
mé.ɔ̃	swell
ā.lū	heavy
à.ɲī	mother

Second, to my knowledge there are no cases of [+ATR] ~ [−ATR] alternations in Ngbugu roots or affixes (Casali 2008: 500).

The absence of vowel harmony in Ngbugu is somewhat surprising given the preponderance of harmony systems elsewhere in the region (cf. Table 11). Sys-

tems which exhibit harmony between the two sets of mid vowels /e, o/ and /ɛ, ɔ/ (labeled “mid” in Table 11, VH column) are found in the Gbaya group (e.g. Gbeya), in Sere-Ngbaka-Mba (e.g. Ngbaka-Ma’bo), and to some degree in the Central Sudanic group Bongo-Bagirmi (e.g. Bagiro, which is immediately to the west of the Ngbugu region). The lingua franca Sango from the Ngbandi group also exhibits harmony of this type, but it has exceptions.⁶

Cross-height harmony systems in which both high and mid vowels undergo ATR harmony on a surface phonetic level (labeled “cross” in Table 11, VH column) are found in both Nzakara and Zande. In these languages, high, mid, and low vowels all undergo ATR harmony. For both languages, the mid vowels show harmony only at the surface phonetic level, i.e. [e] and [o] are allophones of /ɛ/ and /ɔ/, respectively. In addition, for Nzakara the [a] ~ [ə] alternation is also surface phonetic.

The presence of ATR harmony in Nzakara and Zande, the identical inventories of phonetic vowels between Ngbugu, Nzakara, and Zande, and the traces of ATR harmony identified by Boyeldieu and Cloarec Heiss for Linda and Ngbugu – all these factors lead to the hypothesis that Proto-Banda exhibited ATR harmony. This harmony system was either inherited or borrowed, and then it was subsequently lost.

What could have led to the loss of ATR harmony in Proto-Banda? There are at least a couple of factors to consider. First, in a crosslinguistic survey, Rolle et al. (2017) observe that ATR harmony and interior vowels (e.g. [i], [ə]) appear to be in an antagonistic relationship, and that the presence of both in a given vowel system is dispreferred. Perhaps Proto-Banda had both ATR harmony and the phoneme /ə/ at some point in its history, and the ATR harmony was subsequently lost due to pressure from the interior vowel.

Second, both Samarin (1982) and Cloarec-Heiss (1995) quote Brunache (1894: 205–206) who provides evidence for the existence of a Banda lingua franca in the region in the late 19th century. If this is true, the loss of ATR harmony may have been a type of simplification of the language structure that is often associated with pidgins and lingua francas.

Either of these possibilities – internal systemic pressure or L2 simplification – could have contributed a certain instability to the phonological system, leading to the loss of the ATR harmony, as well as other eventual structural changes.

⁶In discussing the simplification of Sango vis-à-vis the Ngbandi group, Samarin (2000: 313) states, “Co-occurrence of vowels has been simplified by vowel harmony: i.e., mid vowels in a single word are either tense or lax, not both.”

5 Conclusion

In summary, extant Ngbugu has a symmetric vowel system (including one interior vowel) that resembles vowel systems of the other groups in the region, except for the absence of vowel harmony. The extant ATR contrasts in Ngbugu lend support to Boyeldieu and Cloarec-Heiss's (2001) reconstructed Proto-Banda vowel system containing ATR contrasts. The traces of a vowel harmony system in Linda and Ngbugu, combined with the similarity of Ngbugu's surface phonetic vowel inventory to that of nearby languages that exhibit vowel harmony (particularly Nzakara) support the hypothesis that Proto-Banda may have had vowel harmony at some point in its history.

Acknowledgments

I wish to thank Tychique Longbo, Jessé-Joël Adoumacho, and Guy-Florent Matchi for their collaboration and friendship, Connie Kutsch Lojenga for assistance with the methodology (and in particular being the first to identify /ɔs/), Pascal Boyeldieu, Mike Cahill, Bill Samarin, Coleen Starwalt, and participants at ACAL 49 for helpful comments (all errors are my own), and the SIL Central African Republic Service Group for funding.

References

- Boersma, Paul & David Weenink. 2018. *Praat: Doing phonetics by computer. Version 6.0.37*. Computer program. <http://www.praat.org/>.
- Boyd, Raymond. 1997. Les harmonies vocaliques du zande. *Lingua* 101(1–2). 1–19. DOI: 10.1016/S0024-3841(96)00017-4.
- Boyeldieu, Pascal. 1987. *Les langues fer («kara») et yulu du nord centrafricain: Esquisses descriptives et lexiques*. Paris: Geuthner.
- Boyeldieu, Pascal. 2000. *La langue bagiro (République Centrafricaine): Systématique, textes et lexique* (Schriften zur Afrikanistik / Research in African Studies 4). Frankfurt: Peter Lang.
- Boyeldieu, Pascal & France Cloarec-Heiss. 2001. Les choix vocaliques de deux parlers banda: Correspondances ou ressemblances régulières? In Robert Nicolai (ed.), *Leçons d'Afrique: Filiations, rupture et reconstitution de langues: Un hommage à Gabriel Manessy* (Collection Afrique et Langage 2), 183–220. Louvain-Paris: Peeters.

- Brunache, Paul. 1894. *Le centre de l'Afrique: Autour du Tchad*. Paris: Ancienne Librairie Germer Baillière.
- Casali, Roderic F. 2008. ATR harmony in African languages. *Language and Linguistics Compass* 2(3). 496–549. DOI: 10.1111/j.1749-818X.2008.00064.x.
- Cloarec-Heiss, France. 1978. Étude préliminaire à une dialectologie banda. In Raymond Boyd & France Cloarec-Heiss (eds.), *Études comparatives* (Bibliothèque de la SELAF 65), 11–42. Paris: SELAF.
- Cloarec-Heiss, France. 1995. Emprunts ou substrat? Analyse des convergences entre le groupe banda et les langues du Soudan central. In Robert Nicolai & Franz Rottland (eds.), *Proceedings of the Fifth Nilo-Saharan Linguistics Colloquium, Nice, 24–29 August 1992*, 321–355. Cologne: Rüdiger Köppe.
- Crothers, John. 1978. Typology and universals of vowel systems. In Joseph H. Greenberg (ed.), *Universals of human language, II: Phonology*, 93–152. Stanford, CA: Stanford University Press.
- Greenberg, Joseph H. 1970. *The languages of Africa*. 3rd edn. (Indiana University Research Center in Anthropology, Folklore and Linguistics 25). Bloomington, IN: Indiana University.
- Kamanda-Kola, Roger. 2003. *Phonologie et morpho-syntaxe du mono: Langue oubanguienne du Congo R. D.* (LINCOS Studies in African Linguistics 60). Munich: Lincom.
- Kutsch Lojenga, Constance. 1996. Participatory research in linguistics. *Notes on Linguistics* 73. 13–27.
- Ladefoged, Peter. 2003. *Phonetic data analysis: An introduction to fieldwork and instrumental techniques*. Oxford: Blackwell.
- Landi, Germain. 2005. *La phonologie et l'orthographe de la langue Nzakara*. Manuscript. Bangui: ACATBA. <https://www.sil.org/resources/publications/entry/71140>.
- Moñino, Yves (ed.). 1988. *Lexique comparatif des langues oubanguiennes*. Paris: Geuthner.
- Olson, Kenneth S. 2005. *The phonology of Mono*. Vol. 140 (SIL International Publications in Linguistics). Dallas, TX: SIL International & University of Texas at Arlington.
- Olson, Kenneth S. 2013. *A sketch of Lutos phonology*. Paper presented at the 43rd Colloquium on African Languages and Linguistics (CALL), 26–28 August, 2013, Leiden, The Netherlands. https://scholars.sil.org/kenneth_s_olson/lutos.
- Pike, Kenneth L. 1947. *Phonemics: A technique for reducing languages to writing*. Ann Arbor, MI: University of Michigan Press.

- Rolle, Nicholas, Matthew Faytak & Florian Lionnet. 2017. The distribution of advanced tongue root harmony and interior vowels in the Macro-Sudan Belt. *Proceedings of the Linguistic Society of America* 2(10). 1–15. DOI: 10.3765/plsa.v2i0.4058.
- Samarin, William J. 1966. *The Gbeya language: Grammar, texts and vocabularies* (University of California Publications in Linguistics 44). Berkeley: University of California Press.
- Samarin, William J. 1982. Colonization and pidginization on the Ubangi River. *Journal of African Languages and Linguistics* 4. 1–42. DOI: 10.1515/jall.1982.4.1.1.
- Samarin, William J. 2000. The status of Sango in fact and fiction: On the one-hundredth anniversary of its conception. In John H. McWhorter (ed.), *Language change and language contact in pidgins and creoles* (Creole Language Library 21), 301–334. Amsterdam: John Benjamins. DOI: 10.1075/cll.21.11sam.
- Segeer, Guillaume & Sébastien Flavien. 2011. *RefLex: Reference lexicon of Africa, Version 1.1*. Paris, France. <http://reflex.cnrs.fr/>.
- Simons, Gary F. & Charles D. Fennig (eds.). 2018. *Ethnologue: Languages of the world*. 21st edn. Dallas, TX: SIL International. <http://www.ethnologue.com>.
- Starwalt, Coleen G. A. 2008. *The acoustic correlates of ATR harmony in seven- and nine-vowel African languages: A phonetic inquiry into phonological structure*. Arlington, TX: University of Texas at Arlington. (Doctoral dissertation). <https://uta-ir.tdl.org/uta-ir/handle/10106/1015>.
- Théret-Kieschke, Régine. 1998. *Esquisse phonologique de ngbugu*. Manuscript. SIL. Bangui.
- Thomas, Jacqueline M. C. 1963. *Le parler ngbaka de Bokanga: Phonologie, morphologie, syntaxe*. Paris, The Hague: Mouton.

