

NOMINAL CLASSES AND PHONOLOGICAL AGREEMENT IN TAGBANA^{*}

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In addition to total vowel harmony and nasal harmony, Tagbana, a Senufo language spoken in Côte d'Ivoire, and more especially the dialect called Fròʔò, has a pervasive consonantal agreement in its nominal domain: the morphologically 'dependent morphemes' (in terms of concord, Corbett 1991) or 'associate morphemes' (Hockett 1958) of nominal heads agree in their articulator and [$\pm$ continuant] features. This is a special case of alliterative concord, because the head noun plays no role in the alliteration. Besides the consonantal agreement features, these free associate morphemes have their own vocalic features and their own [$\pm$ voice] feature. The paper starts with a review of nominal classes in Fròʔò and the morphological structure of simple nouns. It is proposed that Fròʔò has a partly non-concatenative morphology and that a standard Distributed Morphology analysis cannot fully account for the phonology of the resulting morphemes. In the second part, the role of phonology is investigated. It is proposed that well-formed morphemes are the result of partial or deficient phonological specifications in need of repair. The phonological approach is couched in an optimality-theoretic framework (see Saba Kirchner 2010 and Bye & Svenonius 2012, among others, for different languages). Part of the final specification of these morphemes is due to phonological repairs needed to fulfill markedness and faithfulness constraints, and the filling in of features due to vowel and nasal harmony, as well as consonant epenthesis.

Keywords: Alliterative concord, Tagbana, morphology and phonology, nominal classes

1 Introduction

We propose a morphological and phonological analysis of agreement in the seven nominal classes of Tagbana (sometimes spelled Tagwana) and more specifically in the dialect called Fròʔò (or Katiola), spoken around the town of Fronan in Côte d'Ivoire. According to Glottolog (Hammarström, Bank, Forkel & Haspelmath 2018), Tagbana is a West African Senufo language. It has been strongly influenced by Gur and Mande languages. A purely morphological analysis delivers deficient phonological structures with non-concatenated features and segments. It is the task of phonology to order the features present in the morphological specification and to repair or fill in the deficient segments.

Almost all language families of the Niger-Congo phylum have nominal classes expressed by affixes called class markers (CM). In many Niger-Congo languages, a noun may belong to a specific class because of the semantic characteristics of its referent; see Creissels (1991:91ff) for examples. However, in Fròʔò, as in other Senufo languages, semantic categories only play a secondary role in the distribution of nouns into classes (see Traoré in prep for more on this topic). Nominal classes are defined here on the basis of agreement that nouns trigger on other elements associated with the nominal domain (the

^{*} The first author of this article is a native speaker of Fròʔò and the data discussed here rely on his knowledge of his own language. In some cases, he made sure that the data were confirmed by other speakers. Our acknowledgments go to Ines Fiedler and Beata Moskal, who gave us valuable comments on different versions of this paper. Conversations with Birgit Alber, Arto Anttila, Jonathan Bobaljik, Fatima Hamlaoui, Andrew Nevins, Annie Rialland and Sharon Rose also helped us to clarify several crucial issues. Lastly, we are also grateful to the anonymous reviews that were largely taken into consideration in this revised version. Many thanks are due to these reviewers and also to the organizers and participants of the 2nd Symposium on West African Languages in Vienna in October 2016 and the 45th Manchester Phonology Meeting (May 2017) for giving us the opportunity to present our work. This work is dedicated to Junko Ito and Armin Mester as an homage to their incredibly productive research at the interface between morphology and phonology in different languages, see for instance Ito & Mester (2003).

‘associated words’ of Hockett 1958). Agreement is a relation between two or more elements: a controller and one or more targets (or agreeing elements), i.e. an adjective, a pronoun etc., that receive their class by virtue of this agreement relation; see Corbett’s (1991:4-5) definition of concord in (1).

(1) Class concord

A nominal expression that is in a relationship of syntactic dependence with the noun carries the class mark of the noun: determiner, adjective, interrogative, pronoun etc.

Fròʔò presents an extensive morphological and phonological nominal concord based on identical consonantal features on all morphemes associated with a noun, depending on their nominal class. We call this phenomenon ‘consonantal agreement’ for lack of a better term. As for the morphological structure, we propose an analysis in the framework of Distributed Morphology (Halle & Marantz 1993). The morphosyntactic features obey the principle of ‘syntax all-the-way-down’ proposed by Halle & Marantz (1993) and Bobaljik (2015), among others. Regarding the phonology, it has non-concatenative properties. The phonological form of morphemes is determined by abstract morphological features, and the surface form is a compromise between faithfulness to the pairing between morphological and phonological form (Vocabulary Insertion) and phonological markedness principles. The pervasive consonantal agreement of Fròʔò is non-local and differs from local consonant harmonies as described by Walker (2000a,b, 2001), Rose & Walker (2004), Hansson (2001) and Bennett (2015) for instance. In this paper, it is analyzed as an epiphenomenon of the morphology and phonology of the nominal domain (see Féry & Moskal 2018 for a typology of alliterative concord, in which Fròʔò finds a marginal place).

Nominal classes in Fròʔò are primarily identified on the basis of their phonological properties. The associated morphemes of a nominal head acquire their phonological shape by fusion of different phonological features expressing morphological features plus default phonology. Specifically, the initial consonants of these morphemes agree with each other. Agreement takes the form of distinctive features, as for example privative features for the articulator [labial], [coronal] and [dorsal] and binary [$\pm$ continuant]. Examples of consonantal agreement are given in (2) with the identificational construction. This construction consists of a noun (lexical root + class marker CM, as in (4)), followed by an anaphoric pronoun (PRO) and an identificational particle (ID).

- | | | | | | | | | |
|-----|----|-------------------------|------|-----|----|---------------------------|------|-----|
| (2) | a. | jē-gē | kī | gī | b. | jē:-rē | tí | dī |
| | | month-CM5 | PRO5 | ID5 | | month-CM6 | PRO6 | ID6 |
| | | ‘It is the month/moon.’ | | | | ‘It is the months moons.’ | | |
| | c. | ju-mū | pī | bī | | | | |
| | | water-CM7 | PRO7 | ID7 | | | | |
| | | ‘It is the water.’ | | | | | | |

In (2)a-b, the singular and plural CMs of classes 5 (singular) and 6 (plural) are suffixed to the lexical root *jē-* ‘month’. The pronouns and the identificational particles are free morphemes following the noun. CM, pronoun and identificational particle share the same nominal class, and they agree with each other in some of their consonantal features. In (2)a, their initial consonant is [dorsal, -continuant], and in (2)b, the agreeing feature is [coronal]. In (2)c, the lexical root, *ju-* is followed by the CM of class 7 *-mū*. The anaphoric pronoun is *pī* and the identificational particle is *bī*. In this case, all three initial consonants are [labial, -continuant].¹

There is also a regular total vowel harmony between the last vowel of the lexical root (henceforth V_{ROOT}) and the first vowel of the CM (V_{CM}), all features of V_{ROOT} being copied to V_{CM} , including tone. Only the length can differ; see (2)b, where [e] is lengthened by the following [r], an effect that we do not

¹ The tones are indicated in all examples. There are three level tones, high (H) ‘ˊ’, mid (M) ‘ˊˊ’ and low (L) ‘ˊˊˊ’. In this paper, we do not provide an analysis of the tonal system of the language; see Traoré, Rialland & Féry (in prep) for the tonal structure of Fròʔò.

discuss here. In the examples in (2), the vowel of the free morphemes is always [i]. The quality of the vowel is determined by the morphemes themselves, and it is not the result of vowel harmony.

Before turning to the phonological properties of the nominal classes, let us briefly introduce the phonemic inventory of Fròʔò. The consonants are shown in Table 1. There are 22 consonants, 11 of which are stops and three of which are voiceless fricatives. There is no voiced fricative. The 11 stops are divided into voiceless and voiced ones, which can take five places of articulation: labial, alveolar, palatal, velar and labio-velar. Two laryngeals are included among the obstruents: [ʔ] and [h]. Additionally, there are eight sonorants, four of which are nasal. The remaining sonorants are two glides, [j] and [w], and two liquids, [l] and [r]. The Fròʔò consonant system is close to that of other Senufo languages, although some differences emerge as well: voiced fricatives exist in other Senufo languages, as for example in Nafara and Tyebara (see Mensah & Tschabale 1983).

Table 1. Fròʔò consonants

		labial	alveolar	palatal	velar	labio-velar	glottal
Plosive	voiceless	p	t	c	k	kp	ʔ
	voiced	b	d	ɟ	g	gb	
Fricative		f	s				h
Nasal		m	n	ɲ	ŋ		
Glide				j		w	
Lateral			l				
Rhotic			r				

Fròʔò has seven ‘plain’ vowels, which can be long in some environments, in particular before a heteromorphemic [r], as shown in (2)b. All vowels can be lengthened by a following [r] (or [l]), but length is not distinctive. All vowels have nasal correspondents, except for the mid [+ATR] [e] and [o], which are never nasalized; thus all in all there are 12 vowels, as shown in Table 2. There is no [ATR] harmony in Fròʔò.

Table 2. Fròʔò vowels

a. Short vowels		b. Nasal vowels	
i	u	ĩ	ũ
e	o		
ɛ	ɔ	ẽ	õ
a		ã	

Nominal phrases may include further morphemes, like adjectives, indefinite articles (there is no definite article), demonstratives, numerals, quantifiers, interrogatives and possessive pronouns. The canonical order of these morphemes appears in (3). Examples will be given below. Numerals and quantifiers are invariant, while all other words are morphologically and phonologically associated morphemes, and vary according to the nominal class of the head noun.

(3) Nominal template in Fròʔò

(Possessive) – Nominal root – (adjective) – CM – (numeral/quantifier) – (demonstrative)
(pronoun) – (identificational particle)

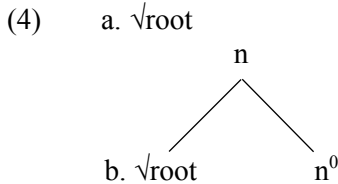
In the remainder of this article, we investigate the morphological and phonological aspects of nominal classes and nominal domains in Fròʔò, paying special attention to the phenomenon of alliterative concord. A ‘nominal domain’ includes all morphemes that agree with a particular head noun plus possible

modifiers of the noun. The next section gives an overview of nouns and nominal classes in this language and provides a morphological analysis in the framework of Distributed Morphology. Section 3 describes alliterative concord in the nominal domain and emphasizes the shortcomings of a purely morphological approach to agreement. In particular, the morphological approach needs a phonological account to explain how the different pieces resulting from Vocabulary Insertion are organized into phonological outputs. Section 4 contains the complementary phonological account. Vowel and nasal harmonies as well as consonant epenthesis are the subject of this section. Finally, Section 5 compares alliterative concord from a typological perspective and shows how Tagbana differs from other languages with alliterative concord. It also contains a conclusion.

2 Nouns and nominals

We adopt a version of Distributed Morphology (DM) for explaining how words—specifically nouns—acquire their category (see Halle & Marantz 1993, Halle 1990, Noyer 1997, Pesetsky 1995, Embick & Noyer 2007, Nevins 2010, Embick 2010, Bobaljik 2015, Moskal 2015, among others). According to DM, there are three kinds of morphemes: first, lexical items or roots—morphemes without category—which are part of the language-dependent open lexicon; second, category-defining nodes n^0 , v^0 , and a^0 ; and third, functional morphemes bearing their own category. We come back to the final category in Section 3 and concentrate in this section on the first two categories.

A lexical root X has the form shown in (4)a. It acquires its category by adjunction of a category-defining functional head, n^0 (for noun) in (4)b, that combines with the root (Marantz 2007). In sum, a lexical root in Fròʔò does not have a category all by itself. It acquires its nominal status by combining with an overt or a covert class marker (CM), i.e. the category-defining functional head n^0 (see Smith 2015, among others, for this view).



An example of a simple lexical root appears in (5). The lexical root $tī$ needs a class marker to become a noun meaning ‘tree’ or ‘wood’. In the examples, the class markers are CM5 or CM6, that is class markers of class 5 or 6, and the nouns formed in this way are themselves of class 5 (singular) or 6 (plural).

(5)	$tī\text{-}ʔī$	$tī\text{-}rī$
	tree-CM5	tree-CM6
	‘tree’	‘trees’

As already mentioned, Fròʔò has seven nominal classes that are recognizable by the phonological form of their CM and associated morphemes. The first six classes come in pairs of singular and plural and class 7 includes mass nouns lacking a plural. In the present paper and following Creissels (1991), we call ‘gender’ the combination of a singular and a plural form.²

We follow suggestions by Clamens (1952) and by Mieke (2012) for Tagbana.³ The nominal classes of Fròʔò are a subset of those proposed by Mieke, Reineke & Winkelmann (2012) in their introductory

² We are well aware that the notion of ‘gender’ does not have the same meaning in African languages as in European languages, but we choose to follow the Africanist tradition.

³ Mieke’s survey is based entirely on Clamens’ notes, which are not glossed and with which the first author of the present article does not always agree (see also Manessy 1996 for this judgment). Mieke classifies Tagbana as a Gur language, a proposal

chapter to the noun classes in Gur. Their proposal is based on Manessy's (1962, 1996) reconstruction work, which itself leans on the Bantu tradition. Our classes 1 and 2 (gender 1) roughly correspond to the Gur classes 1-2 of Mieke et al. (2012), our classes 3 and 4 (gender 2) to their classes 5-6, our classes 5 and 6 (gender 3) comprise their classes 12, 15 and 21, and our class 7 (gender 4) comprises their classes 14 and 22-23.

In Table 3, examples of the seven classes are listed with their class markers and examples of nouns for each class (for a more detailed survey, as well as a comparison with Mieke et al.'s proposal, see Traoré in prep). A typical root is mono- or disyllabic, regardless of the nominal class it acquires. If it is longer, it is most probably a compound. The class marker adds a syllable—or two in class 2 and class 4, the plurals of genders 1 and 2, respectively.

The vowel of the V_{CM} is typically a total copy of the V_{ROOT} . However, in disyllabic [-hele], [-bele] for class 2 and [-gele] for class 4 the vowel is prespecified as [e]. In class 4, one of the two possible CMs starts with a glottal stop, and the vowels are in total harmony with the V_{ROOT} , even though there are two vowels; see also the examples in (10).

Table 3. Overview of the nominal classes of Fròʔò and the class markers

Class markers (CM)	Examples of nouns of each class	
Class 1 (sg. of gender 1) CM: [-IV], [-ɲV], [-hV]	hō-lō elephant-CM1	wótiò.1 python
Class 2 (pl. of gender 1) CM: [-IV], [-hele], [-bele]	hō-bēlē elephants-CM2	wótiò-hélé pythons-CM2
Class 3 (sg. of gender 2) CM: [-IV]	lā:-lā belly-CM3	kpē-lē knife-CM3
Class 4 (pl. of gender 2) CM: [-ʔVIV], [-gele]	lā-ʔālā bellies-CM4	kpē-gēlē knives-CM4
Class 5 (sg. of gender 3) CM: [-gV], [-ɲV], [-ʔV]	jē-gē month-CM5	āfɔ̃-ɲɔ̃ new thing-CM5
Class 6 (pl. of gender 3) CM: [-rV]	jē:-rē months-CM6	āfɔ̃:-rɔ̃ new things-CM6
Class 7 (sg. of gender 4) CM: [-mV], [-bV]	ɲū-mū water-CM7	wē-bē foliage-CM7

Nominal classes 1 and 2 (gender 1) contain the largest number of nouns. In contrast to genders 2 and 3, gender 1 can partly be characterized in semantic terms: the referents of the nouns of these classes include most human beings and other living beings, as well as animate and inanimate objects relating to humans. Moreover, this gender also contains loanwords. However not all the referents corresponding to this description are included in gender 1, as there are also animals or objects related to humans belonging to the other genders.

Class 1 nominal roots (the singular) usually form a noun by suffixing a CM, but there is also a non-negligible number of nouns that do not take an overt CM; these are followed by '1' indicating that they belong to class 1. Lack of a CM is much more frequent in class 1 than in the other classes. An additional complication of this class is that the CM can take several forms by varying its onset consonant (C_{CM}). It can be a lateral [l], a nasal [ɲ] or [h].⁴ As in all classes, total vowel harmony between V_{ROOT} (the last vowel of the root, which is the trigger) and V_{CM} (the target) is the rule.

Class 2 (plural of class 1) can also take different forms. In contrast to the other classes, class 2 nouns do not respect clear formation rules. The largest group of class 2 nouns have a CM starting with [l]

that differs from the classification in Glottolog. It is thus not an understatement to claim that the present article, Traoré & Féry (2018) and Traoré (in prep) are the first linguistic studies of Fròʔò.

⁴ It is the nouns themselves that determine the CM they take, i.e. a noun within class 1 always appears with the same CM consonant. If there is systematic phonologically or morphosyntactically conditioned allophony here, we could not identify it.

and a vowel harmonizing with the V_{ROOT} . The root vowels are often different in the singular (class 1) and in the plural (class 2). In short, gender 1 is not homogeneous as far as the noun (nominal root + optional CM) is concerned. Some examples appear in (6) to (9). In (6), words with a CM—both singular and plural— and in (7), words without a CM in the singular are listed.

- (6) Gender 1 nouns with $-IV_{\text{CM}}$ in the singular (class 1) and $-IV_{\text{CM}}$ in the plural (class 2)

Sg.	Pl.	Sg.	Pl.
pō-lō	pīē:-lē	cē-lē	cīē:-lē
male-CM1	males-CM2	woman-CM1	women-CM2
hó-ló	húó:-ló		
mouse-CM1a	mice-CM2		

- (7) Gender 1 nouns without a CM in the singular (class 1) and with $-IV_{\text{CM}}$ in the plural (class 2)

Sg.	Pl.	Sg.	Pl.
nū.1	nī:-lī	gànū.1	gànī:-lī
mother	mothers-CM2	rat	rats-CM2
tō.1	tīē:-lē	nùbūō.1	nùbīē:-lē
father	fathers-CM2	friend	friends-CM2

As already mentioned, class 2 plural CMs may have a specific form: $-bēlē$ or $-hēlē$. With these CMs, there is no vowel harmony between V_{ROOT} and V_{CM} . V_{CM} is always [e], regardless of the V_{ROOT} . Examples illustrating these plural formations appear in (8) and (9). The nouns in (9) are di- or trisyllabic and they do not differ in their singular and plural forms. The nouns that take $-hēlē$ as their plural CM have no singular CM. The class is indicated with “.1” following the lexical root.

- (8) Class 1 nouns with a CM in the singular and CM $bēlē$ in the plural

Sg.	Pl.	Sg.	Pl.
hō-lō	hō-bēlē	nābō-ŋō	nābō-bēlē
elephant-CM1	elephants-CM2	stranger-CM1	strangers-CM2
kā-ŋā	kā-bēlē		
gecko-CM1	geckoes-CM2		

- (9) Class 1 nouns without a CM in the singular and $hēlē$ CM in the plural

Sg.	Pl.	Sg.	Pl.
lēpiē.1	lēpiē-hélé	wótiò.1	wótiò-hélé
snake	snakes-CM2	python	pythons-CM2
tōkpò.1	tōkpō-hélé	jà:rà.1	jà:r-hélé ⁵
grandfather	grandfathers-CM2	lion	lions-CM2

Classes 3 and 4 (gender 2) are more regular. In gender 2, the singular and the plural nominal roots are generally identical. This is also true of gender 3.

In class 3 nouns, the onset consonant of the CM is always the lateral [l]. Moreover, total vowel harmony always applies between V_{ROOT} and V_{CM} .

Class 4 nouns are formed in two different ways. The plural CM is either $-ʔVIV$, as in (10), or $-gélē$, as in (11).⁶ Total vowel harmony applies between V_{ROOT} and both vowels in $-ʔVIV$, but in $-gélē$, the CM vowels are prespecified as [e].

⁵ The final a in $jà:rà$ is not retained in the plural. Some vowels are weak and delete easily. This concerns especially V_{CM} and V_{ROOT} in total harmony with each other (see Traoré & Féry 2018 for vowel elision).

⁶ With $-gélē$ as CM4, the vowel of the nominal root is always a front mid vowel.

- (10) Classes 3 and 4: Plural CM is -ʔVIV

Sg.	Pl.	Sg.	Pl.
lā:-lā	lā-ʔālā	ɲĩē-lē	ɲĩē-ʔēlē
belly-CM3	bellies-CM4	eye-CM3	eyes-CM4

- (11) Classes 3 and 4: Plural CM is -gēle

Sg.	Pl.	Sg.	Pl.
cē-lē	cē-gēlē	hē-lē	hē-gēlē
calabash-CM3	calabashes-CM4	kidney-CM3	kidneys-CM4
kpē-lē	kpē-gēlē		
knife-CM3	knives-CM4		

In class 5 (the singular of gender 3) as well, V_{ROOT} is generally copied into V_{CM} . Thus, in most cases, total vowel harmony applies between the last vowel of the root and the vowel of the class morpheme. The C_{CM} can take different forms: it is either [g], [ŋ] or [ʔ]; see (12) to (14), respectively. We address the allophonic variation between [g] and [ŋ] in Section 4.2.2 below. There are also a small number of nouns of this class that have no overt CM; see (15) for examples.

Class 6 plural nouns always end with CV:-rV, where rV is the class morpheme. Vowel harmony is again total between the long V_{ROOT} and the V_{CM} (except for length, which is not copied). There is no consonantal allophony in the form of the CM. All nouns of this class have C_{CM} [r].

- (12) Class 5 C_{CM} is [g] and class 6 C_{CM} is [r]

Sg.	Pl.	Sg.	Pl.
jē-ge	jē:-rē	wē-gē	wē:-rē
month-CM5	months-CM6	medicine-CM5	medicines-CM6
tò-gò	tò:-rò		
earthworm-CM5	earthworms-CM6		

- (13) Class 5 C_{CM} is [ŋ] and class 6 C_{CM} is [r]

Sg.	Pl.	Sg.	Pl.
ɲĩ-ɲĩ	ɲĩ:-rĩ	pĩ-ɲĩ	pĩ:-rĩ
moment-CM5	moments-CM6	tam-tam-CM5	tam-tams-CM6
āfĩ-ɲĩ	āfĩ:-rĩ		
new thing-CM5	new things-CM6		

- (14) Class 5 C_{CM} is [ʔ] and class 6 C_{CM} is [r]

Sg.	Pl.	Sg.	Pl.
tī-ʔī	tī:-rī	l̩-ʔ̩	l̩:-r̩
tree-CM5	trees-CM6	river-CM5	rivers-CM6
frù-ʔù	frù:-rù		
mat-CM5	mats-CM6		

- (15) Class 5 has no C_{CM} and class 6 C_{CM} is [r]

Sg.	Pl.	Sg.	Pl.
ɲĩō.5	ɲĩō:-rō	ɲĩō.5	ɲĩō:-rō
house	houses-CM6	mouth	mouths-CM6

In contrast to all other classes, class 7 nouns share a clear semantic property. This class contains mass or uncountable nouns, which have no plural. Accordingly, only singular forms are found here. The nouns of this class also have total vowel harmony between V_{ROOT} and V_{CM} . C_{CM} is usually [m]. In some instances, it

is [b]; see (17).⁷ As can be seen in (16), the vowels preceding and following C_{CM} [m] are often nasal themselves. However, as (18) shows, nasal harmony is not obligatory. Recall from Section 1 that [e] has no nasal equivalent, which explains the absence of nasal harmony in *lē-mē* and *hiē-mē*. However, the vowels of *lā-mā* are not nasal either, even though [a] does have a nasal equivalent. The generalization is that if V_{ROOT} is nasal, then nasal harmony applies, but V_{ROOT} does not need to be nasal, even if it is followed by a nasal; see Section 4.2.2 for more on the subject.

- (16) Class 7 nouns (C_{CM} is [m])
- | | | |
|--------------|---------------|---------------|
| <i>nũ-mũ</i> | <i>cē-mē</i> | <i>gbā-mā</i> |
| water-CM7 | knowledge-CM7 | recovery-CM7 |
- (17) Class 7 nouns (C_{CM} is [b])
- | | |
|--------------|-----------------|
| <i>wē-bē</i> | <i>kātià-bù</i> |
| cheek-CM7 | foliage-CM7 |
- (18) Class 7 nouns (no nasal vowels)
- | | | |
|--------------|--------------|---------------|
| <i>lā-mā</i> | <i>lē-mē</i> | <i>hiē-mē</i> |
| belly-CM7 | burial-CM7 | family-CM7 |

Class 7 nouns and their dependent morphemes again have a clear harmonizing feature, namely [labial]; C_{CM} , pronoun and identificational particle share this feature. Labiality in class 7 is always realized with the feature [-continuant], which accounts for the alternation between stop and nasal. The feature [nasal] is optional.

Once a lexical root takes a specific CM, it acquires the class of the CM, and all dependent morphemes agree with it. Lexical roots without an overt CM nevertheless belong to a specific class, as easily verified by the phonological form of their dependent morphemes. Functional morphemes depend on the class of the noun they refer to, which means that if a noun had no class, it could not be referred to by pronouns, articles, relative pronouns etc. In sum, it is not possible for a noun to lack a class.

In some cases, a CM plays the role of a derivational morpheme. It can attach to different lexical roots and induce semantic shifts. Consider the nominal doublets in (19). The lexical root *cie-* can attach to CM1 and mean ‘woman’, as in (19)a, and the same root can also attach to CM7 *-mũ*, as in (19)b. In this case, the noun has the meaning of ‘womanhood, property of being a woman’. The same doublet is illustrated with the lexical root *pi* ‘child’. Notice that, when it this CM is derivational, it has a specified form *-mũ*.

- (19) a. *cē-lē* b. *clē-mũ*
 woman-CM1 woman-CM7 ‘womanhood’
 c. *pì-ò* d. *pì-mũ*
 child-CM1 child-CM7 ‘property of being a child’

Diminutives and augmentatives are formed by affixing CM3 and CM5, as illustrated in (20). We saw in (7) that *gànũ* ‘rat’ in its neutral meaning belongs to class 1, and has a covert CM.

- (20) *gànũ.1* *gànũ:-lũ* *gànũ-ʔũ*
 rat rat-CM3 ‘small rat’ rat-CM5 ‘big rat’

⁷ This CM may indicate a different historical origin for these words, and this may imply that different classes came together at a certain stage in the history of the language. When the class marker is a stop, the corresponding identificational construction is invariably formed with the stops as well.

Lexical roots that are primarily used as verbs (without a CM, but in combination with an auxiliary) can easily become nominal by attachment to a nominal CM, as illustrated in (21). It is not yet clear what determines the choice of CM for each individual verb.

- (21) a. cā → cā-lā
to.look.for search-CM3
'to look for' 'search'
- b. wèlé → wlè.ʔè
to.bark 'bark-CM5'
'to bark' 'barking'
- c. táʔǎ → táʔǎ-mũ
to.walk walk-CM7
'to walk' 'the fact of walking'

Turning now to the phonological properties of the class markers, at least in classes 3, 5, 6 and 7, the same articulatory features [labial], [coronal] and [dorsal] as the ones found for the associate morphemes are present in the C_{CM}. This is of course no accident, rather it is part of the pervasive articulatory specification for the classes.⁸ In the overview (22), V stands for a vowel that is the result of total harmony of V_{root}, thus the last vowel of the lexical root. Only the CMs of classes 2 and 4 have a prespecified vowel [e] in their disyllabic allomorphs.⁹

- (22) Class markers
- a. [CM CLASS 1] ⇔ {[ŋV], [nV], [rV], [lV], Ø}
- b. [CM CLASS 2] ⇔ {hele, bele, [-lV]}
- c. [CM CLASS 3] ⇔ [lV]
- d. [CM CLASS 4] ⇔ {[ʔVlV], gele}
- e. [CM CLASS 5] ⇔ {[gV], [ŋV], [ʔV], Ø}
- f. [CM CLASS 6] ⇔ [rV]
- g. [CM CLASS 7] ⇔ [mV]

Table 4 provides an overview of the consonantal features in each class, together with the morphemes of the so-called identificational constructions that we already encountered in (2) (pronoun and identificational particle) in boldface. The next section discusses the phonological properties of functional morphemes. It should be noted that pronouns and identificational particles can be used without the overt noun and still agree with the class marker; see (26) for an example with the pronoun.

⁸ There is more to be discovered in the phonological form of the CMs. We strongly suspect that some of the specific forms are due to diachronic changes and lexicalized forms; see Dombrowsky-Hahn (2015) and Miede et al. (2012) for some remarks on this issue in related languages.

⁹ Notice that the class markers with fixed vowels are all disyllabic (only one disyllabic CM has harmonizing vowels). A reviewer hypothesizes a relationship between the size of CM and the presence of a prosodic boundary (foot or prosodic word) that interferes with conditions for vowel harmony (see also Urbanczyk 2006 on root-size affixes). We have no answer to this problem at this stage.

Table 4. Agreeing consonantal features of two functional morphemes

Consonantal features	Example of identificational construction		
Class 1: [w] [labial, consonantal, vocalic]	hō-lō elephant-CM1 'It is the elephant.'	wī PRO1 ID1	wī ID1
Class 2: [p, b] [labial, -continuant]	hō-bēlē elephant-CM2 'It is the elephants.'	pē PRO2 ID2	bē ID2
Class 3: [l] [lateral]	bùò-lò granary-CM3 'It is the granary.'	lí PRO3 ID3	lí ID3
Class 4: [k, g] [dorsal, -continuant]	bùò-ʔólō granary-CM4 'It is the granaries.'	kē PRO4 ID4	gē ID4
Class 5: [k, g] [dorsal, -continuant]	jē-ge month-CM5 'It is the month/moon.'	kī PRO5 ID5	gī ID5
Class 6: [t, d] [coronal, -continuant]	jē:-rē month-CM6 'It is the months/moons.'	tī PRO6 ID6	dī ID6
Class 7: [m, p, b] ¹⁰ [labial, -continuant, ([nasal])]	ṵ-ṵ water-CM7 'It is the water.'	pī PRO7 ID7	bī (or mī mī)

3 Associate functional morphemes

In this section, we present a formal approach to the consonantal agreement of associate functional morphemes. First, section 3.1 introduces the morphosyntactic features of functional morphemes. Section 3.2 reviews the agreeing phonological features for all associate morphemes of classes 5 and 6 (gender 3) and sums up the phonological agreeing features of all classes. In section 3.3, it is shown how the abstract morphological features are paired with phonological exponents in the DM operation of Vocabulary Insertion.

3.1 Morphosyntactic features of functional morphemes

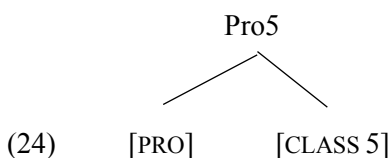
In Distributed Morphology, besides lexical roots and the category-defining nodes n^0 , v^0 and a^0 , a third category consists of functional morphemes bearing their own category. These morphemes are accounted for in morphosyntactic terms. Whether such morphemes are pronouns, demonstratives, interrogatives etc. is established in the syntax and expressed by means of abstract syntactic features; see Moskal (2015) for the difference between lexical roots and functional morphemes in other languages. Some of the morphological categories needed in Fròʔò are listed in (23).

- (23) a. [pronoun] b. [interrogative] c. [demonstrative]

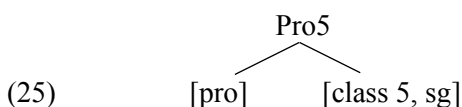
Inflection begins in syntax, by combining abstract elements according to general principles. As an example, a pronoun associated with several inflectional features has an articulated morphosyntactic

¹⁰ In the identificational construction, pronoun and identificational particle have two alternative forms: *pī bī* or *mī mī*. These two forms appear to be in free variation. Notice that in the variant with [m], the following vowel is nasal, while it is oral when following [p] and [b]. This strongly suggests nasal harmony.

representation. The assignment of nouns or pronouns to one of the seven nominal classes of Fròʔò is determined by such syntactic abstract features, as illustrated in (24).



Class markers define nominal classes but are also the bearers of number. The abstract feature [SG] may fuse with [CLASS 5]; see (25). We do not indicate number in the following, as singular and plural are intrinsic to their respective classes, as shown above.



3.2 Functional morphemes

Table 5 sums up the functional morphemes for all seven classes. In this section, we concentrate on functional morphemes of classes 5 and 6, in boldface in Table 5, for illustration.

Table 5. Dependent morphemes in the seven nominal classes

	Pronoun/ Possessive	Identifica- tional particle	Interro- gative	Indefinite article	Demon- strative/ Relative pronoun	Deictic particle
Class 1 [w]	wī	wī	wíʔí	wà	ŋā	wè
Class 2 [p, b]	pē	bē	béʔélé	pè:lè	bēʔēlē	bē
Class 3 [l]	lī	lī	líʔí	là	lā	lè
Class 4 [k, g]	kē	gē	géʔélé	kè:lè	gēʔēlē	gē
Class 5 [k, g]	kī	gī	gíʔí	kà	gā	gè
Class 6 [t, d]	tī	dī	díʔí	tà	dā	dè
Class 7 [m, p, b]	pī~mī	bī~mī	bíʔí~míʔí	pà~mā	bā~mā	bè~mè

In the rows, the morphemes are organized by classes, and in the columns by the morpheme category. In the former case, the similarity of the articulatory features is striking, and in the latter case, the syllabic templates and the quality of the vowels stand out. The phonological form of the morphemes is the result of the articulatory and continuancy features of the respective classes, as well as the voicing in the case of stops, the vowels and the syllabic templates.¹¹ It must be emphasized that in regard to consonant harmony on the associate morphemes, all classes are regular.

¹¹ Notice that the prespecified vowel of the morphemes is always [i], [e], [ɛ] or [a], never a round back vowel.

The morphemes participating in the concord pattern are: pronouns/possessives (3.2.1), identificational/clause-ending particles (3.2.2), interrogatives (3.2.3), indefinite articles (3.2.4), demonstratives (3.2.5), relative pronouns (3.2.6) and deictic particles (3.2.7). All these morphemes acquire their consonantal form by sharing their articulatory features; in the case of classes 5 and 6, the shared features are [dorsal, -continuant] in class 5 and [coronal, -continuant] in class 6, as established in Table 4. These features arise in the right branch of (24). In contrast, the vowel and the number of syllables of each morpheme are prespecified by the morphemes themselves, and not by the class of their head noun, thus by the specification in the left branch of (24).

3.2.1 Pronouns *kí* and *tí*

The class 5 pronoun is *kí* and the class 6 pronoun is *tí*; see (26). The pronouns have the articulator feature [dorsal] in class 5 and [coronal] in class 6. Both are [-continuant]. They are monosyllabic and their vowel is [i]. There is no morphological marker for case in Fròʔò, and pronouns can be subjects, direct objects, indirect objects, possessives, obliques etc.

(26) Pronouns of classes 5 and 6

kí	nǎ́	sīē	tí	nǎ́	sīē
PRO5	AUX.PROG	go	PRO6	AUX.PROG	go
‘She/he/it is going.’			‘They are going.’		

Possessive articles *kī* and *tī*

Similarly, the 3rd person possessive articles *kī* and *tī* agree according to the class they are standing for. These forms are identical to the pronouns; see the examples in (27).

(27) Class 5 and 6 possessives

kī	tī-í	tī	tī:-rí
POSS5	tree-CM5	POSS6	tree-CM6
‘her/his/its tree’		‘their tree’	

3.2.2 Identificational/Clause-ending particles

The identificational particles *gī* and *dī* are parts of the identificational construction; see the examples in Section 2 and in (28). They share the same consonantal features as the pronouns, except for voicing, which is not a property of the morphological feature [pronoun]. Their vowel is invariably [i] except for classes 2 and 4, where it is [ε].

3.2.3 Interrogatives *gíʔi* and *díʔi*

Interrogative ‘which’ is *gíʔi* in class 5 and *díʔi* in class 6; see (28). Its initial consonant is again the same as that of the identificational *gī* in class 5 and *dī* in class 6. The consonant of the second syllable is [ʔ], which is analyzed as the result of consonant epenthesis between two identical vowels; see Section 4.3. The interrogative is disyllabic and its vowel is [i].

(28) Class 5 and 6 *wh*-words

tī-í	kí	gíʔí	gī	tī:í	tí	díʔí	dī
tree-CM5	PRO5	WH5	ID5	tree-CM6	PRO6	WH6	ID6
‘Which tree is this?’				‘Which trees are these?’			

3.2.4 Indefinite articles *kà* and *tà*

It can be seen in (29) that the indefinite article *kà/tà* starts with [k] in class 5 and with [t] in class 6. The indefinite article has the articulator feature [dorsal] in class 5 and [coronal] in class 6. The indefinite article is monosyllabic and its vowel is [a], except for classes 2 and 4, where it is [e].¹²

(29) Class 5 and 6 indefinite articles

wē-gē	kà	wē:rē	tà
medicine-CM5	INDEF.ART5	medicine-CM6	INDEF.ART6
‘a medicine’		‘medicines’	

3.2.5 Demonstratives *gā* and *gā:gē*; plural *dā* and *dā:dē*

Demonstrative articles of classes 5 and 6 are proximal *gā* (*gè*) and *dā* (*dè*) ‘this’ or distal *gā:gē* (*gè*) and *dā:dē* (*dè*) ‘that’; see the examples in (30). The difference between the two is in the length of the vowel [a] and the disyllabicity of the distal form. Demonstratives show the same consonantal features as before. The pure demonstrative is just the first morpheme; the second morpheme is a deictic marker, comparable to *ci* and *là* in *celui-ci* ‘this one (here)’ or *celui-là* ‘that one (there)’ in French; see 3.2.7 for these particles without the demonstrative.

(30) Class 5 and 6 proximal demonstratives

tī-ṛī	gā	gè	tī:rī	dā	dè
tree-CM5	DEM.ART.5	DEICT 5	tree-CM6	DEM.ART.6	DEICT6
‘this tree’			‘these trees’		

3.2.6 Relative pronouns *gā* and *dā*

The simple proximal demonstratives *gā* and *dā* also take the function of the relative pronoun, as illustrated in (31).¹³ Again [g] and [d] are present and indicative of the class of the antecedent.

(31) Class 5 and 6 relative pronouns

- a. tī-ṛī **gā** mǐ nǎ pǐ
 tree REL.PRO5 I AUX talk.about
 ‘The tree that I am talking about.’
- b. tī:rī **dā** mǐ nǎ pǐ
 trees REL.PRO6 I AUX talk.about
 ‘The trees that I am talking about.’

3.2.7 Deictic particles

The deictic particles *gè* and *dè* were already shown in (30), as part of the distal demonstratives. They also vary according to the class of the noun they refer to. Their vowel is always [è].

¹² There is no definite article in Fròṛò. The CM may in some cases take the function of the definite article, although it does not fulfill this role in an unambiguous way.

¹³ The sentence structure of Fròṛò generally has the form S Aux O V X, X being everything else.

3.3 Vocabulary Insertion

In Distributed Morphology, Vocabulary Insertion (VI) refers to the pairing of syntactic nodes with phonological representations or exponents, thus the mapping from syntax to phonological form. This pairing takes place after the morphosyntactic operations, like fusion or merger, have been completed. The functional morphemes of each class are associated with their features, which then play the role of filling in the abstract morphosyntactic information with phonological content.

The phonological form of the functional morphemes is the result of putting together several bits of morphophonological information.¹⁴ First, the different classes are paired with the consonantal features that are specific to them and which have been reviewed in Table 4. The VI pairing between class features and their phonological features takes the form in (32). The remaining classes pair their own features. Class 7 has two variants, but so far, we have not been able to ascertain what triggers the choice of one alternant over the other in individual cases.¹⁵

- (32) a. [CLASS 1] ⇔ [labial, +consonantal, +vocalic]
 b. [CLASS 5] ⇔ [dorsal, -continuant]
 c. [CLASS 7] ⇔ [labial, -continuant]/[labial, -continuant, nasal]

The second bit of phonological insertion concerns the voicing of the stops, summed up in Table 6. In classes 2, 4, 5, 6 and 7, the initial consonants of the functional morphemes are stops that can be voiced or voiceless. The glide of class 1 and the lateral of class 3 are always voiced: they cannot be [-voice], and are thus unaffected by this alternation. Pronouns/possessives and indefinite articles are voiceless and the other morphemes, i.e. demonstratives/relative pronouns, interrogatives, deictic particles and identificational particles, are voiced. In sum, the feature [±voice] changes according to morphological features.

Table 6. The role of voicing

Morphemes	Voicing
Pronouns/possessives, indefinite articles	[-voice]
Demonstratives/relative pronouns, interrogatives, deictic particles, identificational particles	[+voice]

Third, the vowel associated with each morpheme delivers additional phonological information specified by the morpheme itself; see Table 7. Pronouns/possessives, interrogatives and identificational particles have [i] in the singular (classes 1, 3, 5 and 7) and [e] in the plural (classes 2 and 4), except for class 6, which has [i] although it is a plural. The indefinite articles and demonstratives/relative pronouns have [a] in classes 1, 3, 5, 6 and 7 and [e/ɛ] in classes 2 and 4. Recall that the vowel of the CM is typically the result of vowel harmony, except in the cases in which it has a complete prespecification. In other words, the CM is not affected by the vowel distribution shown in Table 7.

The trisyllabic morphemes always have prespecified vowels and are thus never subject to vowel harmony. This could be related to the fact that vowel harmony generally does not iterate (the CM of class 4 being the sole exception). Most of the disyllabic morphemes have a prespecified vowel (see Kaplan 2008 for iteration in phonology).

¹⁴ Plus tonal information, which we ignore here.

¹⁵ Ines Fiedler has proposed that two historically different classes may have fused into one. This hypothesis should be investigated in future research.

Table 7. Vowel distribution

Morphemes	Vowels
Pronouns/possessives Interrogatives Identificational particles	[i] in classes 1, 3, 5, 6 and 7 [e] in classes 2 and 4
Indefinite articles Demonstratives/relative pronouns	[a] classes 1, 3, 5, 6 and 7 [e/ē] in classes 2 and 4

Finally, the number of syllables is also part of the phonological exponence of morphemes, as shown in Table 8. All syllables are of the form CV (written σ_{CV} below), thus an open syllable with an onset and a simple nucleus (there are no diphthongs in Fròʔò); see Traoré & Féry (2018) and Traoré (in prep.) for a survey of the syllable structure.¹⁶ The morphemes are always monosyllabic in the singular (classes 1, 3, 5 and 7), except for the interrogative, which is always disyllabic in the singular and consists of the identificational particle Cí plus a syllable ʔi. The initial consonant of the interrogative is determined by the articulatory features listed in Table 5, and the second consonant is epenthetic; see Section 4.3. All pronouns, deictic particles and identificational particles are monosyllabic in the plural (classes 2, 4 and 6). Indefinites and demonstratives/relative pronouns are either mono-, di- or even trisyllabic, depending on the class. The last syllables of polysyllabic morphemes always start with [ʔ] or with [l]. We assume that [l] is prespecified, but [ʔ] is epenthetic.

Table 8. Syllabic templates (number of syllables in each morpheme)

	Syllabic templates
Monosyllabic templates	Singular (classes 1, 3, 5 and 7): all morphemes except for the interrogative Plural (classes 2, 4 and 6): pronouns/possessives, identificational particles
Disyllabic templates	Interrogative singular (classes 1, 3, 5 and 7) and plural of indefinite articles of classes 2 and 4 <i>pè:lè</i> and <i>kè:lè</i>
Trisyllabic templates	Demonstratives/relative pronouns and interrogatives of classes 2 and 4 (plural): <i>bēʔēlē/ bēʔélé</i> and <i>gēʔēlē/ géʔélé</i>

As a result of Vocabulary Insertion of consonantal features and the information provided in Tables 6 to 8, morphosyntactic abstract morphemes in Fròʔò are not paired with fully specified segments or syllables but rather with several partial phonological chunks of information, as is typical for non-concatenative morphology. The phonological form of the class 5 pronoun *ki* must be analyzed as the result of two pairing operations, articulated as in (33): one for pronoun and one for class. Whether the information should be provided in the form of a syllable is open to discussion. In this case, there is no reason to assume anything else than a CV syllable that can bear the feature [-voice] and the vowel [i]. Putting the features [dorsal, -continuant] in this template leads to the fully specified syllable: *ki*.

(33) a. [PRO] ⇔ [-voice], [i] or $\begin{array}{c} \sigma \\ \swarrow \quad \searrow \\ C \quad \quad V \\ [-voice] \quad i \end{array}$

¹⁶ The underlying syllable structure is always open, but resyllabification, and more specifically vowel deletion, can result in closed syllables in connected speech, which is ignored here. Codas are limited to sonorants.

b. [CLASS 5] $\Leftrightarrow$ [dorsal, -continuant]

In the case of a demonstrative/relative pronoun, the vowel is [a]. The other specifications are similar to those for the pronoun; see (34)a. And the class information remains the same. The result is again a fully specified syllable: *ka*.

- (34) a. [DEM] $\Leftrightarrow$ [-voice], [a]
 b. [CLASS 5] $\Leftrightarrow$ [dorsal, -continuant]

The class 5 interrogative *giʔi* must contain the information that it is disyllabic. If one consonant is voiced, dorsal, and [-continuant] and one of the vowels is [i], as shown in (35), one syllable is fully specified. However the result of VI is not enough to fully specify the disyllabic template: VI only provides information for one syllable, not for two. The result of VI is thus deficient. Neither the featural content of one of the consonants nor that of one of the vowels is prespecified. We assume that the quality of the second vowel is due to vowel harmony and that the second consonant is epenthetic; see Section 4 for more detail.

- (35) a. [INTERR] $\Leftrightarrow$ [σ _{CV} σ _{CV}], [+voiced], [i]
- σ
 $\swarrow \quad \searrow$
 [-voice] i

σ
 $\swarrow \quad \searrow$
 C V
- b. [CLASS 5] $\Leftrightarrow$ [dorsal, -continuant]

The articulatory features inserted in other classes were listed in Table 3, and the results of VI for all morphemes listed in Tables 6 to 8 can be deduced by analogy.

Peculiarities in the phonological form of some morphemes are accounted for by specific VI rules or pairings that take precedence over the regular ones. An often-cited example of suppletion is provided for English by an abstract feature like [PLURAL], which may be realized by different phonological exponents. The ordering of more specific rules before general ones has been addressed several times in the phonology, Kiparsky's (1973) Elsewhere condition being the option chosen in DM. An alternative is the ranking of specific, context-dependent faithfulness constraints above general, context-free ones in Optimality Theory. In this framework, the choice between phonological allomorphs is best understood as a competition between different forms, and the most restricted rule must apply first in order to be applicable. In (36), *ox* forms its plural by suffixing *-en*, the most restrictive plural in this list. *Fish* and *foot* do not take any suffix. Because they list specific morphemes, the rules in (36)a-b take precedence over (36)c, the regular plural formation.

- (36) Plural allomorphy in English
 a. [PLURAL] $\Leftrightarrow$ - en / { $\sqrt{\text{ox}}$, ...}
 b. [PLURAL] $\Leftrightarrow$ - $\emptyset$ / { $\sqrt{\text{fish}}$, $\sqrt{\text{foot}}$, ...}
 c. [PLURAL] $\Leftrightarrow$ - /z/

A suppletive pairing in Fròʔò is the class 1 demonstrative/relative pronoun [ɲã̃], mentioned in Table 5, which has a special nasal consonant and a nasal vowel. Recall that [w] is the regular consonant of this class. We assume that [ɲã̃] is the nasalized allomorph of [wa] + [nasal]. The vowel is nasal [ã̃] and the preceding consonant is the result of replacing labio-velar [w], which is not allowed before a nasal vowel, by its dorsal nasal alternant. Specific Vocabulary Insertion (37)a takes precedence over (37)b by

Elsewhere. The pairing (37)a applies in class 1 demonstratives/relative pronouns, and (37)b applies in all other class 1 functional morphemes.

- (37) a. [CLASS 1] $\Leftrightarrow$ [dorsal, consonant, nasal] / {demonstrative/relative pronoun}
 b. [CLASS 1] $\Leftrightarrow$ [labial, consonant, vocalic]

A second peculiarity has to do with the exceptional di- and trisyllabic templates found in class 2 and 4 interrogatives, indefinites and demonstratives. Examples of such prespecifications are exemplified for interrogatives of classes 2 and 4 in (38).

- (38) a. [INTERR, class 2] $\Leftrightarrow$ [béʔélé]
 b. [INTERR, class 4] $\Leftrightarrow$ [géʔélé]

A third prespecification concerns the exceptional vowels in some morphemes of Table 5. For instance, in class 2 and 4 pronouns, we find [e] instead of regular [i]. These morphemes have their own prespecified vowels. This also takes the form of specific VI rules that take precedence over the elsewhere rules.

- (39) a. [PRONOUN] $\Leftrightarrow$ [V=e] (class 2, class 4)
 b. [PRONOUN] $\Leftrightarrow$ [V=i]

The fourth singularity that was mentioned in Tables 4 and 5 concerns the free variation between [p/b] and [m] in most class 7 morphemes. This is due to optionality of the feature [nasal] in this class. We assume that VI has the form shown in (40). The feature [nasal] can be present or not, except when the CM starts with a stop. In this case, nasality is forbidden.

- (40) a. [CLASS 7] $\Leftrightarrow$ [labial, -continuant] (CM = bV)
 b. [CLASS 7] $\Leftrightarrow$ [labial, -continuant] or [labial, -continuant, nasal]

Despite these additional specifications, it is important to notice that the initial consonant of the agreeing morphemes is always alliterating. Not a single exceptional specification affects the regularity of the initial consonant. In other words, consonantal alliteration is fully regular.

4 The role of phonology

4.1 VI instructions as inputs in an optimality-theoretic analysis

VI delivers phonological features and some structure, but not enough for completing the phonological form of the functional morphemes described above. In this section, we propose a phonological analysis of the nominal functional morphemes in the framework of constraint-based Optimality Theory (OT). The results of VI instructions play the role of inputs, and faithfulness constraints are responsible for their emergence (or phonological exponence) in the output. Markedness constraints determine whatever phonological structure is not specified by VI instructions but is needed in the output. The result of the markedness constraints is that unspecified slots—features, segments and syllable positions—are filled in. Syllable structure, vowel harmony, nasal harmony and consonant epenthesis are located in the phonological module, where syntax is no longer available; see Saba Kirchner (2010) and Bye & Svenonius (2012:428), among others, for a similar view.

We already saw how the class 5 pronoun *kī* emerges as the result of filling a consonant with the prespecified consonantal features [-voice], [dorsal] and [-continuant] and the prespecified vowel [i], all information coming from VI; see (33) for how the prespecified features are organized in a syllable at VI. A faithfulness constraint IDENT(F) in (41) preserves the prespecified information, as shown in Tableau 1. The constraint IDENT(F) comes in two versions. The first context-free one is formulated as in (41)a, but the identity of the features present in the lexical root is more important than the identity of the features present in the functional morphemes. For this reason, the constraint-sensitive constraint IDENT(F)_{root} in (41)b is needed as well, as will become clear in Tableau 5.

- (41) a. IDENT(F): Let α be a segment in the input and β be any correspondent segment of α in the output. If α has [F], then β has [F]. And if β has [F], then α has [F].
 b. IDENT(F)_{root}: Let α be a segment of a lexical root in the input and β be any correspondent segment of α in the output of the lexical root. If α has [F], then β has [F]. And if β has [F], then α has [F].

Markedness constraints, like ONSET, NOCODA and NUCLEUS in (42), are responsible for the fact that the consonantal features are located in the onset rather than in the coda, and that the vowel is the nucleus of the unique syllable. In the tableaux, these constraints are put together under the name SYLLABLESTRUCTURE or SYLLABLE for short. These constraints are always fulfilled in the functional morphemes: all syllables have the form CV.

- (42) Markedness Constraints (SYLLABLESTRUCTURE)
 a. ONSET: Syllables have onsets.
 b. NOCODA: Syllables have no codas.
 c. NUCLEUS: Each syllable has a vocalic nucleus.

In Tableau 1, the optimal candidate a. fulfills all constraints. This is because the information delivered by VI is sufficient to deliver the phonological content of the functional morpheme. Candidate b. has a voiced consonant and violates IDENT(F) and candidate c. violates ONSET and NOCODA. Since all constraints are fulfilled in the optimal candidate, it is not possible to establish a ranking among them. IDENT(F)_{root} is not active here because the word has no lexical root.

Tableau 1. Class 5 pronoun

[-voice], [dorsal], [-continuant], [i], [σ]	IDENT-IO(F)	SYLLABLE
☞ a. <i>kī</i>		
b. <i>gī</i>	*! (voice)	
c. <i>īk</i>		*!*

In the functional morphemes that have been reviewed above, the prespecified consonantal features are implemented in the first consonant, and the prespecified vowel is the morpheme's first vowel. When it has to do with a single syllable, these requirements are satisfied by the constraints of (42), and there is no alternative. In the di- or trisyllabic functional morphemes, like the class 5 interrogative *gīʔ*, the input consonantal and vocalic features are also associated with the first consonant and the first vowel of the word. In this case, alternatives are available, and the position of the input features must be regulated by

constraints. We propose a constraint called ANCHOR(F) in (43) (see McCarthy & Prince 1995 for anchoring in OT). Due to the effect of SYLLABLESTRUCTURE, the consonantal features are associated with the onset, and the vocalic features with the nucleus.

- (43) ANCHOR(F): The consonantal features specified in the input are anchored to the left peripheral element of the morpheme.

The constraints at play so far have nothing to say about the form of the second syllable of *giʔi*. The second C and V nodes are phonologically unspecified. Vowel harmony and consonant epenthesis are responsible for the remaining phonological specifications. We thus need a formal analysis for vowel harmony and for [ʔ]-epenthesis between identical vowels.¹⁷ Harmonies are the subject of Section 4.2 and [ʔ]-epenthesis of Section 4.3.

4.2 Vowel and nasal harmonies

Vowel and nasal harmonies are pervasive in the entire phonology of Fròʔò, and many examples have been encountered in this article. We understand phonological harmony as ‘a phonological effect in which feature(s) agree over a string of multiple segments’; see Rose & Walker (2011) for a slightly different definition. In such a process, at least two segments interact. This interaction may occur locally, between adjacent segments (nasal harmony), or ‘at a distance’ across at least one unaffected segment (vowel harmony).

Segments can participate in a harmony, but they can also be transparent or block the harmony process. Transparent segments are not participating segments, but they let the harmony apply across them. The blockers also do not participate, and they stop the harmony. If the harmonizing feature reaches a blocker, i.e. an incompatible segment, it stops. Incompatibility arises when a segment is already specified for the feature in question, or if it cannot carry the feature. Harmony processes are usually directional, forward or backward, from the beginning or the end of a prosodic domain.¹⁸ In Fròʔò, vowel harmony always takes place from left to right, and nasal harmony applies in both directions.

4.2.1 Total vowel harmony

In total vowel harmony or vowel copy in Fròʔò, vowels harmonize completely across a consonant, i.e. in all their features (and tone). The process is illustrated schematically in (44). In most of the examples that we have discussed in the previous sections, the trigger is V_{ROOT} and the target is V_{CM} . The process applies in the domain of a prosodic word; in the case that we are studying here, it corresponds to a noun comprising a lexical root and a CM, and in the case of a functional morpheme, the first vowel is specified by the constraints formulated above plus vowel harmony. In both cases, the second vowel takes over all vocalic features of the first one.

$$(44) V_1 C_2 V_3 \rightarrow V_1 C_2 V_1$$

Some additional examples of vowel harmony in nouns appear in (45). V_{ROOT} (in bold), the last vowel of the lexical root, is the trigger. It harmonizes with V_{CM} , the target. In (45)b, the CM is disyllabic, and both

¹⁷ In a morpheme like *béʔélé*, it must be assumed that only [b] is subject to ALIGN. The vowel [e] and [l] are prespecified. The glottal stop is epenthetic as shown for *giʔi* in Section 4.3.

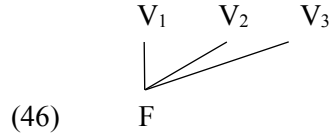
¹⁸ Another option is that an entire domain agrees in a feature without there being a clear origin and/or direction of the process. Since harmonies in Fròʔò are directional, we do not discuss this option.

vowels of the CM harmonize with V_{ROOT} .¹⁹ As mentioned before, this is the only case of iteration of vowel harmony in the language.

- (45) a. kájīē-lēē kógũ-ŋũ kà-ʔà
bird-CM3 knee-CM5 village-CM5
- b. ciē-ʔēlē buo-ʔolo
foot-CM3 granaries-CM4

All vowels may participate in total vowel harmony, including the nasal ones.²⁰ In other words, all features harmonize by spreading across transparent consonants. At least all consonants that start a CM are transparent, obstruents included. We assume that the target of vowel copy is unspecified prior to harmony and that vowel copy is equivalent to a feature-filling process.

After the harmony process is completed, all segments V_1 , V_2 and V_3 harmonize in all their features F . The trigger is always V_1 ; see (46).²¹



In the OT model proposed here, total vowel harmony is regulated by two constraints, HAVEFEATURES in (47)a, which requires that a vocalic position is filled in by a vowel with features, and AGREEV in (47)b, requiring total vowel harmony, see Bakovic (2000) for a similar constraint. More generally, these constraints demand that if a vowel is completely unspecified in the input, it must acquire vocalic features, and this happens as the result of copying all features from the specified vowel in the same prosodic word rather than by inserting any other vowel. In our examples, V_{ROOT} is fully specified and V_{CM} acquires the same features by fulfilling the constraints in (47). No prespecified vocalic features are changed because $\text{IDENT}(F)_{\text{root}}$ prohibits featural changes in the root.

- (47) OT constraints for vowel harmony
- a. HAVEFEATURES: Vocalic and consonantal nodes must have features.²²
- b. AGREEV: Output vowels in the same prosodic word agree in all features.²³

¹⁹ Notice that the vowels resulting from vowel harmony are often deleted in casual speech; see Traoré & Féry (2018) for a discussion of vowel deletion.

²⁰ It is important to note, however, that total harmony does not apply across-the-board. In some (rare) cases, V_{ROOT} does not spread to V_{CM} , as in class 5 nouns: *jù-gò* ‘head-CM5’, *dā-gò* ‘sheet-CM5’. In such cases, V_{CM} is prespecified.

²¹ There is an ongoing debate in the literature about the arguments and counterarguments for spreading- vs. correspondence-based theories of copy epenthesis (see Walker 2001, Rose & Walker 2004 and Stanton & Zukoff 2018). The Fròʔò data presented here are compatible with both approaches.

²² This constraint is reminiscent of Itô & Mester’s (1993:201) notion of segment licensing by Root and Place.

²³ We are aware of the ‘sour grapes’ effect identified by McCarthy (2011) in relation with AGREEV or AGREENAS. However due to the distinction between prespecified versus unspecified segments in OT (see also Inkelas, Orgun & Zoll 1997) and because no opaque consonant blocks harmony in Fròʔò, no sour grapes effects appear here.

Tableau 2. Total vowel harmony

kà -ʔV village-CM5	IDENT(F) _{root}	HAVEFEATURES	AGREEV	IDENT(F)
a. kà-ʔà				
b. kì-ʔì	*!			*
c. kà-ʔV		*!		
d. kà-ʔì			*!	

Some class markers do not copy V_{root} . Instead they have a prespecified initial vowel: class 2 *hélé* or *bēʔēlē* and class 4 *gēlē* or *gēʔēlē*. In addition to the trisyllabic template, this prespecification is part of the VI instructions and has to appear as such in the input. As before, the first vowel is prespecified and the other vowels are just a copy.

As for the class 1 demonstrative *ŋā* the vowel is nasal and as such it is different from the unmarked one for class 1 which is oral. However, default phonology is also active in the sense that the nasality of the consonant may be the result of nasal harmony, to which we turn in the next subsection.

4.2.2 Nasal harmony (vowel-consonant harmony)

Nasal harmony differs from vowel harmony in three respects: First, a continuous string of vowels and consonants is involved, as shown in (48). Nasal harmony is thus strictly local. Second, the process is feature changing rather than feature filling. Third, both consonants and vowels can be trigger and target. In (48)a, the vowels are triggers, and in (48)b, the consonant is the trigger.

$$\begin{array}{ll}
 (48) \quad \text{a. } V_{[\text{nas}]} C V_{[\text{nas}]} & \rightarrow V_{[\text{nas}]} C_{[\text{nas}]} V_{[\text{nas}]} \\
 \quad \text{b. } C_{[\text{nas}]} V & \rightarrow C_{[\text{nas}]} V_{[\text{nas}]}
 \end{array}$$

Let us start with vowels as triggers and consonants as targets, as in (48)a. In (49), a nasal consonant appears between two nasal vowels. The crucial point is that only a nasal consonant is allowed between two identical nasal vowels. This is illustrated here with the dorsal nasal and [g], but the same point can be made with the other obstruents, stops and fricatives, both voiced and voiceless. None of them are allowed between two nasal vowels.

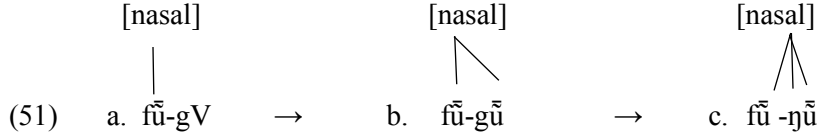
$$\begin{array}{ll}
 \begin{array}{c} [\text{nasal}] \\ \wedge \\ \text{a. } \text{fũ-ŋũ} \end{array} & \text{'anger-CM5'} \\
 \begin{array}{c} [\text{nasal}] \\ \wedge \\ \text{b. } \text{jĩĩ-mũ} \end{array} & \text{'milk-CM7'}
 \end{array}$$

We assume that /g/ is phonemic and [ŋ] may be an allophone of /g/ when it is surrounded by nasal vowels. [g] can appear between two oral vowels or between an oral and a nasal vowel in both orders, as illustrated in (50) with nominal roots. In (50)a, the vowel preceding [g] is nasal and the vowel following [g] is oral, in (50)b, it is the other way around, and in (50)c, both vowels around [g] are oral.

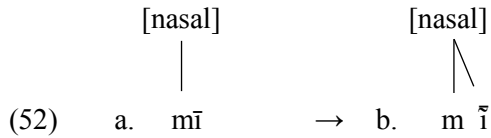
$$\begin{array}{lll}
 \begin{array}{c} [\text{nasal}] [\text{oral}] \\ | \quad | \\ \text{a. } \text{kāgālā} \\ \text{'jackal'} \end{array} & \begin{array}{c} [\text{oral}] [\text{nasal}] \\ | \quad | \\ \text{b. } \text{kógũ-ŋũ} \\ \text{'knee'} \end{array} & \begin{array}{c} [\text{oral}] [\text{oral}] \\ | \quad | \\ \text{c. } \text{kōgō} \\ \text{'cat'} \end{array}
 \end{array}$$

However, [g] does not appear between two nasal vowels, and [ŋ] is found instead; see (49).

In the allophonic relationship between [g] and [ŋ], total vowel harmony applies first, as in (51)a, resulting in two identical nasal vowels, as in (53)b. In a procedural description, the [nasal] feature that is found at both sides of [g] spreads back to the consonant, which becomes nasal as well; see (53)c.²⁴ In other words, the feature [nasal] originates in V_{ROOT} (the trigger) and spreads to V_{CM}, and then back to the intervocalic consonant.



In the second type of nasal assimilation, (48)b, a nasal consonant is the trigger, and the following vowel is the target; see (52) for illustration. The example is the nasal allophone of the class 7 pronoun, the non-nasal alternant being *pĩ* with an oral vowel.



The nasal harmony illustrated in (52) only targets a vowel that has at least some underlying specification; it cannot affect an oral vowel resulting from total vowel harmony: such a vowel cannot be changed again by nasal harmony. Because of this restriction, oral vowels can be adjacent to nasal consonants, as was illustrated in (18) with the word *lā-mā* ‘belly-CM7’, but only when they are the result of vowel harmony. In this word, the oral V_{ROOT} is copied to the unspecified V_{CM}, which harmonizes with its oral specification. As such, nasal harmony cannot apply, and a sequence of a nasal consonant and an oral vowel arises, as the result of a bleeding relationship. In other words, in a derivational view, vowel harmony and nasal assimilation apply in this order, and vowel harmony bleeds nasal assimilation. Moreover, since vowel harmony is always left-to-right, there is no way that the nasality of the CM consonant can have a regressive effect on the preceding vowel, which remains oral in *lāmā*.²⁵

Tableau 3 illustrates the vowel-triggered nasal harmony. Two additional constraints are needed. The first one, *[$\tilde{\text{V}}\text{Obs}\tilde{\text{V}}$], prohibits an oral obstruent between nasal vowels; see (53)a. The second one requires that adjacent segments agree in the feature [nasal]: if a segment is prespecified for [nasal], adjacent segments are nasal as well.

- (53) a. *[$\tilde{\text{V}}\text{Obs}\tilde{\text{V}}$]: No obstruent between nasal vowels.
b. AGREE(nasal): Adjacent segments agree in their nasal feature

The constraint AGREE(nasal) may be violated when segments are prespecified as oral, as explained above. In the present case, the initial [f] is prespecified as such and has no nasal allophone. It remains oral and violates AGREE(nasal).

²⁴ This looks like what Lionnet (2016) calls ‘subphonemic teamwork’: in this case, two distinct nasal features must be present to result in nasalization of another segment.

²⁵ There is at least one piece of evidence for an additional regressive nasal harmony from a vowel to a consonant. The palatal glide [j] has an allophone [ɲ] before a nasal vowel: *jō* ‘tell’ vs. *ɲā* ‘see’. These segments seem to be in complementary distribution. However, more data are needed in order to be entirely confident that this analysis is correct.

Tableau 3. Nasal harmony (vowel to consonant)

fũ- V _{ROOT}	g/ŋ V C V _{CM}	IDENT(F) _{root}	HAVE FEATURES	*[ṼObsṼ]	AGREE (nasal)	AGREEV	IDENT(F)
☞	a. fũ-ŋũ				*		
	b. fũ-gũ			*!	**		
	c. fũ-gũ				**	*!	
	d. fũ-gV		*!		**		
	e. fũ-gũ	*!					*

The word *lā-mā* ‘belly’ with a nasal consonant between two oral vowels is illustrated in Tableau 4. As shown above, the first vowel is specified as an oral vowel, and does not change its specification due to IDENT(F)_{root}. The vowel is copied to the V_{CM} without this vowel acquiring the nasality of its onset consonant. This is the result of the ordering of AGREEV above AGREE(nasal). The effect of HAVEFEATURES is taken for granted in the following tableaux.

Tableau 4. Vowel harmony bleeds nasal harmony

lā- V _{ROOT}	m V C V _{CM}	IDENT(F) _{root}	AGREEV	AGREE(nasal)	IDENT(F)
☞	a. lā-mā			**	
	b. lā-mā̃		*!	*	
	c. lā̃-mā̃	*!		*	*
	d. lā-pā				

As for the consonant-triggered allophony, no additional constraint is needed. AGREE(nasal) is sufficient to guarantee that nasal features are shared with neighboring segments, as long as these segments are not the result of total vowel harmony. In Tableau 5 for *mĩ* ‘I’, it is assumed that the input vowel is unspecified for nasality and that adding a nasal feature by harmony does not violate IDENT(F)_{root} since the vowel undergoing harmony is not part of a lexical root. The context-insensitive IDENT(F) is ranked lower than AGREE(nasal), allowing the vowel to agree with the preceding consonant in its nasality.

Tableau 5. Nasal harmony (consonant to vowel)

/mĩ/ ‘I, me’	IDENT(F) _{root}	AGREE(nasal)	IDENT(F)
☞ a. mĩ̃			*
b. mĩ		*	

4.3 Epenthetic [ʔ]

In this subsection, it is shown that the glottal stop in the second C is the result of [ʔ]-epenthesis. [ʔ]-epenthesis applies between identical vowels.²⁶ Epenthesis is needed to fill in an unspecified consonant position in the CV skeleton. It violates the DEP constraint in (54).

(54) DEP: No epenthesis.

Returning next to the interrogative *giʔi*, the first consonant gets the consonantal features because of ANCHOR(F) in (43). The first vowel of the interrogative is specified with all input features as shown above for *kī*, and the second vowel is a copy of the first by total vowel harmony. It must be noted that the form of the interrogative strongly resembles a lexical root plus a CM5, pointing to a characteristic pattern of the language beyond lexical root plus CM. Verbs also very often consist of two syllables with harmonizing vowels and a glottal stop between them.

Tableau 6 ignores candidates containing syllables that do not conform to the canonical structure CV. Candidate a. fulfills all constraints except for low-ranking DEP. Candidate b. violates SYLLABLE because the second syllable lacks an onset. Candidate c. violates ANCHOR(F). Candidate f. violates AGREEV. To eliminate candidate e., we need to guarantee that prespecified consonantal features only emerge once, and we propose to use the constraint INTEGRITY(C) to this effect (McCarthy and Prince 1995).

(55) INTEGRITY(C): No consonantal element of the input has multiple correspondents in the output.

The template [σσ] (or [CVCV]) also needs to be fulfilled, and this is achieved with the constraint MAX-IO[σ] in (56). Candidate d. violates this constraint, because the second syllable is lacking entirely.

(56) MAX-IO(σ): The number of syllables in the output corresponds to the number of syllables in the input.

Tableau 6. *giʔi*: [ʔ]-epenthesis in class 5 interrogative

[+voice], [dorsal, -cont], [i], [σσ]	IDENT(F)	SYLLABLE	ANCHOR(F)	MAX-IO(σ)	INTEGRITY (C)	AGREEV	DEP
a. <i>giʔi</i>							*
b. <i>gi.i</i>		*!				*!	
c. <i>ʔigi</i>			*!				*
d. <i>gi</i>				*!			
e. <i>gigi</i>					*!		
f. <i>giʔá</i>						*!	*

²⁶ This analysis is confirmed by the neighboring dialect Katiola that has [gi:] with a long vowel instead of *giʔi*, as in many other words where a long vowel takes the place of VʔV.

This closes the survey of the phonological processes governing vowel and nasal harmonies as well as filling in deficient phonological structure in the associate morphemes of a head noun in Fròʔò.

5 Discussion and conclusion

The main topic of this article is the phonological properties of morphemes of the same nominal class in Fròʔò, the most striking aspect being the presence of recurrent articulatory features for each inflectional class, a case of alliterative concord. This pattern arises when several functional morphemes of the same class are linearized. The best answer of morphology is to reproduce the pairing between class and phonological features each time a function word is present. In (57), a longer sequence of functional morphemes, the same pairing is reproduced six times.

(57)	jē-gē	ki	gíʔi	gī	gā	gè
	month-CM5	PRO5	which5	ID5	DEM5	CL-END.PTC5
	↕	↕	↕	↕	↕	↕
	[dor, -cont]	[dor, -cont]	[dor, -cont]	[dor, -cont]	[dor, -cont]	[dor, -cont]
	‘Which is this month?’					

In this approach, alliterative concord is considered a purely morphological phenomenon that does not need to be given a phonological account. However, the free associate morphemes consist not only of alliterating consonantal features coming from their nominal class, but also of other morphosyntactic features paired with additional phonological features. The order of these different phonological features is not reflected in the linearization of the exponents. Instead, features are organized in a non-concatenative fashion, and if there is a hierarchy of morphological features at all, it is not crucial. Purely phonological effects across segments have been uncovered in this study as well, and an optimality-theoretic analysis has been proposed for them. Different types of vowel and consonant harmonies in the nominal domain have been explored: total vowel harmony, nasal consonant-vowel harmony and consonant epenthesis. Although they all apply in the nominal domain, they have different operational ranges. Vowel harmony concerns only two (exceptionally three) vowels separated by a transparent consonant. Nasal consonant-vowel harmony only affects a sequence of two vowels and in some cases, the consonant in-between. The domain of harmonies and consonant epenthesis seems to be limited to the prosodic word. Alliterative concord has a larger domain, and concerns all morphemes related to a head noun.

Alliterative concord is not an accident in Fròʔò, but rather it is part of the phonological system of the language. Fròʔò speakers recognize the class of nouns primarily by the initial consonant of the functional morphemes. The class markers may also help the categorization, but since they may be absent or have ambiguous forms, class markers are less reliable than agreeing functional morphemes, since they take different forms, or even be absent altogether. We propose that class markers participate in the alliterative concord rather than eliciting it.

The alliterative pattern of Fròʔò is rather atypical when we compare it to similar cases described in the literature. Alliterative patterns have been described for several languages; see for instance Fortune (1942), Nekitel (1986), Aronoff (1992), Dobrin (1995) and Dimitriadis (1997) for phonological concord in nominal classes in Arapesh and Abu’ (Mountain Arapesh), Papuan languages spoken in New Guinea. In Arapesh, the last consonant of a noun is often copied into the pronoun and the verb with which it agrees, resulting in an alliterating concord pattern. This even happens with consonants newly introduced into the consonant inventory of the language through loanwords. However, this process is restricted to part of the vocabulary, which is for the most part non-alliterative.

Sauvageot (1967, 1987) cites Bañuk, a West Atlantic language spoken in Senegal, where the first CV syllable of some words may be copied in part of its vocabulary (mainly borrowed words but

nonetheless 25% of the words) and plays the role of a gender agreement morpheme on an associate adjective or demonstrative.

Moreover, Kaye (1981), Marchese (1986, 1988) and more recently Sande (2017) show that Vata, Godié and Guébié, respectively, all Kru languages of Côte d'Ivoire, have phonologically motivated pronominal systems, in addition to other agreeing words. Non-human nouns are organized into five (for Godié or Vata) or three classes (for Guébié) according to their final vowel, and subject pronouns referring to them take five or three different shapes, depending on this vowel. Again, this kind of alliterative system is limited to a small part of the functional morphemes, although other kinds of alliterative agreement also take place in adjectives. In Guébié, the third person subject pronoun has an invariable singular form [ɔ] and an invariable plural form [wa], when it refers to a human being. The exponent of a non-human third person pronoun, however, is variable: it is [ʊ], [ɛ] or [a], where the feature [-ATR] of the dependent morpheme is lexically specified. Sande (2017:50) writes, “Non-human third person pronouns agree with their nominal antecedent not in semantic features like person or number, but in phonological features, where the final vowel of the noun stem determines the vowel of the pronoun.” The choice between the three forms of the pronoun is determined by the features [±back] and [±low] of the final vowel of the stem. These features are phonologically copied from the root. When a noun ends in one of the [+back, -low] vowels [u, ʊ, o, ɔ], its corresponding pronoun is [ʊ]. When the noun ends in one of the [-back, -low] vowels [i, ɪ, e, ɛ], the pronoun is [ɛ], and when it ends in a [+back, +low] vowel [ə] or [a], the pronoun is [a].

Thus Arapesh, Bāinuk and Guébié, copy (or are faithful to) a syllable, a segment, or part of a segment as phonological agreement. However, this strategy is unavailable for Fròʔò because the alliterative features are often not literal parts of the head noun (lexical root + CM): the lexical root does not carry any of the features appearing in the alliterative concord, and the CM may or may not carry the agreeing features. In many cases, the features that are copied are not present in the CM, be it because the CM has a different phonological form, or because the CM is covert, and then absent altogether. If the alliterating features originate in the lexical root or in the CM, they can only be abstract features. These original features may be unrealized in a sentence with a pronoun or any other functional morpheme referring to a head noun; see (26) for an example of a sentence where a pronoun refers to an absent head noun. In other words, the CM sometimes participates in the alliteration but does not necessarily do so.

In sum, alliteration in Fròʔò is not a classic spreading relationship and not a reduplication or copy and deletion operation. All associate morphemes start with similar consonants, but there is no locality involved. Vowels interfere, as do words and in some cases entire constituents, see (58) for an example in which alliterative concord takes place across a relative clause. In (58)b, the pronoun *wí* refers to a person and has to agree with class 1. The referent of the pronoun *wí* does not need to be literally pre-mentioned in the discourse; it can be contextually present.

- (58) a. *tī-ṭī gā kí tō wā klōʔō nã kí nĩ kpàgna-ṇã*
 tree-CM5 RC.PRO.5 PRO.5 fall.down there street on PRO.5 ASP big-CM5
 ‘The tree that fell down on the street is big.’
 b. *wí mǎ sɛbé kǎ John mǎ*
 PRO.1 ASP book give John to
 ‘S/he gave the book to John.’

In future research, it will be important to establish a typology of alliterative concord, and to understand the role it plays in the different languages cited above, as well as in others. It will also be important to give a phonological account that can cover all the cases, something which has not been done so far.

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