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Elaine Marie Scherrer 
SIL Chad
elaine.scherrer@gmail.com

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A phonological description of Naba

Elaine Marie Scherrer

SIL Chad

elaine.scherrer@gmail.com

Abstract

Naba, also known as Bilala, is a Nilo-Saharan (Sara-Bagirmi) language of Chad with about 410,000 speakers from three ethnic groups. This paper gives a basic description of the Naba phonological system, using segmental phonology and lexical phonology approaches. Topics covered include the phonemic inventory, syllable structure and phonotactic restrictions, the tone system and its interaction with other phonological processes, and the main lexical and post-lexical processes. A special focus is given to the important role of sonority hierarchy in Naba phonological structure and processes. This hierarchy groups affricates and non-sibilant fricatives with stops in a single obstruent category, while nasals, liquids, and approximants comprise the sonorant category. The distinction is key for syllable structure, phonotactic restrictions, tone sandhi, and a number of both lexical and post-lexical processes. It is proposed that the two sibilant fricatives /s/ and /z/ exist as a separate sonority level in between obstruent and sonorant, and evidence is given as to why they cannot be classed with either group.

Keywords: Naba, Bilala, Nilo-Saharan, phonological description, sonority, sonority hierarchy, lexical phonology

1 Introduction

1.1 The Naba-Speaking Community

The Naba, or Melbene, language is spoken in the Batha-Est region in central Chad by about 410,000 people according to Eberhard et al. (2022). Naba is part of the Nilo-Saharan family, more specifically a Bongo-Bagirmi language of the Central Sudanic branch. Closely related languages with previous documentation include Kenga, Bagirmi, and Sar.

The majority of Naba speakers live in the East Batha and Bahr-el-Gazel regions of Chad, but many speakers are also found in the Guéra and Hadjer-Lamis regions as well.

There are three ethnic groups who speak Naba as their first language, the Bilala, Kuka, and Medogo. Each ethnic group has its own dialect typically referred to with the same name as the group (Bilala, Kuka, and Medogo), but the Bilala dialect appears to have at least four sub-dialects as well.¹ Members of the ethnic groups themselves and sociolinguistic research affirm that Naba is a single language (Maass 2001: 5). Among these ethnic groups, the Bilala are the majority, and for this reason the language is often referred to as “Bilala” rather than as “Naba”. More recently, representatives of the Naba-speaking community as a whole have proposed the term “Melbene” to refer to the language, because it is seen as more neutral and inclusive, whereas “Naba” has come to imply speakers who are not ethnically Bilala. Since the language is officially known at the international level in publications such as Eberhard et al. (2022) as Naba, I will restrict myself to the name “Naba” and not make reference to other names unless dialectal differences are being considered.

1.2 Data collection methods

This description of the phonology of Naba is based on data from speakers who participated in a series of language development workshops led by the Federation of Associations for the Promotion of National Languages (FAPLN), a Chadian literacy organization. I worked as a consulting linguist with FAPLN during these workshops from late 2018 to early 2021 as an orthography and literacy materials were developed. The speakers, mostly of the Bilala ethnic group, came from the three largest Bilala towns, Yao, Ambassetna, and Am-Djaména-Bilala, as well as one speaker of Kuka origin and one speaker of mixed Bilala-Medogo heritage. The work of these speakers was the basis for Naba literacy materials, but the data used in this paper either originated from or was confirmed by a speaker from Yao currently living in the town of Bitkine in the Guéra region of central Chad, Mr. Abderhaman Daoud. Since the dialect of Bilala spoken in Yao has been selected by the language community as the basis

1 These subdialects have not been confirmed by sociolinguistic research but are acknowledged by Bilala speakers, who refer to them by the names of the four major Bilala towns, Yao, Ambassetna, Amjamena-bilala, and Moeto.

for language development and as the majority of data comes from speaker of this sub-dialect, this article will be describing Yao pronunciation unless otherwise indicated.

I would like to acknowledge here the members of the Naba-speaking community with whom I have worked: Abderhaman Daoud from Yao, my main language informant; and the members of the FAPLN Naba literacy initiative: Hawa Agid Mahamat, Fatime Sabur Beglar Beshar, Adoum Abakar Mahamat, Goni Mahamat, Halime Mahamat Hassan, Hassaballah Yermie, Hissein Sali Ngale, and Mahamat Abdel Kerim. Informed consent was obtained with an audio recording from Abderhaman Daoud with the understanding that data could be used for academic research as well as for Naba language development. Oral consent was also given by Hissein Sali Ngale on behalf of the Naba literacy initiative.

The data set includes over 4500 recordings of individual lexical items and short phrases, 1,200 recordings of specific grammatical constructions, ten natural recorded texts (three procedural, one hortative, and six narrative), 16 recorded descriptive texts prompted by images, and seven written texts created for the literacy program. The total time of the recordings is approximately 17 hours.

My work with the Naba community began as involvement in their literacy project. Because our initial goal was to create a writing system, and the representatives of the Naba community were insistent on not using tone marking, earlier data was unmarked for tone. Later as I began researching the tone system independently of the literacy project, tone marking was used. The result is that my data is not marked consistently. When writing this paper, phonological issues that involved tone necessarily drew upon data marked for tone, but in parts of the analysis in which tone does not appear to play a role, I made use of unmarked data. The overall tone system of Naba is still being researched as I continue work on the grammar; since grammatical tone is still being analyzed, the presentation of tone in this paper is incomplete.

1.3 Literature Review

A study of the phonology of Naba, specifically focused on the Bilala dialect, was previously written by missionaries Paul and Amy Schultz (Schultz & Schultz 2001). This was followed by a grammatical description (Schultz & Schultz 2003). These studies covered the

basics but were not geared towards an academic audience and seem to focus on comparing Bilala with English in order to assist foreigners attempting to learn the language. Their studies were also almost exclusively based on data from three Bilala men living in the Chadian capital city far from the Bilala territory (Schultz & Schultz 2001: 2) and this fact is reflected in the high level of borrowing from Chadian Arabic present in the data. For this reason, I have not incorporated the Schultz's research into the current analysis.

In 2002, Olsen and Schultz presented a brief paper on the morpho-phonological behaviour of Naba's third person singular object marker *ɲa* (Olson & Schultz 2002). Using a geometry feature tree approach, they suggested that the way in which this suffix assimilates to a previous segment (discussed below in section 5.3) gives evidence for the spreading of the feature [sonorant].

This article is meant to serve as a technical description of the phonology of Naba with special focus on the role of the sonority hierarchy in many of Naba's phonological processes. The sonority status of sibilants is of particular interest. It has been adapted from my previous phonological sketch, written in French as a basis for the development of the Naba orthography (Scherrer 2020; 2021a). This article will cover the segmental phonology with special attention to sonority groupings, phonological structure (syllable types and phonotactics), the tone system and its interaction with syllable structure and sonority-based restrictions, and finally an overview of phonological processes. Since I have used the theory of Lexical Phonology extensively in development of the Naba orthography (Scherrer 2021b), these processes will be presented in the categories of lexical and post-lexical phonological processes.

1.4 Notes on Naba Grammar

The basic word order of Naba is SVO. The noun phrase consists of the noun followed by a number of modifiers. Clitics on the noun phrase level indicate plurality, definiteness, and connection to certain non-verbal elements.

The Naba verb takes subject and object morphology as well as a number of affixes and auxiliaries that indicate aspect. Verbs can be nominalized, and most adjectives and adverbs are derived from stative verbs. It is often with syntax alone that derived nouns and adjectives/adverbs can be distinguished from verbs. In this paper glosses

will reflect the syntactic category of the word in a given context, while isolation forms will generally be glossed as the root verb.

Independent pronouns in Naba are optional, and while there are object affixes for each person and number, subject marking on the verb is less distinct. For vowel-initial verbs, prefixes mark the first person singular and plural, and suffixes mark the second and third person plural for any kind of verb. However second and third person singular subjects are not marked on the verb, and the subject prefixes for first person singular and plural are not evident on consonant-initial words. The reader should thus be aware that glossing of pronominal verb subjects is context-dependent. Also, some of the data will have independent subject pronouns (used normally for emphasis or contrast in Naba discourse), while others will not. For purposes of simplicity, I have only used verbs with ambiguous subject marking when I know them to refer to third person singular; thus, any apparently ‘unmarked’ verb is translated with the English subject ‘he/she’.

2 Segmental Phonology

Naba has 25 consonant and five vowel phonemes. The consonants fall into four main places of articulation, labial, alveo-dental, palatal, and velar. The consonants can be divided into categories of sonorant and obstruent, with sibilants having characteristics of both. The vowel system is a symmetrical five-vowel system with contrast between single and double vowels.

2.1 Consonants

The following Table 1 shows the consonant phonemes of Naba, including simple, prenasalised, and implosive obstruents; sibilants, nasals, liquids, and approximants.

The main places of articulation are labial, alveolar, palatal, and velar, with one glottal /h/. There is some question as to the status of /h/ as a phoneme, discussed in section 5.6, and it would also be possible to include it with the velars as a single category.

The category “alveolar” could also be labelled “alveo-dental” because there is variation in the pronunciation of obstruents at this place of articulation. Stops are usually pronounced in a dental manner, particularly in the Yao sub-dialect, while the sibilants show more variation between alveolar and dental place of articulation.

Table 1. Consonants

	Labial	Alveolar	Palatal	Velar	Glottal
Obstruent	f b	t d	tʃ dʒ	k g	h
Prenasalised	mb	nd	ndʒ	ng	
Implosive	ɓ	ɗ			
Sibilant		s z			
Nasal	m	n	ɲ	ŋ	
Liquid		l r/ɾ			
Approximant	w		j		

2.1.1 Notes on obstruent consonants

As /b/ is the only stop without a voiceless correspondent, and /f/ has no voiced correspondent, these phonemes are presented as corresponding labial obstruents. As we will see in more detail as the different phonological processes of Naba are presented, grouping /f/ and /h/ as well as the two affricates /tʃ/ and /dʒ/ together with the stops in a single obstruent category explains the overall phonological system better than maintaining separate fricative and affricate categories. This is especially noticeable in the behaviour of these phonemes compared to the sibilant fricatives /s/ and /z/, which I do maintain as a separate category.

The fricative /f/ may also be pronounced as the voiceless labial stop [p] in initial position. This is a case of free variation, although in certain words [p] is pronounced more often, particularly in loan words. /f/ is proposed as the underlying phoneme because [p] may only occur in initial position, as shown in (1a) whereas [f] occurs in initial position, intervocalic position, and between a consonant and a vowel, as shown in (1a–c):

- (1) a. *fene* ‘one’ > [fene] or [pene]
 b. *naafe* ‘moon’ > [naafe] not *[naape]
 c. *terfe* ‘shoulder blade’ > [terfe] not *[terpe]

Additionally, in Kuka and Medogo wordlists [p] does not occur at all (Maass 2001, Laya 2003), suggesting that this alternation is restricted to the Bilala dialect.

There are two implosives in Naba, /ɓ/ and /ɗ/, with /ɗ/ being much more frequent. /ɓ/ is not attested in medial position except in

the word *ebe* ‘heal’. In several other Sara-Bagirmi languages there is also a palatal implosive, but we do not see this in Naba.

The prenasalised stops are analysed as single phonemes rather than as consonant sequences in this paper, although there is some evidence to suggest that underlyingly they are nasal-stop sequences. This analysis is explained further in section (6.6).

The affricate /tʃ/ is pronounced as [ʃ] intervocalically. The sound [ʃ] is also found initially in many loan words from Arabic and there is ongoing debate as to whether it should be considered a separate phoneme and written as a digraph <ch>, as distinct from <c> which represents the phoneme /tʃ/.² Although the <ch> and <c> both currently exist in the orthography, it is fairly clear that in non-loans, [ʃ] only exists as an allophone of /tʃ/. This description will thus not consider a separate phoneme /ʃ/.

The affricates /tʃ/ and /dʒ/ become /c/ and /j/ when followed by a consonant as discussed in section (6.3). The main reason for proposing the affricates rather than the palatal stops as the underlying phonemes is their wider distribution. The affricates are found word-initially, and between a consonant and a following vowel. Intervocalically, /dʒ/ is pronounced as [dʒ] while /tʃ/ changes to /ʃ/. The palatal stops /c/ and /j/ are restricted to pre-consonantal position, and this process of fortition before a consonant corresponds to the fortition of /f/ to [p] and /h/ to [k]. Examples are shown in Table 2 below.

Table 2. Palatal obstruent distribution

Position	Voiceless Palatal	Voiced Palatal
Word-initial	<i>tforlo</i> ‘giraffe’	<i>dʒere</i> ‘short’
Post-Consonantal	<i>kurtfu</i> ‘cucumber’	<i>kendʒe</i> ‘fish’
Intervocalic	<i>itfi</i> [iʃi] ‘defecate’	<i>tedʒe</i> ‘bee’
Pre-Consonantal	/reece-na/ [rec-tʃa] break-3SG.OBJ ‘he/she breaks it’	/miidʒe = ge/ [miʃge] addax = PL ‘addaxes’

Native speaker intuition also contributes to this analysis. During the development of the Naba orthography, Naba speakers were clearly

² In both Arabic and French, the languages of wider communication in Chad, <ch> is used to represent the phoneme /ʃ/, rather than <sh> as is typical in languages with an English influence. Because the <ch> represents /ʃ/, <c> is used in many Chadian languages to represent /tʃ/.

aware of the phonemes [tʃ] and [dʒ] and were able to identify them in various positions. However, the speakers were not aware that [c] and [j] existed in their language until the pronunciation in pre-consonantal position was pointed out to them.

2.1.2 Notes on Sonorant Consonants

The phoneme /r/ is generally pronounced as an alveolar trill, but is pronounced more like a retroflex approximant [ɽ] in fast speech, particularly in intervocalic position (2a); it is difficult to confirm which is the underlying form. It also may be pronounced as the uvular trill [R] when adjacent to a back vowel (2b). While it seems that the trill is the underlying phoneme, since it patterns with the liquid /l/ in Naba, I consider it as belonging to the liquid class and not to a separate class of trills. /r/ also is often pronounced as [dr] or [dR] in phrase-initial position in the Yao sub-dialect (2c).

- (2) a. *dʒiriri* ‘gills’ [dʒiɽiɽi] *gere* ‘fart’ [geɽe]
 b. *uuru* ‘sew’ [uuRu] *kurtʃu* ‘cucumber’ [kʊɽtʃu]
 c. *raaga* ‘mat’ [draaga] *ruunu* ‘hip’ [dRuunu]

The two liquid consonants /r/ and /l/ are occasionally interchanged in fast speech when in word-medial position, but there are a number of minimal pairs that make it evident that they are two separate phonemes, several of which are given in (3):

- (3) a. *iiri* ‘name’ *iili* ‘be black’
 b. *ndere* ‘comb’ *ndele* ‘become’
 c. *kerhe* ‘mucus’ *kelhe* ‘alone’

The approximants /w/ and /j/ show the same behaviour of being interchangeable in fast speech word-medially.

2.1.3 Notes on sibilant consonants

The two Naba sibilants /s/ and /z/ do not fall neatly into either the obstruent or sonorant category. The unique behaviour of the sibilants will be noted throughout this analysis, and a summary is given in section 7.

/s/ is much more frequent in Naba than /z/, with the lexicon showing 292 examples of /s/ and only 97 instances of /z/, a good portion of which are found in Chadian Arabic loan words, particularly when /z/ is in word-initial position. While it is possible that

word-initial /z/ derives from Arabic, there are many instances of /z/ in medial position in non-loans that show clear contrast with /s/, as in example (4) below:

- (4) a. *ozo* ‘slip’ *oso* ‘eat’
 b. *keeze* ‘hatred’ *keese* ‘cough’
 c. *kaza* ‘horn’ *kasa* ‘lure’

Table 3 shows the distribution of the consonants. There are only few examples of final consonants, which reflects the fact that in Naba nearly all words are underlyingly vowel-final, excluding a handful of ideophones and grammatical function words. See sections 3.2 and 5.1.

Table 3. Consonant distribution

Conso- nant	Initial position	Medial position	Final position
/b/	<i>biisi</i> ‘dog’	<i>raaba</i> ‘to roast’	-
/β/	<i>bormo</i> ‘thigh’	<i>ebe</i> ‘heal’	-
/d/	<i>daana</i> ‘nice’	<i>dede</i> ‘feather’	-
/d/	<i>doho</i> ‘woman’	<i>tfoodo</i> ‘whip’	-
/f/	<i>fili</i> ‘kitchen’	<i>gufufu</i> ‘viper’	-
/t/	<i>terle</i> ‘jackal’	<i>nduutu</i> ‘dry’	-
/dʒ/	<i>dʒaŋala</i> ‘clay jar’	<i>eedze</i> ‘birth’	-
/tʃ/, [ʃ]	<i>tʃuuru</i> ‘sesame’	<i>gumafe</i> ‘heart’	-
/g/	<i>gundzu</i> ‘camel’	<i>aaga</i> ‘to crawl’	<i>derg</i> ‘under’
/k/	<i>kaawa</i> ‘long’	<i>lohoko</i> ‘chameleon’	<i>tak</i> ‘all’
/h/	<i>hilek</i> ‘throat’	<i>oho</i> ‘have’	-
/s/	<i>sinde</i> ‘horse’	<i>keese</i> ‘to cough’	-
/z/	<i>zuriye</i> ‘clan’	<i>gaaza</i> ‘confuse’	-
/mb/	<i>mbala</i> ‘choose’	-. ³	-
/nd/	<i>ndufo</i> ‘duck’	-	-
/ng/	<i>ngaala</i> ‘belly’	-	-

³ Nasal-stop sequences do occur word-medially, but are analysed as being two separate phonemes belonging to different syllables rather than as prenasalised stops in this environment. See sections 3.3.2 and 6.6.

/ndʒ/	<i>ndʒa</i> ‘leg’	-	-
/m/	<i>mahala</i> ‘slow’	<i>noomo</i> ‘enter’	<i>kam</i> ‘TAM marker’
/n/	<i>naafe</i> ‘moon’	<i>uunu</i> ‘take’	<i>an</i> ‘possessive marker’
/ŋ/	-	<i>naaŋa</i> ‘ground’	-
/ɲ/	-	<i>aŋa</i> ‘to run’	-
/l/	<i>laaba</i> ‘grandfather’	<i>eel</i> ‘say’	<i>kal</i> ‘TAM marker’
/r/	<i>roŋo</i> ‘to want’	<i>gara</i> ‘thing’	<i>kar</i> ‘plus’
/w/	<i>waaye</i> ‘spear’	<i>gowa</i> ‘snail’	-
/j/	<i>jiimi</i> ‘grasshopper’	<i>kaje</i> ‘see’	-

For reference, Table 4 shows the proposed sonority hierarchy of Naba consonants; the first row indicates the overall hierarchy, with the second showing the proposed hierarchy among the obstruents:

Table 4. Naba Sonority Hierarchy

Obstruent	Sibilant	Nasal	Liquid	Approximant
Stop	Implosive		Affricate/Fricative	

2.2 Vowels

Naba has five vowel phonemes, shown below in Table 5:

Table 5. Vowels

	Front	Central	Back
Close	i		u
Mid-close	e		o
Open		a	

All five vowels show contrast between a single phoneme and a doubled sequence (V vs. VV). Our analysis is that a long vowel is a sequence of two identical vowels (VV) rather than a single separate vowel phoneme (V:). One reason for this is that each vowel acts as a separate mora and can thus be a tone-bearing unit. Diphthongs and sequences of two non-identical vowels are not permitted. There are

many contrasts between single and double vowels in the lexicon, as in the following examples in (5):

(5) V	<i>naŋa</i> ‘children’	VV	<i>naaŋa</i> ‘ground’
V	<i>tele</i> ‘to cultivate’	VV	<i>teele</i> ‘to kill’
V	<i>iri</i> ‘root’	VV	<i>iiri</i> ‘hibiscus’
V	<i>kolo</i> ‘rope’	VV	<i>koolo</i> ‘pot’
V	<i>ulu</i> ‘to swallow’	VV	<i>uulu</i> ‘to braid (a rope)’

2.2.1 Vowel harmony

Example (5) above shows the strong tendency in Naba for complete vowel harmony at the word level. A significant portion of the lexicon retains identical vowels throughout the word, especially in verbs. For words without complete vowel harmony, there are restrictions on which vowels can appear in what order. /a/ may appear in any position, but for the other vowel phonemes two rules apply:

- If the word contains either two front vowels or two back vowels, the close vowel must precede the mid-close vowel (/u/ before /o/ and /i/ before /e/); see examples (6a–d).
- If the word contains two vowels with the same level of openness, the back vowel must precede the front vowel (/u/ before /i/ and /o/ before /e/); see examples (6e–h).

(6) a.	<i>tugo</i> ‘wash’	e.	<i>guwi</i> ‘calf’
b.	<i>rulo</i> ‘shadow’	f.	<i>wurli</i> ‘peanuts’
c.	<i>miidze</i> ‘addax’	g.	<i>ode</i> ‘to vomit’
d.	<i>inde</i> ‘give’	h.	<i> yolhe</i> ‘goods’

The vast majority of trisyllabic words show complete vowel harmony, so there is not enough data to show whether the same rules of vowel ordering apply. Several examples of complete trisyllabic vowel harmony are given in (7a–d) with incomplete harmony in (7e–g), and (7h) showing three completely different vowels:

(7) a.	<i>batana</i> ‘bushbaby sp.’	e.	<i>berije</i> ‘porridge’
b.	<i>bedede</i> ‘spark’	f.	<i>gedzafa</i> ‘tree sp.’
c.	<i>tforoŋo</i> ‘thorn’	g.	<i>maruwa</i> ‘grass sp.’
d.	<i>titiri</i> ‘ant sp.’	h.	<i>tubijo</i> ‘lion’

Trisyllabic words usually display at least two of the three syllables with harmony as in (7e–g), but examples such as (7h) show that all three vowels may differ in a handful of cases.

2.2.2 Other vowel phones

There are other vowel phones in Naba to consider. All of the vowel phonemes with the exception of /a/ have open allophones that appear in (C)VC syllables. In this environment (i, u, e, and o) become (ɪ, ʊ, ɛ, and ɔ). The central vowel phone [ə] also occurs in fast speech and in vowel epenthesis.

The vowels (ɪ, ʊ, ɛ, and ɔ) function as allophones of the phonemic vowels (i, u, e, and o) in closed syllables.

The vowels [ɪ] and [ʊ] occur only in this particular environment of the closed syllable. Example (8) shows the vowel alternation:

- (8) /*mindɪ*/ ‘river’ > [mɪndɪ]
 /*dirli*/ ‘tear’ > [dɪrli]
 /*urde*/ ‘granary’ > [ʊrde]
 /*gundʒu*/ ‘camel’ > [gʊndʒu]

The open-mid vowels [ɔ] and [ɛ] occur both as allophones of /o/ and /e/ in closed syllables, and as free variants of these phonemes in open syllables. This free variation generally occurs only in non-final syllables, though there are a handful of exceptions. The open-mid allophones [ɔ] and [ɛ] may also be doubled, which is not permitted for the allophones [ɪ] and [ʊ]. Example (9) shows the open-mid allophones [ɔ] and [ɛ] in closed syllables, while Example (10) shows them in open syllables:

- (9) /*kergese*/ ‘quiver’ > [kɛrgese]
 /*nderŋe*/ ‘cane’ > [ndɛrŋe]
 /*mborŋo*/ ‘beard’ > [mbɔrŋo]
 /*korondʒo*/ ‘chicken’ > [korɔndʒo]
- (10) /*keere*/ ‘elephant’ > [keere] or [kɛɛɛɛ]
 /*neere*/ ‘be wet’ > [neere] or [nɛɛɛɛ]
 /*joje*/ ‘be heavy’ > [joje] or [jɔje]
 /*boodo*/ ‘warthog’ > [boodo] or [bɔɔɔɔ]

Some Naba speakers, particularly those of the Yao sub-dialect, do hear a distinction between [o]/[ɔ] and [e]/[ɛ], but many others

cannot tell the difference unless it is pointed out to them. Certain words have a clear tendency to be pronounced with open-mid allophones even in final position, as in example (11).

- (11) /oŋo/ ‘be hot, heat’ > [ɔŋɔ], not [oŋo]
 /eere/ ‘ripen’ > [ɛɛɛ], not [eere]

In other Sara-Bagirmi languages, such as Kenga (Neukom 1993: 26), Gor (Kosmadji & Roberts 2009: 3), and Na (Keegan 2015: v), *ɛ* and *ɔ* exist as distinct phonemes, and it seems quite possible that Naba originally had a similar seven-vowel system that has been partially retained in the Yao sub-dialect. However, there are several reasons to conclude that these sounds are not phonemic in the current system:

- There are very few examples of minimal pairs for [e]/[ɛ] or [o]/[ɔ] and these can also be distinguished by tone melody
- Words with stable pronunciation of [ɛ] and [ɔ] in open consonants are restricted to a certain sub-dialect.
- The same speaker may show free variation in pronunciation of these allophones in identical contexts.

The central vowel [ə] is found in Naba but is not involved in any kind of alternation. It is used in epenthesis to break up 3-consonant clusters, and in rapid speech. The process of epenthesis is discussed in section.

3 Phonological structure

In this section we treat the phonological structure of Naba, including the form of the syllable and its basic types, restrictions on syllable position, and phonotactic rules for both vowel and consonants.

3.1 Syllable types

Example (12) is a list of all syllable types found in Naba; the first four are open syllables and the last two are closed:⁴

4 A reviewer suggested that because liquid consonants may be part of the syllable nucleus rather than a coda, the analysis of closed syllable structure does not follow a priori. However, as non-liquid consonants may also appear in this final syllable position, the existence of closed syllables seems the simplest explanation of the data.

(12)	V	<i>i.ri</i> ‘root’	CV	<i>mbu</i> ‘grass’
		<i>e.he</i> ‘climb’		<i>ba.da</i> ‘tomb’
	VV	<i>ii.li</i> ‘black’	CVV	<i>maa.re</i> ‘crocodile’
		<i>uu</i> ‘pull’		<i>ndii</i> ‘scatter’
	VC	<i>ar.ge</i> ‘search’	CVC	<i>ter.dze</i> ‘insult’
		<i>ul.be</i> ‘tree sp.’		<i>len.dze</i> ‘friend’

Ideophones, which are common in Naba, often do not follow structural rules, and one lexicalized ideophone exists with the syllable type CVCC, the preposition *derg* ‘under’. There is also a process of final vowel deletion that creates (C)VCC sequences not found in underlying word forms, which I discuss in section 5.1. Leaving these cases aside, Naba has a symmetrical system of syllable types, shown in the following Table 6:

Table 6. Syllable types

	With onset	Without onset
Open Single	CV	V
Open Double	CVV	VV
Closed	CVC	VC

These syllable types can also be categorized as light (V, CV) and heavy (VC, VV, CVV, and CVC); a double vowel or a consonant add a second mora to the syllable. This distinction between light and heavy is significant for the realization of tone melodies, as the mora, rather than the syllable, is the tone-bearing unit in Naba.

3.2 Syllable restrictions

Certain restrictions apply in Naba as to the order of syllables within a word. First, for monomorphemic words that are not ideophones, the final syllable must be open. Closed syllables are only permitted in initial or medial position, with the exception of lexicalized ideophones such as *derg* ‘under’ and *tak* ‘all’, and of grammatical function morphemes such as *in* (possessive marker), *kar* (used to join count numbers)⁵, *kal* (inceptive aspect marker), and *nen* (proximal demon-

⁵ *kar* plays the same role as the hyphen in English count numbers and can be translated as ‘and’ (but it cannot be used in any other context besides that of count numbers). For example *twenty-two* in English becomes *si rujo kar rujo* ‘ten two [twenty] and two’ in Naba.

CV	<i>jo</i>	‘hear’
CVV	<i>mbaa</i>	‘breast’
V.CV	<i>i.tfi</i>	‘pull out’
CV.CV	<i>ndu.jo</i>	‘weak’
VV.CV	<i>oo.bo</i>	‘refuse’
VC.CV	<i>ur.de</i>	‘granary’
CVV.CV	<i>boo.do</i>	‘warthog’
CVC.CV	<i>kor.ho</i>	‘scratch’
V.CV.CV	<i>a.ri.di</i>	‘demon’
CV.CV.CV	<i>be.ri.je</i>	‘porridge’
VC.CV.CV	<i>or.lo.ho</i>	‘throat’
CVC.CV.CV	<i>bar.ta.la</i>	‘flat basket’
CV.CVC.CV	<i>ko.ron.dzo</i>	‘chicken’
CVC.CVC.CV	<i>gor.dzon.ko</i>	‘wrinkle’
V.CV.CV.CV	<i>i.bi.ri.ti</i>	‘traditional clay jar’
CV.CV.CV.CV	<i>ku.gu.du.mu</i>	‘hyena’
V.CVC.CV.CV	<i>o.nan.gi.da</i>	‘moringa tree’
CV.CVC.CV.CV	<i>bo.hol.ko.lo</i>	‘rooster’
CVC.CV.CV.CV	<i>bar.da.wi.ja</i>	‘type of drum’
V.CV.CVC.CV	<i>e.le.mar.ja</i>	‘vulture’

Of all structures, the two-syllable word is by far the most frequent, followed by trisyllabic, then monosyllabic words. There are some four-syllable words that appear to be single morphemes, but anything over four syllables is either a reduplication serving as an ideophone or a compound word.

3.3 Phonotactics

Both within syllables and at syllable boundaries there exist rules concerning which phonemes can occur in what sequence. Phonotactic rules are either based on the level of sonority of the phonemes in question or on syllable weight.

3.3.1 Vowel phonotactics

Long vowels are analysed as sequences of two identical vowel phonemes which are pronounced as a single unit. Naba contains no

sequences of non-identical vowels, neither as diphthongs nor as two distinct syllables. There are occasions in fast speech when diphthong-like sounds are pronounced, but in slow speech it is clear that an approximant /w/ or /j/ actually exists between the two vowel sounds. The deletion of the final vowel before a following morpheme (the deletion of the final vowel is discussed in section 5.1) creates the diphthong sound. This can be seen in examples of fast speech in (14):

(14) a. /*ba.wo*/ ‘to go’

<i>ja</i>	[<i>baŋ</i>]	<i>ndzerhe = n</i>	<i>taaga</i>
3SG.SBJ	go	field = CN	yesterday

‘he/she went to the field yesterday’

b. /*ko.je*/ ‘owl’

[<i>koŋ</i>]	<i>il = ge</i>
owl	black = PL

‘black owls’

c. /*no.je*/ ‘blacksmith’

<i>man</i>	<i>ngeere</i>	[<i>noŋ</i>]	<i>bobo-ma</i>
1SG.SBJ	know	blacksmith	father-1SG.POSS

‘I know my father’s blacksmith’

3.3.2 Consonant Phonotactics

As noted above, CC sequences in a single syllable are not found in monomorphemic words pronounced in isolation. However, CC sequences are found across syllable boundaries, in cases where the final consonant of one syllable is followed by the onset of the next syllable.

The type of consonant permitted at the end of the first syllable is restricted, while the second syllable can take any consonant as its onset. The rule is that in a $C_1.C_2$ sequence, C_1 must be a sonorant consonant, most frequently a nasal or a liquid, as we see in Example (15):

(15) <i>on.do</i> ‘put’	<i>ter.fe</i> ‘shoulder-blade’
<i>ram.ba.ja</i> ‘type of basket’	<i>tful.mo</i> ‘ulcer’

In discussing CC sequences across syllable boundaries, it is necessary to explain why a CVNCV structure is to be analysed as CVN.

CV rather than CV.nCV, as prenasalised stops are phonemic in Naba. Many words in Naba have the CVNCV... structure, with pronunciation affected by nasal assimilation (treated in section 6.4). Example (16) shows a number of such structures:

- (16) a. /*sinde*/ [smde] 'horse'
 b. /*lendze*/ [lɛndzɛ] 'friend'
 c. /*bongoro*/ [bɔŋgoro] 'scythe'
 d. /*tʃanga*/ [tʃaŋga] 'pen'
 e. /*bambara*/ [bambara] 'stool'
 f. /*tʃimba*/ [tʃimba] 'tree stump'

From these examples, there is a clear possibility of analysing the sequences as CV.ⁿCV..., with the syllable boundary consisting of an open syllable followed by a prenasalised onset. The idea is supported by the fact that all of the NC sequences take identical place of articulation, just as the prenasalised obstruent phonemes. The analysis of these examples as (16a) *si.nde*, (16b) *le.ndze*, (16c) *bo.ngo.ro*, (16d) *tʃa.nga*, (16e) *ba.mba.ra*, and (16f) *tʃi.mba* would use known Naba phonemes and would not create any new syllable types.

However, there are three reasons to posit that the prenasalised stops occur only at the beginning of the word and not medially:

- The pronunciation of examples (16a–f) in slow speech always results in separation into distinct syllables CVN and CV, never CV and ⁿCV. It is possible that a prenasalised onset adds a mora to a syllable, and that a final ⁿCV syllable would counter the restriction against heavy final syllables.
- CVN.CV corresponds well with the rule that allows liquid and approximant classes, also sonorants, to be in the final position at a syllable boundary, while non-sonorant consonants are typically excluded from this position.
- Not all word-medial NC sequences match the components of prenasalised stops as shown in example (17)⁶:

6 The examples here all involve the nasal /m/, as other nasals will always assimilate to the place of articulation of the following consonant, making it impossible to tell if the underlying nasal is different.

- (17) /*namse*/ ‘taste’
 /*ngulumka*⁷/ ‘hum’
 /*amraje*/ ‘antelope sp.’
 /*tɔmbɔ*/ ‘diarrhea’
 /*samdʒaj*/ ‘make similar’

Approximants are the most sonorant of the consonants, but they are rarely found in underlying CC sequences, with /w/ not occurring at all in this position within the available data. The reason for this may simply be that approximants occur less frequently than other sonorants in general. There are, however, certainly a few examples of /j/ occurring as C₁ in a consonant sequence, as shown in (18):

- (18) *al.raj.ta* ‘type of flute’
su.buj.buj ‘skeleton’
goj.bo ‘bell’
lej.te ‘bird sp.’

An exception to the sonorant-only rule for final consonant at a syllable boundary is the existence of /s/ in this position in certain words. Many, if not all, of these words are Arabic in origin, but as the sibilants in Naba have a tendency to shift between properties of sonorants and obstruents, it is possible that for this particular situation /s/ is classified as a sonorant. /z/ is only found once in C₁ position in the corpus, but it is a rare phoneme both in Naba and in Arabic. In C₁.C₂ sequences, /s/ is always followed by /k/ as the C₂. The suffixation of *-ka* to an Arabic root produces Naba verbs, and most cases of ... Vs.kV# are in these types of verbs; however there are several words in which an Arabic origin is unclear. Some examples are shown in Table (8).

Table 8. Words with syllable-final sibilants

Lexeme	Gloss	Origin
<i>keske</i>	‘quickly’	Naba (may be ideophone)
<i>aske</i>	‘divorce’	unknown
<i>bandaska</i>	‘dwarf’	possibly from Arabic <i>anduuru</i> ‘dwarf’

⁷ /*ngulumka*/ is one of a class of words whose roots are borrowed from Arabic and to which *-ka* is added to form a Naba verb, discussed just below.

the monosyllabic *tjē* (19c) and *tjé* (19d) in isolation and may conclude them to have underlying melodies M and H. But if we attach the plural-marking clitic =*ge*, a toneless morpheme (see 4.3), we see that the melodies are in fact ML and HL. For nouns, comparing the form in isolation with the plural form gives a better idea of the underlying melody, as in (20):

(20) / <i>tjē</i> /	→	[<i>tjē</i>]	‘rib’	(ML)
		[<i>tjégè</i>]	‘ribs’	
/ <i>tjé</i> /	→	[<i>tjé</i>]	‘mother’	(HL)
		[<i>tjégè</i>]	‘mothers’	
/ <i>dū</i> /	→	[<i>dū</i>]	‘sore’	(M)
		[<i>dūgē</i>]	‘sores’	
/ <i>sā</i> /	→	[<i>sā</i>]	‘cow’	(ML)
		[<i>sāgè</i>]	‘cows’	
/ <i>māāme</i> /	→	[<i>māāmē</i>]	‘python’	(HM)
		[<i>māmgē</i>]	‘pythons’	
/ <i>jòró</i> /	→	[<i>jòró</i>]	‘teak’	(LH)
		[<i>jòrgé</i>]	‘teaks’	
/ <i>jòrò</i> /	→	[<i>jòrò</i>]	‘saliva’	(L)
		[<i>jòrgè</i>]	‘salivas’	

4.2 Tone melodies

Naba has nine attested tone melodies, with two (MH and LHL) being rare enough to question their validity. The melodies manifest themselves differently depending on the number of moras in the word to which they apply. Table 9 shows melodies that have been confirmed in the corpus with examples presented both according to number of syllables and number of moras. With some examples of nouns lacking enough moras in isolated form, the clitic =*ge* has been added to show the full underlying melody.

Table 9. Tone melodies

Melody	Monosyllable	Disyllable	Trisyllable
H	1 μ: <i>ú</i> ‘ostrich’ 2 μ: <i>tjíí</i> ‘saw’	2 μ: <i>tádé</i> ‘sauce’ 3 μ: <i>ndírgí</i> ‘accept’	3 μ: <i>fitíí</i> ‘lake’ 4 μ: <i>bámbará</i> ‘stool’

M	1 μ: <i>bī</i> ‘hair’ 2 μ: <i>mbāā</i> ‘breast’	2 μ: <i>bānā</i> ‘yellow’ 3 μ: <i>tʃōōdō</i> ‘whip’	3 μ: <i>tōrōṅō</i> ‘ant’ 4 μ: <i>tʃōrōṅdzō</i> ‘porcupine’
L	1 μ: <i>jò</i> ‘hear’ 2 μ: <i>nòò</i> ‘paternal aunt’	2 μ: <i>dōṅò</i> ‘answer’ 3 μ: <i>mòrṅò</i> ‘bull’	3 μ: <i>gùlùlù</i> ‘centipede’ 4 μ: -
HM	1 μ: - 2 μ: -	2 μ: <i>óṅò</i> ‘find’ 3 μ: <i>dáānā</i> ‘forehead’	3 μ: <i>dzājālā</i> ‘clay jar’ 4 μ: <i>tīhirdi</i> ‘gecko’
HL	1 μ: <i>bégè</i> ‘houses’ 2 μ: <i>sī</i> ‘milk’	2 μ: <i>éfè</i> ‘fishing net’ 3 μ: <i>kéèlè</i> ‘wrap’	3 μ: <i>kólìjò</i> ‘tree sp.’ 4 μ: <i>kárkàbà</i> ‘chicken tick’
ML	1 μ: <i>tʃégè</i> ‘ribs’ 2 μ: -	2 μ: <i>tēlè</i> ‘cultivate’ 3 μ: <i>kāārà</i> ‘chest’	3 μ: <i>mēlèlè</i> ‘goiter’ 4 μ: -
MH (rare)	1 μ: - 2 μ: -	2 μ: <i>ōdó</i> ‘to reap’ 3 μ: <i>ndīrí</i> ‘cricket’	3 μ: <i>gālájá</i> ‘shield’ 4 μ: <i>bāndáská</i> ‘dwarf’
LH	1 μ: - 2 μ: -	2 μ: <i>fèné</i> ‘one’ 3 μ: <i>dàáná</i> ‘accompany’	3 μ: <i>bàrúwá</i> ‘morning’ 4 μ: <i>kùndúlú</i> ‘gizzard’
LHL ⁸	1 μ: - 2 μ: -	2 μ: - 3 μ: -	3 μ: <i>dzàràjè</i> ‘hoe’ 4 μ: <i>ràmbájà</i> ‘basket type’

Among level tone melodies, M is the most common, with HL being by far the most common melody overall, particularly among verbs. Tones will attach to vowels, unless there are more tones in the melody than there are vowels in the word; in such cases a sonorant consonant may become a tone-bearing unit. Since sonorant consonants do not carry tone in underlying forms, attachment of tone to sonorants is caused by processes such as final vowel drop (section 5.2). In example (21) we see five disyllabic words which lose their

⁸ LHL is almost exclusively found in Chadian Arabic loan words, reflecting the stress system of that language.

final vowel before another morpheme. The tone from the deleted vowel moves leftwards and attaches to the sonorant consonant.⁹

- (21) a. /bárà/ ‘year’ (HL)
 → [bár̩ fāsā]
 year good
 ‘a good year’
- b. /tēlè/ ‘cultivate’ (ML)
 → [tēl̩-ɲá]
 cultivate-3SG.OBJ
 ‘he/she cultivates it’
- c. /jéēlē/ ‘bird’ (HM)
 → [jēl̩ s̩]
 bird ten
 ‘ten birds’
- d. /sǐjè/ ‘scatter’ (HL)
 → [sǐj̩-ɲá]
 scatter-3SG.OBJ
 ‘he/she scatters it’
- e. /dàwá/ ‘pen (animals)’ (LH)
 → [dàw̩ fāsā]
 pen good
 ‘a good pen’

4.3 Toneless morphemes

A handful of Naba morphemes do not appear to have any underlying tone melody. These include the nominal clitics =*ge*, =*ne*, and =*n*, and possibly the locative particle *tí*. Many of the pronominal affixes also show behaviour that indicates tonelessness, but as we currently

⁹ As discussed in 4.4.1, it is the following morpheme’s tone melody that “blocks” spread and provokes this leftward movement. If the next morpheme is toneless, the attachment to a sonorant consonant will not occur.

have more data on the tonal behaviour of noun phrases than of verb phrases, we will here focus on the nominal clitics.

If a Naba speaker is prompted to pronounce one of the clitics in isolation (which is difficult to accomplish because the clitics have no meaning in themselves), the perceived tone level is mid. However, this does not necessarily mean that the tone of these morphemes is mid, as we note that M may be a kind of default tone in (section 4.4.1). Further, if these clitics were underlyingly mid, they would display the same kind of behaviour as other mid-toned morphemes. In example (22a) we see the mid-toned word following a low-toned word, and in (22b) the clitic =*ge* following the same word. Then we see another comparison following a LH word in (22c) and (22d):

- (22) a. /jòrò fāsā/ → [jòr fāsā]
 saliva good
 ‘good saliva’
- b. /jòrò =ge/ → [jòrgè]
 saliva = PL
 ‘salivas [spits]’
- c. /dàwá fāsā/ → [dàw fāsā]
 pen good
 ‘good pen’
- d. /dàwá =ge/ → [dàwgé]
 pen = PL
 ‘pens’

The underlyingly M word *fasa* is not changed significantly by either the L tone of *joro* in (22a) or the LH of *dawa* in (22c) (although downstep may slightly alter the pronunciation after L, see 4.4.2). However, the L in (22b) and the H in (22d) are spread completely to =*ge*, which is pronounced with a low tone and a high tone respectively.

However, it could be argued that clitics are different in their tonal behavior from separate words, and that they naturally take the tone of the word they attach to because they do not have a word boundary marking tone spread. To determine if this is the case, we must com-

pare the nominal clitics with examples of other bound morphemes that do have underlying tone. One such morpheme is the third person singular suffix *-ná*, which marks the object when attached to a verb or the possessive when attached to a noun (see 5.2). *-ná* is underlyingly H, whereas the clitics =*ge* (plural marker) and =*ne* (definite marker) we suppose to be toneless. Example (23) shows L, M, and HL nouns followed by the plural and definite clitics and by *-ná*.

- (23) a. /jòrò = *ge*/ [jòrgè]
 saliva = PL
 ‘salivas [spits]’
- /*jòrò* = *ne*/ [jòrnè]
 saliva = DEF
 ‘the saliva’
- /*jòrò-ná*/ [jòrná]
 saliva-3SG.POSS
 ‘his/her saliva’
- b. /tjēlē = *ge*/ [tjēlēgē]
 bed = PL
 ‘beds’
- /*tjēlē* = *ne*/ [tjēlēnē]
 bed = DEF
 ‘the bed’
- /*tjēlē-ná*/ [tjēlēná]
 bed-3SG.POSS
 ‘his/her bed’
- c. /rámè = *ge*/ [rámgè]
 squirrel = PL
 ‘squirrels’

/rámè = ne/ [rámnè]
 squirrel = DEF
 ‘the squirrel’

/rámè-ńá/ [rámnā]
 squirrel-3SG.POSS
 ‘his/her squirrel’

In (23a) and (23b) we see a clear difference in tonal behavior; in both cases = *ge* and the = *ne* take the tone melody of the noun while *ńá* retains its underlying H tone. In (23c) the tone of *-ńá* is M rather than H, which occurs because of the limitation on HH sequences (treated in 4.4.3). These examples support the premise of toneless morphemes, although a broader study of the tonal behavior of clitics, affixes, and particles is needed (the behavior of the connective clitic = *n* is treated in 5.4).

4.4 Tone processes

An in-depth analysis of tone processes in Naba is beyond the scope of this paper, but three phenomena will be briefly addressed: tone spread, downstep, and restriction of HH sequences.

4.4.1 Tone Spreading

In Naba, a word’s tone melody spreads across the word and to a toneless segment that directly follows (such as certain clitics and affixes). The melody will only spread to one further syllable, not across whole strings of toneless segments. It is important for the tonal analysis of Naba to note that the mid tone functions as a “default” tone; that is, if toneless morphemes are not assigned tone as a result of spreading, they will be pronounced with a mid-tone by default. It is thus difficult to determine whether M actually spreads in the same manner as H or L tone, because M on a toneless unit after a melody ending in M can be interpreted either as a result of M spreading or as a result of default tone assignment.

In trimoraic words with underlying melodies of only one tone, that tone will be realized on all three moras (24a–c); with two-tone melodies, the first tone will attach to the first mora, with the final two moras taking the second tone (24d–g). However, with the MH melody, the M usually is assigned to the first two syllables, with H

only on the last syllable, as in (24h) and (24i). The reason for this is yet to be determined, though it should be mentioned that MH is the rarest tonal melody attested in Naba.

- (24) a. /bédédé/ ‘spark’ (H)
 b. /lōhōkō/ ‘chameleon’ (M)
 c. /gùlùlù/ ‘centipede’ (L)
 d. /mélèsè/ ‘to stammer’ (HL)
 e. /bàrúwá/ ‘early morning’ (LH)
 f. /áālā/ ‘let go’ (HM)
 g. /rūùnù/ ‘hip’ (ML)
 h. /māgāná/ ‘sorghum sp.’ (MH)
 i. /mūgūlú/ ‘pestle’ (MH)

Leftward tone movement occurs when a tone melody is blocked from spreading rightwards by the presence of another tone melody, as seen in 24b–f. In those examples, however, the spread is facilitated by a sonorant consonant. An obstruent consonant in the same position blocks leftward movement. Tone may spread rightwards across a stop, but may not be “pushed” leftwards, as we see in (25). The clitic =*ge* appears to be toneless (discussed in section 4.3) and because tone can spread rightwards across an obstruent it takes the L tone of *seede* (25a). But when *seede* is followed by the word *si* which carries its own H tone, the L of *seede* can neither spread rightwards to replace the tone *si* nor be preserved by moving leftwards (25b). This is because an obstruent cannot take tone.

- (25) a. /sēèdè = *ge*/ [sēdgè] (ML-Ø)
 wild.animal = PL
 ‘wild animals’
 b. /sēèdè sí/ [sēd sí] (ML H)
 wild.animal ten
 ‘ten wild animals’

Sibilant fricatives have variation in this environment, giving strength to the argument that they have their own special sonority category. Sibilants may not take tone themselves, but a tone attaching to an underlying vowel may move leftwards across a sibilant when the

vowel is dropped, creating a contour tone on the preceding vowel, as seen in (26):

- (26) a. /*másà*/ [màsà] (HL)
 ‘tamarind’
- /*másà = ge*/ [mázgè] (HL = Ø)
 tamarind = PL
 ‘tamarinds’
- /*másà sí*/ [màs sí] (HL H)
 tamarind ten
 ‘ten tamarinds’
- /*másà bò*/ [mâz bò] (HL L)
 tamarind big
 ‘a big tamarind’
- b. /*òsò*/ [òsò] (ML)
 ‘pierce’
- /*jà òsò-rege*/ [jà òsrégè] (ML-Ø)
 3SG.SBJ pierce-3PL.OBJ
 ‘it pierces them’

4.4.2 Downstep

A L tone at the end of one morpheme may downstep a H or M tone at the beginning of the following morpheme. This automatic downstep does not create a complete lowering; H is not downstepped to M nor is M downstepped to L, but a slight lowering can be perceived. For the current research I rely on listener perception, but an acoustic analysis would enable a better understanding of downstep in Naba’s tone system.

- (27) a. /*sūlō-já*/ [sūlōjá] (M-H)
 gather-3SG.OBJ
 ‘he/she gathers him/her/it’

5 Lexical Phonological Processes

Lexical phonological processes are those that occur at the word level, whereas post-lexical processes occur beyond word boundaries. We will summarize in this section those lexical processes that are most significant in the analysis of Naba phonology.

5.1 Final vowel drop

Nearly all words in Naba end in a final vowel when pronounced in isolation or in the final position of a phrase (“prepausal” position). However, in non-final position, the majority of Naba words (about 70 percent), drop the final vowel, and this process provokes a change to the word’s syllabic structure.

Before treating the process of final vowel drop, we must establish that the underlying form of words undergoing this process are indeed vowel-final. Another possible analysis is that some words are underlyingly C-final, and that they take a final vowel in pre-pausal position. This is a valid argument, but the following evidence supports the case for the V-final analysis:

1. Variation in final vowels. If C-final words have a final vowel added in prepausal position, one would expect some regularity as to the quality of this vowel. We would expect either a single vowel sound to apply in all such cases, or a vowel that in some way regularly ‘matched’ the quality of vowels in the word root. As discussed in section (2.2.1), the tendency in Naba is for complete vowel harmony, but there are many exceptions. None of the words in (29) have final vowels pronounced before another morpheme. (29a–b) are identical except for the final vowel, and (29c–d) show analogous environments.

- (29) a. *ode* ‘vomit’
 [ot kolo]
 vomit much
 ‘he/she vomits a lot’

- b. *odo* ‘reap’
 [ot kolo]
 reap much
 ‘he/she reaps a lot’
- c. *ngaala* ‘stomach’
 [ɲgal bo]
 stomach big
 ‘a big stomach’
- d. *ngaare* ‘sultan’
 [ɲgar bo]
 sultan big
 ‘a big sultan’

If these words have underlying C-final structure, there is no explanation as to why the final vowel should differ between (29a) and (29b) or between (29c) and (29d). If the final vowel is inserted by a phonological process, the environment should dictate a specific vowel quality.

2. Behavior of Arabic loan words. Chadian Arabic has both V-final and C-final words, but when they enter Naba, a final vowel is always added. This would be expected for pre-pausal forms in either analysis. What is more relevant is that when positioned before another morpheme, Arabic loans separate into the same two categories as Naba, those that have a final vowel and those that do not. Yet there is no predictability linking this behavior in Naba to the syllabic structure of the Arabic source. The comparison is shown in Table 10:

Table 10. Chadian loans

	Naba lexeme	Chadian Arabic lexeme	Naba lexeme in context
a.	/faharka/ ‘think’	fakkar (C-final)	[faharka koolo] think much ‘he/she thinks a lot’

b.	/abatʃe/ 'ant sp.'	<i>abu'aache</i> (V-final)	[<i>abaje si</i> ant (sp.) ten 'ten ants'
c.	/katʃatʃa/ 'rake'	<i>tchakarkara</i> (V-final)	[<i>kafac fasa</i> rake good 'a good rake'
d.	/tʃoloho/ 'sparrow'	<i>abuntchulukh</i> (C-final)	[<i>tʃolɔg an bob-ma</i> sparrow POSS father-1SG.POSS 'my father's sparrow'

The Chadian Arabic source words in (a) and (d) are both consonant-final words that had vowels inserted finally as they were absorbed into the Naba language. However, (a) keeps that final vowel before another morpheme while (d) does not. (b) and (c) show loans derived from vowel-final Arabic words, but they show the same variance. While this is not definitive evidence, we can at least say that the apparent randomness of loan word behavior concerning the final vowel does not support an underlying distinction between V-final and C-final words.

3. Related languages. The analysis of final vowel drop as described here has been attested in varying degrees for two closely related languages, Kenga (Nekukom 1993: 40) and Bagirmi (Djibrine & Keegan 2016: xi), as well as in some other languages of the Sara-Bagirmi group, like Bongo (Kilpatrick 1985), and Baka (Parker 1985). In his work on the historical reconstruction of Sara-Bagirmi, Boyeldieu suggests a historic *CVCV pattern that has eroded to CVC in some languages (Yulu, Fer, Gula, and the Central Sara languages) and which has retained the final underlying vowel in others (Modo, Baka, Na, Kulfa, Bagiro, and possibly Ndoka) (Boyeldieu 2000: 55).

It is not clear why final vowel drop occurs in the majority of words but not in all. There is no clear correspondence between underlying syllabic structure or phoneme quality and the division of words into these two categories, although it is possible that tone melodies play a role. In the study of noun and verb tone melodies, there is a strong correspondence between the M tone melody and the retention of the final vowel; there are only a handful of cases of M tone verbs or nouns with final vowel drop. However, there are many words that retain

the final vowel that are not M tone. A good number of HL words keep the final vowel, and about half of all LH words keep the final vowel. H, L, and ML words nearly always drop the final vowel, and there are no cases of LM, MH or HM retaining the final vowel. Thus, while there is no hard rule linking tone melody to final vowel retention or deletion, there are certainly tendencies, particularly with M tone.

There is also a tendency for words with (C)VC.CV structure to retain the final vowel in context, although, again, this is just a tendency and not a rule. However, since there is also a strong correlation between this syllabic pattern and M tone, it could be that the tone melody alone is really in question.

The final vowel is always retained in monosyllabic words, although non-final position shortens a double vowel in such words, as in (30). This is further discussed in the following section (5.2):

- (30) a. /lii = ge/ → [lige]
 snake = PL
 ‘snakes’
- b. /ndii/ ‘sow’
 → [ja ndi ŋgal kala = ñ ti]
 3SG.SBJ sow in bush = CIRC LOC
 ‘he/she sows in the bush’

When the final vowel of a polysyllabic word drops, a new structure emerges because the last consonant of the word, underlyingly the onset of the final open syllable, now closes the previous syllable. This causes the morpheme to end in a closed syllable, which is not acceptable in underlying forms. As shown in (31), restructuring occurs both with the attachment of a clitic or suffix, or simply in context before another word.

- (31) a. V.CV → VC
 /umu/ ‘nose’
 → [um = ge]
 nose = PL
 ‘noses’

b. CV.CV → CVC

/golo/ 'trick'

→ [gol-ɲa]

trick-3SG.OBJ

'he/she tricks him/her'

c. CV.CV → CVC

/domo/ 'palm leaf'

→ [kaj dɔm an bɔb-ma]

see palm_leaf POSS father-1SG.POSS

'he/she sees my father's palm leaf'

d. V.CV → VC

/eje/ 'die'

→ [ja ɛc taaga]

3SG.SBJ die yesterday

'he/she died yesterday'

e. VC.CV → VCC

/arge/ 'search'

→ [ja arg askari = ne]

3SG.SBJ search soldier = DEF

'he/she searches for the soldier'

In (31a–d) above, we see words with the structure (C)V.CV, sequences of two open vowels; these syllabic structures lead to simple VC or CVC syllables after final vowel drop, syllables that are normally permitted in Naba. With the structure VC.CV in (31e), the closed syllable followed by an open syllable leads to a VCC syllable which is not part of the underlying syllable inventory of Naba.

When final vowel drop occurs in a word that contains a double vowel in the penultimate syllable, that vowel is shortened. Syllable weight is restricted in Naba to two moras, and final vowel drop creates a new consonant-final syllable. If the double vowel is retained in the new structure, it would create a three-mora ultra-heavy syllable, (C)VVC, so the vowel must be shortened, as in (32).

- (32) a. CVV.CV → CVC
 /baaga/ ‘turn over’
 → [ja **bag** koolo = ne]
 3SG.SBJ turn_over pot = DEF
 ‘he/she turns the pot over’
- b. CVV.CV → CVC
 /ruuzu/ ‘flour’
 → [**ruz** an tfe-ma]
 flour POSS mother-1SG.POSS
 ‘my mother’s flour’
- c. VV.CV → VC
 /aaja/ ‘drink’
 → [ja **aj** berije]
 3SG.SBJ drink porridge
 ‘he/she drinks the porridge’

The process of vowel shortening only occurs in the specific environment of final-vowel drop after a syllable containing a double vowel. Words that do not undergo final vowel drop retain their double vowels in any environment, as in (33):

- (33) a. VV.CV
 /aafa/ ‘leave’
 → [aafa-k]
 leave-2.PL.SBJ
 ‘you (pl.) leave’
- [aafa saba]
 leave tomorrow
 ‘he/she leaves tomorrow’
- b. CVV.CV
 /boono/ ‘robe’

→ [boono = ge]

robe = PL

‘robes’

→ [boono fasa]

robe good

‘a good robe’

5.2 Pronunciation of *-ɲa* ‘3SG.OBJ/POSS’

Naba has a series of pronominal suffixes that indicate the object of a verb, and a series of suffixes indicating the possessor of a noun. These suffixes are identical for the first, second, and third person singular while the possessive markers for plural person differ slightly from their object-marking counterparts. The difference is due to the incorporation of the clitic =ge into the plural object markers. All the suffixes are shown in Table (11) below.

Table 11. Possessive and object suffixes

	Possessive (on Noun)	Object (on Verb)
1 SG	-ma	-ma
2 SG	-i	-i
3 SG	-ɲa	-ɲa
1 PL ¹⁰	-ze	-zege
2 PL	-se	-sege
3 PL	-re	-rege

Possessive marking on nouns often co-occurs with use of the definite clitic =ne; with the 1st person or 3rd person singular possessive markers, the nasal element is elided and only the vowel quality changes, as we see in (34):

(34) a. /kore-ma/ → [kɔrma]

worm-1SG.POSS

‘my worm’

¹⁰ Naba does have an inclusive/exclusive distinction in the 1st person plural, but it is not widely in use anymore and is only evident in subject marking; for possessive and object marking -ze/-zege is used for both.

/kore-ma = ne/ → [kɔrme]
 worm-1SG.POSS = DEF
 ‘the worm of mine’

b. */bi-ɲa/* → [biɲa]
 hair-3SG.POSS
 ‘his/her hair’

/bi-ɲa = ne/ → [biɲe]
 hair-3SG.POSS = DEF
 ‘the hair of his/hers’

The /ɲ/ of the *-ɲa* ‘3SG.OBJ/POSS’ suffix, whether marking possession or verbal object, undergoes an entire system of surface pronunciation allophony based on the sonority level of the preceding phoneme. This is considered a lexical process, as it is quite specific to this one affix and does not occur in general with either palatal or nasal consonants.

The suffix *-ɲa* behaves differently depending on the previous sound. When affixed to a final vowel (as is the case with words that do not undergo final vowel drop), *-ɲa* does not itself undergo any change, but fronts the preceding vowel if it is a back vowel. So /o/ is pronounced as [e] (35a), while /u/ is pronounced as [i] (35b). /a/ is not affected by the affixation of *-ɲa* (35c).

(35) a. */ja tɬoso-ɲa/* → [ja tɬoseɲa]
 3SG.SBJ shell-3SG.OBJ
 ‘he/she shells it’

b. */ja ulu-ɲa/* → [ja uliɲa]
 3SG.SBJ swallow-3SG.OBJ
 ‘he/she swallows it’

c. */ndaafa-ɲa/* → [ndaafɲa]
 fan-3SG.POSS
 ‘his/her fan’

After a sonorant consonant (nasal, liquid, or approximant), *-na* does not change its pronunciation as in (36), but may provoke assimilation of the first nasal to the palatal nasal (36d, e).

- (36) a. /*ŋgeere-na*/ → [*ŋɛɾɲa*]
 ‘he/she knows it’
- b. /*baala-na*/ → [*baɭna*]
 ‘his/her ram’
- c. /*omo-na*/ → [*ɔmɲa*]
 ‘he/she pours it’
- d. /*aana-na*/ → [*aɲna*], [*aɲɲa*]
 ‘he spreads it (fire)’
- e. /*raaŋa-na*/ → [*raɲɲa*], [*raɲna*]
 ‘his/her tree (sp.)’
- f. /*toŋo-na*/ → [*tɔɲna*]
 ‘his/her millet’
- g. /*sowa-na*/ → [*sɔwɲa*]
 ‘he/she digs it up’
- h. /*aaɟe-na*/ → [*aɟna*], [*aɟɲa*]
 ‘he/she drinks it’

In (36h), we see variation in the pronunciation of *-na* after the approximant /*j*/. The distinction between the two palatals is difficult to maintain, and unless the speaker is enunciating slowly, the tendency is for /*ɲ*/ to assimilate to /*j*/. We will see a similar process with the sibilants.

Non-sibilant obstruents include the regular, prenasalised, and implosive stops, the fricatives /*f*/ and /*h*/, and the affricates. When following an obstruent, the consonant of *-na* loses its sonority by assimilating to a voiceless or voiced palatal obstruent [*tʃ*] or [*dʒ*]. The following pronunciations (37d–f) also show the post-lexical pro-

cess of fortition of the consonant before *-na*, a process which will be discussed below in section (6.3).

- (37) a. */baga-na/* → [*bagdʒa*]
 ‘he/she closes it’
- b. */nduutu-na/* → [*ndʊtʰtʃa*]
 ‘he/she dries it’
- c. */daba-na/* → [*dabdʒa*]
 ‘he/she sells it’
- d. */ode-na/* → [*ɔddʒa*]
 ‘he/she vomits it’
- e. */reetʃe-na/* → [*rɛcʰtʃa*]
 ‘he/she breaks it’
- f. */uufu-na/* → [*ʊpʰtʃa*]
 ‘he/she blows it’

With sibilant consonants, the *-na* suffix also loses its sonority, but instead of assimilating to a full obstruent, it becomes a palatal sibilant. This is another indicator that sibilants in Naba have their own level of sonority somewhere in between that of obstruent and sonorant. The similarity of the palatal sibilant to the alveolar sibilant preceding it provokes a total assimilation like that seen with *-na* preceded by /j/ (36h). This total assimilation is shown for /s/ in (38a) and for /z/ in (38b).

- (38) a. */deese-na/* → [*dɛʃʃa*]
 ‘he/she fills it’
- b. */ozo-na/* → [*ɔʒʒa*]
 ‘he/she milks it’

5.3 Pronunciation of the connective marker =*n* and circumstantial =*ṅ*

The connective marker (CN) is a single nasal segment =*n* that attaches to the end of a noun phrase in order to link the NP to a certain stative and descriptive elements, such as adjectival and positional verbs, adverbials, and quantifier predicates. The connective marker appears in many contexts, and the analysis of its syntactic role is beyond the scope of this paper. The term ‘connective’ is taken from the Neukom’s analysis of Kenga, in which a syllabic nasal clitic plays a similar role (Neukom 1993: 55). Like Kenga, Naba also has a “pronominal circumstantial” marker =*ṅ* (CIRC) that attaches to the end of a word to indicate a following locative phrase (Neukom 1993: 113). The circumstantial can attach to a verb with a non-obligatory locative complement, or to a noun phrase that is the subject of a non-verbal predicate. The circumstantial may also appear *within* a locative phrase to attach a nominal element to the locative particle *tɪ*¹¹. The circumstantial has an underlying low tone, as opposed to the connective =*n*, which is underlyingly toneless. However, outside of tone both connective and circumstantial display the same phonological behavior.

=*n* and =*ṅ* are pronounced syllabically in certain contexts. When attached to a morpheme that retains its final vowel, they are pronounced as the end of the final syllable (39a–b), but when attached after final vowel drop, these markers are pronounced as a syllabic nasal. The nasal assimilates to the place of articulation of the preceding consonant if the consonant is obstruent (39d–e). If the preceding consonant is a non-nasal sonorant, the clitic may assimilate to a following obstruent consonant (39c).

¹¹ It appears that the circumstantial marker in all three of these contexts is non-obligatory, with the same speaker either using it or not using it in identical environments. The post-verbal context is the least observed, which is reflected in the examples

- (39) a. [elɛn tə də ti]
 /ele = ñ tɛ də ti/¹²
 tail = CIRC DAT DIST LOC
 ‘a tail is there’
- b. [bis fasan tə nan ti]
 /biisi fasa = ñ tɛ nani ti/
 dog good = CIRC DAT PROX LOC
 ‘a good dog is here’
- c. [balɿ koolo]
 /baala = n koolo/
 ram = CN many
 ‘[there are] many rams’
- d. [kabm fasa]
 /kaabe = n fasa/
 egg = CN be.good
 ‘the egg is good’
- e. [ngabm kaawa]
 /ngaaba = ñ kaawa/
 man = CIRC long
 ‘a man is far’

If the final consonant of the NP (after final vowel drop) is also a nasal, the nasal clitic assimilates to it completely and is not pronounced syllabically, as in (40a). However, when the final consonant is the labial nasal *m*, an epenthetic vowel ə is inserted finally as in (40b). This insertion after the nasal clitic only occurs with *m*.

¹² In locative non-verbal predicates, the dative marker *tɛ* nearly always appears before a demonstrative pronoun. The dative marker is obligatory before demonstratives *də* and *nani*, but optional before other locative elements such as prepositions.

- (40) a. [*madan tə də ti*]
 /*madana* = *ɲ* *tè* *də* *ti*/
island = CIRC DAT DIST LOC
 ‘an island is there’
- b. [*jimə tən gooro*]
 /*jümi* = *ɲ* *tè* *ngooro*/
 cricket = CIRC DAT near
 ‘a cricket is near’

The connective marker takes last position in the NP, including in noun phrases with multiple clitics (41a–b), while the circumstantial can attach either to the end of the NP subject of a locative predicate (41c) or as the final element of a verb connected to a locative complement (41d).

- (41) a. [*bi rab nɛŋ koolo*]
 /*bi* *raafa* = *ne* = *n* *koolo*/
 hair white = DEF = CN many
 ‘(there are) many of the white hairs’
- b. [*marəb bobogenɛn mafa*]
 /*marba* *bobo* = *ge* = *ne* = *n* *matfa*/
 Patas.monkey big = PL = DEF = CN six
 ‘[there are] six of the big Patas monkeys’
- c. [*ŋgar dzammen tə jaw ti*]
 /*ngaare* *dzaama* = *ne* = *n* *tè* *jawo* *ti*/
 sultan old = DEF = CIRC DAT Yao LOC
 ‘the old sultan is at Yao’
- d. [*ŋgabge utvɛn taara*]
 /*ŋgaaba* = *ge* *utu* = *ɲ* *taara*/
 man = PL exist = CIRC above
 ‘the men are above’

As with the other NP clitics, = *ge* and = *ne*, the connective marker = *n* appears to be underlyingly toneless (section 4.3) and is pronounced according to the spread of the melody of the preceding morpheme as in (42).

- (42) a. [gùrń kóòlò]
 /gùrú = n kóòlò/
 basket = CN many
 ‘(there are) many baskets’
- b. [sīndē tē mbúúrū = ge = n sīlí]
 /sīndē tē mbúúrū = ge = n sīlí/
 horse DAT donkey = PL = CN seven
 ‘(there are) seven horses and donkeys’

5.4 /k/ in medial position

In certain dialects, particularly in the subdialect of Yao Bilala, the phoneme /k/ is pronounced as a fricative [x] in pre-vocalic, non-initial position. The [x] varies in quality and is often perceived as [h], leading to questions about the phonemic status of /h/, which mainly occurs in the same medial position. (43) shows some clear examples of the /k/ becoming [x], which are easier to identify because they have correspondences in the Medogo dialect, which sometimes retains the underlying /k/ in surface pronunciation:

- (43) /*daa.ka*/ ‘sow’ → [*daa.xa*] in Bilala, [*daa.ka*] in Medogo
 /*tu.ku*/ ‘hit’ → [*tu.xu*] in Bilala, [*tu.ku*] in Medogo

However, there are many words in the Bilala dialect that retain the pronunciation [k] intervocally. Since all of these are of at least three syllables, in most cases with the [k] being the consonant onset of the final syllable, it could be that another phonological process prevents /k/ from changing in this particular position, as shown in (44):

- (44) a. /*ma.da.ka*/ [ma.da.ka] ‘border of mat’
 b. /*lo.ho.ko*/ or /*lo.ko.ko*/? [lo.ho.ko] ‘chameleon’
 c. /*fa.ka.ha*/ or /*fa.ka.ka*/? [fa.ka.ha] ‘fishing stick’

With (44b) and (44c) it is difficult to determine if there are two underlying /k/ phonemes or if these show actual /h/ and /k/ phonemes in the same word. As no words in the Bilala dialect contain either two surface [k]s or two surface [h]s simultaneously, a possible interpretation is that /k/ becomes [h] intervocalically but may only do so once in a single morpheme.

It is fairly clear that /k/ always becomes a fricative in the position of final syllable onset following a penultimate closed syllable in the Yao sub-dialect. The fricative in such cases is [x], with less variation in pronunciation. In corresponding words from the Kuka and Medogo dialects, the /k/ is often retained in the surface pronunciation, as seen in example (45):

- (45) /bur.ku/ ‘ashes’ [bur.xu] in Bilala, [bur.ku] in Medogo
 /kor.ko/ ‘to scratch’ [kɔr.xo] in Bilala, [kɔr.ko] in Kuka

It is interesting to note that the fricativization of /k/ is the only phonological process that causes a phoneme to become more sonorous rather than less sonorous. In a sonorant environment (between two vowels or between a sonorant consonant and a vowel), a fully occlusive obstruent becomes a fricative obstruent. Why this only happens with the stop /k/ is not evident, but it is comparable to similar processes in related languages, as in Kenga, where /h/ does not exist and [x] only exists as an allophone of /k/ in this position (Weiss 2000: 3; 6).

5.5 The phonemic status of /h/

Previous work on the Bilala dialect by Schultz (2001: 5) suggests that /h/ does not exist as a phoneme outside of Chadian Arabic loan words. He states that we hear it only as an allophone of /k/, as discussed above. It is a possible interpretation, and one that adds to the symmetry of Naba’s phonemic inventory, which otherwise has voiced/voiceless correspondents for obstruents at each other place of articulation. However, this interpretation necessitates that we focus solely on the Bilala dialect of Naba and that we conclude that [x] and [h] are both allophones of /k/ in the same positions. But in looking at all three main dialects of Naba, I find it harder to eliminate a phonemic /h/. One reason is the number of words (albeit small) in all three dialects with a clearly pronounced initial /h/ that have no evident link to Arabic; some of these are shown in example (46):

- (46) Medogo: *haku* ‘falcon’ *halgom* ‘goiter’
 Bilala: *hormo* ‘foam’ *hojo* ‘body’
 Kuka: *hala* ‘abort, refuse’ *hatedzi* ‘stallion’

In fact, Kuka has many words beginning in /h/ that have vowel-initial correspondents in Bilala (Laya 2003). The examples in Table (12) suggest a development in which the /h/ (or perhaps initially a /k/) in Kuka was eventually dropped at the beginning of certain words:

Table 12. /h/ in initial position in Kuka

Bilala	Kuka	Gloss
<i>ele</i>	<i>hele</i>	‘tail’
<i>ere</i>	<i>here</i>	‘urine’
<i>arle</i>	<i>herle</i>	‘twist’

We can dismiss the idea that Kuka adds an [h] to the beginning of vowel-initial words, because Kuka also has correspondent words beginning with vowels, as shown in Table (13):

Table 13. Comparison of word-initial vowels in Bilala and Kuka

Bilala	Kuka	Gloss
<i>ooŋo</i>	<i>ɔŋ</i>	‘wound’
<i>aza</i>	<i>azi</i>	‘brother-in-law’

As for /h/ in non-initial position, there are perceivable differences between [h] and [x] that suggest the possibility of both /k/ and /h/ occurring intervocally; this is however, difficult to prove since one could argue that [h] and [x] represent a range of variant pronunciations of /k/. (47) shows a few examples where a consistent difference is heard:

- (47) a. [*roho*] ‘attach’ [*roxo*] ‘fall’
 b. [*tehe*] ‘be full’ [*exe*] ‘climb’

A possible interpretation of the status of *h* is that it originally was not a phoneme but that over the period of Naba’s interaction with Arabic, it became phonemic, to varying degrees in the different dialects. Cross-linguistic studies in the Sara-Bagirmi family show that /h/ is often infrequent or restricted to certain positions. /h/ does not exist as a phoneme in Kenga (Neukom 1993: 19), which is closely related to Naba. According to Keegan’s cross-linguistic research, /h/ is very rare in Central Sara and Western Sara languages (Keegan 2014a: 16)

but somewhat common in Eastern Sara languages (Keegan 2014b: 17).

6 Post-lexical phonological processes

Post-lexical processes are those that occur after morpheme-specific processes have applied. They are not restricted to certain types of morphemes and occur within words, across morpheme boundaries in the same word, and across word boundaries. Unlike most lexical processes in Naba, which need to be ordered in their application, post-lexical processes in Naba are not generally ordered amongst themselves, with the possible exception described in 6.1. They must be applied after all relevant lexical processes have first applied.

6.1 Unreleased Voiceless Stops

Voiceless stops are pronounced without release when they occur before another consonant. Since surface voiceless stops may be created by the voicing assimilation (48a, b) and/or fortition processes (48c), it does appear that the unreleasing process is ordered to apply after assimilation and fortition.

- (48) a. /*tada*/ ‘chase’
 /*ja* *tada* *kere*/ → [ja *tat*^ʔ *kere*]
 3SG.SBJ chase elephant
 ‘he/she chases an elephant’
- b. /*boodo*/ ‘warthog’
 /*kaje* *boodo* *kaawo*/ → [kaj *bɔt*^ʔ *kaawo*]
 see warthog long
 ‘he/she sees a long warthog’
- c. /*reetfe*/ ‘break’
 /*ja* *reetfe* *kudz*_u = *ne*/ → [ja *rɛc*^ʔ *kudz*_u *ne*]
 3SG.SBJ break knee = DEF
 ‘he/she breaks the knee’

Voiced stops are always pronounced as released in Naba. Sometimes a slight epenthetic vowel may even be heard after a voiced stop followed by a consonant in order for the release to be distinct.

6.2 Voicing Assimilation

In Naba, all obstruent consonants undergo the process of assimilation in voicing to a following consonant. This process occurs most frequently with morphemes that first undergo final vowel drop, leaving a final consonant before another morpheme that may begin with a consonant. Assimilation to the voiced /g/ occurs with nouns that drop their final vowel before being pluralized by the clitic =ge, as in (49):

- (49) /gete/ ‘winnowing basket’ + =ge → [gɛdʒe] ‘winnowing baskets’
 /lohoko/ ‘chameleon’ + =ge → [lohogge] ‘chameleons’
 /naafe/ ‘moon’ + =ge → [nabge] ‘moons’
 /tʃaʃa/ ‘turban’ + =ge → [tʃaʃge] ‘turbans’

Devoicing occurs with the suffix marking a second person plural subject on verbs, -ki, as in (50):

- (50) a. /uudu/ ‘grind’
 /uudu-ki toɲo/ → [utʰki toɲo]
 grind-2PL.SBJ millet
 ‘you(pl.) grind millet’
- b. /deebe/ ‘store’
 /deebe-ki mɔndʒo/ → [dɛpʰki mɔndʒo]
 store-2PL.SBJ beans
 ‘you(pl.) store beans’

Assimilation occurs across word boundaries as well, with both voicing (51a–b) and devoicing (51c–d):

- (51) a. /tatʃa/ ‘track’
 /ja tatʃa boodo/ → [ja taʃ boodo]
 3SG.SBJ track warthog
 ‘he/she tracks a warthog’

- b. /gerfe/ ‘cloud’
 /kaye gerfe bo/ → [kaj ger**əb** bo]
 see cloud big
 ‘he/she sees a large cloud’
- c. /bobo/ ‘father’
 /bobo tforlo/ → [bɔpʰ tforlo]
 father giraffe
 ‘giraffe’s father’
- d. /aaga/ ‘crawl’
 /ja aaga koolo/ → [ja akʰ koolo]
 3SG.SBJ crawl much
 ‘he/she crawls a lot’

The implosive consonants /b/ and /d/ do not have voiceless correspondents in Naba, but as fortition changes them to non-implosive stops before a consonant as seen below in example (55) in section (6.3), they simply follow the voicing assimilation patterns of /d/ and /b/.

Sibilants do not consistently undergo voicing assimilation, this is another instance of these consonants resting somewhere in between obstruents and sonorants. Voicing assimilation of sibilants is a matter of free variation, as shown in (52), although it does seem to occur more regularly with verbs than with nouns.

- (52) a. /masa/ ‘tamarind’
 /masa = ge/ → [masge] or [mazge]
 tamarind = PL
 ‘tamarinds’
- b. /biisi/ ‘dog’
 /biisi = ge/ → [bisge] or [brzge]
 dog = PL
 ‘dogs’

c. /usu/ ‘wear’

[mus bɔn fasane] or [muz bɔn fasane]

/m-usu boono fasa = ne/

1SG.SBJ-wear garment good = DEF

‘I wear the nice garment’

d. /deese/ ‘fill up’

[ja dɛs dude] or [ja dɛz dude]

/ja deese dude/

3SG.SBJ fill.up water.jar

‘he/she fills up the water jar’

6.3 Fortition

The non-occlusive members of the obstruent class – implosives /d/ and /b/, the affricates /tʃ/ and /dʒ/ and the fricatives /f/ and /h/ – undergo a fortition process before another consonant. The sibilant fricatives do not fortify at all except for in the specific lexical process of the suffixation of *-na*, discussed above. This suggests that fortition is a post-lexical process acting on the obstruent class, which does not include sibilants in this case.

All non-occlusive obstruents in Naba become stops when they immediately precede another consonant, whether the following segment is an affix, clitic, or separate word. As we will explore below, the implosives, which are technically occlusive, also change sonority quality by becoming egressive stops. The following consonant can be of any quality, sonorant or obstruent.

The affricates affected by fortition become palatal stops, which are not part of the Naba phonemic inventory. /dʒ/ becomes [j] and /tʃ/ becomes [c]. (For more on the palatal obstruents see 2.1.1) Voicing assimilation applies to the fortified consonant simultaneously. The palatal quality spreads if the following consonant is a nasal (53a, c):

(53) a. /miidʒe/ ‘addax’

/miidʒe = ne/ → [mɪjɲe]

addax = DEF

‘the addax’

- b. /reetsfe/ ‘break’
 /reetsfe-sege/ → [rɛcʰsege]
 break-2PL.OBJ
 ‘he/she breaks you(pl)’

- c. /gumatfe/ ‘heart’
 /gumatfe = ne/ → [gumafne]
 heart = DEF
 ‘the heart’

The phonemes /f/ and /h/ are fortified to [b]/[p] (54a–b) and [g]/[k] (54c–d) according to the voicing of the following consonant. There is some uncertainty as to the status of /h/, as it frequently occurs as an allophone of /k/ intervocalically (see section 5.6). The following examples of fortition involving /h/ (54c–d) are those that I have transcribed with an underlying /h/, but it is possible that the isolation forms contain the allophone of /k/ whereas the “fortified” forms actually show the underlying consonant.

- (54) a. /naafe/ ‘moon’
 /naafe = ge/ → [nabge]
 moon = PL
 ‘moons’
- /naafe fasa = ge/ → [napʰfasage]
 moon good = PL
 ‘good moons’
- b. /uufu/ ‘blow’
 /ja uufu koolo/ → [ja ʊpʰ koolo]
 3SG.SBJ blow much
 ‘he/she blows a lot’
- /ja uufu-ma/ → [ja ʊbma]
 3.SG.SBJ blow-1SG.OBJ
 ‘he/she blows on me’

- c. /*booho*/ ‘depot’
 /*booho* = *ge*/ → [bɔgge]
 depot = PL
 ‘depots’
- d. /*naha*/ ‘touch’
 /*naha kinzir*/ → [nakʰ kinzir]
 touch pig
 ‘he/she touches a pig’

Implosive stops become non-implosive before another consonant, as shown in (55), suggesting that in Naba implosives may have a higher level of sonority than egressive stops. As /b/ occurs rarely in non-initial position, there are only examples for the fortition of /d/:

- (55) a. /*kade*/ ‘gourd’
 /*uunu kade fene*/ → [ʊn katʰ fene]
 take gourd one
 ‘take one gourd’
- /*kade* = *ge*/ → [kadge]
 gourd = PL
 ‘gourds’
- b. /*ode*/ ‘vomit’
 /*m-ode koolo*/ → [mɔtʰ koolo]
 1SG.SBJ-vomit much
 ‘I vomit a lot’
- /*ode-rege*/ → [ɔdrege]
 vomit-3PL.OBJ
 ‘he/she vomits them’

6.4 Nasal Assimilation

The alveolar nasal /n/ assimilates to the point of articulation of either a preceding or following obstruent consonant, no matter what

the manner of articulation of this consonant. Nasal assimilation of /n/ occurs morpheme-internally and across morpheme boundaries, as shown in (56), although there is some variation in the level of assimilation across word boundaries (56f). In careful speech, nasal assimilation at the word boundary may not occur at all, particularly if the assimilation is to the labial place.

- (56) a. /andʒe/ ‘light’ → [aⁿdʒe]
- b. /tʃanga/ ‘pen’ → [tʃaŋa]
- c. /ngaaba/ ‘man’
 /ŋgaaba = n̄ te de ti/ → [ŋgabm tə de ti]
 man = CIRC DAT DIST LOC
 ‘that man is there’
- d. /kudʒu/ ‘knee’
 /reetʃe kudʒu-ŋa/ → [rʊc kuʃne]
 break knee-3SG.POSS
 ‘he/she broke their knee’
- e. /doogo/ ‘buffalo’
 /doogo = n̄ te nani ti/ → [dogŋ tə nan ti]
 buffalo = CIRC DAT PROX LOC
 ‘this buffalo is here’
- f. /muuno/ ‘child’
 /muuno bo/ → [mum bo] or [mun bo]
 child large
 ‘a large child’
- g. /tʃono/ ‘be old’
 /sige tʃono-ki/ → [sig tʃɔŋki]
 2PL.SBJ be.old-2PL.SBJ
 ‘you (pl.) are old’

- b. /*waaje* = *n koolo*/ → [*wajɲ koolo*]
 spear = CN many
 ‘there are many spears’

6.5 Vowel Epenthesis

Sequences of three consonants are prohibited in Naba, so in such cases a vowel is inserted to break up the cluster. Because of the nature of syllabic structure, such clusters only occur at morpheme boundaries following the lexical process of final vowel deletion. The schwa [ə] is normally inserted between the first and second consonants to modify syllable structure, although the epenthetic vowel may assimilate to the vowel of the first morpheme in rapid speech, particularly in the case of high vowels (59b, 60b).

- (59) a. /*mar.ba*/ ‘Patas monkey’ CVC₁.C₂V
 /*marba* = *ge*/ CVC₁C₂V = C₃V
 Patas.monkey = PL
 ‘Patas monkeys’
 → [*ma.rəb.ge*] CVC₁C₂.C₃V
- b. /*girli*/ ‘mahogany’ CVC₁.C₂V
 /*girli bo*/ CVC₁C₂V C₃V
 mahogany big
 ‘a big mahogany’
 → [*gi.rɪl bo*] CVC₁C₂ C₃V

While the norm is for the epenthetic vowel to be inserted between the first and second consonants of a sequence, it may be inserted between C₂ and C₃, particularly if C₃ is a sonorant consonant:

- (60) a. /*mar.ba*/ ‘Patas monkey’ CVC₁.C₂V
 /*marba* = *ne*/ CVC₁C₂V = C₃V
 Patas.monkey = DEF
 ‘the Patas monkey’
 → [*mar.bə.ne*] CVC₁C₂.C₃V

b. / <i>girli</i> / ‘mahogany’	CVC ₁ .C ₂ V
/ <i>girli-ma</i> /	CVC ₁ C ₂ V -C ₃ V
mahogany-1SG.POSS	
‘my mahogany’	
→ [<i>gir.lə.ma</i>]	CVC ₁ C ₂ C ₃ V

6.6 Resyllabification of prenasalised Stops

In non-initial position in a phrase, the nasal element of a prenasalised stop may move to the end of the previous word or be deleted entirely. The sonority level of the previous sound determines how the prenasalised stop is structured. Prenasalised stops exist in many of the Sara-Bagirmi languages, but little research has been done into their behaviour and underlying status. The resyllabification of prenasalised stops as discussed here has been observed in at least one other Central Sudanic language, Bongo (Kilpatrick 1985: 29), but most phonological treatments list the prenasalised stops as phonemes without giving additional evidence for their status. An exception to this is in the analysis of Gor, in which Kosmadji and Roberts treat the prenasalised stops as homorganic consonant sequences (Kosmadji & Roberts 2009: 6).

The resyllabification process suggests that prenasalised stops may be underlyingly nasal-stop sequences, but as there are no other consonant sequences permitted in the underlying structure of the Naba syllable, particularly in initial position, the analysis of these sounds as single phonemes seems more congruous with the overall phonological system. For this analysis I adopt the position that prenasalised stops are underlyingly single phonemes, although further research may indicate nasal-stop sequences.

The nasal element of a prenasalised stop detaches from the stop and closes the final syllable of a previous vowel-final word, as in (61):

- (61) a. [*o.sɔn dar sa*]
 /*oso ndaara sa*/
 eat skin cow
 ‘he/she eats the cow skin’

- b. [dɔg nɛn u.gum biɲɛn ti]
 /doho nen ugu mbi-ɲa = ɲ ti/
 woman PROX hit ear-3SG.POSS = CIRC LOC
 ‘this woman hits herself on her ear’

If the previous word undergoes final vowel drop, resulting in a final nasal or liquid consonant, the nasal element of the prenasalised stop will be deleted altogether. In careful speech, however, the nasal element may be retained after a liquid (62c):

- (62) a. [nɔm gal bene]
 /noomo ngaala be = ne/
 enter in house = DEF
 ‘he/she enters the house’
- b. [ɓaw kalan tar ɗɛrle]
 /ɓawo kala = ɲ tara nderle/
 go bush = CIRC do turn
 ‘he/she got lost in the bush’
- c. [ndar ndufo]
 /ndaara ndufo/
 skin duck
 ‘duck skin’ (slow speech)

Unlike the other sonorants, approximants do not provoke a deletion of the nasal element. Rather, the nasal element is pronounced syllabically after /j/ (63a) or /w/ (63b):

- (63) a. /kaje ngerse/ → [kaj.ɲ gɛrse]
 see louse
 ‘he/she sees a louse’
- b. /suwa mboje/ → [suw.m boje]
 Arab wash.self
 ‘an Arab washes himself’

Non-occlusive obstruents also provoke the syllabification of the nasal element of the prenasalised stop, as in (64). In this case, sibilants group with the other fricatives and with affricates (64c):

- (64) a. [ŋgɔmne uf.ɲ dʒan ti bo]
 /ngomo = ne uufu ndʒa = ñ ti bo/
 hernia = DEF swell leg = CIRC LOC be.big
 ‘the hernia that swells the leg is big’
- b. [mɪ.ɲ goxo]
 /miidzi ngoko/
 addax be.bent
 ‘the addax is bent’
- c. [ja ɔz.ɲ gal bene]
 /ja oozo ŋgaala be = ne/
 3SG.SBJ sweep in house = DEF
 ‘he/she sweeps the house’

If the final consonant of the preceding word is a stop, the prenasalised stop is not restructured at all, as in (65):

- (65) a. /gooto ndame/ → [gɔt ndame]
 place dance
 ‘place for dancing’
- b. /rige ndooro-ni koolo/ → [rɪg ndorɔn koolo]
 3PL.SBJ fight-3PL.SBJ much
 ‘they fight a lot’

7 Conclusion

In this article I have presented an overview of the segmental phonology, syllable structure, tonal system, and lexical and post-lexical processes of Naba. We have seen that the distinction between sonorant and obstruent consonants plays a major role in all aspects of the phonological system. I have also shown that sibilants in Naba have a special sonority status placing them in between obstruents and sonorants. Table 14 is a summary of the patterning of sibilants for different phonological processes:

Table 14. Sonority behaviour of sibilants

Property	Sonorant-like	Obstruent-like	Comment
Can occur as syllable-final in underlying structure	no	yes	Occurs in a few words with <i>sk</i> sequence but is not normally allowed
Can be a TBU	no	yes	
Blocks leftward tone movement	yes	no	
Provokes <i>-ɲa</i> sonority assimilation	yes	yes	<i>-ɲa</i> assimilates, but to palatal sibilant, not to an affricate
Assimilates in voicing	no	no	voice assimilation is optional
Undergoes fortition	yes	no	
Provokes following syllabic nasal	no	yes	

Table 14 shows that sibilants pattern consistently with neither sonorants nor obstruents, and sometimes exhibit their own specific behaviour.

In addition to the particular status of sibilants, this current research has shown correspondence between tone behaviour and the sonority hierarchy; further research will show how tightly the two factors are interwoven.

I have intended this description to be a preliminary investigation into the phonology of Naba, and hope that it will be beneficial to those studying related languages and doing cross-linguistic typology, particularly in the domains of sonority hierarchy and tone systems.

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