Distributing morphologically conditioned phonology: Three case studies from Guébie

by

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Abstract

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The focus of this study is process morphology in Guébie, an endangered Kru language spoken in Côte d'Ivoire. Unlike many primarily affixing morphological systems, much of the morphology in Guébie involves root-internal phonological changes like tone shift and vowel replacement. For this reason, Guébie data have much to offer discussions of the interface between morphology and phonology. Based on the Guébie facts presented here, I argue 1) that process morphology, where a non-concatenative phonological process is the sole exponent of a morpheme, is a subtype of morphologically conditioned phonology, and 2) that not all morphology involves underlying phonological items. I conclude that whether a morpheme triggers a phonological process is independent of whether a morpheme is associated with underlying phonological content. Instead, morphologically conditioned phonological processes are driven by phonological constraints, whose rankings are determined by particular morphosyntactic features present in the domain being phonologically evaluated.

This study describes the phonology and morphology of Guébie, focusing in particular on three case studies of morphologically conditioned phonological processes. These include phonologically determined noun class agreement, scalar tone shift, and vowel replacement. In each of these case studies we see evidence for specific interactions between not only morphology and phonology, but also syntax and phonology. On the morphological side, Guébie tonal morphology shows us that not every morpheme is associated with an underlying (abstract) phonological item. With respect to syntax, we see that domains of phonological evaluation in Guébie must be larger than a single word, but not larger than a syntactic phase. We also see phonological processes sensitive to both morphosyntax and lexical class in Guébie, suggesting that any model of phonological grammar must be able to reference morphosyntactic and lexical information. By exploring morphological exponents across a language, we can narrow down the space of possible models that account for morphosyntactic interaction with phonology.

Contents

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Chapter 1

Introduction

1.1 Process morphology

The primary concern of this study is the extent to which morphology and phonology interact, and how that interaction is best modeled. To investigate the relationship between morphology and phonology, morphologically conditioned phonological patterns are explored. I take morphologically conditioned phonology to include any phonological alternation that is not fully general in a language, but occurs in a particular morphological environment or set of environments. In some cases, these phonological alternations co-occur with an overt segmental affix or clitic. In other cases, though, a phonological alternation takes place in a root or stem context without the addition of segmental material. I refer to the latter case as *process morphology*.

Two central questions of this study involve the status of process morphology. First, should process morphology be modeled in the same way as morphologically conditioned phonology more generally (cf. Inkelas 2014)? And second, are morphologically conditioned phonology and process morphology best modeled with (abstract) underlying phonological items? Sections 1.1.1 and 1.1.2 delve deeper into the theoretical significance of these questions.

1.1.1 Process morphology and morphologically conditioned phonology

Morphosyntactically conditioned phonology involves phonological allomorphy triggered in particular morphosyntactic contexts. Sometimes, morphologically conditioned phonology accompanies a segmental affix or clitic, or a compounding or reduplication strategy. I use the abbreviation MCP to refer to morphologically conditioned phonology that occurs together with a segmental exponent. For example, in Hausa (Chadic), intensive adjectives and pluractional verbs are marked with prefixing reduplication; in the same context, stem initial consonants undergo gemination (Newman, 2000, 16, 47, 234-235, 365, 425).

(1) **Hausa gemination in prefixing reduplication contexts**

	Verb	**Pluractional**	**Gloss**
a.	búga:	búbbúgà:	'beat'
b.	dánnè:	dáddàné	'press down, oppress'
c.	g^jàrú	g^jàgg^jàrú	'be well repaired'
d.	bí	bíbbí	'follow'
e.	ʃá:	ʃáʃʃá:	'drink'
	Adjective	**Intensive**	**Gloss**
f.	gáutsí:	gàggáutsá:	'brittle'
g.	ƙárfi:	ƙàƙƙárfá	'strong'

In Hausa, gemination is a morphologically conditioned phonological alternation, which co-occurs with prefixing reduplication in intensive and pluractional contexts. Root-initial consonant gemination is morphologically conditioned because it does not occur after every prefix: /táɓà/, 'work', plus the diminutive prefix /ɗan/ surfaces as [ɗan-táɓà], not *[ɗan-t̲t̲áɓà].

There are also phonological alternations which occur in particular morphosyntactic contexts without any additional segmental material (i.e. gemination not accompanied by reduplication or any additional segmental material). I refer to this non-affixal morphology as *process morphology* here. For example, in Alabama (Muskogean), the imperfective aspect is marked by gemination of the onset of the penultimate stem syllable, without additional segmental material (Hardy and Montler, 1988, 400-401).

(2) **Alabama gemination in imperfective contexts**

	Base	**Imperfective**	**Gloss**
a.	balaaka	bállaaka	'lie down'
b.	cokooli	cókkooli	'sit down'
c.	atakaali	atákkaali	'hang up one object'
d.	atakli	áttakli	'hang more than one object'

One could ask whether morphologically conditioned phonology which co-occurs with added segmental material, like gemination in Hausa, is fundamentally different from process morphology, like gemination in Alabama. Inkelas (2014) carries out an informal survey of MCP and process morphology, demonstrating that the two involve the same operations on several levels (ch. 2, 3). While both MCP and process morphology involve a phonological process triggered in particular morphosyntactic contexts, MCP involves an additional exponent, added segmental material, while process morphology does not. There is no other difference between MCP and process morphology, thus there is no reason to distinguish between the two in a model of morphophonological interaction. I follow Inkelas's generalization here in treating process morphology as a subtype of morphologically conditioned phonology, where there is no meaningful theoretical difference between the two.

Morphologically conditioned phonological alternations like the Hausa and Alabama examples in (1, 2) have been modeled in a number of theories which involve multiple distinct phonological grammars present in a single language. These distinct phonological grammars allow for phonological processes like gemination to occur in some morphological contexts, but not others. Such theories, which Inkelas (2014) refers to as Multiple-Grammar Theories, include Lexical Phonology and Morphology (Kiparsky, 1982), Stratal OT (Bermúdez-Otero, 1999; Kiparsky, 2000, 2008), and Cophonology Theory (Orgun, 1996; Inkelas et al., 1997; Anttila, 2002; Inkelas and Zoll, 2005, 2007). Other theories limit the number of phonological grammars per language to one, but allow rules or constraints to be indexed to particular morphosyntactic contexts. These include the Sound Pattern of English (Chomsky and Halle, 1968), as well as parallel Optimality Theory (Prince and Smolensky, 1993; Itô and Mester, 1995a,b; Fukazawa, 1998; Itô and Mester, 1999; Pater, 2007), referred to as Single Grammar Theories by Inkelas (2014). Inkelas and Zoll (2007) and Inkelas (2014) argue for a multiple-grammar approach over a single-grammar one, eliminating the need for indexed rules or constraints. I follow their line of reasoning here, adopting a multiple-grammar approach to morphologically conditioned phonology.

1.1.2 Item versus process morphology

One could imagine an analysis where MCP that co-occurs with segmental material is triggered by that segmental material. For example, in the Hausa gemination example in (1), this would mean that the presence of the reduplicative prefix itself triggers gemination of the initial root consonant. On this analysis, it is unclear what would trigger process morphology like gemination in Alabama, which does not co-occur with any additional segmental material. One option is to say that all morphologically conditioned phonology, including process morphology, is triggered by additional phonological material, where in the case of process morphology that added material would be abstract, and would not surface. Its function would be simply to trigger the phonological process, like gemination in Alabama.

Much recent literature has indeed adopted the view that all morphology is item-based, meaning that any morphology with phonological exponence is the result of the addition of phonological material (Benua, 1997; Alderete, 2001; Wolf, 2007; Bermúdez-Otero, 2012; Gouskova and Linzen, 2015; Zimmermann, 2013; Trommer and Zimmermann, 2014; Köhnlein, 2016). This recent work builds on more traditional work in item-based morphology, including Lieber (1980) and Selkirk (1982). Process morphology like truncation, scalar shifts, metathesis, and replacive morphology pose challenges for a purely item-based view of morphology. Hockett (1954) and Anderson (1992) famously raise this debate, both coming down in favor of the need for process morphology without underlying items.

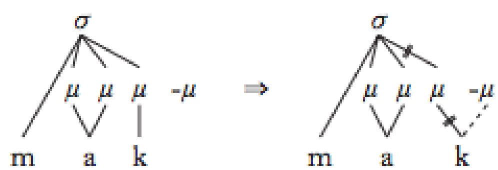
Often, purely item-based analyses of process morphology like truncation involve complex, otherwise unmotivated, abstract underlying representations. For example, Trommer and Zimmermann (2014) analyze even subtractive morphology as affixation, in this case affixation of a defective mora. The addition of this mora, through constraints referencing autosegmental structure, results in the removal of a mora on the surface. In Tohono O'Odham, the final segment (mora) of a verb is absent in the perfect (Fitzgerald and Fountain, 1995, 5-6).

(3) **Tohono O'Odham subtractive morphology**

	Imperfect	**Perfect**	**Gloss**
a.	má:k	má:	'giving'
b.	hí:nk	hín	'barking'
c.	híhim	híhi	'walking (pl)'

Trommer and Zimmermann (2014) analyze this subtraction as affixation of a defective mora in the perfect aspect, which through constraint-based evaluation results in a form that has one fewer surface mora than its input, (4).

(4) **Mora affixation: An abstract item-based account of process morphology** (Trommer and Zimmermann, 2014, 468, 487)



While Trommer and Zimmermann's item-based account derives the correct output for Tohono O'Odham subtractive morphology, the analysis is unintuitive and highly abstract. Here the addition of phonological material results in the removal of a mora between input and output.

An alternative solution to the approach that all morphology is item-based is to allow for constraints to drive phonological processes without the addition of abstract phonological information. I propose such a solution throughout the following chapters, termed Distributed Cophonology Theory, which is based in the morphological operations of Distributed Morphology (DM) (Halle and Marantz, 1994) and a constraint-based implementation of Cophonology Theory. While DM is strictly speaking an item-based theory itself, we will see that when combined with morpheme-specific cophonologies, the result is a model that allows for MCP and process morphology to be derived the same way, via constraint-based interaction, in particular morphosyntactic environments.

1.1.3 Evidence from a highly process-based morphological system

Guébie (Kru) [Côte d'Ivoire] is an understudied, endangered language with a highly process-based morphological system. While there are a handful of nominal and verbal affixes in the language, which interact phonologically in interesting ways with each other and with the stems they attach to, much of Guébie morphology is not obviously affixal. That is, much of the morphology involves non-concatenative processes such as root-internal tone changes or vowel alternations.

Due to its rich array of both concatenative and non-concatenative morphology, data from Guébie has much insight to offer questions of how to model process versus item-based morphology, and whether process morphology and other types of morphologically conditioned phonology should be modeled with the same tools. This study provides an initial in-depth description of affixal and non-affixal morphology in Guébie, focusing in particular on three non-concatenative processes: phonologically determined noun class agreement marking, scalar tone shift to mark imperfective aspect, and lexically and morphologically conditioned alternations in root vowels.

Examining the interactions between morphology and phonology across an entire language can guide the choice of theoretical tools used to model such interactions. While there may be more than one model capable of accounting for a single morphophonological phenomenon, considering the full array of phonological phenomena within a language can help to narrow down which models make the best predictions.

1.1.4 The proposed model

The model proposed here on the basis of morphologically conditioned phonological processes in Guébie involves a Distributed Morphology style morphological component of grammar (Halle and Marantz, 1993, 1994) combined with morpheme-specific phonological grammars of constraint interaction, as per Cophonology Theory (Orgun, 1996; Inkelas et al., 1997; Anttila, 2002; Inkelas and Zoll, 2005, 2007). I refer to the combination of tools used in this model as Distributed Cophonology Theory. The justification for this choice of Distributed Cophonology Theory over other models is made throughout chapters 3, 4, and 5, as the Guébie morphophonological data are explored in depth.

In Distributed Morphology, morphology is interpreted from syntactic structure, and phonological information is inserted late in the derivation, unavailable to syntactic operations. Due to the late insertion of phonological material, we do not expect syntactic operations to be sensitive to phonological information. The phonologically determined agreement data in chapter 3 bears specifically on this question.

Cophonology Theory allows for multiple phonological constraint rankings in a single language, where each distinct phonological grammar is triggered by a particular morpheme, and more specifically by a morphosyntactic feature. In the version of Distributed Morphology adopted here, morphosyntactic features persist through the morphology and remain in the input to the phonology, such that the phonological component can reference those morphosyntactic features when determining which phonological grammar to apply. These morphosyntactic features alone trigger a particular constraint ranking, which is used to evaluate possible output candidates, much like constraint-based evaluation in Optimality Theory (Prince and Smolensky, 1993).

The fact that morphosyntactic features trigger cophonologies allows for constraint-driven phonological processes to occur in particular morphosyntactic contexts, without referring to an abstract underlying phonological form. The scalar tone shift in imperfective contexts, presented in detail in chapter 4, which cannot adequately be analyzed as involving an underlying phonological item, provides evidence for such a process-based analysis.

While many phonological processes in Guébie are morphologically conditioned, we also find lexically conditioned phenomena, and processes that are both lexically and morphologically conditioned. The data from root-internal vowel alternations presented in chapter 5 addresses the question of how to incorporate both morphological and lexical specificity into a model of phonology.

1.2 Roadmap

We begin in section 1.3 with a description of the Guébie language and people, along with an explanation of the data collection and corpus that this study is based on.

Chapter 2 provides a full description of Guébie phonology and morphology. This chapter includes a proposed phonemic and tonemic inventory, an exposition of the syllable structure and prosodic properties of words, a discussion of phonological alternations, a description of the affixal and non-affixal morphology of the language, along with an introduction to phonological processes specific to morphosyntactic constructions.

Chapters 3, 4, and 5 each describe in detail a particular morphosyntactically conditioned phonological phenomenon. These chapters are best read after chapter 2, which contains relevant phonological and morphological background.

Chapter 3 focuses on phonologically determined noun class agreement, where pronouns and adjectives agree phonologically with the phonological form of the head noun. The data in this chapter bear on questions of how much interaction phonology has with morphology and syntax (i.e. Is syntax really phonology free?), and how to model phonological agreement or alliterative concord.

Chapter 4 examines scalar tone shift in imperfective contexts in Guébie, where in imperfective contexts only, the tone on on a verb surfaces one step lower than it does elsewhere. If the verb tone is already low, the tonal shift affects the preceding word, the subject of the sentence, and the final subject tone raises one step. This data bears on questions of item-based versus process morphology, category-specific phonology (nouns vs verbs), and the interaction of phonology with morphology and syntax.

Chapter 5 focuses on two vowel alternations that both affect the same subset of roots in Guébie: vowel reduction and vowel replacement. Vowel reduction involves CVCV words that surface as CCV, and vowel replacement involves featural changes to the initial vowel in a CVCV root in particular morphosyntactic environments. This chapter bears on questions of how to model lexically and morphosyntactically specific phonological alternations; the interplay between phonology and morphology and syntax on one side, and phonetics and psycholinguistics on the other; and the phonological representation of non-arbitrary sublexical patterns.

Chapter 6 highlights the interaction of the three phenomena discussed in chapters 3, 4, and 5, and discusses the implications of these data and analyses for theories of morphology and phonology.

1.3 Background on Guébie

1.3.1 Language background

Kru is a language family of the Niger-Congo phylum, made up of languages spoken in Liberia and Côte d'Ivoire. There are two major sub-branches of Kru, Eastern and Western (Delafosse, 1904). For the most part, Eastern Kru is spoken in Côte d'Ivoire, and Western Kru is spoken in Liberia, though some Western Kru languages extend into western Côte d'Ivoire.

Guébie (pronounced [ge.bi.e]) is an Eastern Kru language spoken by approximately 7000 people in seven villages in southwest Côte d'Ivoire. Until recently, Guébie was classified twice as two distinct Eastern Kru languages in Ethnologue [dic, btg], though initial comparative data suggest it is part of the Dida sub-group (Sande, forthcoming), closely related to Vata [dic], described by Koopman (1984). In spring 2017, Guébie was given an independent ISO code, [gie] (Lewis et al., 2013).

Guébie is also sometimes called Gaɓogbo; however, there is a village called Dodougnoa, spoken only eight kilometers from Gnagbodougnoa, whose residents speak a Kru dialect or language called Gaɓogbo which is related to Guébie, though is morphophonologically and syntactically distinct. Both Gaɓogbo and Guébie come from the Guébie phrase [*ga*^{3} *ɓi-ə*$^{3.2}$], *rope finish*-CAUS, 'the rope was finished', which refers to a specific type of rope that Guébie people use to build traditional houses.

Guébie is sometimes written in French as Guébié, which follows the pronunciation; however, speakers write Guébie, without the final accent, which is the convention I use here.

There are seven Guébie villages, which straddle the prefectures of Gagnoa and Sud-Bandama. Bété-Gagnoa is often described as the language of the prefecture of Gagnoa, and Dida as the Kru language of Sud-Bandama. The geographic situation of Guébie across these two prefectures explains its misclassification as both Bété-Gagnoa and Dida-Lakota (Lewis et al., 2013). Gnagbodougnoa is the largest of the seven Guébie villages with a total population nearing 1000. About 2/3 of the people in Gnagbodgougnoa speak Guébie, while others who were misplaced during the 2010 crisis in Côte d'Ivoire are Dioula (Mande) or Lobi (Gur) speakers. French is the lingua franca of the village. Guébie is not recognized by the Ivoirian census, thus this information comes from my own fieldwork experiences in Côte d'Ivoire in the summers of 2014-2016, as well as from the governor of the sub-prefecture of Gnagbodougnoa.

Guébie people are subsistence farmers, growing rice and cassava for their families and occasionally growing cacao to sell to the government for profit. Until recently, Guébie-speaking villages were isolated with little access to the nearest city. However, in the late 1990s, a road was created from Gnagbodougnoa to Gagnoa, the nearest city. Gagnoa, a city of more than 200,000 people, is only 31 kilometers from Gnagbodougnoa, and now Guébie speakers have easy access and make regular trips there. The indigenous language of Gagnoa is Bété-Gagnoa (btg), a Kru language not mutually intelligible with Guébie. French is the lingua franca of the city.

Since having access to Gagnoa, Guébie speakers have begun speaking more French and less Guébie. French is the language taught in schools, used in government, and it is the lingua franca of all urban areas in the country. It is becoming the norm for children in Guébie villages to learn French before Guébie, thus the language is in critical condition.

There is only one known living monolingual speaker of Guébie, and all other speakers are bilingual in French, the official language and language of education in the country. Many Guébie speakers also speak a second Kru language, due to common exogamy practices in the area. There are no extant resources on the Guébie language, neither for acquisition nor maintenance, nor does the language have a standard orthography.

Though formal documentation of Guébie is nonexistent, documentation and description of Kru languages has been carried out since colonization of Côte d'Ivoire and establishment of Liberia. Some of the earliest work on Kru includes a set of wordlists from five Western Kru languages documented by Koelle (1854). Also from this time period are grammars of Grebo (Payne, 1864) and Bassa (Crocker, 1844), both Western Kru languages. Work on Eastern Kru did not begin until a French colonial administrator published a grammar and vocabulary of Nyo (also called Neyo, Néoulé) (Thomann, 1905). After this grammar, there was little to no work published on Kru until after the independence of Côte d'Ivoire from France in 1960. In the 60's there was a second Grebo grammar Innes (1966) along with a dictionary Innes (1967) published. Beginning in the 1970s, Marchese published numerous works on Kru languages, including descriptions of particular languages like Godié (Eastern Kru), and much comparative work across the family (Marchese, 1975, 1978, 1979, 1982, 1986a,b, 1988, 1989).

Though there have been relatively few in-depth studies of individual Kru languages, the extant literature on Kru has shown that these languages are of great theoretical interest. Existing theoretical work informed by Kru language data includes Lightfoot (1974) on tone, Singler (1983, 1984) on vowels and tone, Bing (1987) on phonological agreement in Krahn, Kaye and Charette (1981) on tone in Dida; Kaye (1982) on vowel harmony; Koopman (1984) on the syntax of verbs; Koopman and Sportiche (1986) on long-distance extraction in Vata; and Marchese (1978, 1979, 1982) on auxiliaries and focus. This study adds to the slowly growing Kru literature by investigating process morphology in Guébie.

1.3.2 The consultants and corpus

The examples and statistics in this paper come from a corpus of original Guébie data collected between October 2013 and the present. Eight months of elicitation was carried out with a speaker in Berkeley, California (2013-2014), and a total of six months of fieldwork over three summers (2014-2016) was carried out in Gnagbodougnoa, Côte d'Ivoire. Various skype calls were made in between the summer trips to clarify data points. The data collected during these three field trips and entered into the corpus ranges from elicitation-based tasks such as word list and sentence translation to text collections of recorded stories, conversations, narratives, proverbs, and various other genres.

All data was collected by the author. The data has been transcribed and entered into an original online linguistic database together with a team of undergraduate researchers at UC Berkeley; however, all transcription mistakes are the author's.

The majority of the data comes from three native speakers, 28-year-old Sylvain Bodji, 40-year-old Olivier Agodio, and 76-year-old Serikpa Emil. All are males who spent the majority of their lives in Gnagbodougnoa, Côte d'Ivoire, the largest Guébie-speaking village. Serikpa Emil is the only known living monolingual Guébie speaker. Sylvain Bodji and Serikpa Emil grew up in Gaba, once a distinct Guébie village, now one of three neighborhoods of Gnagbodougnoa. Olivier Agodio lives in another of the three neighborhoods of Gnagbodougnoa, called Diaouralilie. The village of Gnagbodougnoa has no more than 1000 occupants, there is much communication across neighborhoods, and all of the consultants recorded for this study know each other well and interact fairly regularly. Most elicited data comes from Sylvain Bodji and Olivier Agodio, and most text data comes from Serikpa Emil. The primary female speaker, Laeureine, 19-years-old, provided both text-based and elicitation data as well. In addition to the previously mentioned four consultants, four others also contributed data: three other male speakers ages 35-52 and one female speaker age 30.

Throughout this study, examples are labeled with database reference codes. These reference codes consist of three letters, which represent the consultant who provided the data, followed by a date, in the form YYYYMMDD, where the year is followed by the month, which is followed by the day. For example, the code syl_20170714 would be used for data provided on July 14, 2017, by a consultant whose three-letter code is 'syl'. For those examples that contain a list of words collected over many recording sessions, where no single reference code is appropriate, none is provided (though this is rare).

At the time of this study, the Guébie database consists of 4582 utterances and 3575 distinct morphemes, including a combination of elicited and textual data. As more data is transcribed and entered into the database, these numbers will continue to grow.

Various scripts have been run on the corpus data over the last twelve months to collect statistical measures for this study. While all of these measures have been updated based on a recent version of the corpus, it is possible that these scripts may have been run at different times, when the number of words or morphemes in the corpus differed slightly. Thus, the total number of words considered in each chart or measurement throughout this study may differ slightly.

Chapter 2

Guébie phonology and morphology

2.1 Introduction

This chapter presents the first phonological and morphological description of Guébie, an Eastern Kru language spoken in Côte d'Ivoire. The descriptions provided here serve as background for the morphophonological phenomena evaluated in more detail in the following chapters[1].

I begin in section 2.2 with the segmental and tonal inventories of the language and the distribution of each segment and tone melody. In this section I also describe syllable and word minimality requirements, surface CVCV reduction to CCV, and vowel harmony.

Following the phonological description, section 2.3 gives a morphological sketch. It begins with a description of the three nominal suffixes and seven verbal suffixes in the language. Also discussed here are interactions between morphology and phonology, including 1) nasal consonant harmony between verb stems and certain suffixes but not others, 2) replacement of vowels in mono- and disyllabic roots in the context of object enclitics, 3) morphologically conditioned tone shift, and 4) phonologically determined agreement. The morphophonological phenomena discussed in this chapter are the focus of chapters 3, 4, and 5.

2.2 Guébie phonology

Like other Kru languages, Guébie is an isolating language in which the plurality of words are monosyllabic. There is a segmental inventory of 24 consonants and 10 vowels, which is described in section 2.2.1. The syllable structure is restricted to V, CV, and CLV syllables, and is detailed in section 2.2.2. Section 2.2.4 describes the tonal inventory of the language,

[1]Abbreviations used throughout this and the following chapters include SG=singular, PL=plural, PFV=perfective, IPFV=imperfective, PERF=perfect, NOM = nominative, ACC=accusative, PROS=prospective, POSS=possessive, EMPH=emphatic, PART=particle, DEF=definite, PASS=passive, CAUS=causative, APPL=applicative, RED=reduplicant, RECIP=reciprocal, NMLZ=nominalizer, OBJ=object, IRR=irrealis, AGT=agentive.

and its possible surface tones. In section 2.2.5 I describe a productive vowel harmony process, which serves as a diagnostic for word-hood in Guébie.

2.2.1 Segmental inventory

2.2.1.1 Consonants

The Guébie consonant inventory consists of 24 underlying segments (5).

(5) **Consonant inventory**

	Bilabial	Lab. dent.	Alveo-palatal	Palatal	Velar	Labialized	Labio-velar
Plosive	p b		t d	c ɟ	k g	k^w g^w	kp gb
Nasal	m		n	ɲ	ŋ	$ŋ^w$	
Fricative		f v	s				
Approx	ɓ		l	j			w

There are contrastive voiced and voiceless oral stops at six places of articulation: bilabial, alveo-palatal, palatal, velar, labialized, and labio-velar. The contrast between velar, labialized, and labio-velar stops is robust; the following examples provide minimal pairs, (6).

(6) **Labialized velars as distinct from Labio-velars**

Labiovelars	Gloss	Labialized velars	Gloss
$\text{kpala}^{4.4}$	'calabash'	$\text{k}^{\text{w}}\text{ala}^{4.4}$	'farm'
gbə^{2}	'chair'	$\text{g}^{\text{w}}\text{ə}^{3}$	'bathing place'

There are five distinct nasal consonants: bilabial, alveo-palatal, palatal, velar, and labialized velar. The distinction between velar and labialized velar nasal stops, like for oral stops, is robust, (7).

(7) **Nasal stop distinctions**

Labiovelars	Gloss	Labialized velars	Gloss
$\text{ŋɛnɛ}^{2.2}$	'phlegm'	$\text{ŋ}^{\text{w}}\text{ɛnɛ}^{4.4}$	'women'

There are three fricatives in the language, /f, v, s/. There is no voiced counterpart of /s/. However, Vata, a Dida (Eastern Kru) language spoken in the nearby town of Lakota, maintains a distinction between /s/ and its voiced counterpart /z/. Those Guébie speakers who travel often to Lakota have borrowed words from Vata containing /z/. These speakers, who tend to be young and male, pronounce /z/ when speaking French as [z]. Other Guébie speakers, especially the elders, pronounce French /z/ as [ɟ]. Vata words with /z/, for example /zri/ 'fish', have /ɟ/ in place of /z/ in Guébie: /$\text{ɟiri}^{2.2}$/. This is not the only source for [ɟ] in Guébie, but in general Vata /z/ corresponds to Guébie [ɟ].

The labio-dental fricative /v/ is not very common in Guébie. While it appears in some key vocabulary, it can only surface in word-initial position (except in ideophones), and it is much less common than the other consonants in the inventory. Specifically, /v/ only appears in distinct nine words in the Guébie corpus, where two of those words are *avio*$^{4.1.1}$, ‘airplane’, from French *avion*, and *olivie*$^{2.2.2.3}$, ‘Olivier’, from the French name *Olivier*. This limited distribution of /v/ could be the result of borrowing from a neighboring Kru language, or perhaps /v/ is undergoing a merger with an existing Guébie phoneme. There is no evidence, though, that Guébie speakers show variation in their production of /v/. For example, the word *nove*$^{2.3}$, ‘bee’, is always pronounced with a [v] intervocalically, and never another sound.

There are four approximants in Guébie: /l, ɓ, w, j/. The implosive /ɓ/ patterns with approximants, and not with other oral stops, as it does in other Kru languages (Kaye et al., 1981). Underlying /l/ can surface as [l] or [r], but the two are not contrastive. While for many speakers [l, r] are in free variation, for some they seem to be allophones with a principled surface distribution. Specifically, in CLV syllables, /l/ is pronounced [r], but when /l/ is the only consonant in a simplex onset position, it is pronounced [l], (8). Forms marked with question marks in (8c,d) are less commonly used than their counterpart, and are never used by some speakers.

(8) **Allophones /l/ and /r/**

	r form	**l form**	**Gloss**
a.	vru^{3}	?vlu^{3}	‘fly’
b.	bra^{3}	?bla^{3}	‘hit’
c.	?gbara$^{2.4}$	gbala$^{2.4}$	‘climb’
d.	?ri^{3}	li^{3}	‘eat’

Despite the fact that /l/ and /r/ are not contrastive, I use /l/ in CV syllables and /r/ as the second consonant of CCV syllables throughout this study, because this distribution most closely mirrors what speakers do in natural speech.

There is a single implosive consonant in the inventory, the bilabial /ɓ/. This bilabial implosive patterns with the lateral approximant /l/ and glides /j,w/ in that it can be elided in word-medial position in fast speech. It patterns with only the glides /j,w/ in that it can be used to break up sequences of vowels to avoid vowel hiatus. It also patterns with /l/ in that these two consonants tend to surface as the second sound of a 2-consonant cluster (9). Recall that /l/ is written as [r] in clusters.

(9) **CLV clusters in Guébie** (syl_20161207)

a. vru^{3} ‘fly’

b. bra^{3} ‘hit’

c. dɓuɓri$^{3.1}$ ‘mourning’

While implosive /ɓ/ patterns with other oral sonorants (approximants) throughout the Kru language family (cf. Marchese 1979:39-41 and Kaye et al. 1981), this is unusual behavior for an implosive cross-linguistically. Parker (2011) does not include implosives in his “complete” sonority hierarchy, stating that there has been too little work on implosives with regards to sonority to make any typological claims. The approximant-like characteristics of implosives in Guébie, especially the fact that they surface as the second consonant in a cluster along with liquids, has much to contribute to the sonority literature.

As discussed further in section 2.2.2, all CLV syllables can also be pronounced CVLV, where the second consonant is a simplex onset. However, CVCV roots tend not to reduce to CCV unless /l/ or /ɓ/ is the medial consonant. If the initial consonant is nasal, and /n/ is the second consonant, reduction is also likely: *mɛnɛ*$^{3.3}$→*mnɛ*^{3}, 'meat'. When the medial consonant is a glide, nasal (unless C1 is also nasal), fricative, or oral stop, reduction to CCV is highly unlikely.

(10) **CVCV reduced to CCV only if C_2 is /l,ɓ/**

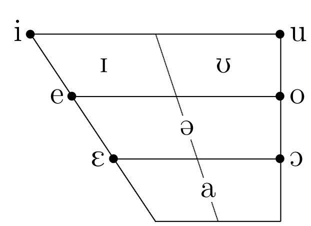
	CVCV	CCV	Gloss
a.	bala$^{3.3}$	bra^{3}	'hit'
b.	duɓuɓuli$^{3.1.1.1}$	dɓ uɓri$^{3.1}$	'mourning'
c.	bete$^{3.1}$	*bte^{31}	'break'
d.	nɛdɛ$^{3.3}$	*ndɛ^{3}	'middle'

The patterning of /ɓ/ as an approximant is not unique to Guébie. It has been attested in a number of other Eastern Kru languages (Marchese 1979:39), as well as Guéré (Fischer, 1976), Dewoin (Welmers, 1977), and Bassa (Bertkau, 1975), three Western Kru languages. There is no /ɓ/ that patterns with oral stops in any Kru language; whenever a Kru language has /ɓ/ in its inventory, it patterns as an approximant. The fact that this distribution of the bilabial implosive holds in both Eastern and Western Kru languages, and that there are no other implosives attested in any Kru language suggests that /ɓ/ was present in Proto-Kru and patterned as an approximant even then. Nearby Southwest Mande languages show the same pattern, perhaps due to contact with Kru (cf. Welmers 1962, 77-78).

2.2.1.2 Vowels

There are ten distinct vowels in Guébie, one of which has two surface allophones (/ʊ/→[ʊ,ʌ]), resulting in eleven possible surface vowels. The ten underlying vowels are shown in (11).

(11) **Vowel inventory**



The ten vowels in (11) can be distinguished with the features [High, Back, Round, ATR], (12). Each +ATR vowel has a -ATR counterpart and vice versa. This distribution of vowels plays a crucial role in productive vowel harmony processes which will be discussed further in sec 2.2.5.

(12) **Vowel features in Guébie**

	i	ɪ	e	ɛ	ə	a	o	ɔ	u	ʊ
High	+	+	-	-	-	-	-	-	+	+
ATR	+	-	+	-	+	-	+	-	+	-
Back	-	-	-	-	+	+	+	+	+	+
Round	-	-	-	-	-	-	+	+	+	+

The high -ATR vowels /ɪ,ʊ/ are significantly less frequent than other vowels (cf. the chart in (15) in section (2.2.2)). While they occur often enough to be considered contrastive vowels of the language, and they alternate with +ATR counterparts /i,u/ in certain contexts, not every consonant is attested as occurring along with /ɪ,ʊ/ in a syllable. This is discussed further in section 2.2.2.

In the context of bilabials, /ʊ/ is often pronounced [ʌ], especially by speakers under 40 years old. For example, /wʊlɪ/, the word for 'goat', is often pronounced [wʌlɪ]. Because it is more common amongst younger speakers, and it is not a stable alternation, the [ʌ] allophone of /ʊ/ seems to be a recent change.

In a number of Eastern Kru languages, there are between 12 and 14 vowels (Zogbo, to appear). In such languages, the inventory includes all 10 vowels in Guébie, plus 1-4 additional central vowels. Godié is one such language, where the inventory includes /ɨ, ʉ, ʌ, ʌ̃/ in addition to the 10 vowels present in Guébie. These central vowels do not exist in Western Kru (Marchese 1979:51). Zogbo (to appear) proposes that central vowels in Eastern Kru have been recently innovated. The ongoing shift of /ʊ/ to [ʌ] in the context of a bilabial in Guébie supports Zogbo's findings.

All Western Kru languages have a full series of nasalized vowels along with their 7-9 oral ones. However, nasal vowels are almost systematically absent in Eastern Kru. The nasality of Western Kru nasal vowels is lost in Eastern Kru, where W. Kru nasal vowels correspond to non-nasalized vowels, typically of the same backness and sometimes the same height, in Guébie and other Eastern Kru languages.

Nasalization on vowels in Guébie is phonetic, predictable and non-contrastive. Vowels are nasalized when the onset of the same syllable is nasal. Contrastively, Guébie has nasal vowels in one specific lexical domain: ideophones (for example, [kẽẽẽ$^{2.2.2}$], 'zoom'). Outside of ideophones, three words in my corpus of 3873 distinct words consistently contain nasal vowels. These three words can be shown to be borrowed from French or a neighboring Kru language.

(13) **Three words with nasal vowels in Guébie**

a. kpãɛ̃$^{3.3}$ 'very'
b. kãɔ̃$^{4.2}$ 'spine'
c. ɟɪ̃ɛ̃$^{3.1}$ 'ocean'

Because there are only three words containing lexically specified nasal vowels in Guébie, I cannot make any generalizations about how nasal vowels interact with the rest of the Guébie system. Thus, I leave them out of further discussion. While it is possible that [kpãɛ̃$^{3.3}$]

'very' could be an ideophone subject to different phonotactic constraints than other lexical categories in Guébie, it is unlikely that the nouns 'spine' and 'ocean' (13) can be classified as ideophones given their nominal distribution and lexical content, thus they seem like lexical exceptions to an otherwise complete lack of phonemic nasal vowels.

Vowel length is not lexically contrastive, but when sequences of the same vowel arise in certain morphosyntactic contexts, they are pronounced as long in fast speech. In careful speech, sequences of identical vowels are rearticulated.

2.2.2 Syllable structure

There are three possible surface syllable types in Guébie, V, CV, CLV, where V stands for any vowel, C stands for any consonant, and L stands for /l/ or /ɓ/. Glides /w,j/ cannot serve as the second consonant in a cluster. While there are labialized velars /k^w, g^w, $ŋ^w$/, no non-velar consonants can surface with an immediately following offglide (except for the French loanword p^w*ɛtie*$^{4.1.1}$ 'nail' from French *point*). For velars, a labial offglide is possible but a palatalized one is not.

While monosyllabic roots are the most common, Guébie lexical roots can have between one and three syllables, with very few longer lexical items. The count of mono-, di-, and trisyllabic roots in the corpus is given in (14).

(14) **Distribution of number of syllables in roots**

Monosyllabic	**Disyllabic**	**Trisyllabic**
2571	2449	602

Suffixes, which are all monosyllabic in Guébie, can be added to lexical roots, increasing their length; however, the numbers in (14) are the number of roots not including affixes that are mono-, di-, and trisyllabic. Affixes are discussed further in section 2.3.1.

All CLV syllables can also be pronounced CVLV. I assume that CLV sequences are underlyingly CVLV, because the vowel quality of the first syllable in CVLV sequences is not entirely predictable from their CLV counterparts. For example, the word /bala$^{2.2}$/, 'hit', is often pronounced [bra^2], where the single vowel in the CLV form has the same quality as both of the vowels in the underlying CVLV form. However, the CVLV word /ɓəli$^{2.3}$/, 'fall' is often pronounced [ɓri^{23}]. In the CLV form [ɓri^3], information about the first vowel and tone in the underlying CVLV is lost. Because CVLV forms are not predictable from CLV forms, but the reverse is true, I posit that CVLV forms must be underlying. This is discussed further in chapter 5.

Almost all combinations of consonants, (5), and vowels, (11), within a syllable are attested in the Guébie corpus. The count of each syllable (in word types, not tokens) in the Guébie corpus is given (15). CLV syllables are included only in their CVLV forms; that is no CLV syllable is represented in the chart in (15).

(15) **The frequency of each CV syllable combination**

	a	e	i	o	u	ɔ	ə	ɛ	ɪ	ʊ	Total
∅	282	94	24	75	32	102	80	47	11	14	761
b	101	23	52	31	58	48	13	35	3	3	367
c	2	9	81	5	12	2	0	11	1	0	123
d	105	14	64	29	56	29	12	35	5	15	364
f	24	2	13	11	9	11	3	7	0	1	81
j	69	57	206	53	60	21	11	62	33	6	578
k	125	13	12	200	175	173	16	24	1	21	760
kp	76	9	3	14	2	25	18	14	1	1	163
k^w	30	17	23	1	0	7	38	12	7	0	135
l	328	100	499	131	113	140	61	170	140	23	1705
m	92	80	18	26	17	44	6	232	4	1	520
n	112	80	91	57	74	107	15	144	15	11	706
p	95	19	35	31	21	42	8	54	15	6	326
s	105	33	75	25	57	43	8	41	10	6	403
t	40	39	62	50	46	24	9	99	13	5	387
v	3	5	6	0	0	0	2	0	0	0	16
w	135	23	19	9	15	16	51	10	6	54	338
ŋ	14	1	2	10	14	26	6	11	0	2	86
ɓ	63	32	52	11	23	28	64	32	3	0	308
ɟ	107	40	52	21	38	77	9	60	13	1	418
ɡ	90	2	7	68	64	39	4	4	0	7	285
ɡb	107	35	5	26	16	38	27	15	0	0	269
ɲ	20	15	23	28	28	114	3	105	4	1	341
ŋ^w	1	1	2	0	6	22	3	5	1	0	41
ɡ^w	1	6	7	2	0	1	15	15	2	1	50
Total	2127	749	1433	914	936	1179	482	1244	288	179	9531

The first row of the data in (15) is the count of onsetless syllables where the nucleus is the vowel in each column. The following rows represent CV syllables where the consonant from the left column combines with the vowel from the top row.

There are very few instances of /ɪ/ and /ʊ/ compared to the other vowels. The +ATR high vowels are more common than the -ATR high vowels, but amongst mid vowels -ATR are more common. /a/ is the most common vowel by far, and /ə/, the +ATR counterpart of /a/, is quite uncommon comparatively.

The consonant /v/ is quite rare; it does not occur more than six times with any given vowel, and because it is so rare there are a number of gaps in the /v/ row of the table in (15). Because it is so infrequent in general, perhaps it is accidental that in the Guébie corpus /v/ does not occur with any -ATR vowel except /a/.

While it occurs at least once with every vowel except /ə, ʊ/, the palatal consonant /c/ is by far more common before the high front vowel /i/ than before any other vowel. The velar consonant /k/ is, on the other hand, much more frequent before non-high vowels. This suggests that the palatal /c/ comes from the velar /k/ historically. The voiced palatal /ɟ/, however, much less obviously comes from /g/. While /g/ is infrequent before high vowels, /ɟ/ is quite robustly found before all vowels, especially the low vowel /a/. Perhaps one source of /ɟ/ is from /g/, but there are also other sources of /ɟ/, or the /g/ to /ɟ/ change occurred much earlier than the more recent /k/→/c/ change. Perhaps relatedly, the palatal glide /j/ is by far more common before the high front /i/ than anything else.

The labialized velars /k^w, g^w, $ŋ^w$/ do not occur before high back vowels /u, ʊ/. The labiovelars /kp, gb/ are uncommon before the same back high vowels.

There are a number of other non-systematic gaps in the table, which I assume are an accident of the data in the corpus. For example, it is unclear why the vowel /ʊ/ should not occur with the consonants /f/ or /ɓ/. Though /ʊ/ and /ɪ/ are underrepresented after other labials as well: /m, kp, gb, ŋʷ, kʷ, gʷ/.

The consonant /l/ is twice as frequent as the next most common consonant. This is true for two reasons. First, /l/ is the most common consonant in non-initial position by a factor of four (cf. 17). Second is a factor of the data; the syllable counts in (15) are based on type-frequency of distinct words in the corpus. However, they are not based on type-frequency of distinct *morphemes*; thus, while a noun or verb root that surfaces often in the corpus will only be counted once in the data above, a common functional morpheme that attaches productively to roots will be counted each time it seen on a different root in the corpus. Much of the morphology in Guébie is process-based, and does not involve affixal material at all, and we should only see data skewing based on affixal morphemes. Of the suffixes that exist, most have the shape of a single vowel; however, the consonant /l/ is present in three distinct suffixes (applicative, reciprocal, and event nominalizer), and no other consonant in the language occurs in productive affixes. Thus, every distinct root with an applicative, reciprocal, or event nominalizing suffix (all of which have the underlying form /-li/), will add to the syllable count of /l+V/ in the chart in (15). The fact that there are three /-li/ suffixes explains why [l] is more commonly seen with the vowel [i] than other vowels. The three suffixes /-li/ surface as [-lɪ] when attached to a root containing only -ATR vowels, which explains why the vowel [ɪ] is more common by a factor of four following the consonant /l/ than it is with any other consonant.

With a formula used by Pierrehumbert (1993) and Frisch et al. (2004) for consonants in Arabic roots, we can calculate the ratio of the observed frequency of each CV to the expected frequency of that syllable. The expected frequency is calculated based on the frequency of each consonant and vowel individually. The result of this calculation is given in (16) where values closer to 1 are observed the expected number of times. Values higher than 1 are observed more often than expected, and values approaching 0 are observed less frequently than expected.

(16) **Observed/Expected (O/E) frequency of CV syllables**

O/E	a	e	i	o	u	ɔ	ə	ɛ	ɪ	ʊ	Total
	1.660	1.572	0.210	1.028	0.428	1.084	2.079	0.473	0.478	0.980	0.080
b	1.233	0.797	0.942	0.881	1.609	1.057	0.700	0.731	0.271	0.435	0.039
c	0.073	0.931	4.380	0.424	0.993	0.131	0.000	0.685	0.269	0.000	0.013
d	1.293	0.489	1.169	0.831	1.567	0.644	0.652	0.737	0.455	2.194	0.038
f	1.328	0.314	1.067	1.416	1.131	1.098	0.732	0.662	0.000	0.657	0.008
j	0.535	1.255	2.370	0.956	1.057	0.294	0.376	0.822	1.889	0.553	0.061
k	0.737	0.218	0.105	2.744	2.345	1.840	0.416	0.242	0.044	1.471	0.080
kp	2.089	0.703	0.122	0.896	0.125	1.240	2.184	0.658	0.203	0.327	0.017
k^w	0.996	1.602	1.133	0.077	0.000	0.419	5.566	0.681	1.716	0.000	0.014
l	0.862	0.746	1.947	0.801	0.675	0.664	0.707	0.764	2.717	0.718	0.179
m	0.793	1.958	0.230	0.521	0.333	0.684	0.228	3.418	0.255	0.102	0.055
n	0.711	1.442	0.857	0.842	1.067	1.225	0.420	1.563	0.703	0.830	0.074
p	1.306	0.742	0.714	0.992	0.656	1.041	0.485	1.269	1.523	0.980	0.034
s	1.167	1.042	1.238	0.647	1.440	0.863	0.393	0.779	0.821	0.793	0.042
t	0.463	1.282	1.066	1.347	1.210	0.501	0.460	1.960	1.112	0.688	0.041
v	0.840	3.977	2.494	0.000	0.000	0.000	2.472	0.000	0.000	0.000	0.002
w	1.790	0.866	0.374	0.278	0.452	0.383	2.984	0.227	0.587	8.507	0.035
ŋ	0.729	0.148	0.155	1.213	1.658	2.444	1.380	0.980	0.000	1.238	0.009
ɓ	0.917	1.322	1.123	0.372	0.760	0.735	4.109	0.796	0.322	0.000	0.032
ɟ	1.147	1.218	0.827	0.524	0.926	1.489	0.426	1.100	1.029	0.127	0.044
g	1.415	0.089	0.163	2.488	2.287	1.106	0.278	0.108	0.000	1.308	0.030
gb	1.782	1.656	0.124	1.008	0.606	1.142	1.985	0.427	0.000	0.000	0.028
ɲ	0.263	0.560	0.449	0.856	0.836	2.703	0.174	2.359	0.388	0.156	0.036
$ŋ^w$	0.109	0.310	0.324	0.000	1.490	4.338	1.447	0.934	0.807	0.000	0.004
g^w	0.090	1.527	0.931	0.417	0.000	0.162	5.932	2.298	1.324	1.065	0.005
Total	0.223	0.079	0.150	0.096	0.098	0.124	0.051	0.131	0.030	0.019	1.000

If each consonant occurred equally as frequently with each possible vowel, and each vowel equally with each consonant, then we would expect all of the observed/expected cells in (16) to come out to 1. We see that in fact there is not an equal distribution of each consonant with each possible vowel.

While all consonants occur in both initial and medial positions, certain consonants are more likely to appear in medial position than others. The chart in (17) shows the count of all attested second syllables in disyllabic roots that occur at least ten times in the corpus. This is specifically disyllabic roots, not disyllabic words, thus there should be no skewing due to common affixes or roots.

(17) **Count of attested medial syllables**

Second Syllable	i	u	ɪ	ʊ	e	o	ɛ	ɔ	a	ə	Total
	5	3	1	8	23	29	5	7	19	24	124
p	6	2	5	0	8	1	25	5	6	4	62
b	10	4	1	0	3	8	4	12	21	1	64
t	19	21	8	2	17	13	23	6	4	6	119
d	11	13	1	6	2	2	14	5	15	2	71
c	15	2	0	0	2	1	0	0	2	0	22
ɟ	8	3	4	1	7	2	12	5	7	1	50
k	3	30	1	11	3	23	5	44	6	3	129
kp	1	2	1	0	2	6	5	17	24	7	65
k^w	15	0	5	0	7	0	1	2	7	9	46
ɡ	1	7	0	2	0	17	1	14	6	0	48
ɡb	0	5	0	0	1	2	2	10	10	2	32
m	5	1	0	0	17	2	66	11	9	1	112
n	14	7	8	3	34	7	75	22	21	8	199
ɲ	3	4	2	1	1	0	20	4	2	1	38
f	5	0	0	0	1	2	3	4	4	1	20
s	5	11	4	2	8	3	7	8	10	1	59
j	34	2	3	1	11	5	8	3	15	0	82
w	1	2	2	5	2	1	4	1	14	4	36
l	162	61	56	13	46	46	73	78	151	39	725
ɓ	6	3	1	0	5	0	4	10	25	23	77
Total	329	183	103	55	200	170	357	268	378	137	2180

We see from (17) that /l/ occurs as the onset of the second syllable in 725 distinct disyllabic roots, while the next most frequent word-medial consonant is /n/, which occurs 199 times as onset of the second syllable in disyllabic roots. Drastically more frequent than expected, /l/ occurs as onset to the second syllable in one third of all disyllabic roots: 725/2180=33.3. Perhaps there was historically an /l/-initial suffix which became reanalyzed as part of the root, accounting for the high frequency of /l/ in root-medial position.

The chart in (17) only shows those consonants which occur in the second syllable of disyllabic roots at least ten times in the corpus. Note that this has excluded /ŋ^w/ and /v/ from the chart, neither of which surfaces more than six times word-medially despite the fact that both are phonemically contrastive in the language.

There is also a non-random distribution of consonants in medial position (C2) given the initial consonant (C1). This is shown in (18), where the consonant in the left column is the root-initial consonant of a CVCV word and the consonant in the top row is the onset of the second syllable.

(18) **The distribution of consonants in CVCV roots**

		p	b	t	d	c	ɟ	k	kp	k^w	g	gb	m	n	ɲ	f	s	j	w	l	ɓ	Total
	0	0	8	0	0	0	4	0	1	0	2	2	7	30	17	1	0	8	0	3	24	107
p	7	24	1	3	0	0	1	5	0	0	2	0	7	0	2	0	4	0	2	39	0	97
b	2	0	5	16	7	0	4	6	0	6	7	0	1	1	0	0	2	2	0	78	0	137
t	5	2	2	18	0	0	2	4	8	3	0	0	3	0	1	0	0	0	0	26	0	74
d	8	0	6	1	24	0	0	28	1	2	0	4	12	5	3	0	0	3	1	20	2	120
c	20	0	0	0	0	6	0	2	0	1	0	0	0	0	0	1	0	2	0	3	0	35
ɟ	11	1	3	2	4	9	13	6	10	7	5	0	3	3	1	0	1	1	0	68	0	148
k	1	5	3	16	9	5	5	14	0	12	1	1	1	1	4	5	9	6	3	41	10	152
kp	0	0	0	0	0	0	0	3	4	0	0	0	0	1	0	3	2	0	1	24	0	38
k^w	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	26	0	27
g	2	1	5	1	6	0	3	2	0	0	8	2	7	3	1	0	2	8	4	38	2	95
gb	3	0	3	15	1	0	1	4	0	3	2	3	0	1	0	0	6	7	0	43	1	93
m	6	1	1	3	0	0	0	2	1	1	1	1	9	51	2	0	1	0	4	5	0	89
n	11	0	1	2	5	0	1	0	6	0	6	4	11	37	0	0	2	18	3	0	1	108
ɲ	6	9	0	7	0	0	0	2	22	0	1	2	9	10	3	0	2	1	2	3	1	80
ŋ	2	0	0	7	3	0	5	0	1	0	0	0	0	16	0	0	0	0	0	2	0	36
$ŋ^w$	1	0	0	1	1	0	0	0	0	0	0	0	0	15	0	0	3	0	1	0	0	22
f	3	0	0	4	0	0	0	0	0	2	0	0	5	0	0	7	0	0	0	2	0	23
s	11	3	9	0	4	0	0	20	4	0	0	4	5	3	3	0	6	7	2	36	0	117
j	2	1	3	0	0	1	1	14	0	4	3	0	1	4	0	1	9	3	0	86	6	139
w	4	0	0	5	1	0	1	0	0	0	1	0	1	8	0	0	0	3	6	66	2	98
l	12	14	8	0	1	0	5	2	7	4	2	8	12	6	0	0	4	7	2	33	11	138
ɓ	5	0	6	17	3	0	1	3	0	0	3	0	0	0	0	0	0	1	2	44	10	95
Total	122	61	64	118	69	21	47	117	65	46	44	31	94	195	37	18	53	77	33	686	70	2068

The first row represents onsetless disyllabic words: V.CV. These include mostly functional words like emphatic pronouns and possessive pronouns. The first column represents those disyllabic roots where the second syllable has no onset: CV.V. These are far more common than roots with no initial consonant, including many content words.

Delineated with double lines are the rows with nasal C1s. Note that while /l/ is the most common or second-most common C2 for every non-nasal initial consonant, shaded in the table above, it is not as common in C2 position following a nasal C1. Instead, it seems that [n] is far more likely after a nasal C1 than any other consonant, shaded above. This suggests that surface [n] in C2 position, in words with a nasal C1, is underlyingly /l/, and there is nasal harmony across consonants within a root.

We see that the most common medial consonant given any initial consonant is either /l/ ([n] in nasal-initial roots), or a consonant identical to the initial consonant (C1=C2). All cells where /l/ is the C2, or where the C2 is identical to the C1 are shaded.

2.2.3 Minimality

There seems to be a minimality requirement that stems in Guébie be at least CV. Every verb and noun is at least CV, and while some affixes are of the shape -V, they surface inside the same stem as the CV root, so they do not violate this word-level minimality requirement. The only exception to this rule is nominative pronouns. Five of the six human nominative pronouns are of the shape V, and one is CV. However, they can be shown to be independent phonological words because these pronouns can be coordinated or surface alone as the answer to a question.

(19) **Nominative pronouns in Guébie**

	Human		Non-human	
	Singular	**Plural**	**Singular**	**Plural**
1st	e⁴	a²	–	–
2nd	e²	a³	–	–
3rd	ɔ³	wa³	ɛ³,a³,ʊ³	ɪ³,wa³

(20) **Nominative pronouns can be coordinated with DPs**

[ɔ³ ɛɟa^3.1 ɟaci^23.1] me³ dabala^4.4.4 ko³
3SG.NOM with Jachi go.PFV market to

'He and Jachi went to the market.'

However, object pronouns, which have the same segmental structure but different tone from nominative ones, cannot stand alone as independent words.

(21) **Accusative pronouns in Guébie**

	Human		Non-human	
	Singular	**Plural**	**Singular**	**Plural**
1st	e³	a¹	–	–
2nd	e¹	a²	–	–
3rd	ɔ²	wa²	ɛ²,a²,ʊ²	ɪ²,wa²

Note that the tone of a given accusative pronoun is exactly one step lower than its nominative counterpart. This is similar to the aspect-specific scalar tone phenomenon which will be discussed in section 2.3.2.2.

Evidence that accusative pronouns are not independent words comes from the fact that they must surface immediately adjacent to a verb or auxiliary, though the same requirement does not hold for objects that are full noun phrases. Additionally, object pronouns cannot stand alone as a response to a question, nor can they be coordinated, (22).

(22) **Accusative pronouns cannot be coordinated**

*e⁴ ni⁴ [ɔ² ɛɟa^3.1 ɟaci^23.1]
1SG.NOM see.PFV 3SG.ACC with Jachi

'I saw him and Jachi.' (syl_20151113)

In order to coordinate an object pronoun, one must use the emphatic form of the pronoun, listed in (23).

(23) **Emphatic pronouns in Guébie**

Human			**Non-human**		
	Singular	**Plural**		**Singular**	**Plural**
1st	mɛ^{3}	aɲɛ$^{2.1}$	**1st**	–	–
2nd	mɔmɛ$^{2.2}$	aɲɛ$^{3.1}$	**2nd**	–	–
3rd	ɔɓa$^{3.3}$	waɓa$^{3.3}$	**3rd**	ɛɓa$^{3.3}$,aɓa$^{3.3}$,ʊɓa$^{3.3}$	ɪɓa$^{3.3}$,waɓa$^{3.3}$

Except nominative pronouns, all independent words are at least CV in size. The largest possible surface syllable in Guébie is CLV, where L is /l/ or / ɓ/.

(24) **CLV clusters in Guébie** (syl_20161207)

a. vru^{3} 'fly'
b. bra^{3} 'hit'
c. dɓuɓri$^{3.1}$ 'mourning'

Some CVLV syllables can be pronounced CLV. All instances of CLV come from CVLV. Certain properties of CVLV strings make them more likely to be pronounceable as CLV. If the two vowels are the same, and the tone on those vowels is the same, a string is almost guaranteed to be pronounceable CLV (25a). However, if only one of those two features holds, it is not entirely predictable whether that CVLV will be reducible to CLV or not (25b,c). Additionally, there are category-specific effects; verbs are more likely to be reducible than other word classes (25d).

(25) **CVCV reduced to CCV** (syl_20161207)

	CVCV	**CCV**	**Gloss**
a.	bala$^{3.3}$	bra^{3}	'hit'
b.	duɓuɓli$^{3.1.1}$	dɓuɓri$^{3.1}$	'mourning'
c.	tɛkɛlɛ$^{3.3.1}$	*tɛkrɛ$^{3.1}$	'be small'
d.	ɓolo$^{2.2}$	*ɓro$^{2.2}$	'one'

The distribution of CVCV reduction to CCV within the Guébie lexicon is discussed in depth in chapter 5.

2.2.4 Tone

Guébie has a four-height tone system, where there are four distinct level tones, here labeled 1-4, where 4 is high. Contours are prevalent, and are possible on short vowels, though not all possible contours given the four-level system are attested. Possible lexical tone melodies are 4, 3, 2, 1, 41, 31, 42, 32, 13, 23, 24, and marginally 423 and 231.

(26) **Attested contours**

	1	**2**	**3**	**4**
1	✓	∅	✓	∅
2	∅	✓	✓	✓
3	✓	✓	✓	∅
4	✓	✓	∅	✓

The tones along the vertical axis in (26) represent the first tone of a two-tone contour. Those along the horizontal axis are the second tone of a two-tone contour. A ✓ marks those contours attested in Guébie, and a ∅ marks those unattested. All four level tone melodies are attested, along with a number of contours.

Other than the absent low-high, 14, contour in Guébie, the chart in (26) is entirely symmetrical over the diagonal axis. Contours involving only tones 2 and 1 are not present in the Guébie lexicon, nor are those involving just 3 and 4. Tone 14 is absent, but 41 is quite common, especially for loan words. All other possible contours are attested on roots.

All attested contours in (26) are also possible melodies on polysyllabic verbs. Below, each attested tone melody is given, followed by a list of example words which take each melody.

(27) **Tone 4**

a. ɟe^{4} 'number'
b. ko^{4} 'cadaver'
c. kpe^{4} 'oil'
d. fafa$^{4.4}$ 'quickly'
e. k^{w}ala$^{4.4}$ 'farm'
f. nukpu$^{4.4}$ 'face'
g. sokolo$^{4.4.4}$ 'cassava'
h. dabala$^{4.4.4}$ 'market'

(28) **Tone 3**

a. li^{3} 'eat'
b. mɛ^{3} 'in'
c. gbɛ^{3} 'sit'
d. saka$^{3.3}$ 'rice'
e. kpãɛ̃$^{3.3}$ 'very'
f. gbɔnɔnɔ$^{3.3.3}$ 'goiter'
g. gbələku$^{3.3.3}$ 'hem'

(29) **Tone 2**

a. ɓa^{2} 'all'
b. su^{2} 'tree'
c. di^{2} 'cut'
d. jili$^{2.2}$ 'day'
e. siə$^{2.2}$ 'skin'
f. gbɔtɔkɔ$^{2.2.2}$ 'clap'
g. kɔkɔjɪ$^{2.2.2}$ 'pimple'

(30) **Tone 1**

a.	go^{1}	'tail'
b.	gba^{1}	'that'
c.	lo^{1}	'field'
d.	pa^{1}	'run'
e.	gbasʊ$^{1.1}$	'trap'
f.	griɓə$^{1.1}$	'family'
g.	tikriti$^{1.1.1}$	'leaf species'

(31) **Tone 41**

a.	nə^{41}	'hole'
b.	pa^{41}	'throw'
c.	li^{41}	'bed'
d.	g^{w}ə^{41}	'buttocks'
e.	koti$^{4.1}$	'clothes'
f.	dugbu$^{4.1}$	'funeral'
g.	kpolu$^{4.1}$	'rat'
h.	disie$^{4.1.1}$	'gizzard'

(32) **Tone 31**

a.	ɟa^{31}	'coconuts'
b.	nə^{31}	'curse'
c.	ɲɔ^{31}	'defecate'
d.	kaɲɪ$^{3.1}$	'mosquito'
e.	lope$^{3.1}$	'speak'
f.	ŋudi$^{3.1}$	'man'
g.	gribuɓə$^{3.1.1}$	'mask'

(33) **Tone 42**

a.	na^{42}	'say.1SG.PFV'
b.	ɛː^{42}	'yes'
c.	padle$^{4.2}$	'think'
d.	taɟɪ$^{4.2}$	'hawk'
e.	sulə$^{4.2}$	'pour'
f.	mumene$^{4.2.2}$	'viper'

(34) **Tone 32**

a.	ɓə^{32}	'plate'
b.	slu^{32}	'wear'
c.	ŋue$^{3.2}$	'remove'
d.	meo$^{3.2}$	'tongue'
e.	nunə$^{3.2}$	'story'
f.	gbɛlɛ$^{3.2}$	'cola nuts'
g.	wakʊlʊ$^{3.2.2}$	'bundle'

(35) **Tone 13**

a.	nu^{13}	'understand'
b.	bu^{13}	'pick.up'
c.	kofə$^{1.3}$	'knee'
d.	liji$^{1.3}$	'cost'
e.	ɓutu$^{1.3}$	'field'
f.	nʊɟɔlɛ$^{1.3.3}$	'gossip'
g.	kranɛnɛ$^{1.3.3}$	'arrange'

(36) **Tone 23**

a.	ne^{23}	'be.intelligent'
b.	po^{23}	'bellows'
c.	drɔ^{23}	'blood'
c.	sIa$^{2.3}$	'worm'
d.	doku$^{2.3}$	'down'
e.	gɔlɔ$^{2.3}$	'palm tree'
f.	jɪla$^{2.3}$	'ask'
g.	galɪɛ$^{2.3.3}$	'ancestor'

(37) **Tone 24**

a.	wʊ^{24}	'sperm'
b.	ji^{24}	'shameful'
c.	k^{w}ə^{24}	'crowd'
d.	gbətə$^{2.4}$	'sleeping mat'
e.	ɟɛli$^{2.4}$	'stars'
f.	gbala$^{2.4}$	'climb'
g.	suk^{w}ala$^{2.4.4}$	'mongoose'

The above tone melodies are possible on mono-, di-, and tri-syllabic words. The following melodies are attested only on tri-syllabic words.

(38) **Tone 4.2.3**

a.	numuŋu$^{4.2.3}$	'lip.plug'
b.	jiluje$^{4.2.3}$	'sun'

(39) **Tone 2.3.1**

a.	gbesiə$^{2.3.1}$	'drag'
b.	gbacɪa$^{2.3.1}$	'mini eggplants'
c.	dɪbalɛ$^{2.3.1}$	'talking drum'

There are not enough examples of tone melodies 4.2.3 and 2.3.1 to show minimal pairs, nor to contrast 4.2.3 with another falling-rising melody like 4.1.3; however, the important point here is that there is one trisyllabic tone melody that is a trough (4.2.3) and another that is a peak (2.3.1). Additionally, each two-tone subpart of these three-tone melodies is an attested two-tone contour: 42, 23, 31.

There are a few two-tone sequences that do not exist on functional words or lexical roots: two falling tones, 43, 21, and four rising tones, 12, 13, 14, 34. While they are not a part of the underlying inventory of tone melodies in Guébie, the sequences 21 and 13 occur in certain morphosyntactic contexts, which will be discussed in section 2.3.2.2. The sequence 12 is also possible just in the case that a noun or verb ends in tone 1 and takes a suffix with fixed tone 2: dibo-ə$^{3.1.2}$ *plantain-pl*, 'plantains'.

When a two-tone melody surfaces on a trisyllabic root, typically the tone is assigned from left to right, resulting in the same tone surfacing on both final syllables, ɲɔkɔlɪ$^{3.1.1}$ 'firewood'. However, this is a tendency and not a fixed principle, since there are also words where the first two syllables share a tone and the second is assigned the the final syllable: sukulu$^{1.1.3}$ 'school'. One similarity between roots that are exceptions to the right-to-left tone association is that their initial syllables tend to have the same vowel. It seems that in general in the language, consecutive syllables with the same vowel are more likely to show the same tone than consecutive syllables with distinct vowels. A total of 614 out of 1839 disyllabic words in guébie has the same tone on both syllables. That is, 33% of the CVCV words have a level tone melody over both syllables. Considering only those 611 CVCV words with the same vowel on both syllables, the percent of words with the same tone on both syllables is much higher than the language average. Over 50% (339) of CV_iCV_i words show the same tone on each syllable. Perhaps there are competing pressures in words like /sukulu$^{1.1.3}$/, then. First, there is a pressure to map the tone from left to right in a 1-to-1 relationship between distinct tones and tone-bearing units. But there is a second pressure, when two consecutive syllables have the same vowel, that they also have the same tone.

Different categories of words tend to occur with different tone patterns. For example, the 31 melody is most common in nouns, but 23 is more common in verbs than nouns. Loan words tend to have tone 41. The distribution of each tone melody for each category is given in (40). Here 'A' stands for a combined adjective+adverb category, because there are only six true adjectives in the language and the data would not show significantly interesting results if adjectives were counted as their own category. 'I' stands for ideophones, 'N' for nouns, and 'V' for verbs and auxiliaries. All other elements including postpositions, complementizers, question-marking operators, conjunctions, and possessive markers fall into the 'Other' category.

(40) **Distribution of tone melodies by category**

Melody	1	2	3	4	13	23	24	31	32	41	42	Total
A	20	57	30	27	3	26	2	28	12	4	15	224
I	1	2	1	5	0	0	0	0	0	0	0	9
N	80	246	275	138	24	268	73	368	133	94	81	1780
V	65	365	299	83	20	205	47	197	188	19	65	1553
Other	16	79	96	31	1	37	5	23	15	1	1	305
Total	182	749	701	284	48	536	127	616	348	118	162	3871

One striking fact we can learn from (40) is that tone melodies with initial level 2 or 3 account for 3077 (79.5%) of the 3871 lexical entries. That is, six of the 11 tone patterns account for 4/5 of the lexemes.

Interestingly, there is a very different distribution of tone melodies depending on the lexical category. Perhaps most striking, though there are only nine distinct ideophones in the corpus to this point, is that all attested ideophones have level tone melodies. Shih and Inkelas (2016) found a similar pattern for ideophones in Mende (Mande) [Sierra Leone]. The most frequent melody for nouns, 31, is only the fourth most common for verbs. While level tone 2 is the most common for adverbs/adjectives and verbs, it is the fourth most common for nouns. The following chart gives the proportion of words in each category with a given tone pattern.

(41) **Tone melody proportion by category**

Melody	1	2	3	4	13	23	24	31	32	41	42	Total
A	0.089	0.254	0.134	0.121	0.013	0.116	0.009	0.125	0.054	0.018	0.067	1.0
I	0.111	0.222	0.111	0.556	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.0
N	0.045	0.138	0.154	0.078	0.013	0.151	0.041	0.207	0.075	0.053	0.046	1.0
V	0.042	0.235	0.193	0.053	0.013	0.132	0.030	0.127	0.121	0.012	0.042	1.0
Other	0.052	0.259	0.315	0.102	0.003	0.121	0.016	0.075	0.049	0.003	0.003	1.0

All cells with a proportion just under .1 is what would be expected if every melody occurred equally as frequently in all categories. However, we see that many melodies never surface in a given category, while others are much more common than would be expected if all things were equal.

While there are nouns that surface with each of the tone melodies, the most common melodies amongst nouns are 31, 3, 23, and 2, in that order. For verbs the most common are 2, 3, 23, and 31. While not ordered in the same way, the four most common tone patterns in verb roots and noun roots are the same. There are some significant differences between the two, though. The 41 melody is far more common in nouns than verbs (5% of nouns and only 1% of verbs), which I believe is due to the fact that it is the most common melody for loan words, especially those from French and English, and loan words into Guébie tend to be nouns rather than verbs.

The most common melodies for the A category of adjectives and adverbs are 2, 3, 31, 4, and 23. These are also very common melodies amongst both nouns and verbs, but the most common melodies for adjectives and adverbs more closely parallel the verbal distribution than the nominal one.

Even the 'other' category, while diverse, patterns closely with the nominal and verbal distribution of tone melodies. The most common melodies for other functional words are 3, 2, 23, 4, and 31, which are the five melodies most common among nouns and adjectives/adverbs, and five of the six most common among verbs.

Tone 13 is far less common than other tone melodies in general (.3% of all melodies are 13), which suggests it might be derived as opposed to underlying. Contour tones 21, 12, 14 also surface in derived contexts but are not lexically contrastive so are left out of (40, 41).

It does not seem that the distribution of tone melody by category is significant overall in Guébie, with the exception of the category of ideophones, which all show level tone melodies.

2.2.5 Vowel harmony

Vowels within a given word agree in ATR harmony in Guébie. Within a root, vowels are also likely to agree in the feature [HIGH]. That is, very few roots contain both [+HIGH] and [-HIGH] vowels. There is no active height-harmony process in the language (see, for example, (42a), where a high root vowel surfaces with a low suffix vowel), though this fact about roots suggests that perhaps there used to be. Suffixes do, however, alternate between +ATR and -ATR depending on the quality of vowels in the stems they attach to. For example, the causative suffix on verbs surfaces as either /-a/, -ATR, or /-ə/, +ATR, (42a) vs (42b).

(42) **Vowel harmony within words in Guébie** (syl_20131024)

a. sɪ^{2}-a^{2}
be.tired.IPFV-CAUS
'causes to be tired'

b. wi^{3}-ə^{2}
cry.IPFV-CAUS
'cause to cry'

c. *sɪ^{2}-ə^{2}

d. *wi^{3}-a^{2}

While most affixes conform to the ATR quality of vowels of the stem they attach to, there are two enclitics that retain their lexical vowel quality no matter the vowels in the stem. One of these is the definite clitic on nouns, which always surfaces as /-a/, never /-ə/.

(43) **Definite clitic unaffected by ATR harmony** (bor_20150603)

a. to^{3}=a^{3}
father-DEF
'The father'

b. gbɔ^{2}=a^{2}
language-DEF
'The language'

c. *to^{3}=ə^{3}

d. *gbɔ^{2}=ə^{2}

Object enclitics also retain their vowel quality no matter the vowels in the stem; however, since these are clitics and not suffixes, perhaps we expect distinct phonological behavior from them.

(44) **Object clitics maintain ATR quality** (lau_20140606)

a. brus^{3}=ɔ^{2}
separate.IPFV=3SG.ACC
'separates it'

b. ɟu^{3}=ɔ^{2}
put.PFV=3SG.ACC
'put it'

c. *brus^{3}=o^{2}

d. *ɟu^{3}=o^{2}

We could analyze the lack of vowel harmony between stems and the definite marker and object enclitic in two ways: 1) We could say that vowel harmony is a test for wordhood; and the fact that it does not show harmony means the definite marker is a clitic, or perhaps even a stand-alone word; 2) We could alternatively say that the object enclitics and definite marker are lexically specified for ATR quality (-ATR), while other affixes lack ATR feature specification. The status of object and definite markers is discussed further in chapters 3 and 5.

There is no evidence in the language that either +ATR or -ATR is a more dominant phonological feature than the other. That is, ATR harmony is always root conditioned, and the ATR value of roots spreads to suffixes independently of whether that feature value is +ATR or -ATR.

2.3 Guébie morphology

Affixal morphology in Guébie, and affixal interactions with phonology are described in section 2.3.1. The highly prevalent non-concatenative morphology of the language is described in section 2.3.2.

2.3.1 Affixes and compounding

Here we examine affixal morphology in the nominal and verbal domains of Guébie. Specifically, there are three nominal and seven verbal suffixes, excluding object pronoun enclitics on verbs. This section discusses the nominal and verbal concatenative morphology in turn, followed by a description of noun-noun compounds.

2.3.1.1 Nominal affixes

There are exactly three nominal suffixes, one that marks plural, one singular, and one definiteness. Additionally, the final vowel of the noun, which can be any of the ten underlying vowels of the language, determines the 'noun class'. That is, the final noun vowel determines the quality of vowels in the agreeing pronouns and adjectives. While I analyze the final vowel of the noun as part of the lexical noun, one could imagine an analysis where final vowels are noun class suffixes. I present the noun class agreement data in section 2.3.2.1 and provide an analysis in chapter 3.

There are two plural suffixes in Guébie, one which surface as [-a, -ə] and the other which surfaces as a front vowel, often [-i, -ɪ]. The ATR quality of the stem determines the ATR quality of the plural suffix. It is unpredictable which nouns will take which plural morpheme. The tone of the [-a, -ə] plural is always 2, independent of the lexical tone of the stem it attaches to. The front vowel plural morpheme has no underlying tone.

(45) **Plural morphology in Guébie**

	Singular	**Plural**	**Gloss**
a.	dibo$^{3.1}$	dibo$^{3.1}$-ə^{2}	'plantains'
	to^{3}	to^{3}-a^{2}	'fathers'
	ɟokʷi$^{2.3}$	ɟokʷi$^{2.3}$-ə^{2}	'birds'
b.	nunə$^{3.3}$	nuni$^{3.3}$	'stories'
	lo^{3}	li^{3}	'songs'
	ɓə^{32}	ɓi^{32}	'plates'

We see that the [-a, -ə] plural morpheme is concatenated to the noun, resulting in vowel hiatus on the surface. In front vowel plural contexts, we see only a single vowel. This could be analyzed as an alternation of the final root vowel, rather than a suffix. Alternatively, it could be analyzed as deletion of the final root vowel in plural contexts. I discuss these options further in chapter 5.

The definite marker is always /=a/. It is unaffected by ATR quality of the root. The definite marker is unusual in another way as well; namely, unlike other suffixes it lacks its own lexical tone. Instead, the tone melody of the noun root extends over the root plus definite enclitic.

(46) **Definite enclitic**

	Indefinite	**Definite**	**Gloss**
a.	ju^{4}	ju^{4}=a^{4}	'the child'
b.	ɟa^{31}	ɟa^{3}=a^{1}	'the coconuts'
c.	goji$^{3.1}$	goji$^{3.1}$=a^{1}	'the dog'
d.	ɲɔkpɔ$^{3.1}$	ɲɔkpɔ$^{3.1}$=a^{1}	'the person'
e.	mobii$^{1.3.1}$	mobii$^{1.3.1}$=a^{1}	'the car'

The definite marker never coalesces with the preceding noun (unless the preceding vowel is *ə,a*: *troɓiə* 'eggplant' surfaces as *troɓiaː*, 'the eggplant').

For both phonological and syntactic reasons, I refer to the definite marker as an enclitic. Nothing can follow the definite marker on the noun, and it does not undergo ATR harmony or coalescence with the root. Further syntactic justification is given in chapter 3.

The definite enclitic and plural suffix can both surface on the same noun. In the case of an /-a/ plural plus a definite /=a/, the result is a final long /aa/, which reduces to a short

[a] in fast speech. A noun root that ends in /a/ and takes the plural suffix /-a/ would have a triply long /-aaa/ in definite plural contexts; though this too is pronounced as short [a] in fast speech. The tone of all three /a/'s, the final vowel of the noun, the plural marker, and the definite marker, remain in both slow and fast speech.

(47) **Plural + Definite**

	Singular	**Plural**	**Plural + Definite**	**Gloss**
a.	tɛlɛ$^{3.3}$	tɛlɪ$^{3.3}$	tɛlɪ$^{3.3}$=a^{3}	'the snakes'
b.	ɲɔkpɔ$^{3.1}$	ɲɛkpɛ$^{3.1}$	ɲɛkpɛ$^{3.1}$=a^{1}	'the people'
c.	dibo$^{3.1}$	dibo$^{3.1}$-ə^{2}	dibo$^{3.1}$-ə^{2}=a^{2}	'the plantains'
d.	ɲɛɲɪ$^{3.2}$	ɲɛɲɪ$^{3.2}$-a^{2}	ɲɛɲɪ$^{3.2}$-a^{2}=a^{2}	'sin'

The plural definite form in (47d), dibo-ə-a$^{3.1.2.2}$, 'the plantains', actually surfaces with a long final /a:/, not as *[diboəa$^{3.1.2.2}$] with a word-final /əa/ sequence. This is an impossible sequence in Guébie and always results in coalescence to [a:].

Some nouns are unspecified for number, having a default mass or collective interpretation. They can be individuated by adding singular suffix. To be countable, these same nouns require an /-a/ or /-i/ plural suffix. Nouns which without additional marking have a plural reading include entities which are often found in bunches: bananas, coconuts, eggs, stars, mosquitos, insects, wires.

(48) **General nouns** (syl_20131024)

a. ɟa^{31}
coconuts
'coconuts'

b. ɟa^{3}-ɓə^{1}
coconuts-SG
'a coconut'

c. ɟa^{3}-ɪ^{12} so^{4}
coconuts-PL two
'two coconuts'

d. *ɟa^{31} so^{4}
coconuts two
Intended: 'two coconuts'

Here we have seen two plural morphemes, the definite enclitic, and the singular suffix on mass nouns. These are the only affixal morphemes in the nominal domain in Guébie.

2.3.1.2 Verbal affixes

Like many Niger-Congo languages (e.g. Bantu languages, Hyman 2003), Guébie uses suffixes to mark valency-changing morphology on verbs: causative, applicative, reciprocal, and passive (CARP). There are three additional affixes on verbs that result in nominalization. These seven affixes plus object pronoun enclitics comprise the entire inventory of concatenative verbal morphology. Like nominal morphology, all of the verbal affixes are suffixal. There are no verbal prefixes, though there are particle verbs, where a postpositional element combines with a verb to result in a distinct verbal meaning. The particle surfaces immediately before the verb when the two are a phonological and morphological unit.

While it is quite uncommon to find a verb with more than one suffix at a time, speakers have clear judgments about the order of multiple suffixes. There seems to be a verbal template the determines suffix order, (49).

(49) **Verbal morphology template**

$$\textsc{particle} - \textit{Root} - \begin{bmatrix}\textsc{Caus}\\ \textsc{Pass}\end{bmatrix} - \textsc{Appl} - \textsc{Recip} - \begin{bmatrix}\textsc{Obj}\\ \textsc{Nmlz}\end{bmatrix}$$

Here I discuss each verbal affix in turn, beginning with the valency changing morphology.

The passive suffix in Guébie surfaces as the vowel [-o, ɔ] on the verb. The ATR quality of the vowel is determined by the ATR quality of the verb stem to which it attaches. The tone of the passive is always tone 2. It is unaffected by and does not affect the tone of the verb to which it attaches.

(50) **The passive suffix** (syl_20151117)

a. mobii$^{1.3.1}$=a^{1} ji^{3} wejil$^{3.2}$-o^{2}
car=DEF FUT steal-PASS
'The car will be stolen '

b. ɲu^{4} sum^{1}-o^{2}
water boil.PFV-PASS
'the water was boiled '

c. li^{3}-li^{3} ji^{3} tabʊlɔ$^{3.2.2}$ ko^{3} ɟɔ^{3}-ɔ^{2}
eat-NMLZ FUT table on put-PASS
'Food will be put on the table '

The causative suffix surfaces as either /-a/ or /-ə/, agreeing in ATR value with the stem to which it attaches. It always has tone 2.

(51) **Causative suffix** (syl_20131031)

a. ɟaciŋono$^{3.3.24.4}$ li^{3}-ə^{2} ɟaci$^{23.1}$
Jachi eat.PFV-CAUS Jachi
'Jachingono fed Jachi'

b. ɟaciŋono$^{23.3.24.4}$ gu^{3}-ə^{2} ɟaci$^{23.1}$
Jachi afraid.PFV-CAUS Jachi
'Jachingono scared Jachi'

Speakers do not judge ungrammatical any verb form with both causative and passive suffixes, and no such forms exist in the corpus.

The applicative suffix has the surface forms [-li, -lɪ, -ni, nɪ], agreeing with the stem in ATR quality, and undergoing nasal harmony with the preceding consonant. It can be used to add an instrumental or locative argument to the verb. The tone of the applicative suffix is always 2. Interestingly the shape of the Guébie applicative suffix is similar to the Bantu applicative surface form /-il/; however, the Bantu applicative adds a recipient, benefactive, or circumstantial argument (Hyman, 2014), rather than an instrument as the Guébie applicative does.

(52) **The applicative suffix** (syl_20151117)

a.

e^{4}	ka^{4}	abiɟa$^{4.2.2}$	mɛ^{3}	e^{24}	mobii$^{1.3.1}$	ka^{2}-lɪ^{2}
1SG.NOM	IRR	Abidjan	go	1SG.NOM.NEG	car	have-APPL

'When I move to Abidjan, I not will have a car'

b.

kɔguliɲo$^{4.2.2.2}$=wa^{2}	li^{2}-li^{2}	saka$^{3.3}$	nuni$^{1.1}$	me^{3}
farmer-DEF	eat.IPFV-APPL	rice	spoon	with

'the farmer eats rice with a spoon '

c.

da^{31}-gba^{1}	e^{2}	jiri$^{2.2}$-li^{2}	kɔguluɲo$^{4.2.2.2}$=wa^{2}	la^{2}	da^{2}	na^{2}
place-which	2SG.NOM	know.IPFV-APPL	farmer-DEF	of	place	Q

'Do you know where the farmer lives? '

When it attaches to a root whose final consonant is nasal, the applicative suffix surfaces with a nasal consonant as well: [-ni, nɪ].

(53) **Nasal harmony between root and applicative** (syl_20151117)

e^{4}	ni^{4}-ni^{2}	k^{w}ala$^{4.4}$	mɛ^{3}	ɟaci$^{2.31}$	joku$^{2.3}$
1SG.NOM	see.PFV-APPL	farm	in	Jachi	PART

'I saw Jachi at the farm '

When both the passive and applicative suffixes appear on a verb we get the order passive before applicative (54).

(54) **Passive before applicative** (syl_20151117)

e^{4}	ti^{3}-o^{2}-li^{2}	k^{w}ala$^{4.4}$	kada$^{4.2}$	me^{3}
1SG.NOM	lose.PFV-PASS-APPL	forest	big	in

'I lost myself in the big forest '

Like the passive suffix, the causative surfaces before the applicative when both are present (55).

(55) **Causative before applicative** (syl_20151117)

a.

e^{4}	pi^{3}-ə^{2}-li^{2}-ɔ^{2}	lili$^{3.2}$	nuni$^{2.2}$	mɛ^{3}
1SG.NOM	cook.PFV-CAUS-APPL-3SG.ACC	food	spoon	with

'I made him cook the food with a spoon.'

b.

e^{4}	li^{3}-ə^{2}-li^{2}-ɔ^{2}	saka$^{3.3}$	nuni$^{1.1}$	me^{3}
1SG.NOM	eat.PFV-CAUS-APPL-3SG.ACC	rice	spoon	with

'I made him eat rice with a spoon.'

In both of the above examples, the causative scopes outside the applicative. That is, the cooking and eating are happening with spoons, and the speaker is causing these things to happen. The causing is not being done with a spoon. Despite the fact that the causative outscopes the applicative, still the applicative surfaces outside the causative suffix. Like a number of Bantu languages, affix order in Guébie seems to be determined by the template in (49) (Hyman, 2003), rather than by syntactic or semantic scope as Rice (2011) predicts.

The final valency-changing suffix is the reciprocal. The reciprocal construction involves a /-li, -lɪ/ verbal suffix as well as reduplication of the verb root. Both the second copy of the verb root and the suffix have tone 2.

(56) **Reciprocal construction** (syl_20151117)

a.

wa^{3}	ji^{3}	la^{3}-la^{2}-lɪ^{2}
3PL.NOM	FUT	call-RED-RECIP

'They will call each other '

b.

wa^{3}	ji^{3}	bala$^{3.3}$-bala$^{2.2}$-lɪ^{2}
3PL.NOM	FUT	kill-RED-RECIP

'They will kill each other'

c.

wa^{3}	ji^{3}	dre^{4}-ɓre^{3}-ɓre^{2}-li^{2}
3PL.NOM	FUT	PART-hug-RED-RECIP

'They will hug each other '

Like the applicative, when the final consonant of a verb root is nasal, the applicative suffix surfaces with a nasal consonant as well.

(57) **Nasal harmony in the reciprocal construction** (syl_20151117)

a.

wa^{3}	ji^{3}	joku$^{2.3}$-ni^{4}-ni^{2}-ni^{2}
3PL.NOM	FUT	PART-see-RED-RECIP

'They will see each other '

b. wa^{3} ji^{3} me^{4}-nu^{3}-nu^{2}-ni^{2}
3PL.NOM FUT PART-understand-RED-RECIP
'They will understand each other '

We know that the reciprocal suffix is distinct from the applicative because the two can be combined. While two applicatives on the same stem are not allowed, the applicative plus reciprocal is okay (58).

(58) **Reciprocal plus applicative** (syl_20151117)
wa^{3} ji^{3} jɪ^{3}-cɛ^{2}-lɛ^{2}-cɛlɛ$^{2.2}$-lɪ^{2}
3PL.NOM FUT PART-write-APPL-RED-RECIP
'They will write to each other'

Besides valency changing morphology, there are three nominalization constructions for verbs. These can occur outside of all valency changing morphology, but cannot co-occur with object enclitics. The first is an agentive suffix /-ɲɔ, -ɲo/, which is similar in form to the word for 'person', *ɲɔkpɔ*$^{3.1}$. The tone of this suffixes is always 2, and the ATR quality of the vowel matches that of the root.

The nominalizer can attach outside of a causative or passive morpheme, as in (59a). I have not yet seen examples of an agentive nominalizer outside of an applicative or reciprocal morpheme.

(59) **Agentive suffix** (oli_20160716)

a. li^{3}-ə^{2}-ɲo^{2}
eat-CAUS-AGT
'feeder'

b. li^{3}-ɲo^{2}
eat-AGT
'eater '

c. weri$^{4.2}$-ɲo^{2}
steal-AGT
'thief'

d. mana$^{2.2}$-dɔ^{1}-ɲɔ^{2}
animal-cut-AGT
'butcher'

The other two nominalization constructions are event nominalizers. The first is a suffix /-li/ with tone 2 whose ATR quality and tone are unaffected by the verb stem it attaches to. It attaches outside all valency-changing morphology and unlike the other suffixes with the same segmental form, applicative and reciprocal, the nominalizer /-li/ does not undergo vowel harmony or nasal harmony with the the stem.

(60) **/-li/ event nominalization** (oli_20160716)

a. jeɓe$^{3.1}$-li^{2}
know-NMLZ
'knowing'

b. pa^{1}-li^{2}
run-NMLZ
'running'

c. gbala$^{2.4}$-li^{2}
climb-NMLZ
'climbing '

There is a second event nominalization construction whose distribution does not seem to be distinct from /-li/ nominalization. This constructions involves reduplication of the verb stem plus the suffix [-e, -ɛ], underlyingly /-E/ with unspecified ATR quality. Both /-li/ nominalization and reduplication plus /-E/ constructions are found in subject and object positions, both can be used to nominalize verbs with valency changing morphology and internal arguments. There does not seem to be an obvious semantic or distributional restriction to either construction except that some /-li/ forms are lexicalized to have particular meanings: ɲɛ-li$^{3.2}$ 'gift', *'giving'.

The tone of the reduplicant in these event nominalization constructions is the same as the base form of the verb. The lexical tone melody extends over the /-E/ suffix. That is, there is no lexical tone for the suffix /-E/.

(61) **Reduplication plus /-E/ event nominalization** (oli_20160716)

a. li^{3}-li^{3}-e^{3}
eat-RED-NMLZ
'eating'

b. jɛ^{3}-jɛ^{3}-ɛ^{3}
dance-RED-NMLZ
'dancing'

c. dra^{2}-dr-ɛ^{3}
slither-RED-NMLZ
'slithering'

All seven of the verbal suffixes described here are fully productive. They can appear on any verb with only one exception: passives and reciprocals cannot surface on an intransitive verb. Outside of that, there are no restrictions on which verb stems these suffixes can attach to.

There are two other instances of concatenative verbal morphology: object pronouns, which are enclitics on verbs, and particles in particle-verb constructions, which surface as prefixes or pro-clitics on verbs in certain syntactic contexts.

Object pronouns, given in section 2.2.2 and repeated in (62), cannot stand alone as independent phonological words. They cannot be the answer to a question, nor can they be coordinated. They must surface as enclitics on auxiliaries, or, if there is no auxiliary, on the verb itself.

(62) **Accusative pronouns in Guébie**

Human			**Non-human**		
	Singular	**Plural**		**Singular**	**Plural**
1st	e^3	a^1	**1st**	–	–
2nd	e^1	a^2	**2nd**	–	–
3rd	$ɔ^2$	wa^2	**3rd**	$ɛ^2$, a^2, $ʊ^2$	$ɪ^2$, wa^2

(63) **Object pronouns are enclitics**

a. e^4 li^3-a^2
1SG.NOM eat.PFV-3SG.ACC
'I ate it'

b. e^4 ji^3-$ɔ^2$ li^3
1SG.NOM FUT-3SG.ACC eat
'I will eat him' (syl_20140213)

The difference in pronoun vowels in (63) is due to a difference in final vowel of the object being referred to. In the case of (63a), the object being referred to must be a non-human noun ending in /-a, -ə/. The third-person singular object in (63b) must be human. See the discussion in section 2.3.1.1 for more on noun/pronoun agreement.

Pronoun enclitics retain their vowel quality no matter the ATR quality of vowels in the verb stem they attach to. They also retain their lexical tone, given in (62). While stem vowels do not affect the quality of pronoun enclitics, the reverse is sometimes true. The process of verb stem vowel replacement in the presence of an object enclitic is discussed in section 2.3.2.4.

The final instance of concatenative verbal morphology discussed here is the particle in particle verb constructions. Particle verbs make up about a third of the verbal lexicon in Guébie. These verbs involve a postposition-like element which prefixes onto the verb if an auxiliary is present and the verb surfaces clause-finally (64a). When there is no auxiliary in a clause, the verb surfaces immediately after the subject, and the particle clause-finally (64b).

The meaning of a particular verb+particle combination is unpredictable, and particles cannot productively be added to verb stems to form new verbs. These are lexically specified combinations of particles plus verbs which have idiomatic verbal meanings.

(64) **Particle verbs**

a. e^{4} ji^{3} ɟaci$^{2.31}$ **joku$^{2.3}$-ni^{4}**
I will Djatchi Part-visit
'I will visit Djatchi.'

b. e^{4} **ni^{4}** ɟaci$^{2.31}$ **joku$^{2.3}$**
I visit.pfv Djatchi Part
'I visited Djatchi.'

c. *e^{4} **joku$^{2.3}$-ni^{4}** ɟaci$^{2.31}$
I Part-visit.pfv Djatchi
Intended: 'I visited Djatchi.' (syl_20140213)

In the presence of an auxiliary, particles surface clause-finally, adjacent to the verb. In these cases, the particle surfaces in the same phonological word as the verb. We know this because there is vowel harmony between the verb and particle. That is, the ATR quality of particle vowels is determined by the ATR quality of verb stem vowels exactly in those cases where the two surface clause-finally, linearly and structurally adjacent to each other.

(65) **Particle verbs as verbal prefixes**

a. jaci$^{2.31}$ ŋʷɔsa$^{3.1}$ ɔnɛ$^{3.3}$ gbɔgɔ$^{2.2}$ joku$^{2.3}$
Jachi scrape.pfv 3sg.poss leg part
'Jachi scraped his leg'

b. jaci$^{2.31}$ ji^{3} ɔnɛ$^{3.3}$ gbɔgɔ$^{2.2}$ jɔkʊ$^{2.3}$-ŋʷɔsa$^{3.1}$
Jachi will 3sg.poss leg part-scrape
'Jachi scraped his leg' (syl_20140213)

We see vowel harmony between the particle and verb in (65b), when the two are adjacent, but not in (65a) where the object intervenes. I claim that when the particle and verb are linearly and structurally adjacent, they form a single morphological and phonological word, where the particle is a prefix or pro-clitic on the verb.

2.3.1.3 Nasal harmony

As described in section 2.3.1, there are three verbal suffixes in Guébie that have the form /-li/. These are the applicative, the reciprocal, and one of the two event nominalizers. While the reciprocal construction also involves reduplication of the verb stem it attaches to, the applicative and nominalization construction both involve just a suffix /-li/ on the verb stem. Additionally, all three are lexically specified with the same tone, tone 2. One phonological difference between them is that the nominalizing /-li/ does not change ATR quality, but the applicative and reciprocal surfaces as either [-li] or [-lɪ] depending on the ATR value of the verb root vowels.

(66) **Three /-li/ suffixes in Guébie**

	Reciprocal	Applicative	Nominalizer /-li/	Gloss
a.	li^3-li^2-li^2	li^3-li^2	li^3-li^2	'eat'
b.	gbala$^{2.4}$-gbala$^{2.2}$-lɪ^2	gbala$^{2.4}$-lɪ^2	gbala$^{2.4}$-li^2	'climb'
c.	pi^3-pi^2-li^2	pi^3-li^2	pi^3-li^2	'cook'

In verbs with +ATR stem vowels, the applicative and nominalized forms are identical (66a,c). This is not true for stems containing -ATR vowels (66b) or for those with nasal consonants. The applicative /-li/ undergoes nasal harmony with the preceding stem consonant, but the nominalized /-li/ is unaffected by the quality of stem consonants.

(67) **Nasal harmony in the applicative but not nominalizer**

	Reciprocal	Applicative	Nominalizer /-li/	Gloss
a.	ni^4-ni^2-ni^2	ni^4-ni^2	ni^4-li^2	'see'
b.	ɲɛ^3-ɲɛ^2-nɪ^2	ɲɛ^3-nɪ^2	ɲɛ^3-li^2	'give'

Nasal harmony between the stem and suffix in applicative but not nominalization constructions maintains contrast between applicative and nominalization constructions as long as final stem consonant is nasal. The same is true of ATR quality. -ATR stems show a difference between applicative and nominalized forms (66b), where the suffix has a -ATR vowel in the applicative but a +ATR one in the nominalization. While these are both instances of contrast maintenance, we see neutralization between applicative and nominalized forms exactly when the verb stem contains +ATR vowels and oral consonants.

Like the definite enclitic and object enclitics, which carry their own tone melodies, and do not undergo ATR harmony with the root, I propose that the /-li/ nominalizer is an enclitic, rather than a suffix. Notably, the definite marker, /-li/-nominalizer, and object enclitics all surface outside of suffixal morphology. That is, the morphology which surfaces more closely to the root (valency-changing morphology, singular and plural suffixes), undergoes ATR and nasal harmony with the root, while morphemes further out do not.

Recall from the distribution of consonants in CVCV words, (18), that if the first consonant of a disyllabic root is nasal, the second consonant is statistically very likely to be a nasal. Specifically, if the first consonant is nasal and the second one is a sonorant, the second one is almost categorically nasal. Both within roots and between a root and its nearest suffixes, we see left-to-right nasal consonant harmony.

2.3.1.4 Genitives and compounds

There are two ways of forming a nominal genitive construction in Guébie. The first involves a genitive particle 'la', glossed here as 'of'. The genitive element surfaces first, followed by 'la', followed by the head noun. In the 'la' genitive, both nouns retain their lexical tone melody.

(68) **Genitive construction with 'la'**

a. ɓabɛlɛ$^{3.3.3}$ la^{2} fak^{w}a$^{3.1}$
sheep of herd
'sheep herd'

b. gbagɔ$^{2.3}$ la^{2} ju^{4}
horse of child
'colt'

c. le^{3} la^{2} greji$^{3.1}$
elephant of tusk
'elephant tusk' (syl_20131114)

The second genitive construction involves a noun-noun compound, with no possessive or genitive particle. In these constructions, the genitive element surfaces before the head noun. Like many Niger-Congo languages, noun-noun compounds come with systematic tone changes. The lexical tone of the final noun of the compound is systematically overridden with a tone-2 melody.

(69) **Noun-noun compounds with tone replacement**

a. ɲito$^{3.1}$ ju^{2}
in-law child
'daughter in-law'

b. mana$^{3.3}$ do^{2}-ɲo^{2}
meat cut-AGT
'butcher'

c. ɓitə$^{2.3}$ wuli$^{2.2}$
house top
'top of house' (syl_20131114)

While in 'la'-genitives nouns retain their lexical tone (i.e. ju^{4} in (68)), the head noun of a compound undergoes tone replacement to show a level 2 tone melody in noun-noun compounds, (69). Verbs can be involved in nominal compounds only when they have first been nominalized, (69b). While we will see other instances of tone replacement in section 2.3.2.2, noun-noun compounds are the only instance of tone replacement (resulting in neutralization) on nouns in Guébie.

2.3.1.5 Summarizing concatenative morphology in Guébie

This section has discussed all instances of concatenative morphology in Guébie. This includes three nominal suffixes, seven verbal suffixes, object enclitics on auxiliaries or verbs, particles which surfaces as prefixes on verbs in certain morphosyntactic contexts, and compounds. We have seen certain tonal and vocalic changes which take place in specific morphological constructions, and vowel and consonant harmony which take place between roots and certain affixes in the environment of particular affixal morphemes. Morphologically conditioned process phonology such as harmony, tone shift, and vowel changes, are discussed in more detail in the next section.

2.3.2 Non-concatenative morphology

While we have seen a number of concatenative morphemes in Guébie, this section details another kind of morphological change: non-concatenative or *process* morphology in Guébie. These morphophonological phenomena include phonologically determined agreement (section 2.3.2.1), tone shift (section 2.3.2.2), tone replacement (section 2.3.2.3), and vowel replacement (section 2.3.2.4).

2.3.2.1 Phonologically determined agreement

The final vowel of non-human nouns determines agreement on pronouns and adjectives. Namely, each of the ten possible final vowels on nouns is mapped to one of three third-person singular pronoun vowels, where the pronoun agrees in backness and rounding features with the final vowel of the noun it is replacing.

(70) **Mapping of Guébie stem-final vowels to pronoun vowels**

	Final vowel		3.SG pronoun	Plural suffix		3.PL pronoun
-Back	i, ɪ, e, ɛ	→	ɛ	-i	→	ɪ
+Back, -Round	ə, a	→	a	-a	→	wa
+Back, +Round	u, ʊ, o, ɔ	→	ʊ			

One example of each a front-vowel-triggering, central-vowel-triggering, and back-vowel-triggering noun is given in (71), where the subject and object pronouns corresponding to the noun in the same row must match in backness and rounding.

(71) **Phonological agreement between noun and pronoun** (syl_20140130)

Noun	**Gloss**	**Object**	**Gloss**	**Subject**	**Gloss**
a. ɟi**e̲**$^{2.2}$	'a prison'	e-^{4} ni-^{4} **ɛ̲**^{2} ji^{3}	'I see it (prison)'	**ɛ̲**-^{3} kadɛ$^{3.2}$	'It (prison) is big.'
b. kʷal**a̲**$^{4.2}$	'a farm'	e-^{4} ni-^{4} **a̲**^{2} ji^{3}	'I saw it (farm)	**a̲**-^{3} kadɛ$^{3.2}$	'It (farm) is big.'
c. t**o̲**^{3}	'battle'	e-^{4} ni-^{4} **ʊ̲**^{2} ji^{3}	'I saw it (battle)'	**ʊ̲**-^{3} kadɛ$^{3.2}$	'It (battle) is big.'

This phonologically determined agreement also holds between nouns and adjectives, where the final vowel of an adjective is determined by the backness of the final vowel of the noun it modifies. In (72a) we see a noun ending in a central vowel triggering a final central vowel on each adjective modifying it. These same adjectives surface with final back vowels in (72b), where they modify a back-vowel noun.

(72) **Phonological agreement between noun and adjective** (syl_20151117)

a. ɓit**ə̲**$^{2.3}$ lel**ə̲**$^{2.3}$ ɟɛl**a̲**$^{1.1}$
house new red
'A new red house'

b. f**u̲**^{3} lel**o̲**$^{2.3}$ ɟɛl**ɔ̲**$^{1.1}$
sponge new red
'A new red sponge'

There are ten vowels in the language and three possible non-human third-person singular pronoun vowels: /ɛ, a, ʊ/. The choice of pronoun is determined by the front/backness of the final vowel of then noun it agrees with.

One could imagine an analysis where the final vowel of the noun is a noun class suffix, and that pronouns and adjectives agree with nouns in noun class. Instead, I do not consider the final vowel of nouns to be suffixes for reasons described in Sande (2015, 2016). Instead, I treat them as part of the lexical noun, and I assume that agreement between nouns and pronouns/adjectives is phonologically determined via a morphologically conditioned phonological process. This phenomenon is described in greater detail in chapter 3, where I also provide a theoretical analysis to account for the data.

2.3.2.2 Morphologically conditioned tone changes

This section describes another non-concatenative morphological phenomenon, an instance of process morphology in Guébie. In the environment of a morphosyntactic imperfective feature, the default tone on any verb lowers one step on the four-tone scale.

(73) **Imperfective scalar tone shift**

Default tone	$\gg$	**Imperfective tone**
4		3
3		2
2		1
1		1

The default tone of the verb is the tone found in perfective contexts, imperative contexts, and in the presence of any auxiliary verb. The imperfective is the only context in which there is a change to the verbal tone melody (74d), and tone is the only feature differentiating perfective from imperfective contexts.

(74) **Default tone in all constructions except imperfective** (syl_20131024)

a. e^{4} ji^{3} ɟa^{31} <u>li</u>^{3}
1SG.NOM FUT coconut eat
'I will eat a coconut.' *Auxiliary*

b. <u>li</u>^{3}
eat.IMP
'Eat!' *Imperative*

c.			
e^{4}	<u>li^{3}</u>	ɟa^{3}-ɓe^{1}	kubə$^{3.1}$
1SG.NOM	eat.PFV	coconuts-SG	yesterday

'I ate a coconut yesterday.' *Perfective*

d.			
e^{4}	<u>li^{2}</u>	ɟa^{31}	koko$^{4.4}$
1SG.NOM	eat.IPFV	coconut	every.day

'I eat coconuts everyday.' *Imperfective*

If the verb is disyllabic, only the tone on the first syllable is lowered in imperfective contexts.

(75) **Only the first syllable is affected**

a.		
ju^{4}	<u>gbala$^{3.4}$</u>	si^{3}
boy	climb.PFV	trees

'A boy climbed trees'

b.		
ju^{4}	<u>gbala$^{2.4}$</u>	si^{3}
boy	climb.IPFV	trees

'A boy climbs trees' (syl_20140314)

In fact, only the very first tone is affected. That is, if there is a contour tone on the initial syllable, only the first tone of that contour is lowered in the imperfective.

(76) **Only the first tone is affected**

a.		
ɟaci$^{23.1}$	<u>pa^{31}</u>	gɔlɔ$^{3.3}$
Jachi	flip.PFV	boat

'Jachi flipped the boat.'

b.		
ɟaci$^{23.1}$	<u>pa^{21}</u>	gɔlɔ$^{3.3}$
Jachi	flip.IPFV	boat

'Jachi flips the boat.' (syl_20140123)

If the verb is polysyllabic but has a level tone melody (2.2.2 or 3.3, for example), the entire tone melody is lowered. This melody lowering follows from the OCP, Obligatory Contour Principle (Leben, 1973), and is discussed further in chapter 4.

(77) **The OCP effect at play in Guébie scalar tone shift**

a.			
a^{2}	ka^{3}	dibo$^{3.1}$-ə^{2}	<u>bala$^{2.2}$</u>
1PL.NOM	IRR	plantain-PL	harvest

'We would harvest plantains'

b.		
a^{2}	<u>bala$^{1.1}$</u>	dibo-ə$^{3.1.2}$
1PL.NOM	harvest.IPFV	plantain-PL

trans 'We harvest plantains' (syl_20140314)

There are verbs with a low underlying tone, 1, which we might expect to lower to a super low tone, 0, in the imperfective. However, default low tones, tone 1, remain tone 1 in imperfective contexts. Alone, this would lead to a lack of contrast between perfective and imperfective forms for verbs with default, underlying, tone 1. To maintain contrast, the final tone of the previous element (the subject) raises one step on the tone scale. The final tone of the subject, whether it is a pronoun, proper name, or complex noun phrase, raises one step on the four-tone scale.

(78) **Contrast for low toned verbs maintained by raising the preceding tone**

a. ɛ³ ɓɔ¹
3SG.NOM wither.PFV
'It withered'

b. ɛ⁴ ɓɔ¹
3SG.NOM wither.IPFV
'It withers' (oli_20160801)

This tone raising phenomenon holds even when the final tone of the subject is already high, 4. That is, a tone 4 subject will raise to tone 5 when the following verb is imperfective and has default tone 1. The super-high tone 5 is otherwise unattested in the language.

(79) **Contrast is maintained even when it results in a super-high tone**

a. e⁴ pa¹
1SG.NOM run.PFV
'I ran'

b. e⁵ pa¹
1SG.NOM run.IPFV
'I run' (syl_20140314)

Recall from section 2.2.3 that object pronouns surface one step lower than their subject pronoun counterparts. It is possible that the same historical trigger for synchronic verb tone lowering was also present on object pronouns. Both the verbal scalar tone phenomenon and the relationship between subject and object pronouns are discussed in further detail and analyzed in chapter 4.

2.3.2.3 Tone replacement

As discussed in section 2.3.1.4, there are two ways of forming a genitive construction in Guébie. The first involves a genitive particle 'la', which surfaces between the head noun and genitive noun. The second involves a noun-noun compounding construction, with no possessive or genitive particle. In such cases, the lexical tone of the final noun of the compound is overridden with a level-2 tone melody.

The nouns in (80) are listed with their lexical or default tone. We can see these same nouns participate in genitive compounds in (81), where no matter its lexical tone, the second noun of a compound surfaces with a level tone-2 melody.

(80) **Lexical tone**

	Noun with default tone	**Gloss**
a.	ɲito$^{3.1}$	'in-law'
b.	ju^{4}	'child'
c.	mana$^{3.3}$	'meat'
d.	di^{3}	'cut'
e.	ɲo^{31}	'person'
f.	ɓitə$^{2.3}$	'house'
g.	wəli$^{3.2}$	'top'

(81) **Noun-noun compounds in Guébie**

a. ɲito$^{3.1}$ ju^{2}
in-law child
'daughter in-law'

b. mana$^{3.3}$ di-ɲo$^{2.2}$
meat cut-AGT
'butcher'

c. ɓitə$^{2.3}$ wəli$^{2.2}$
house top
'top of house' (syl_20131114)

Here we see a case of tone replacement marking a particular morphosyntactic construction, namely genitive noun-noun compounds. Because there is no vowel harmony between the two nouns in a noun-noun compound, I assume the two nouns are part of separate phonological words. However, they must be morphosyntactically close enough to trigger tone replacement on the head noun.

2.3.2.4 Vowel replacement

As discussed in section 2.2.2, the largest possible surface syllable in Guébie is CLV, where L can be /l/ or /ɓ/. All CLV syllables can also be pronounced CVLV. However, not all CVLV sequences can be pronounced CLV.

(82) **CVCV reduced to CCV** (syl_20161207)

	CVCV	**CCV**	**Gloss**
a.	bala$^{3.3}$	bra^{3}	'hit'
b.	duɓuɓli$^{3.1.1}$	dɓuɓri$^{3.1}$	'mourning'
c.	tɛkɛlɛ$^{3.3.1}$	*tɛkrɛ$^{3.1}$	'be small'
d.	ɓolo$^{2.2}$	*ɓro$^{2.2}$	'one'

In exactly those words where CVLV strings can be reduced to CLV, the vowels in the word undergo a vowel replacement process in the presence of certain suffixes. For example, when 'hit' combines with a third person singular human object enclitic /ɔ²/, the vowels of the verb are replaced with the vowels of the enclitic (83).

(83) **Vowel replacement** (syl_20131121)

a. bala³·³ (bra³)
hit.PFV
'hit'

b. bɔl³=ɔ² (brɔ³²)
hit.PFV.3SG.ACC
'hit him'

c. jɪla³·³ (jra³)
ask.PFV
'asked'

d. jɔl³=ɔ² (jrɔ³²)
ask.PFV.3SG.ACC
'asked him'

While vowels in monosyllabic verb stems are often affected by vocalic suffixes due to coalescence, the first syllable of other disyllabic verb stems is never affected by vowel quality of suffixes. Such vowel replacement is restricted to CLV/CVLV alternating verbs.

(84) **Local effect of suffix vowels** (syl_20161207)

a.	wa²	like
b.	w=ɔ²	like=3SG.ACC
c.	ɟʊla³·²	take/borrow
d.	ɟʊl³=ɔ²	take=3SG.ACC
e.	*ɟɔl³=ɔ²	Intended: take=3SG.ACC

We might expect given the vowel replacement facts in (83) that (84e) would be allowed. However, *ɟʊla*³·², 'take/borrow' can never be reduced to a single syllable. In the case of 'take/borrow' and other such disyllabic verb stems, the vowel of the initial syllable is unaffected by the quality of suffix or enclitic vowels.

While the object enclitic /=ɔ²/ affects the vowel quality of CLV/CVLV alternating stems, the passive suffix [-ɔ², -o²], which in -ATR contexts surfaces with the same vowel as the third-person singular human object enclitic, [ɔ], does not affect vowel quality of the stem. While we see local local effects of the passive (85a), just as in (84), the first vowel in CVLV syllables is unaffected by the passive vowel suffix (85c).

(85) **Passive does not affect stem vowels**(syl_20151117)

	Active	Passive	Gloss
a.	ɓə^{31}	ɓ-o^{31}	'finish'
b.	pi^{3}	pi^{3}-o^{2}	'cook'
c.	bulu$^{2.2}$ (bru^{2})	bul^{2}-o^{2} (br-o^{2}), *bol^{2}-o^{2}	'fly'
d.	bala$^{3.3}$ (bra^{3})	bal^{3}-ɔ^{2} (brɔ^{32}), *bɔl^{3}-ɔ^{2}	'hit'

The fact that the passive does not affect the initial syllable of any verb stem, including CLV/CVLV alternating stems ensures contrast between verb=object and verb-passive forms. However, the replacement of all CLV/CVLV stem vowels with the vowel of the object enclitic results in a loss of contrast. Any CLV/CVLV verb with the same consonants, no matter how different its vowels are underlyingly, will surface with the same surface segmental form in the presence of an object enclitic. For example, bulu$^{2.2}$ 'fly' and bala$^{3.3}$ 'hit' will both surface as bɔlɔ or blɔ in the presence of a third-person singular human object enclitic. While it is true for these two particular words that the resulting tone will differ (2 'fly' and 32 'hit'), there are many cases where the result is complete segmental and tonal neutralization of forms, (86).

(86) **Vowel replacement results in neutralization**(bor_20150603)

	Verb-Passive	Verb=Object	Gloss
a.	gbɔlɔ$^{3.3}$-ɔ^{2}	gbɔ^{3}l=ɔ^{2}	incubate.PFV
b.	gbulu$^{3.3}$-o^{2}	gbɔl^{3}=ɔ^{2}	crawl.IPFV

The neutralization of verb forms only occurs in a subset of the lexicon, and in sentences without auxiliary verbs (otherwise the object enclitic surfaces on the auxiliary), but the result is still a loss of contrast that could hinder the ease of communication.

The facts described here show that some, but not all, suffixes, trigger vowel replacement within verb stems that alternate between CLV and CVLV. This raises a question of why some, but not all suffixes are triggers for this process. In chapter 5, I propose that distinct phonological grammars triggered by particular suffixes result in vowel replacement in some contexts, but not others. The difference between roots that undergo reduction and replacement versus those that do not is represented via phonological encoding strength.

2.3.3 Interim summary

This section has provided a preview into the non-concatenative morphology of Guébie. We have seen vowel alternations and tone shift specific to particular morphosyntactic contexts. These processes in Guébie bear on questions of morphologically conditioned phonology, process morphology, and item-based approaches to non-concatenative morphology, as introduced in sections 1.1.1 and 1.1.2. These questions will be reintroduced as we explore Guébie process morphology in more detail in the following chapters.

The non-concatenative morphology presented here forms the basis of discussion in chapters 3, 4, and 5. Chapter 3 focuses on phonologically determined agreement, chapter 4 on scalar tone shift, and chapter 5 on vowel replacement.

Chapter 3

Phonologically determined agreement

3.1 Introduction

This chapter presents the first case study of morphosyntax and phonology interacting in Guébie. This case study involves agreement marking on pronouns and adjectives triggered by the phonological form of the noun root, rather than by syntactic or semantic features of that noun. The noun class data presented throughout this chapter has implications for morphologically conditioned phonology, apparent non-local agreement, and models of phonology-free syntax.

It is an assumption of most models of syntax that phonological features are not present during syntactic derivations, thus cannot influence syntactic structure (cf. Pullum and Zwicky 1986, 1988). The Minimalist Program and its predecessors assume that grammar is modeled as in (87) (Chomsky, 1993), where syntactic operations apply entirely before phonological ones. A similar model is assumed by advocates of Distributed Morphology, where morphological operations (including insertion of all phonological information associated with the relevant morphosyntactic features) take place between the syntactic and phonological modules (Halle and Marantz, 1994; Embick and Noyer, 2001; Harley and Noyer, 1999).

(87) **The Y-model of grammar**

Syntax

Phonological Form **Logical Form**

One phenomenon that challenges the assumption of phonology-free syntax is *phonologically determined agreement*. Here I use the term phonologically determined agreement to refer to a system where agreement (between a verb and its arguments or a noun and its modifiers) is determined by the phonological form of the noun controlling agreement, rather than by its semantic or syntactic features. If agreement takes place in the syntax (Preminger, 2009, 2011), then the existence of agreement dependent on phonological information suggests that phonological features are present in the syntax as well. This would contradict a model where syntax is phonology-free.

A phonological agreement system is found in Guébie, and I describe it here based on original data. Guébie shows a typologically remarkable phonologically determined agreement system in which nominal concord is determined not by semantic class but by the phonological form of the agreement-controlling noun.

The main goal of this chapter is to assess whether phonologically determined agreement is, in fact, phonologically determined. Secondarily, this chapter examines whether the phenomenon can be accommodated in theories in which syntax is never sensitive to phonological information. I suggest that indeed such theories can account for phonologically determined agreement, but that the mere existence of the phenomenon weakens the underlying motivation for maintaining that syntax is phonology-free.

Section 3.2 provides an exposition of Guébie phonologically determined agreement. This is followed in section 3.3 with an analysis of the Guébie data that does not require phonological features to be present in the syntax. The proposed analysis involves interaction between morphology, syntax, and phonology, and proposes a novel approach to ellipsis at PF. Section 3.4 tests the predictions of the proposed analysis by extending the model to other languages that display similar phonologically determined agreement phenomena. These include other Kru languages, as well as Bainuk (Atlantic) and Abu' (Arapesh). In section 3.5 I discuss the implications of the data presented throughout the paper, asking whether phonologically determined agreement systems raise sufficient doubts about the common assumption that syntax is phonology-free. I conclude in section 3.6.

3.2 Guébie phonologically determined agreement

This section details the phonologically determined agreement system of Guébie, demonstrating that pronouns and adjectives agree with nouns not in semantic class but in phonological features.

Relevant background information from chapter 2 is repeated here. Basic word order in Guébie alternates between SAuxOV and SVO. When there is no overt auxiliary, the verb surfaces immediately after the subject (Sande, In Press), as in Vata, a neighboring Kru language (Koopman, 1984). Like other Kru languages (Marchese, 1979), Guébie is highly tonal, with four distinct lexical tone heights and a number of contour tones (see chapter 2 for a description of the tonal system in Guébie, and Gnahore 2006 on tone in a closely related Kru variety). Tone is marked throughout with numbers 1-4, where 4 is high. Syllables are usually CV and maximally CLV on the surface, where L is a liquid. Words other than pronouns must be at least CV. Pronouns take the form of a single vowel. Subject pronouns are free words, but object pronouns are part of the phonological word of the verb, surfacing as enclitics on the element auxiliary, or on the verb in the absence of an auxiliary.

3.2.1 Phonological agreement between nouns and pronouns

Human pronouns in Guébie always take set forms. Specifically, third person pronouns take the form /ɔ^{3}/, singular, (88a), and /wa^{3}/, plural, (88c). The use of other pronouns is infelicitous when referring to humans, (88b,d).

(88) **Human third-person pronouns**

a. ŋudi$^{3.1}$=a^{1} **ɔ**^{3} wa^{2} jɛrɛ$^{3.3}$-lili$^{2.2}$
man-DEF 3SG.NOM like.IPFV spice-food
'As for the man, he likes spicy food.'

b. # ŋudi$^{3.1}$=a^{1} **ɛ**^{3} wa^{2} jɛrɛ$^{3.3}$-lili$^{2.2}$
man-DEF 3SG.NOM like.IPFV spice-food
Intended: 'As for the man, he likes spicy food.'

c. anɛ$^{2.3}$ no^{1} ɔ^{2} nɔwʊ$^{3.2}$ la^{2} wʊ^{21} **wa**^{3} ji^{3}
1PL.POSS mother 3SG.POSS brother of children 3PL.NOM come.PFV
'The children of my mother's brother, they came.'

d. # anɛ$^{2.3}$ no^{1} ɔ^{2} nɔwʊ$^{3.2}$ la^{2} wʊ^{21} **ɪ**^{3} ji^{3}
1PL.POSS mother 3SG.POSS brother of children 3PL.NOM come.PFV
Intended: 'The children of my mother's brother, they came.' (syl_20151113)

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.

There are ten vowels in Guébie, and all words end in a vowel because there are no licit syllable codas in the language. There are two possible plural suffixes on nouns, /-i/ and /-a/. The final vowel of a noun stem, which is the plural suffix when present, determines the vowel of the pronoun used to replace that noun, as well as the vowel of the possessive pronoun, according to the chart in (89).

(89) **Mapping of Guébie stem-final vowels to pronoun vowels**

Final vowel		3.SG pronoun	Plural suffix[1]		3.PL pronoun
i, ɪ, e, ɛ	→	ɛ	-i	→	ɪ
ə, a	→	a	-a	→	wa
u, ʊ, o, ɔ	→	ʊ			

It is not predictable which noun will take which plural suffix[2]. For example, both *ɟukpə*$^{3.1}$, 'bracelet', and *ɓitə*$^{2.3}$, 'house', trigger the central vowel third singular pronoun ə. However, *ɟukpə*$^{3.1}$ takes the /-a/ plural suffix, which surfaces as [ə] due to ATR harmony with the root,

[2]The representations of the plural morphemes in (89) are a simplification. The underlying representations of the two plural morphemes are discussed in more detail in chapter 5

ɟukpə-ə$^{3.1.2}$, while *ɓitə*$^{2.3}$ takes the /-i/ plural suffix, *ɓitə-i*$^{2.3.2}$. Because of the unpredictability of the plural suffix given the phonological shape of the noun, I conclude that each noun must be indexed, or lexically specified, for which plural class it falls into. In (89) we see a mapping of non-human nominal final vowels to pronoun vowels. The examples in (90) come from a Guébie text about making plantain fufu, a starchy ball of dough eaten with sauce. Both examples show pronouns agreeing with a non-human antecedent in vowel quality, /i/ in (90a), and /ɛ/ in (90b). The agreeing element in (90a) is an enclitic object pronoun, while in (90b) it is an emphatic pronoun. The nominal trigger vowel is underlined in all following examples, and agreeing vowels are bold. Full pronoun charts are given in (91, 92, 93).

(90) **Quality of pronoun is determined by final vowel of noun**

a. a^{2} ɟɛ^{3} ɲokol<u>i</u>$^{3.2.2}$ ne^{4} a^{2} ɲo^{3}**-ɪ**^{2}
2PL.NOM cut.IPFV firewood.PL and 2PL.NOM bring.IPFV-3PL.ACC

'You cut firewood and you bring them.'

b. e^{2} ka^{3} wa^{2} ne^{2} jɛr<u>ɛ</u>$^{3.3}$ ɛja$^{3.1}$ ɔɓɛ$^{3.3}$ e^{2} su^{2}
2SG.NOM IRR want REL pepper with 3SG.EMPH 2SG.NOM grind.IPFV
ɛɓa$^{3.3}$ ɓolo$^{1.1}$ bɛ^{3}-a^{1}
3SG.EMPH one thing-DEF

'If you want peppers with it, you grind them one at a time.' (lau_20140606)

The complete subject pronoun chart is given in (91). All pronouns in (91) are shown in their nominative (subject pronoun) forms. Segmentally, object pronouns are identical to subject ones, though tonally they are each one step lower on the 4-tone scale than the corresponding subject pronoun.

(91) **Human and non-human subject pronouns**[3]

Human			**Non-human**		
	Singular	**Plural**		**Singular**	**Plural**
1st	e^{4}	a^{3}	**1st**	–	–
2nd	e^{2}	a^{2}	**2nd**	–	–
3rd	ɔ^{3}	wa^{3}	**3rd**	ɛ^{3},a^{3},ʊ^{3}	ɪ^{3},wa^{3}

The pronoun /ɪ^{3}/ is the only reconstructed non-human plural pronoun form in Proto-Kru, as per Marchese (1982) and (Zogbo, 2017, 244). The human pronoun /wa^{3}/ comes from Proto-Kru /ʊ+a/, where /*ʊ/ is the reconstructed human third-plural pronoun, and /*a/ is a reconstructed aspectual marker. Marchese (1982) argues that the two fused to become the human plural pronoun /wa/ in certain modern Kru languages. In Guébie, the use of /wa/

[3]Note that in previous version of this work (Sande, 2016) third-person pronouns were written as underlyingly +ATR. Based on new data, they have been reanalyzed as -ATR vowels in all cases, and are written as such here.

as a third-person plural pronoun must have been extended to certain non-human nouns over time. Zogbo reconstructs /*ɔ, *ʊ/ for human singular and plural pronouns, respectively, and /*ɛ, *a, *ʊ, *ɪ/ for non-human (p. 246).

There is an additional set of pronouns used solely in emphatic or focused contexts, given in (92). Just like nominative and accusative pronouns, the initial vowel in non-human emphatic pronouns is phonologically determined by the final vowel of the noun.

(92) **Emphatic pronouns**

	Human			**Non-human**	
	Singular	**Plural**		**Singular**	**Plural**
1st	mɔ^{3}	aɲɛ$^{3.2}$	**1st**	–	–
2nd	mɔmɛ$^{3.2}$	aɲɛ$^{2.2}$	**2nd**	–	–
3rd	ɔɓa$^{3.2}$	waɓa$^{3.2}$	**3rd**	ɛɓa$^{3.2}$,aɓa$^{3.2}$,ʊɓa$^{3.2}$	ɪɓa$^{3.2}$,waɓa$^{3.2}$

Possessive pronouns, which surface immediately before the possessed noun, are shown in (93), where for non-human possessors, the initial vowel of the possessive marker is phonologically determined.

(93) **Possessive pronouns**

	Human			**Non-human**	
	Singular	**Plural**		**Singular**	**Plural**
1st	na^{4}	anɛ$^{2.3}$	**1st**	–	–
2nd	na^{2}	anɛ$^{2.2}$	**2nd**	–	–
3rd	ɔnɛ$^{2.3}$	wanɛ$^{2.3}$	**3rd**	ɛnɛ$^{2.3}$,anɛ$^{2.3}$,ʊnɛ$^{2.3}$	ɪnɛ$^{2.3}$,wanɛ$^{2.3}$

The forms in (93) are used for alienably possessed nouns: /na^{4} ɓitə$^{2.3}$/ 'my house'. A separate set of possessive pronouns are used for inalienably possessed nouns, mostly kinship terms. The inalienable pronouns are identical to the personal pronouns in (91) with one exception; the first person singular inalienable pronoun is /a^{4}/ instead of /e^{4}/: /a^{4} no^{4}/ 'my mother'. The inalienable pronouns are of less interest to us because they are quite infrequently used with non-human pronouns. It is quite rare that a non-human noun (one whose agreement is phonologically determined) is the possessor of an inalienably possessed noun in Guébie.

Human pronouns take set forms, while non-human ones are always phonologically determined by their antecedents. As far as I have seen across various genres of Guébie data, and across speakers, this phonologically determined agreement of third-person pronouns is exceptionless.

In (94) I show examples of this phonologically predictable agreement, where the noun in the left column determines the form of the object pronoun in the center column and the subject pronoun in the rightmost column. The final vowel determining agreement and the pronoun vowels are underlined.

(94) **Phonological agreement of pronouns with antecedents** (syl_20140130)

Noun	Gloss	Object	Gloss	Subject	Gloss
a. ɟie̱$^{2.2}$	'a prison'	e-^{4} ni-^{4} **ɛ**^{2} ji^{3}	'I see it (prison)'	**ɛ**-^{3} kadɛ$^{3.2}$	'It (prison) is big.'
b. k^{w}ala̱$^{4.2}$	'a farm'	e-^{4} ni-^{4} **a**^{2} ji^{3}	'I saw it (farm)	**a**-^{3} kadɛ$^{3.2}$	'It (farm) is big.'
c. to̱^{3}	'battle'	e-^{4} ni-^{4} **ʊ**^{2} ji^{3}	'I saw it (battle)'	**ʊ**-^{3} kadɛ$^{3.2}$	'It (battle) is big.'

As above, the antecedent does not have to be in the same utterance, nor nearby in the discourse for this agreement to hold.

Examples of words that fall into each class are given below. Note that there is no semantic distinction between the groups. For example, body parts, animals, large things, and small things are found in all three categories. The word for a small spider species falls into the /ɛ/ category and the word for a large spider species falls into the /a/ category, though neither of these classes is limited to small or large things. 'Bee' and 'honey', which is derived from 'bee', are in the /ɛ/ category, but 'beehive', also derived from 'bee', is in the /a/ agreement class. Zogbo (2017) discusses possible semantic determinedness for Proto-Kru noun classes, but those semantic distinctions have been lost in Guébie, along with a number of other Kru languages (cf. Bing (1987) on Krahn).

(95) **Words that take the front vowel pronoun, /ɛ/**

k^{w}əli$^{2.4}$	'face'	ɟɔk^{w}ɪ$^{2.3}$	'bird species'
ŋəte$^{3.1}$	'yam'	gbele$^{3.2}$	'cola nut'
nove$^{2.3}$	'bee'	nove$^{2.4}$-kpe^{2}	'honey'
ɟe^{2}	'leopard'	tɛlɛ$^{3.2}$	'snake'
ɟak^{w}ɛlɛ$^{2.3.2}$	'small spider'	pɔpɛ$^{2.3}$	'leaf'

(96) **Words that take the central vowel pronoun, /a/**

gama$^{2.2}$	'big spider'	ma^{1}	'butt'
tak^{w}a$^{3.2}$	'basket'	nove$^{2.4}$-guɓə$^{3.1}$	'bee hive'
ɟaɓə$^{3.1}$	'coconut'	ɟukpə$^{3.1}$	'bracelet'
ɓitə$^{2.3}$	'house'	uɓə$^{3.1}$	'head'

(97) **Words that take the back vowel pronoun, /ʊ/**

nukpu$^{4.4}$	'quill (pen)'	kasu$^{3.2}$	'fire'
sabu$^{3.2}$	'night'	nɔpɔpʊ$^{2.4.3}$	'palmwine'
sio$^{2.2}$	'snail'	gbo^{2}	'dispute'
go^{3}	'abdomen'	takpɔ$^{2.3}$	'cheek'

There are examples of animals, liquids, large and small objects, round objects, nature, animates, and inanimates in each of the three non-human classes in Guébie, which shows that Guébie noun class assignment is not semantically coherent. However, it is likely that this system stems from a semantically determined Proto-Kru noun class system (Marchese Zogbo, 2012; Zogbo, 2017). Some Kru languages show tendencies for like-things to have the same final vowel, such as Godié (Marchese, 1986b), though others, like Guébie, Tepo (Dawson, 1975), and Krahn (Bing, 1987), show no semantic coherence of classes and are phonologically predictable. It seems that in Guébie, Tepo, and Krahn, at least, the Proto-Kru semantic noun class system has been reanalyzed as a phonologically determined agreement system.

The phonological assignment of nouns to noun classes is not only predictable for Guébie lexical items, but also for loan words (98) and nonce words (99).

(98) **Phonological agreement in loan words from English/French**

a. sukulu̲$^{1.1.3}$ kɔ^{2}-da^{1} e-^{4} ni-^{4} **ʊ**^{2} ji^{3}
school exist-there. I see.PFV 3SG.ACC PART
'There is a school. I saw it (the school).'

b. baraʒɛ̲$^{2.3.2}$ kɔ^{2}-da^{1} e-^{4} ni-^{4} **ɛ**^{2} ji^{3}
dam exist-there. I see.PFV 3SG.ACC PART
'There is a dam. I saw it (the dam)'

(99) **Phonological agreement in nonce words**

a. fo̲^{2} kɔ^{2}-da^{1} e-^{4} ni-^{4} **ʊ**^{2} ji^{3}
Nonce exist-there. I see.PFV 3SG.ACC PART
'There is a NONCEWORD. I saw it (the NONCE).'

b. gbele̲$^{4.2}$ kɔ^{2}-da^{1} e-^{4} ni-^{4} **ɛ**^{2} ji^{3}
Nonce exist-there. I see.PFV 3SG.ACC PART
'There is a NONCEWORD. I saw it (the NONCE).' (syl_20140130)

Unlike what Marchese (1986a) describes for Godié, a neighboring Eastern Kru language, there is no default pronoun. The choice of non-human pronoun in Guébie must always agree phonologically with the contextually relevant noun. When a Guébie speaker asks about an unknown object, like "What is it?", she uses the front-vowel pronoun, /ɛ/ for singular and /ɪ/ for plural "What are those?". This /ɛ/ is the same pronoun used to replace the word /ɓe^{3}/, 'thing', and the /ɪ/ could be replacing plural 'things' /li^{3}/.

(100) **No default pronoun in Guébie**

a. (ɓe̲^{3}) **ɛ**^{3} le^{2} na^{2}
(thing) 3SG.NOM be.IPFV Q
'What is it/that?'

b. (li̲^{3}) **ɪ**^{3} le^{2} na^{2}
(things) 3PL.NOM be.IPFV Q
'What are they/those?' (gna_20150603)

The choice of nominative pronoun in (100) is determined by the final vowel of the words for 'thing, things'. This shows the lack of a default pronoun and the full phonological predictability of the Guébie system.

Further evidence for the phonological predictability of this agreement pattern in Guébie comes from definite enclitics. We have already seen that plural suffixes on nouns trigger phonologically agreeing plural pronouns. Other than number-marking suffixes, the only remaining nominal morphology is the definite marker. The exact semantics of overt definite marking in Guébie are as yet not fully understood, though the definite marker appears in a subset of the cases where we would use a definite article in English, and has a subset of the semantic properties of specificity. The definite marker is exponed by an enclitic /=a/ on the noun. It is an enclitic and not a suffix because of both phonological and syntactic properties. Phonologically, /=a/ never undergoes ATR harmony with the root it attaches to, unlike other suffixes. Syntactically, the definite marker can surface on the noun, or whatever phrasal project is in the specifier of the DP. The syntactic structure of the definite marker within a noun phrase in Guébie is discussed further in section 3.3.2.1. Examples of nouns with definite markers are given in (101).

(101) **Definite nouns** (lau_20150617)

	Noun	**Def noun**	**Gloss**
a.	ɲu^{4}	ɲu^{4}=a^{4}	'water'
b.	jigo$^{3.1}$	jig^{3}=a^{1}	'fire'
c.	ɟe^{42}	ɟe^{4}=a^{2}	'egg'
d.	sukulu$^{1.1.3}$	sukulu$^{1.1.3}$=a^{3}	'school'

When using a pronoun to refer to a noun that would be definite in that same context, the pronoun vowel does not agree with the final vowel of the noun root. Instead, it agrees with the final vowel of the definite marker, /=a/, which results in a central pronoun vowel surfacing, [a], (108).

(102) **Definite nouns trigger central pronouns** (lau_20150617)

	Definite noun	**Subject pronoun**	**Gloss**
a.	ɲu^{4}=a^{4}	a^{3}, *ʊ^{3}	'water'
b.	jigo$^{3.1}$=a^{1}	a^{3}, *ʊ^{3}	'fire'
c.	ɟe^{4}=a^{2}	a^{3}, *ɛ^{3}	'egg'
d.	sukulu$^{1.1.3}$=a^{3}	a^{3}, *ʊ^{3}	'school'

If each noun were arbitrarily indexed for a particular noun class, we would not expect the definite marker to have any affect on the form of the pronoun. The fact that the presence of the definite marker triggers the central vowel pronoun serves as further evidence that the form of the pronoun is determined by the final vowel of the spelled-out noun.

While speakers are consistent in their judgments of which pronoun should be used to replace a given noun, they avoid constructions where a pronoun replaces coordinated noun phrases like 'A spider or a bee, it...'. When attempting to coordinate nouns that end in vowels with different backness values, speakers prefer not to choose any pronoun vowel to replace those nouns. Instead, they say that the construction of using a pronoun in such cases would be avoided in natural speech. Indeed, no such examples are found in the Guébie text corpus.

(103) **Pronouns used for coordinated noun phrases** (lau_20150617)

	Noun phrase	Pronoun	Gloss
a.	gam<u>a</u>$^{2.2}$	a	'spider'
b.	tak^{2}<u>a</u>$^{3.2}$	a	'basket'
c.	nov<u>e</u>$^{2.3}$	ɛ	'bee'
d.	gam<u>a</u>$^{2.2}$ ɔja$^{3.1}$ tak^{2}<u>a</u>$^{3.2}$	a	'spider or basket'
e.	gam<u>a</u>$^{2.2}$ ɔja$^{3.1}$ nov<u>e</u>$^{2.3}$	*ɔ, *a, *ɛ, *ʊ, *ɪ, *wa	'spider or bee'

When coordinating nouns that end in the same vowel, speakers have no trouble replacing that coordinated structure with the appropriate phonologically agreeing pronoun (cf. the singular pronoun in disjunctive coordination in 103d). The same is true for two coordinated definite-marked nouns, where the appropriate pronoun vowel is the one which agrees phonologically with the definite marker. However, speakers are not happy with any third-person pronoun in the case of replacing two coordinated nouns that separately trigger distinct pronoun vowels (103e). We might assume that the final vowel of the final noun in the coordinated structure should determine the pronoun vowel, but it seems that speakers instead attempt to come up with a vowel that could replace both the first and second coordinated element, and if no such pronoun vowel exists, the construction is avoided.

3.2.2 Phonological agreement between nouns and modifiers

The same agreement pattern found in noun/pronoun agreement in Guébie also holds between nouns and the final vowel of adjectives that directly modify them, (104).

(104) **Noun-modifier phonological agreement** (syl_20151117)

a. ɓit<u>ə</u>$^{2.3}$ lel**ə**$^{2.3}$ ɟɛl**a**$^{1.1}$
house new red
'A new red house'

b. f<u>u</u>^{3} lel**o**$^{2.3}$ ɟɛl**ɔ**$^{1.1}$
sponge new red
'A new red sponge'

Word-internal ATR harmony influences the quality of the final vowel of the adjectives; however the backness and rounding values of the final vowel are determined by the final vowel of the noun. That is, the difference between the final [ə] on 'house' and 'new' versus the final [a] on 'red' in (104a) is due to ATR harmony with the root. The difference between the final [ə] in 'new' in (18a) and the final [o] in 'new' in (18b) is due to agreement with the different final vowels of the nouns in (18a) vs (18b).

Adjectives surface after nouns and before numerals within a noun phrase. There are only six adjectives that can directly modify nouns in Guébie, while other modifiers are predicative, surfacing with verbal morphology. Those adjectives that can surface within a noun phrase include 'big, small, new, red, black, white'. All six of these adjectives can also surface predicatively; but it is only these six adjectives that can directly modify nouns within a noun phrase.

I return to noun-modifier agreement in more detail in Section 3.4.2.

3.3 An interface model of phonologically determined agreement

While phonologically determined noun class agreement in Guébie could be what remains of a once-semantically determined noun class system, here I focus on the synchronic phonological predictability of the pattern. The proposed model relies on specific interactions between syntax, morphology, and phonology, described in section 3.3.2. Before detailing the proposal, I first rule out a long-distance phonological approach and three purely syntactic approaches to phonological agreement in section 3.3.1.

3.3.1 Considering possible analyses

Based on the facts in section 3.2, one might consider pursuing a purely phonological analysis in accounting for the Guébie data. This could take the form of long-distance phonological agreement in an Agreement-By-Correspondence (ABC) (Rose and Walker, 2004) analysis. In such a case, we could say that the pronoun and its antecedent are in correspondence and phonological identity is required between the two. However, the phonologically agreeing pronoun occurs even when the noun is not pronounced in the discourse, as in (105).

(105) **Agreement without an overt noun**

- *Context: There are eggplants (*trobiə̠$^{3.2.2}$*) on the table. You and your wife are sitting next to the table talking about going to the market, when all of a sudden one eggplant starts to roll off the table.*
- *Response:*

  a^{3} ka^{3} briɟo$^{2.3}$
  3SG.NOM PROS fall

  'It is going to fall!' (lau_20150604)

In the context above, the word 'eggplant', /trobiə$^{3.2.2}$/ has not been uttered aloud; however, the pronoun must surface with the agreeing vowel [a^{3}] and not another third-person singular pronoun vowel, *[ɛ, ʊ, ɔ].

Agreement by Correspondence requires agreeing elements to be overt and within the same local domain so that one element can copy features from the other. Because agreement between a noun and pronoun is required in Guébie even when the noun is not present (105), Agreement by Correspondence is not enough, at least on its own, to account for the phonological agreement of pronouns with nouns in Guébie. Because Guébie nominal agreement is non-local, and the head noun need not be in the same utterance or even in the same discourse for agreement to hold, a long-distance phonological agreement analysis will not suffice (Sande, 2014).

Alternatively, one could consider one of the following purely syntactic accounts:

(106) **Possible syntactic analyses of phonological agreement**

1. Phonological features are present in the syntax and available for copying during morphosyntactic agreement processes.
2. Final vowels on nouns, and their agreeing pronoun vowels, are simply arbitrary noun classes that coincidentally surface as entirely phonologically predictable.
3. Phonological agreement is the result of multiple copy spell-out of the noun, as proposed by Dimitriadis (1997) for Bainuk (Atlantic) and Abu' (Arapesh).

I walk through each of these possible analysis, demonstrating that none of them satisfactorily accounts for the Guébie data.

First, option one in (106) requires rejecting the accepted theoretical claim that syntax does not have access to phonological information (Pullum and Zwicky, 1986, 1988). The Y-model of grammar discussed in section 3.1 is repeated in (107).

(107) **The Y-model of grammar**

Syntax

Phonological Form **Logical Form**

There are empirical reasons for adopting the Y-model of grammar, where syntactic operations occur before phonological ones, and syntax has no access to phonological information. An analysis where phonological features are present during the syntactic module makes pathological predictions; if syntax was sensitive to phonology, we would expect word orders and other syntactic phenomena to be sensitive to phonological features such as segmental properties. Such phenomena are not found across languages.

The objection to this particular analysis is an architectural one. A model of grammar which disallows syntactic sensitivity to phonological features, like the Y-model, is more restrictive than one which allows phonology to affect syntactic operations.

Option two above is entirely arbitrary, where all lexical items are indexed for noun class, and the fact that the phonological form of the pronoun is predictable given the form of the noun is coincidental. While this analysis is feasible, it assumes that all noun class assignments are memorized rather than fully productive. Additionally, this analysis predicts exceptions to the phonological predictability of the Guébie agreement system, which we do not see in the data. In Bantu languages we find two different /*mu*-/ noun class prefixes. These prefixes surface on the noun, and for one of the two *mu*- forms, there is a phonologically identical *mu*- which surfaces on agreeing elements in the noun phrase (ex: Class 18 in Ganda). However, there are other nouns which take a *mu*- prefix but trigger phonologically distinct prefixes on agreeing elements (ex: Class 1 in Ganda) (Meeussen, 1967). We never see such non-phonological agreement in the Guébie system.

A particularly problematic set of data for this analysis comes from nouns marked for definiteness, which always trigger the central vowel pronoun, agreeing with the definite marker, /=a/ rather than the noun itself.

(108) **Definite enclitics trigger central vowel phonological agreement**

	Noun	Agreeing subject pronoun	Gloss
a.	sukulu$^{1.1.3}$	ʊ^{3}	'school'
b.	sukulu$^{1.1.3}$=a^{3}	a^{3}, *ʊ^{3}	'the school'

The definite marker is used in a narrower set of contexts in Guébie than, for example, in English. However, when referring to a noun that would take the definite marker, the central vowel pronoun must be used.

If each noun was indexed for a particular lexical class, there would be no a priori reason to predict that the definite marker should suppress the noun class agreement triggered by the noun itself. We might expect that the diacritic on the noun would still determine noun class. However, a phonology-based analysis accounts for this data without additional stipulation, and even predicts that the presence of a definite enclitic should have this affect.

An analysis of arbitrarily assigned noun classes might also predict a default noun class for loan words or certain semantic categories. These predictions are not born out in Guébie. An arbitrary noun class analysis fails to capture the generalization that all noun-pronoun agreement is phonologically predictable; a better analysis would predict this agreement, rather than write it off as coincidental.

Option 3 above says that phonological agreement results from multiple copies of the noun being spelled out, some of which can be reduced to the final vowel of that noun. Dimitriadis (1997) proposes a version of this analysis for phonologically determined agreement in Bainuk (Atlantic) and Abu' (Arapesh).

On this analysis, for the Guébie noun phrase 'new red house' in (109), we would need to say that there are three copies of the noun, one which surfaces as a full copy, and two at the end of each adjective, which are reduced to the final vowel of the noun.

(109) **Multiple copy spell-out of nouns in Guébie**

ɓitə̠$^{2.3}$ lel-~~ɓit~~~~**ə**~~$^{2.3}$ ɟɛl-~~ɓit~~**a**$^{1.1}$
house new-house red-house

'new red house'

A Guébie noun phrase like (109) would require three copies of the noun to be present in the syntactic structure, where one of them is fully pronounced and the other two are partially pronounced. The problem is that there is no supporting evidence, syntactic or morphophonological, for such redundancy in Guébie. This analysis is uneconomical and unmotivated, and an alternative analysis is preferred if possible. Additionally, this analysis predicts the existence of some language in which multiple copies of the noun exist and are fully pronounced on the surface. To my knowledge, this pattern is not attested.

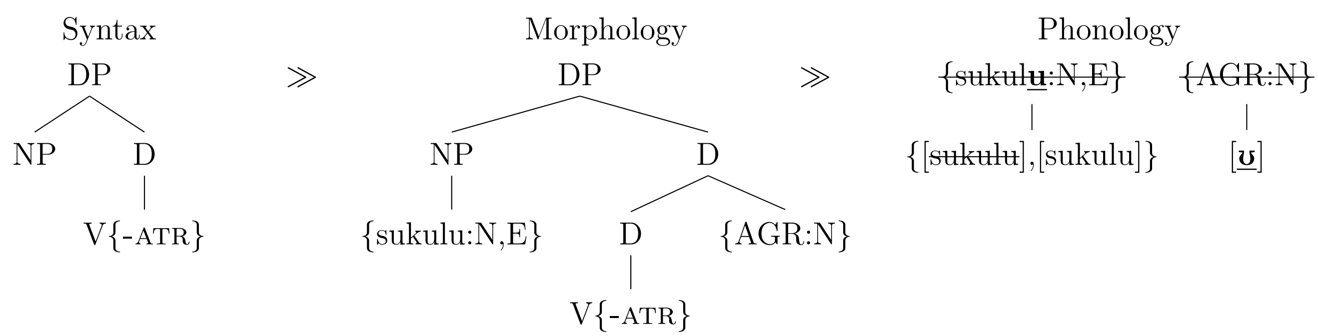
3.3.2 The proposed model

Here I propose a novel model of phonologically determined agreement which relies on specific interactions between morphology and its interfaces. Unlike the above analyses, the model proposed here predicts the phonological determinedness of the Guébie system, and it does not require syntax to be sensitive to phonological features. In addition to accounting for phonologically determined agreement in a manner compatible with current linguistic theories, this model also explicitly details how ellipsis occurs at PF. I focus here on deriving pronoun agreement, and I leave adjectival agreement to section 3.4.2.

The proposed analysis assumes a Distributed Morphology style model of grammar, where syntax precedes morphological operations which precede phonology (Halle and Marantz, 1994).

To briefly foreshadow the analysis to be detailed in the following sections, I claim that an agreement-controlling noun is always present covertly, and sometimes overtly, in a noun phrase. This noun conditions phonologically determined agreement. The nominal agreement trigger may or may not actually be pronounced, but either way it is present in the syntax and the pronoun agrees with it morphosyntactically and phonologically. During the morphological component, an Agr(eement) node is inserted on the pronoun, and features of the noun are copied to it. The phonology, which applies at phase boundaries, has access to the morphosyntactic features of heads within that phase, and phonological constraints ensure phonological identity between those heads in the DP which agree in specific features. Ellipsis of the noun optionally occurs at PF, licensed by overt phonological agreement between the noun and the pronoun. The proposed analysis is outlined by the (simplified) diagram in (110) and is detailed in the remainder of this section.

(110) **Diagram of the proposed analysis**



The structure in (110) is a simplified version of the model to be proposed in the following sections. In section 3.3.2.1 I provide more information about the syntactic structure of noun phrases in Guébie, which is necessary for a full understanding of the morphological and phonological analyses of phonologically determined agreement. In 3.3.2.2 I discuss the morphological component, based in Distributed Morphology, and in section 3.3.2.3 I provide a formal analysis of phonologically determined agreement in Guébie, reliant on morphosyntactic features being maintained through the morphology, available to the phonological component. The feature bundles in (110) include N (noun) features, as well as E (ellipsis) features, which are explained in more detail in sections 3.3.2.2 and 3.3.2.3.

3.3.2.1 The syntactic structure

Before detailing the full analysis of noun class agreement in Guébie, I provide more information on DP structure in the language in general.

There are two well-formed surface orders of full noun phrases, given in (111). Note that the definite marker can either surface on the noun itself, with numeral and adjective surfacing after the definite-marked noun, or the definite marker can surface at the end of the noun phrase. Examples of each of the grammatical orders are given in (112a,b).

(111) **Noun phrase order in Guébie**

a. NOUN-DEF NUMERAL ADJ

b. NOUN ADJ NUMERAL-DEF

(112) **Two possible word orders in noun phrases**

a. NOUN-DEF NUMERAL ADJ

gama-ɪ-a$^{3.3.2.2}$ mɔna$^{2.31}$ ɟalɪ$^{2.2}$
spider-DEF four red

'the four red spiders'

b. NOUN ADJ NUMERAL-DEF

gama-ɪ$^{3.3.2}$ ɟalɪ$^{2.2}$ mɔna-a$^{2.3.1}$
spider red four-DEF

'the four red spiders'

c. *NOUN-DEF ADJ NUMERAL

*gama-ɪ-a$^{3.3.2.2}$ ɟalɪ$^{2.2}$ mɔna$^{2.31}$
spider-DEF red four

Intended: 'the four red spiders'

d. *NOUN NUMERAL ADJ-DEF

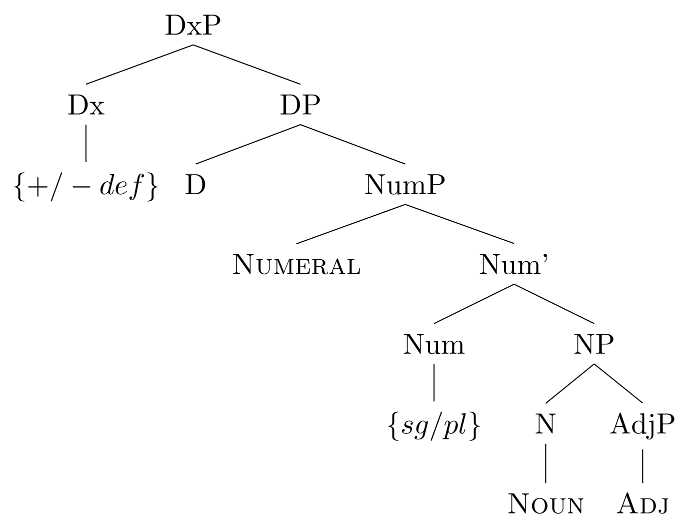
*gama-ɪ$^{3.3.2}$ mɔna$^{2.31}$ ɟalɪ-a$^{2.2.2}$
spider four red-DEF

Intended: 'the four red spiders' (syl_20170322)

Note that when the noun is immediately followed by a definite marker, the order of the other elements in the noun phrase can only be numeral≫adjective (112a), *adjective≫numeral (112c). However, the order adjective≫numeral is fine if the definite marker surfaces at the end of the noun phrase, as a clitic on the numeral (112b). In such cases, it is ungrammatical to have *numeral≫adjective=def order (112d). Marchese-Zogbo (p.c.) reconstructs the order in (111b) to Proto-Kru, based on the fact that NOUN ADJ NUMERAL order is found across the Kru family. Both of the above orders are used in natural speech in Guébie, and both are judged grammatical in elicitation tasks.

The surface orders in (111) can be analyzed as having a syntactically head-initial DP, (113).

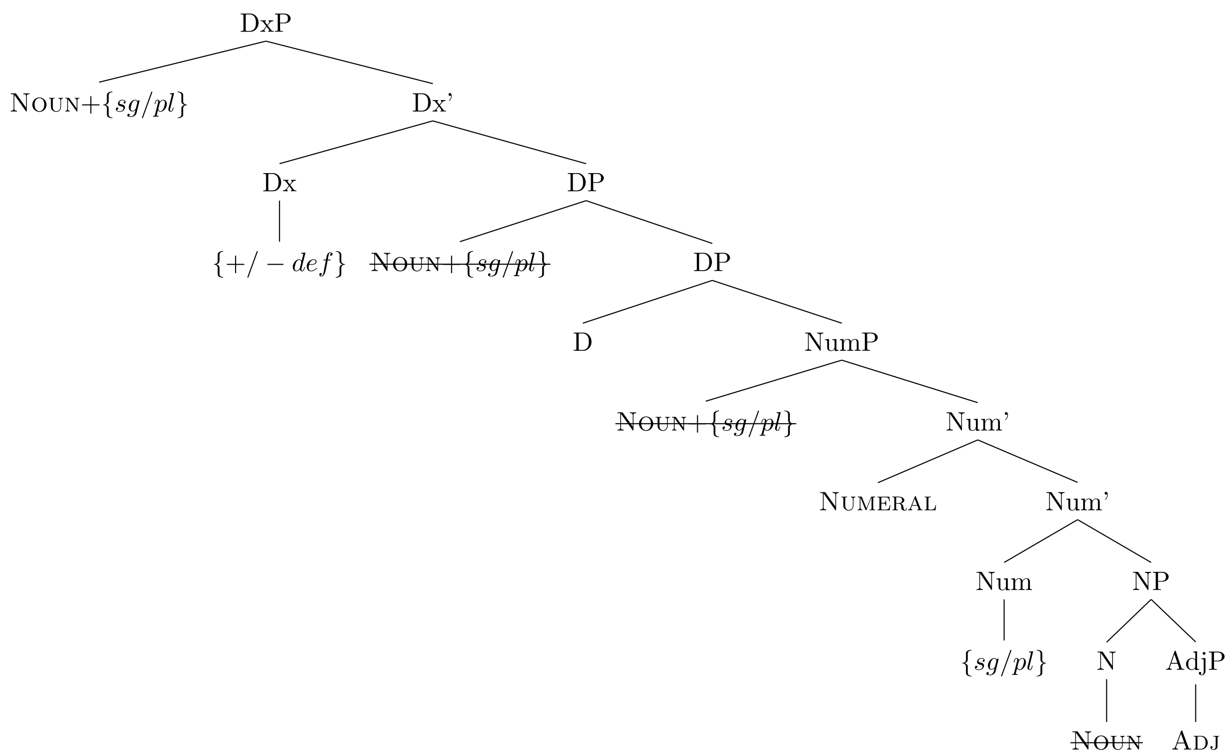
(113) **Head-initial Guébie DP**



I assume bare phrase structure (Chomsky, 1994) but use X for terminal nodes, X' for intermediate nodes, and XP for maximal projections throughout in order to differentiate between the three in prose. I follow Ioannidou and Den Dikken (2009) in using DxP to represent the definite projection. This convention goes back to Lyons (1999); Szabolcsi (1994); Pesetsky and Torrego (2001). D in the following structure is ultimately where pronouns are introduced. DP here could be thought of as a PhiP in Déchaine and Wiltschko (2002)'s terms, and is even in the same structural position as PhiP in Dechaine and Wiltschko's analysis. I first discuss the structure of DPs without pronouns.

In (111a) the noun has moved via morphological merger (*m*-merger) (Embick and Noyer, 2001; Bobaljik, 2002; Matushansky, 2006a) from the most embedded position in the noun phrase, through the specifier of Num, where it picks up singular/plural features, through spec-D, to the specifier of the definite-marking head, as shown in (114). The definite marker then cliticizes onto the noun in its specifier position. This head-movement analysis has been proposed for Bantu (Carstens, 2000), which shows the same surface DP order.

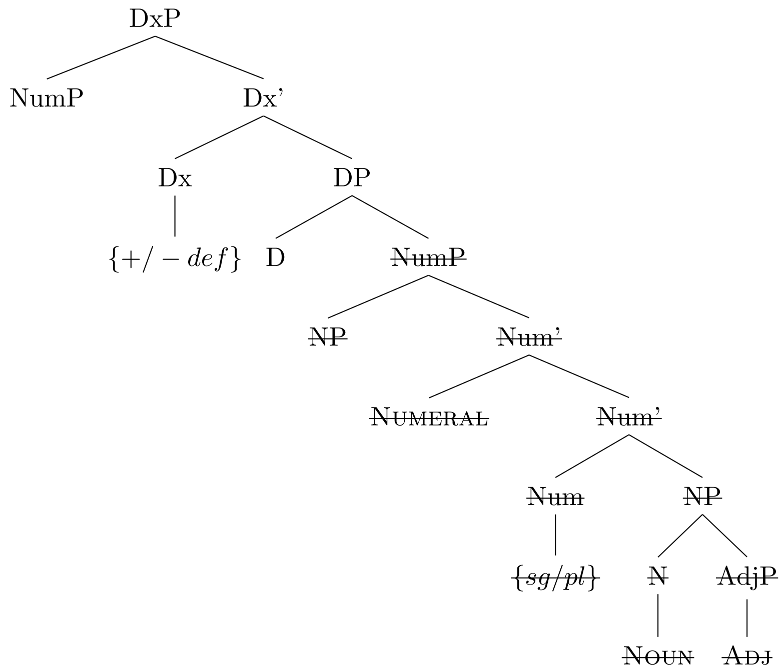
(114) **Head movement DP structure**



The result of head movement and *m*-merger as in (114) is the word order NOUN-DEF NUMERAL ADJ, (111a), where the definite marker is a clitic on the noun, and the numeral and adjective surface in their base positions.

To arrive at the surface order in (111b), instead of movement of only the noun, we see phrasal movement of the NP to spec-Num, such that the order is then NOUN ADJ NUMERAL. Then the entire NumP moves to spec-DxP. The definite marker, the head of the DxP, cliticizes to the entire NumP in its specifier position, with the surface result that the definite marker is an enclitic on the numeral. We have no evidence to determine whether NumP stops in spec-DP before moving up to spec-DxP.

(115) **Roll-up DP structure**



The tree in (115) results in the surface order Noun Adj Numeral-Def, where the definite marker is a clitic on the phrase in its specifier position.

Now that we have covered the structure of full noun phrases, we can ask about the structure of pronouns. To do so, let us first consider the distribution of pronouns with nouns and definite markers in Guébie noun phrases.

Pronouns in Guébie can occur alone within a noun phrase, (116b), or can occur together with an overt noun, (116c). For some speakers, that noun can optionally be marked with a definite agreement suffix (116e). For others, the definite marker can never co-occur with the pronoun. Unlike pronouns, definite markers cannot surface without an overt noun, (116f). For both groups of speakers, adjectives and numerals are impossible in noun phrases that contain a pronoun, (116g,h).

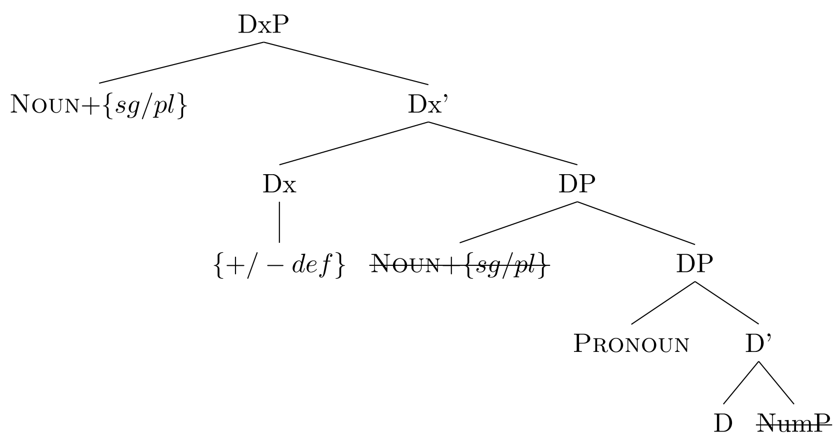
(116) **Distribution of nouns and pronouns** (lau_20150617)

a.	sukulu$^{1.1.3}$	'school'
b.	ʊ^{3}	'it' (the school)
c.	sukulu$^{1.1.3}$ ʊ^{3}	'it school'
d.	sukulu-a$^{1.1.3.3}$	'the school'
e.	?sukulu-a$^{1.1.3.3}$ ʊ^{3}	'it the school'
f.	*a, *a ʊ^{3}	'the (school)'
g.	*sukulu$^{1.1.3}$ ʊ^{3} lelu$^{2.3}$	'it new school'
h.	*sukulu$^{1.1.3}$ lelu$^{2.3}$ ʊ^{3}	'it new school'

Constructions like (116c), where the noun and pronoun surface together within the same noun phrase, are similar to the 'we linguists' construction in English, except that in Guébie they are not restricted to first and second persons. This noun-pronoun construction is distinct from topic, focus, and definiteness in Guébie, though I leave its exact semantic interpretation for future work.

Following Elbourne (2001)'s analysis of e-type pronouns, I assume that pronouns take a noun phrase complement which is elided at PF. In Guébie the noun head-moves to a functional position above the pronoun, as in (114), and the complement of the pronoun (the NumP) is elided. The complement of the pronoun includes any numerals or adjectives present. This accounts for why we never see an overt adjective or numeral when a pronoun is present. The noun, which has head-moved to a higher position, is optionally elided (where ellipsis is licensed by the presence of the pronoun), resulting in all and only the two grammatical overt pronoun structures, (116b,c).

(117) **The structure of pronoun DPs**



I have left the elided material below NumP out of the tree in (117), for simplicity.

Following Giusti (2002) I assume that pronouns and determiners other than the definite marker, when they occur, are specifiers of DP. The noun moves through spec-D via *m*-merger and lands in spec-Dx, so that the noun is no longer in the complement of D. The complement of D is elided when a pronoun is present, leaving only the noun, with definite marking if it is a definite context, and the overt pronoun.

For those speakers who allow the definite marker to co-occur with pronouns in specific contexts, we need not say anything additional. The definite marker /=a/ cliticizes onto the noun in its specifier position. For those speakers who do not allow the definite marker and pronoun to co-occur, we could posit a morphological filter on having both morphemes present in the same derivation. In either case, pronouns sit in some functional position, here D, separate from the definite marker within the noun phrase (Postal, 1966; Elbourne, 2005; Arkoh and Matthewson, 2013).

Returning to phonological agreement, whenever a pronoun is produced, it agrees in phonological content with the noun in the same noun phrase, whether or not that nouns is overt at PF. I propose that this phonological agreement is conditioned by morphosyntactic agreement between the noun and pronoun. That is, the pronoun probes for some feature, say a noun feature {N}, and the two are in a syntactic agreement relationship. At each syntactic phase boundary, morphological and phonological operations take place (Marvin, 2002), and crucially DP (here DxP) is a phase, (Svenonius, 2004).

3.3.2.2 The morphological structure

In the proposed model, morphology and phonology apply cyclically to syntactic structures by phase (Marvin, 2002), and each DP (here DxP) is a phase (Svenonius, 2004). The morphology takes the structure in (117) as an input. Via regular Distributed Morphology agreement mechanisms, an AGR-node is inserted on X, and the [N] feature is copied to it from the noun (cf. Halle and Marantz 1994). Node insertion in Distributed Morphology occurs only when the relevant morphological features have no bearing on semantics. That is, only those terminal nodes which affect the truth value of the sentence are present in the syntax, and others are inserted during the morphological module of grammar. See Norris (2014) for a previously analyzed case of nominal concord where AGR-nodes are inserted in the morphological component.

Agreement proceeds as shown in the noun-pronoun construction in (118) for the noun *sukulu* 'school'. The vocabulary item *sukulu* has the feature {N} because it is a noun, and the feature motivating optional ellipsis at PF, which following Merchant (2001, 2008) I call {E}. The {E} feature is discussed further in section 3.3.2.3. The noun feature of *sukulu* has been copied to the AGR node on D. Because the shape of pronouns, whether human or non-human, is always a vowel, V, I assume that the non-human pronoun vocabulary item is a vowel specified for the phonological feature {-ATR}, but underspecified for other features, specifically {BACK}. The backness value will be specified via the constraint-based phonology[4].

(118) **Morphological agreement**

DxP
{sukulu:N,E} Dx'
Dx DP
{*def*} PRONOUN D
{V{-ATR}} {AGR:N}

[4]The shape of the pronoun as a single vowel could also be derived via phonologically optimizing constraints such as REALIZEMORPH and *STRUCTURE, which would result in the minimal possible output content (a single segment) that still results in output realization of each input morpheme. However, because even human pronouns, which are fully specified vocabulary items (discussed further in section 3.4.1), have the shape of a vowel, I assume that the V shape of even non-human pronoun is specified in the lexicon.

For simplicity, I leave out the syntactic nodes below D, the projection introducing the pronoun, in (118).

For the majority of terminal node feature bundles in Guébie, there is some lexically associated phonological content. This content can be fully specified, as in 'school', /*sukulu*$^{1.1.3}$/, or partially specified, as in third-person non-human pronouns, /V{-ATR}/. We also predict, then, that there could be a set of features for which there is no corresponding phonological content. We will see this prediction born out in chapter 4.

After vocabulary items and AGR-nodes are inserted, the morphological structure in (118) is linearized via Distributed Morphology Linearization mechanisms (as laid out by Embick 2010). Note that in the proposed analysis, the morphological features associated with terminal nodes are preserved through morphology, including Linearization, and are available to the phonology (following Gribanova and Harizanov 2015; Winchester 2016; contra Halle 1990; Bobaljik 2000).

3.3.2.3 The phonology

Here I adopt a constraint-based approach, combining Cophonology Theory (Itô and Mester, 1995b; Anttila, 2002; Inkelas and Zoll, 2005) with paradigm output-output faithfulness (Burzio, 1994; Benua, 1997; Kager et al., 1999).

The choice of Cophonology Theory is crucial here, because it allows for distinct morpheme-specific phonological grammars, as opposed to a single grammar which applies across all constructions in a given language. While I choose to show each cophonology evaluated in parallel, a cyclic approach like Stratal OT (Kiparsky, 2000, 2008; Bermúdez-Otero, 1999), or serial derivation like Harmonic Serialism (McCarthy, 2000) would work equally as well as the parallel approach provided here. Since my point here is not to choose between a parallel and stratal or serial phonology, but rather to show that a model of grammar where phonology follows syntax and is sensitive to morphosyntactic features can account for phonologically determined agreement, I set aside the differences between stratal or serial and parallel approaches and use parallel evaluation for simplicity. We will also see in chapters 4 and 5 that cophonologies are better suited than a stratal or serial derivation to account for other morphophonological phenomena in Guébie.

In this model, phonology applies at phase boundaries, and DP (DxP) is a phase. Thus, the entire DP will be evaluated simultaneously by phonological constraints. For Guébie, phonological agreement applies within a DP, but not within other spell-out domains. This is an instance of nominal morphophonology which shows distinct properties from the rest of the language, much like the data explored by Smith (2011). Cophonology Theory easily predicts this kind of categorial (nominal vs. other) difference in phonological phenomena across constructions within the same language. There are two construction-specific grammars relevant for our purposes: the phonological constraint ranking that applies within DPs, and the one that applies elsewhere. I focus first on the DP-specific grammar.

The linearized structure provided by the morphological component of grammar serves as the input to phonology on this model. This linearized structure consists of vocabulary items and morphosyntactic features, (119). Note that there is no specified pronoun vowel in the input to the phonological component. The quality of the pronoun will instead be determined via ranked constraints.

(119) **Morphosyntactic input to phonology**
{sukulu:N,E} {V{-ATR}:AGR:N}

To arrive at the correct output [sukulu ʊ] or [~~sukulu~~ ʊ] based on the linearized input in (119), we need a constraint within the DP cophonology ensuring identity between the final vowel of the noun and the vowel of the pronoun. This is accomplished with ANCHOR-R, which anchors agreement to the right edge of a word, (120).

(120) **Anchor-R** (McCarthy and Prince, 1993)
Segments at the right edge of agreeing heads correspond.

This constraint is only active if the heads in question agree in some morphosyntactic feature. If they do agree morphosyntactically, segments at the right edge of each head will correspond. We also need a constraint ensuring that heads in correspondence are phonologically identical. I propose an output-output identity constraint IDENT-OO which says that heads that agree in the feature N must agree in phonological features.

(121) **Ident-OO** (Benua, 1997)
Assign one violation for each set of corresponding heads that Agree in some morphosyntactic feature and are not phonologically identical.

The IDENT-OO constraint will be crucially dominated in other cophonologies, since it is only in the DP domain that we see phonological agreement across elements that agree morphosyntactically.

The combination of the two constraints in (120, 121) has the result that two heads agreeing in the morphosyntactic feature N within the same spell-out phase will be phonologically identical, starting from the right edge of the word. The optimal candidate violates a single constraint here, namely DEP-FEATURE, which penalizes output features not present in the input. DEP-FEATURE is violated by the optimal candidate because the pronoun vowel has fully specified vowel features in the output, but not in the input. The benefit of DEP-FEATURE is that it rules out candidates like [sukulu sukulu] where the pronoun is identical to the noun in more than just one segment, because [sukulu sukulu] involves more output features without corresponding input features than does [sukulu ʊ].

(122) **Dep-feature** (McCarthy and Prince, 1993)
Assign one violation for each feature in the output that lacks a corresponding input feature.

The tableau below shows that the presence of IDENT-OO rules out a pronoun vowel that does not agree phonologically with the noun (123d). ANCHOR-R rules out a pronoun that is phonologically identical to the left edge of the noun (123c). DEP is necessary to rule out a pronoun that is identical to the entire phonological form of the noun, or even anything more than the final vowel (123b). Here I mark a single violation of Dep for each segment present in the output that was underspecified or not present in the input. This decision is for simplicity of reading the tableaux, because in fact each candidate below would incur many more Dep-feature violations than marked–one for every phonological feature inserted, rather than one for every consonant/vowel segment inserted. The justification for the ranking in (123) follows.

(123) **Ident-OO, Anchor-R $\gg$ Dep**

{sukulu:N,E} {V{-atr}:N}	Id-OO	Anchor-R	Dep-feature
☞a. sukulu ʊ			1
b. sukulu sukulu			6!
c. sukulu sʊ		*!	2
d. sukulu ɛ	*!		1

The combination of the correspondence constraint Anchor-R and the identity constraint Ident-OO function to rule out candidates that fail to agree, as per Agreement-by-Correspondence Theory (Hansson, 2001; Rose and Walker, 2004).

While the tableau in (123) rules out a number of unwanted candidates, without an additional constraint, the candidate [sukulu] with a null pronoun would beat the optimal candidate because it involves no feature insertion. We must ensure that the pronoun surfaces overtly, despite its lack of fully-specified phonological feature information in the input. This can be assured with a RealizeMorpheme constraint, which penalizes an output candidate that does not overtly realize an input morpheme, (124).

(124) **RealizeMorph(eme)** (Samek-Lodovici, 1993; Rose, 1997; Walker, 2000; Kurisu, 2001)
Assign one violation for each input morpheme that is not phonologically realized in the output.

(125) **Ident-OO, Anchor-R, RealizeMorph**

{sukulu:N,E} {V{-atr}:N}	Id-OO	Anchor-R	RealizeMorph	Dep-feature
☞a. sukulu ʊ				1
b. sukulu			*!	

While the constraints in (125) explain why we get a surface pronoun that is a single segment and agrees with the final segment of the noun, they do not explain why the features of the final vowel of the output noun are identical to the input features. That is, why don't we have an optimal output candidate [sukul**e ɛ**][5]? This is solved with a highly ranked Ident-IO constraint.

[5]Note here that I am not treating feature *changes* such as input /u/ surfacing as [ɛ] to involve feature epenthesis (i.e. a violation of Dep-feature. Instead, I consider feature changing to be violation of input-output identity. This choice is not crucial for the overall analysis.

(126) **Ident-IO** (McCarthy and Prince, 1995a)
Assign one violation for each output segment whose features differ from the corresponding input segment.

The full Guébie vowel inventory contains ten vowels, [i, ɪ, e, ɛ, u, ʊ, o, ɔ, ə, a], but there are fewer possible singular non-human pronoun vowels, [ɛ, a, ʊ]. The specified {-ATR} feature on the pronoun vocabulary item limits the possible pronoun vowels to [ɪ, ɛ, ʊ, ɔ, a]. Additional constraints such as PeriphVowel preferring peripheral vowels [ɪ, ʊ, a] and *I dispreferring the output segment [ɪ] in Guébie account for the reduced number of pronoun vowels [3: ɛ, a, ʊ], compared to the full Guébie vowel inventory [10, above]. As this is secondary to the point of this section, I leave these constraints out of the tableau below.

Ranked as in (127), the above constraints lead to the correct output of a [[Noun] Pronoun] structure, where both the noun and the pronoun are overt. These constraints ensure that the pronoun agrees phonologically with the final vowel of the noun in question.

(127) **Ranking:** Ident-OO, Anchor-R, Ident-IO, RealizeMorph $\gg$ Dep-feature

For those cases where a pronoun surfaces without an overt noun I posit that the noun is present in the syntax but is elided at PF, [~~sukulu~~ ʊ], 'it (school)' (cf. Merchant 2001; Lasnik 2007). Constituents that can optionally be elided are marked with a feature E in the syntax (Merchant, 2001), and here I propose a model of ellipsis where the phonology has access to the E feature of the noun, just as it has access to other morphosyntactic features, such as the N feature triggering phonological agreement. The option of eliding the noun is then determined via constraints.

The presence of an E feature triggers what I call here an *ellipsis paradigm*. This paradigm involves the entire spell-out domain being evaluated, both where ellipsis has occurred, and where it has not. Both cells of the paradigm are evaluated simultaneously by the relevant cophonology.

The novel constraint in (128) is an output-output paradigm correspondence constraint (Burzio, 1994; Benua, 1997; Kager et al., 1999; McCarthy, 2005), which ensures that the phrase (or syntactic phase) containing the elided element is as similar to the optimal non-elided output as possible. For example, the elided form [~~sukulu~~ ʊ] must be faithful to the non-elided [sukulu ʊ].

(128) **Faith-NoElide**
For each form in an ellipsis paradigm, assign one violation for each output segment whose features differ from corresponding output segments across the paradigm.

In an output-output paradigm correspondence model such as this, candidates consist of paradigms, which are evaluated together as a unit. In (129) there are both input-output correspondence relationships, as well as output-output paradigmatic correspondence relationships. We see that in Guébie, when DPs containing elided and non-elided nouns are evaluated together in a paradigm, the undominated constraint in (128) together with those constraints in (127) gives the correct output. That agreement can be sensitive to unpronounced material is well known (Merchant 2015:16), and the proposed constraints show an articulated model of this particular phenomenon.

(129) **A constraint-based approach to ellipsis**

{sukulu:N,E} {V{-ATR}:N}	FAITH-NOE	Id-IO	Id-OO	ANCHOR	REALIZE	DEP
☞a. sukulu ʊ, ʊ					*	2
b. sukulu ʊ, Ø					**!	1
c. sukulu s, sʊ				*!	*	3
d. sukulu ɛ, ɛ			*!		*	2
e. sukule ɛ, ɛ		*!			*	2
f. sukulu ʊ, ɛ	*!				*	2

Every form in (129) receives at least one REALIZEMORPH violation because the noun /sukulu$^{1.1.3}$/ is unrealized in the second form of the paradigm.

The proposed analysis forces phonological agreement and provides the option of ellipsis at PF simultaneously via constraints (with regards to the latter, this analysis is similar to Bennett et al. (2015)'s analysis of Irish ellipsis at PF). A terminal node which has a morphosyntactic E features, available to the phonology, can optionally be elided via an ellipsis paradigm at PF, as in (129).

By evaluating paradigms of elided and non-elided candidates in Cophonology Theory, we predict phonological agreement of elements within a DP that agree in some morphosyntactic feature. Further predictions of the proposed model are discussed in section 3.4.

The resulting model is as shown in (130), where the noun with an E feature is present in the syntax along with the pronoun head. An AGR-node is inserted on the pronoun head during morphology, and linearization takes place. The phonology has access to the linearized terminal nodes and their features, and it ensures phonological identity between nodes that agree morphosyntactically. Optionally, a noun with an E-feature is elided, but the noun phrase with an elided noun must be as similar to the non-ellipsis member of the paradigm as possible, resulting in agreement between noun and pronoun, even when the noun is not pronounced.

(130) **An interface model of Guébie pronoun DP agreement**

a. **The syntax**

[DxP NOUN+{*sg/pl*} [Dx' [Dx {$-def$}] [DP ~~NOUN+{*sg/pl*}~~ [DP PRONOUN [D' D ~~NumP~~]]]]]

b. **The morphology**

[DxP {sukulu:N,E} [Dx' Dx [DP [D {V{-ATR}}] {AGR:N}]]]

c. **The phonology**

~~{sukul**u**:N,E}~~ → {~~sukulu~~,[sukulu]}

~~{AGR:N}~~ → [**ʊ**]

3.4 Typological predictions

The constraints presented in section 3.3.2.3, together with the proposed syntactic and morphological structure of the DP, account for the Guébie phonological agreement between nouns and pronouns. The same analysis explains the phonological agreement in nominative, accusative, emphatic, and possessive pronouns in Guébie; all involve a pronoun head with an optionally elided noun in the same DP. We will see that the proposed analysis not only also accounts for the human pronouns and noun/adjective agreement in Guébie, but it also accurately predicts the types of existing phonologically determined agreement systems cross-linguistically.

The analysis in section 3.3.2.1 relies on the assumption that DP is a syntactic phase, and that morphology and phonology apply cyclically by phase. It predicts that any two elements within the same syntactic phase could show phonological agreement, as long as those two elements share some morphosyntactic feature. For Guébie, it is only the DP-specific phonological grammar which ensures phonological agreement; however, the constraints in section 3.3 do not rule out phonologically determined subject or object agreement on a verb in some other language, as long as the agreement controlling element is spelled out within the same domain as the verb.

Additionally, due to the nature of correspondence and identity constraints, the phonologically corresponding segments in the morphosyntactically agreeing elements must be either edge-based or surface in some prominent position in a word. The ANCHOR-R constraint in Guébie ensures correspondence at the right-edge of the noun and pronouns. However, we could imagine a system where ANCHOR-L is at play instead, requiring that corresponding segments be anchored to the left edge of the agreeing elements.

Perhaps a more specific statement of the prediction above, only an edge-aligned or prominent segment (or, perhaps, suprasegmental) can control phonological agreement. We saw in section 3.3.2.3 that IDENT-OO plus ANCHOR-R ensures that the final segment of two elements with {N} features are identical. This means that in Guébie, the final vowel of the noun will control agreement. Rather than a final vowel, we could imagine a system where the agreement controlling segment is a consonant or is suprasegment.

The above predictions are summarized in (131).

(131) **Predictions of the model**

A. Only elements within the same syntactic phase can surface in phonological agreement.

B. Phonologically corresponding segments will be edge-based or surface within some prominent position in a word.

C. Any edge-aligned or prominent segment or suprasegment can control agreement.

In section 3.4.1 I show that the model holds for human pronouns and in section 3.4.2 for noun/adjective agreement in Guébie. In sections 3.4.3-3.4.5 I turn to other attested phonologically determined agreement systems cross-linguistically. Very few languages outside of Kru have been described as having such systems; however, in those languages, we see the above predictions born out.

3.4.1 Guébie human pronouns

Recall that human pronouns in Guébie do not follow the phonological agreement pattern that all other nouns follow. Instead, they predictably take the forms /ɔ/, singular, and /wa/, plural. I repeat the pronoun chart for Guébie from (91) in (132) below.

(132) **Human and non-human subject pronouns**

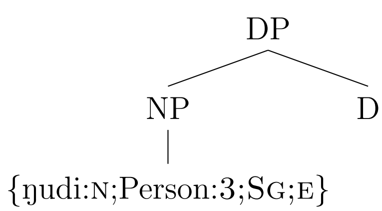
Human			Non-human		
	Singular	**Plural**		**Singular**	**Plural**
1st	e^4	a^3	**1st**	–	–
2nd	e^2	a^2	**2nd**	–	–
3rd	$ɔ^3$	wa^3	**3rd**	$ɛ^3$,a^3,$ʊ^3$	$ɪ^3$,wa^3

The model described in section (3.3) extends to human pronouns in Guébie without modification. We saw that nouns are present in the syntax in the same DP as pronouns, and their features are copied to the pronoun via a morphological AGR node. I claim here that human nouns not only have a [Noun] feature which is copied to the pronoun, they also have a [Person] feature (Richards, 2008; Van der Wal, 2015). This is summarized in (133) and exemplified for *ŋudi*$^{3.1}$ 'man' in (134).

(133) **Pronoun features and realization**

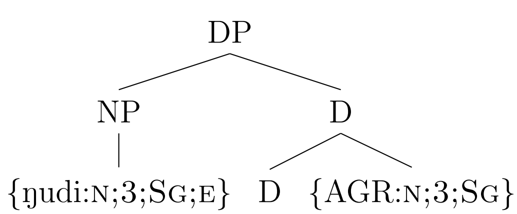
	Human	**Nonhuman**
Features	[+Person, n, e]	[-Person, n ,e]
Vocabulary Item	/ɔ, wa/	/V{-ATR}/
Surface forms	[ɔ, wa]	[ɛ, a, ʊ, ɪ, wa]
	semantically determined	phonologically determined

(134) **Syntactic representation of human pronouns**



When features are copied from a human noun to the AGR node on the pronoun D, [Person] and [Number] features are copied along with the [Noun] feature. These are absent on non-human nouns.

(135) **Morphological agreement between human nouns and pronouns**



Then, during Vocabulary Insertion, this particular bundle of features is spelled out as [ɔ], as in (132). That is, the 3rd singular human vocabulary item /ɔ/ is inserted in the context of the features [+Person:3SG N]. Similarly, the plural human pronoun [wa] is inserted in the context of the features [+Person:3PL N]. This differs from all non-human nouns which are not marked for person or number features in the syntax.

(136) **Phonological representation of human pronouns**

~~{ŋudi:N;**Pers:3,Sg**;E}~~ ~~{AGR:N;Pers:3,SG}~~

| |

{~~ŋudi~~/ŋudi} [**ɔ**]

We see that if certain semantic features of the noun (person, number) are copied to the pronoun D via morphological agreement mechanisms and spelled out by a vocabulary item with specified phonological features ([N, PERS:3SG → [ɔ]), that vocabulary item is not subject to phonological identity. Instead, a highly ranked constraint ensures faithfulness to the phonological content inserted during Vocabulary Insertion. This IDENT-IO constraint must be ranked higher than the IDENT-OO constraints requiring phonological agreement between agreeing elements in the DP, providing evidence for a more nuanced constraint ranking than the one presented in (127). We could imagine, then, a language with the same constraints but where input-output faithfulness was low-ranked, where the entire pronoun system would be phonologically determined, including first and second persons. As far as I know, no such language has been described, but the system proposed here predicts that it could exist.

Phonological identity between the pronoun and agreement-controlling noun seems to be a last resort agreement strategy in Guébie. Specifically, phonological identity holds only in those cases where there is no relevant vocabulary item with specified phonological content to insert. This prediction is supported by Corbett (1991)'s generalization that when semantic and phonological criteria for determining noun class are at odds, semantic features take precedence.

3.4.2 Guébie adjectives

Adjectives in Guébie agree in final vowel with the noun that they modify.

(137) **Noun-modifier phonological agreement** (repeated from 104) (syl_20151117)

a. ɓit**ə**$^{2.3}$ lel**ə**$^{2.3}$ ɟɛl**a**$^{1.1}$
house new red
'A new red house'

b. f**u**^{3} lel**o**$^{2.3}$ ɟɛl**ɔ**$^{1.1}$
sponge new red
'A new red sponge'

We can derive this agreement in the same way as noun-pronoun agreement. Syntactically, nouns, along with the adjectives that directly modify them, are present in a single syntactic phase (DP). An AGR node is inserted on the adjective by the morphology. Features of the noun (namely, N) are copied to the adjective so that the adjective and noun are in morphosyntactic agreement. The phonology ensures that agreeing heads (the noun and its adjectival modifiers) are phonologically similar, via the same constraints discussed in section 3.3.

Further evidence that noun/adjective agreement works the same way as noun/pronoun agreement comes from ellipsis. In the same way that pronouns license ellipsis of the agreement-triggering noun (116b,c), adjectives that agree with the head noun license ellipsis of that noun, (138).

(138) **Overt agreement on adjectives licenses ellipsis of the noun** (syl_20151117)

a. lel**ə**$^{2.3}$ ɟɛl**a**$^{1.1}$
new red
'A new red one' (house)

b. lel**o**$^{2.3}$ ɟɛl**ɔ**$^{1.1}$
new red
'A new red one' (sponge)

Just like optional nominal ellipsis in [[Noun] Pronoun] constructions, [Noun [Adjective]] candidates are evaluated in paradigms, with two forms in each paradigm: one where the noun is elided and one where it is overt. A FAITH-NOELIDE constraint ensures output-output paradigm faithfulness so that the adjective agrees phonologically with the noun even when the noun is elided. The relevant constraint ranking is identical to the one shown for noun/pronoun agreement in in (129).

Though they are few, other languages have also been described to have phonologically determined agreement systems. These include other Kru languages, Bainuk (Atlantic) (Sauvageot, 1967), Abu' (Arapesh) (Nekitel, 1986), Bə́ná (Adamawa) (Van de Velde and Idiatov, 2017), and Frὸʔὸ (Gur) (Traoré and Féry, 2017). Like Guébie, phonological agreement in each of these other languages is productive, predictable, and not strictly local. Three of these systems are examined in the remainder of this section.

3.4.3 Other Kru languages

A similar phonologically determined agreement system to Guébie is present in other Kru languages. These include but are not limited to Krahn, a Western Kru language (Bing, 1987); Godié, an Eastern Kru language (Marchese, 1986b, 1988); and Vata, an Eastern Kru language (Kaye, 1981; Marchese, 1979; Corbett, 1991).

3.4.3.1 Krahn

Bing (1987) describes an agreement pattern in Gbɔbo, a dialect of Krahn (Western Kru) spoken in Liberia and Côte d'Ivoire, that is quite similar to the Guébie pattern. There are nine vowels in the Krahn system, and there are four possible third-person singular pronouns vowels: one for humans and three phonologically determined ones for non-humans. Non-human nouns that end in front vowels take the front vowel pronoun ɛ, those that end in non-high back vowels take the pronoun vowel ɔ, and those that end in high back vowels take the pronoun vowel ʊ.

(139) **Krahn phonological agreement**

Noun	Gloss	Pronoun
ɟi	'leopard'	ɛ
ni	'water'	ɛ
kasee	'cassette'	ɛ
gba	'dam'	ɔ
sɔɔ	'basket'	ɔ
pu	'gun'	ʊ
tau	'basket'	ʊ
dʊ	'honey'	ʊ

Since the Krahn system is so similar to the Guébie one, it requires no extra theoretical tools to account for the data. The proposed model would apply to Krahn just as it does to Guébie, ensuring phonological agreement between the final vowel of the noun and pronoun unless the noun is human, in which case the semantic features win out. The only significant difference is that Bing does not mention any category of element other than pronouns that agrees with the noun in Krahn. If adjectives do not agree phonologically with the nouns they modify, we can assume that adjectives in Krahn do not agree *morphologically* in features with nouns; thus, no phonological identity is required to hold between them.

3.4.3.2 Godié

Godié is an Eastern Kru language spoken in Côte d'Ivoire. Just like Guébie and Krahn, there are four possible pronoun vowels in Godié: one human vowel and three phonologically determined vowels. However, Godié agreement processes target not only pronouns, but also definite clitics, demonstratives, and adjectives (Marchese, 1986b, 1988).

In the Godié example below, the human word 'man' triggers the agreement vowel [ɔ] on the adjective and demonstrative following it. The final front vowel of the word 'animal' triggers the front agreement vowel [ɛ] on the adjective [kəd-ɛ] that describes the word 'animal.'

(140) **Godié pronoun agreement**

ɲʊkpɔ̱	kəd-ɔ̱	nɔ̱	nii	ml**ɛ**	kəd-**ɛ**
man	big	this	saw	animal	big

'This big man saw the big animal.'

Since demonstratives, definite clitics, pronouns, and adjectives are all within the DP domain, all of them should be equally likely to agree with the noun. I have proposed that the phonology applies by phase, and that DP is a phase, so the phonological analysis applies to any two elements within a DP phase as long as they are in morphosyntactic agreement.

Thus, the difference between the Godié agreement system and the Guébie system is that in Godié demonstratives and definite markers are in morphosyntactic agreement with the noun, while in Guébie they are not. Guébie lacks demonstratives entirely but has a definite clitic /=a/ which surfaces on the noun. Further research is need to determine whether there are any true syntactic differences between Guéibe and Godié definite markers which shows that they are in agreement with the noun in Godié but not Guébie. What matters for this analysis, though, is that demonstratives and definite markers in Godié agree *morphologically* with the head noun.

3.4.3.3 Vata

Vata is an Eastern Kru language spoken in south-central Côte d'Ivoire (Kaye, 1981). The Vata system differs slightly from the phonological agreement systems of other Kru languages discussed thus far. There are ten contrastive vowels in Vata, at five places of articulation with an ATR contrast, /i, ɪ, e, ɛ, u, ɯ, o, ɔ, ə, a/. Rather than three possible non-human pronoun vowels like Guébie, Krahn, and Godié, Vata has five non-human pronoun vowels: one for each of the five degrees of height and backness /ɪ, ɛ, ɯ, ɔ, a/.

Agreement holds between a noun and a personal pronoun in Vata, as well as between a noun and a relative pronoun, as shown in (141).

(141) **Pronouns in Vata**

Nouns	Glosses	Pronoun-be.big	Relative Pronoun
lɪ, di	'songs, villages'	ɪ-ɣli	mɪmɪ
cɪcɛ, ɓle	'eagle, cow'	ɛ-ɣli	mɛmɛ
gɔlɯ, du	'progue, village'	ɯ-ɣli	mɯmɯ
lagɔ, deto	'god, spider'	ɔ-ɣli	mɔmɔ
jla, slə	'lion, home'	a-ɣli	mama

I have chosen one noun ending in a +ATR and one ending in a -ATR vowel for each of the five height/backness distinctions in (141). The pronoun and relative pronoun themselves remain -ATR even when the noun ends in a +ATR value. Only the backness, height, and rounding of the vowel is determined by the final vowel of the noun.

We can extend the analysis from section 3.3 to Vata agreement with little change. We only need to rerank certain constraints to get the right output. In Guébie, there is a ten-vowel system in the language which is reduced to three possible agreeing vowels for non-human pronouns. I mentioned in section 3.3 that in order to account for the reduced number of possible pronoun vowels in Guébie, [ɛ, a, ʊ] as opposed to the full ten [i, ɪ, e, ɛ, ə, a, u, ʊ, o, ɔ], we would need constraints like PeripheralVowel which prefers the peripheral -ATR vowels /ɪ, a, ʊ/, and *I to prefer /ɛ/ over /ɪ/. In Guébie these constraints must be highly ranked, only crucially out-ranked by Ident-IO. However, in Vata, the same constraints must be very low-ranked, because they play no role in the Vata agreement system. In Vata, for every distinct final vowel on nouns, there is a corresponding pronoun vowel that has the same height, backness, and rounding features. Only the ATR features of the pronoun are prespecified on the pronoun vowel in Vata. Thus, by simply ensuring that IDENT-OO outranks PERIPHERALVOWEL and other such vowel markendess constraints, we get the correct output for Vata without otherwise changing the analysis for Guébie presented in section 3.3.

It is worth noting that the kind of minor typological variation we see between Guébie and Vata is predicted by a constraint-based analysis like the one presented here, but is less obviously expected in a rule-based phonology or a purely syntactic approach to phonologically determined agreement.

3.4.3.4 Summary of Kru phonological agreement

Krahn and Godié, like Guébie, have three possible forms for non-human third-person singular pronouns. The optimal form is the one that agrees with the noun phonologically. In Vata, there are five possible vowels for non-human third-person singular pronouns, where height and backness, as opposed to just backness of the pronoun vowel is determined by the final vowel of the noun.

(142) **Phonological agreement across Kru**

	Guébie	**Krahn**	**Godié**	**Vata**
Number of Agreeing Vowels	3	3	3	5
(Non-human) Pronoun-Noun	Yes	Yes	Yes	Yes
Possessive-Noun	Yes	Yes	Yes	Yes
Adjective-Noun	Yes	No	Yes	No
Demonstrative-Noun	N/A	No	Yes	No
Definite-Noun	No	No	Yes	No
Relative Pronoun-Noun	No	No	No	Yes

The phonologically determined agreement systems in Krahn, Godié, and Vata all closely resemble the Guébie system except that a different set of elements agrees with the noun in each language. However, because all of the agreeing elements occur within the DP phase, each system above is predicted by the proposed analysis (cf. Prediction A in 131).

3.4.4 Bainuk

Bainuk, a Western Atlantic language spoken in Senegal and Guinea (Sauvageot, 1967), also shows phonological agreement within DPs[6]. Most nouns in Bainuk take one of 18 fixed noun class prefixes; however, there is a class of prefixless nouns that triggers phonologically determined agreement. Prefixed nouns are much like human pronouns in Guébie, where semantic

[6]Some Atlantic specialists are skeptical that this is actually a case of phonologically determined agreement, according to Merrill, p.c..

feature bundles determine the agreement marker (143, 144). Agreement classes of prefixless nouns in Bainuk can be derived phonologically in the same way as the phonologically determined non-human pronouns, (145).

(143) **Bainuk prefixed nouns**

Singular	Plural	Gloss
si-nɔx	mu-nɔχ	'tree'
si-deːn	mu-deːn	'pirogue'
gu-sɔl	ha-sɔl	'tunic'
bu-sumɔl	i-sumɔl	'snake'
bu-domel	i-domel	'papaya'

Demonstratives (144a), numbers (144b), interrogatives (144c), pronouns (144d-e), and adjectives (144f) agree in noun class with the prefixing nouns. Prefixed nouns are marked for plural number by changing the noun class prefix.

(144) **Prefixed noun agreement**

a. <u>si</u>-deːn-o in-<u>si</u>
pirogue this
'this pirogue'

b. <u>mu</u>-deːn <u>mu</u>-nak
pirogues two
'two pirogues'

c. <u>si</u>-nɔx <u>se</u>-rã
tree which
'which tree?'

d. in-<u>si</u>
this-one
'this one (pirogue)'

e. uɲ-<u>gu</u>
this-one
'this one (tunic)'

f. si-de:n si-wuri
pirogue long
'long pirogue'

Prefixless nouns do not have a noun-class prefix to trigger agreement on the following modifiers. Because there is no prefix, there is no affect of plurality on prefixes for these nouns. Instead, there is a change in final vowel that makes a prefixless noun plural (Sauvageot

1987:18). Though there is no noun class prefix for this group of nouns, the first syllable, no matter its shape, surfaces as the agreement marker on demonstratives, numerals, Wh-words, adjectives, and pronouns.

(145) **Bainuk prefixless noun agreement**

a.	**ka**ta:ma-ã	<u>ka</u>-nak-ã	b.	**da**pɔn	<u>da</u>-wuri
	river	two		grass	long
	'two rivers'			'long grass'	

The possible number of agreement prefixes is extremely high in Bainuk, not limited to three possible vowels as in Guébie, but rather determined by the number of distinct first syllables in prefixless nouns. However, only a small set of nouns trigger such agreement in Bainuk, unlike Guébie where all non-human nouns require phonologically determine agreement.

Note that in Bainuk, phonological correspondence is anchored to the left edge of the agreement-controlling noun and the agreeing elements. Though this is distinct from Guébie right-edge vowel agreement, it is predicted by the proposed analysis (cf. Prediction B in 131).

3.4.5 Abu'

Abu', also spelled Abuq, a dialect of Arapesh spoken in Papua New Guinea (Nekitel, 1986), also shows phonologically determined agreement. Here, the final consonant of a noun triggers phonological agreement on demonstratives, adjectives, and verbs (Aronoff, 1992; Dobrin, 1995)[7].

(146) **Abu' phonological agreement** (Nekitel 1986 cited in Dobrin 1995)

a. aleman**n** afu-**n**-eri **n**-ahe'
man good-CLN-ADJ CLN-went
'a good man went'

b. almi**l** afu-**l**-i **l**-ahe'
bird good-CLL-ADJ CLL-went
'a good bird went.

c. ihiaburu**h** afu-**h**-i **h**-ahe'
butterfly good-CLH-ADJ CLL-went
'a good butterfly went.

[7]See Aronoff (1992) for an analysis of the difference between noun class agreement within a noun phrase and agreement between a noun and a verb, with specific reference to the Arapesh data.

Traditionally there are 13 possible final consonants in Abu'. Since contact with Tok Pisin and other languages, words have been borrowed with other final consonants. Even in borrowed words with non-native segments, like /r, p/ in (147a,b), the final consonant of the noun triggers agreement, thus this is clearly a phonologically-determined system.

(147) **Borrowed words undergo phonological agreement**

a. pate**r** a**r**a
priest this
'This priest'

b. pai**p** a**p**a
pipe this
'This pipe'

In Abu' it is right-aligned *consonants*, rather than vowels (Guébie) or syllables (Bainuk) that trigger agreement. The analysis proposed in section 3.3 predicts such a system (cf. Prediction C in 131).

3.5 Discussion

We have seen that an interface approach to phonologically determined agreement accounts for the Guébie data as well as for a range of cross-linguistic phonologically determined agreement data.

Noun class agreement for a subset of the lexicon of each of the languages discussed here, Guébie and other Kru languages, Bainuk, and Abu', is purely phonologically determined. However, in each of these languages, there is part of the lexicon for which semantic features are also necessary to determine the agreement markers. There is no attested noun class or gender system, to my knowledge, that is entirely phonologically determined (Corbett, 1991). In Guébie, for example, all human nouns have specified pronoun forms irrelevant of the phonological form of the noun; though, for all non-human nouns, phonological form is the determining factor.

While Guébie nominal concord is not quite entirely phonologically determined, the analysis in section 3.3 does not rule out the possibility of a purely phonologically determined system. The analysis requires that any vocabulary item whose insertion criteria are met given the syntactic input to morphology be inserted during the morphological component, leaving the phonology to take care of the rest. In this way, the proposed model predicts exactly the generalization by Corbett (1991) that when semantic and phonological features determining noun class are at odds, the semantics will win out. Vocabulary items inserted in the context of particular semantic features will be unaffected by phonological agreement, while those underspecified for insertion context (and phonological feature content) are predicted to show phonologically determined agreement.

Given this analysis, we could imagine a language where no set of semantic person, number, and gender features is spelled out by a particular vocabulary item during the morphological vocabulary insertion operation. This would leave the phonology to determine the output of all phonologically underspecified agreeing heads.

The fact that we do not find an entirely phonologically determined system is unsurprising from a functionalist perspective. As Corbett (1991) notes, the most common noun class distinctions are human versus non-human, animate versus inanimate, and masculine versus feminine. All of these features are prominent ones in daily human interaction, and it is not surprising that many grammars distinguish between these semantic categories for ease of communication. While from the perspective of a formal grammatical model, the analysis in section 3.3 predicts the existence of a purely phonologically determined system, the functional load of distinguishing between, say, human and non-human referents is too important for a grammar to ignore.

While phonological features are not predicted to influence morphosyntactic processes like agreement (Pullum and Zwicky, 1986, 1988), agreement within a noun phrase is often determined, at least partially, by phonological features. The question raised here, then, is whether phonologically determined agreement systems can be modeled without violating the assumption that syntax is phonology-free. Crucially, the analysis proposed in section 3.3 does not require us to say that phonological information is present in the syntax, or that syntax is sensitive to phonological information in any way. Instead, agreement within the noun phrase is a morphological operation resulting in two or more syntactic heads that share morphosyntactic features. Phonological constraints, which are active only after the syntactic and morphological components of grammar, have access to morphosyntactic features of heads and ensure phonological identity between agreeing elements. In this way, the proposed analysis does not question the assumption of a phonology-free syntax.

One may wonder, however, whether the given analysis requires more stipulation or makes different predictions than an analysis which allows phonological information to be present in the syntax, before morphosyntactic agreement takes place. Addressing this question requires more data and perhaps psycholinguistic experimentation. That is, in order to retract the assumption that syntax is phonology free, we as a field will want more evidence than just a single phenomenon like phonologically determined agreement. Anttila (2016) provides a review of work on prosodic size restrictions on syntax, where to some statistically significant extent (Bresnan et al., 2007), word order seems to be conditioned by phonological factors. He shows that with a view of phonological filters on possible syntactic structures (Anttila, 2008; Anttila et al., 2010), we need not say that phonological information is present during the syntactic component. Other recent work has also claimed that there is a closer relationship between phonology and syntax than previously thought, and that syntactic structure must be able to reference at least prosody (McFadden and Sundaresan, 2015; Richards, 2016, 2017a,b,c).

In the analysis in section 3.3 we saw that apparent phonologically determined agreement can be analyzed without needing syntax to be sensitive to phonology. In Anttila (2016) and prior work, phonologically conditioned word orders are analyzed with a phonology-free syntax as well. We can ask the question, if not word order or agreement data, what kind of data would convince us that syntax is sensitive to phonological information? While I cannot provide an answer to this question here, I encourage that we as a field revisit the assumption of phonology-free syntax.

3.6 Conclusion

This chapter provides an initial description of the phonologically determined agreement system of Guébie (Kru, Niger-Congo), and proposes an interface-based analysis where phonologically determined nominal concord arises through phonological identity to output forms via morphological agreement mechanisms. In addition to accounting for phonologically determined agreement, the proposed analysis includes a formal account of ellipsis via constraints at PF.

I have shown that the proposed analysis accounts for the variation in attested cross-linguistic phonologically determined agreement systems, though I leave as a question for further research whether it could serve as a model of gender and noun class systems more generally.

Crucially, this chapter demonstrates that phonologically determined agreement systems can be modeled without requiring phonological features to be present in syntax. Thus *we can maintain that syntax is not sensitive to phonological features.* I raise another question in its place: Given the existence of partially phonologically determined agreement systems like the one in Guébie, what is the real benefit in maintaining that syntax is phonology-free?

Chapter 4

Scalar tone shift

4.1 Introduction

The second case study of the interaction between phonology and morphosyntax in Guébie is a pattern of scalar tone shift in imperfective contexts. The imperfective morpheme has no segmental exponent, nor a single suprasegmental realization. Instead, in imperfective contexts, we see a tonal interaction between subject and verb that is absent in other contexts. This pattern bears on questions of process morphology. Namely, is all morphology item-based, or can morphology be exponed by constraint-driven processes in the absence of an abstract underlying item?

As discussed in section 1.1.1, morphosyntactically conditioned phonology (MCP) involves any instance of phonological allomorphy triggered in particular morphosyntactic contexts. Many instances of MCP occur in the presence of a particular overt morpheme. For example, in Turkish root-final consonant deletion occurs before certain over suffixes, *bebek-cik*, *baby-DIM* → *bebecik*, 'little baby' (Inkelas, 2014, 4). However, there are also those alternations which occur in particular morphosyntactic contexts where there is no additional affixal material present. The pattern presented in this section falls into the latter category. (Inkelas, 2014, ch. 3) demonstrates that morphologically conditioned phonology and process morphology involve the same operations at several levels, and argues that phonological constraint rankings can easily drive process morphology without abstract underlying morphemes. Inkelas's generalization provides a direct argument that both process morphology and morphosyntactically conditioned phonological alternations are due to cophonologies, the association of distinct phonological grammars with particular morphosyntactic constructions (Orgun, 1996; Inkelas et al., 1997; Anttila, 2002; Inkelas and Zoll, 2005, 2007). Cophonology Theory is adopted here, where process morphology and morphosyntactically conditioned phonology are both constraint-driven, and are not theoretically distinct phenomena.

Much recent literature has claimed that all morphology is item-based, meaning that any morphology with phonological exponence is the result of the addition of phonological material (Benua, 1997; Alderete, 2001; Wolf, 2007; Bermúdez-Otero, 2012; Gouskova and Linzen, 2015; Zimmermann, 2013; Trommer and Zimmermann, 2014; Köhnlein, 2016). However, subtractive, scalar, metathesizing, and replacive morphology pose challenges for an item-based view of morphology. This chapter focuses on a novel pattern of scalar tone shift from Guébie, reraising Anderson (1992)[63]'s question: "Is it possible to reduce all of morphology to affixation [...]? If not, the item-based theory should probably be rejected." I demonstrate that indeed there is no workable underlying representation of the Guébie imperfective morpheme, and on the basis of Guébie scalar tone shift and countless other morphologically conditioned phonological processes across languages, we should give up a purely item-based view of morphology. I propose an alternative solution based in the morphological operations of Distributed Morphology (DM) (Halle and Marantz, 1994) and a constraint-based implementation of Cophonology Theory.

The model of scalar tone shift proposed here relies on the assumption that phonological constraint rankings can differ with morphosyntactic construction within a single language, and that syntactic units larger than a single word can be evaluated simultaneously. The effect of Guébie scalar tone shift can surface on the subject or adjacent inflected verb, thus the subject and verb must both be present during the phonological evaluation cycle where scalar tone shift takes place. This phrase-level phonological phenomenon bears on questions of syntactic interaction with morphophonology (cf. Embick and Marantz (2008) and Embick (2010, 111)).

Section 4.2 describes a scalar tone shift phenomenon in Guébie, where in the environment of the morphosyntactic imperfective feature, tones on verbs or subjects shift one step on the four-height tone scale. In section 4.3 I rule out item-based analyses of this scalar tone phenomenon and propose instead a DM plus Cophonology Theory account. Two other instances of tonal morphology are described in section 4.4, and the same model used to account for scalar tone is shown to also account for tonal case marking and replacive tone in noun-noun compounds. I conclude in section 4.5 with a discussion of the implications of the data and model.

4.2 Guébie scalar tone shift

As described in chapter 2, Guébie is a tonal language with four distinct tone heights, marked here with numbers 1-4 where 4 is high. Here I summarize relevant details of the tonal inventory of the language before describing the scalar tone shift in question.

Attested tone melodies on lexical roots in Guébie include four level tones (1, 2, 3, 4), along with those contours represented in (148).

(148) **Attested contours**

	1	**2**	**3**	**4**
1	✓	∅	✓	∅
2	∅	✓	✓	✓
3	✓	✓	✓	∅
4	✓	✓	∅	✓

The tones along the vertical axis in (148) represent the first tone of a two-tone contour. Those along the horizontal axis are the second tone of a two-tone contour. A *checkmark* marks those contours (or level melodies) attested in Guébie, a ∅ marks those that are unattested.

Word order in Guébie alternates between SAuxOV and SVO. When auxiliaries (which mark tense, polarity, and mood) are present, there is no inflection on verbs (151a). However, when there is no auxiliary, the verb surfaces immediately after the subject, and in exactly these cases the verb is inflected for aspect (151c, 152). Nothing can ever intervene between subject and auxiliary or subject and inflected verb. The syntactic structure responsible for these two surface word orders is discussed in section 4.3.1.

In all contexts except SVO clauses with imperfective aspect, any given verb surfaces with a single consistent tone melody. This includes all SAuxOV constructions, (149), the imperative, (150), and perfective SVO clauses (151).

(149) **SAuxOV: Default tone**

a. *Future*

e^{4}	ji^{3}	ɟa^{31}	<u>li^{3}</u>
1SG.NOM	FUT	coconuts	eat

'I will eat coconuts.'

b. *Irrealis*

e^{4}	ka^{3}	ɟa^{31}	<u>li^{3}</u>
1SG.NOM	IRR	coconuts	eat

'I would eat coconuts.'

c. *Negative perfective*

e^{4}	la^{2}	ɟa^{31}	<u>li^{3}</u>
1SG.NOM	IRR	coconuts	eat

'I did not eat coconuts.' (syl_20131024)

(150) **Imperative: Default tone**

<u>li^{3}</u>
eat.IMP

'Eat!' (syl_20131024)

(151) **Perfective SVO: Default tone**

e^{4}	<u>li^{3}</u>	ɟa^{3}-ɓe^{1}	kubə$^{3.1}$
1SG.NOM	eat.PFV	coconuts-SG	yesterday

'I ate a coconut yesterday.' (syl_20131024)

In all SAuxOV, V, and SVO constructions in (149, 150), and (151), the surface tone on the verb *eat* is a level tone 3. However, in imperfective SVO contexts, tone on the verb surfaces one step lower on the four-height tone scale, (152).

(152) **Imperfective SVO: Tone one step lower**

e^{4}	li^{2}	ɟa^{31}	koko$^{4.4}$
1SG.NOM	eat.IPFV	coconuts	everyday

'I eat coconuts everyday.' (syl_20131024)

Perfective and imperfective clauses, the only SVO constructions, are identical segmentally and syntactically, except for the tone on the verb. Thus, we get minimal tone pairs like the one in (153).

(153) **Scalar tone minimal pairs**

a. Perfective: Lexical tone

e^{4}	li^{3}	ɟa^{3}-ɓə^{1}
1SG.NOM	eat.PFV	coconuts-SG

'I ate a coconut.'

b. Imperfective: One step lower

e^{4}	li^{2}	ɟa^{3}-ɓə^{1}
1SG.NOM	eat.IPFV	coconuts-SG

'I am eating a coconut.' (oli_20160801)

This scalar tone shift in imperfective contexts is an example of a tone change triggered in a particular morphosyntactic environment. Similar patterns are found elsewhere in Guébie and in other West African languages. For example, see the tonal overlay phenomena recently described for Dogon by McPherson (2014); Heath and McPherson (2013); McPherson and Heath (2016)[1].

In the case of a contour tone on a verb, only the first tone level is lowered in the imperfective (154).

(154) **Only the first tone of a contour lowers**

a.

ɟaci$^{23.1}$	pa^{31}	gɔlɔ$^{3.3}$
Jachi	flip.PFV	boat

'Jachi flipped the boat.'

[1]In section 4.4 I discuss a tonal overlay phenomenon in Guébie that even more closely resembles the Dogon replacive tone phenomena discussed by McPherson and Heath.

b. ɟaci$^{23.1}$ pa^{21} gɔlɔ$^{3.3}$
Jachi flip.IPFV boat
'Jachi flips the boat.' (syl_20140123)

c. e^{4} na^{42}
1SG.NOM say.PFV
'I say'

d. e^{4} na^{32}
1SG.NOM say.IPFV
'I said' (syl_20131024)

Tone is associated to tone bearing units within a word from left-to-right, so on monosyllabic verbs we typically only see contours on the initial syllable, as in the examples in (154). If a contour surfaces on a later syllable in the word, we would not expect either tone of the contour to lower. This is because on polysyllabic verbs, only the first level tone is affected by the scalar tone shift, (155).

(155) **Only the first syllable lowers**

a. ju^{4} gbala$^{3.4}$ si^{3}
boy climb.PFV trees
'A boy climbed trees'

b. ju^{4} gbala$^{2.4}$ si^{3}
boy climb.IPFV trees
'A boy climbs trees' (syl_20140314)

c. ɔ^{3} liɓe$^{2.3}$
3SG.NOM dine.PFV
'I dined'

d. ɔ^{3} liɓe$^{1.3}$
3SG.NOM dine.IPFV
'I am dining' (oli_20160801)

e. wa^{3} lope$^{4.1}$ gamaraŋ$^{1.1.1}$-gbo^{1}
3PL.NOM speak.PFV white.man-speech
'They spoke French.'

f. wa^{3} lope$^{3.1}$ kaɟɛ$^{2.2}$ gamaraŋ$^{1.1.1}$-gbo$^{1.1.1.1}$
3PL.NOM speak.IPFV now white.man-speech
'Nowadays, they speak French.' (syl_20151113)

When a polysyllabic verb begins with a level tone melody across multiple syllables, tone on all of those syllables lowers (156). This suggests that there is only a single underlying tone in verbs like *bala*$^{2.2}$ in (156), which is associated with two tone-bearing units, as per the Obligatory Contour Principle (Leben, 1973). That single tone is lowered in imperfective contexts, resulting in both tone-bearing units surfacing with tone one step lower than in the perfective.

(156) **The OCP effect at play in Guébie scalar tone shift**

a. a^{2} ka^{3} dibo$^{3.1}$-ə^{2} bala$^{2.2}$
1PL.NOM IRR plantain-PL harvest
'We would harvest plantains'

b. a^{2} bala$^{1.1}$ dibo$^{3.1}$-ə^{2}
1PL.NOM harvest.IPFV plantain-PL
trans 'We harvest plantains' (syl_20140314)

While there are very few verbs larger than two syllables in Guébie, all polysyllabic verbs pattern like disyllabic ones, where only the first level tone melody of a verb lowers in imperfective contexts.

A more extensive list of perfective (default) and imperfective verb forms is given in (157).

(157) **Perfective and imperfective verb forms**

		Perfective	Imperfective	Gloss
Levels	a.	gba^{4}	gba^{3}	'bark'
	b.	gbala$^{4.4}$	gbala$^{3.3}$	'sew'
	c.	ɓʊlʊ$^{4.4}$	ɓʊlʊ$^{3.3}$	'crawl'
	d.	bala$^{3.3}$	bala$^{2.2}$	'hit'
	e.	gbete$^{3.3}$	gbete$^{2.2}$	'boil'
	f.	wi^{3}	wi^{2}	'cry'
	g.	ɓili$^{3.3}$	ɓili$^{2.2}$	'sing'
	h.	ji^{3}	ji^{2}	'come'
	i.	li^{3}	li^{2}	'eat'
	j.	pa^{2}	pa^{1}	'tell'
Contours	k.	lope$^{4.1}$	lope$^{3.1}$	'speak'
	l.	pɪa$^{3.1}$	pɪa$^{2.1}$	'buy'
	m.	cie$^{4.2}$	ci.e^{32}	'learn'
	n	na^{42}	na^{32}	'say'
	o.	jiri$^{2.3}$	jiri$^{1.3}$	'steal'
	p.	galɛ$^{2.3}$	galɛ$^{1.3}$	'give birth'
	q.	gbala$^{2.4}$	gbala$^{1.4}$	'rise'
	r.	gbala$^{3.4}$	gbala$^{2.4}$	'climb'
Non-alternating	s.	gala$^{1.1}$	gala$^{1.1}$	'perch'
	t.	ci^{1}	ci^{1}	'start'
	u.	pa^{1}	pa^{1}	'run'

Given the data in (155-157), we can restate the imperfective scalar tone shift by saying that the first tone level of a verbal tone melody surfaces one step lower in imperfective contexts than elsewhere, (158).

(158) **Imperfective scalar tone shift**

Default tone	$\gg$	**Imperfective tone**
4		3
3		2
2		1
1		1

When a verb is low-toned (tone 1) by default, we might expect it to lower further, to a super-low, 0, in the the imperfective, following the regular imperfective pattern of tones lowering one step. Instead, it remains tone 1. There is no surface instance of a super-low tone , tone 0, in Guébie, and the imperfective is no exception. However, we also do not see complete neutralization between perfective and imperfective low-toned verbs; instead, contrast is maintained by raising the final tone of the subject when the verb is already low, (159).

(159) **Subject tone raising when verb tone is low**

a. ɛ^{3} ɓɔ^{1}
3SG.NOM wither.PFV
'It withered'

b. ɛ^{4} ɓɔ^{1}
3SG.NOM wither.IPFV
'It withers'

c. ɟaci$^{2.31}$ pa^{1}
Djatchi runPFV
'Djatchi ran'

d. ɟaci$^{2.32}$ pa^{1}
Djatchi run.IPFV
'Djatchi runs'

e. [ju^{4} e^{4} ji^{2} ne^{2}] pa^{1}
boy I know REL run.PFV
'The boy that I know ran.'

f. [ju^{4} e^{4} ji^{2} ne^{3}] pa^{1}
boy I know REL run.IPFV
'The boy that I know runs.' (oli_20160801)

The default low tone, 1, on the verbs 'wither, ran' in (159a,c,e) do not lower in imperfective contexts, (159b,d,f), but we see a change in the final subject tone between perfective and imperfective. Here we are seeing an aspectual feature exponed on the subject of the sentence, whether that subject is a pronoun or full noun phrase. It is quite common for subject pronouns to be inflected for tense and aspect in West Africa, especially in South Mande languages, which border Kru languages in Côte d'Ivoire and Liberia (Vydrine, 2006, 51); however, it is quite uncommon for non-pronominal subjects in the area to show this effect. In Guébie, all subjects, pronouns and full noun phrases, undergo final-tone raising in imperfective contexts if the verb tone is low.

This Guébie scalar subject raising occurs even when the result is a super-high tone, tone 5, which is not found elsewhere in the language, (160). This is particularly surprising given that a low-toned verb cannot lower to superlow, but a superhigh surfaces in subject-raising contexts.

(160) **Contrast is maintained even when it results in a super-high tone**

a. <u>e</u>^{4} pa^{1}
   1SG.NOM run.PFV
   'I ran'

b. <u>e</u>^{5} pa^{1}
   1SG.NOM run.IPFV
   'I run' (syl_20140314)

Thus, before a low-toned verb (tone 1) we get the subject tonal alternations in (161).

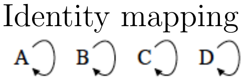
(161) **Subject tone alternations**

Default subject tone	≫	**Raised subject tone**
4		5
3		4
2		3
1		2

The scalar shift in Guébie, where the first tone of a verb lowers one step if possible, and if not the subject tone raises one step, represents a novel type of scale cross-linguistically. Mortensen (2006) presents a typology of phonologically scalar phenomena, introducing the five possible types of scales shown in (162).

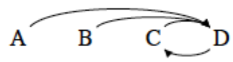
(162) **Types of phonological scalar shifts** (from Mortensen 2006, 56-67)

a. Identity mapping

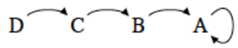


b. Neutralization

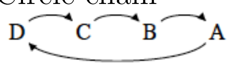
c. Bounceback



d. Chain shift



e. Circle chain



The verb-tone lowering scalar shift in Guébie is similar to the chain shift in (162d); however, there is a second dimension to the chain shift in Guébie, where upon reaching the end of the scale, we see a scalar chain shift in the opposite direction on a nearby word. I call this a *collateral damage chain shift*.

An alternative way to think of the scalar tone shift in Guébie is as affecting the difference in scalar value between two words or morphemes. That is, this tonal shift affects the difference in tone height between the subject and verb, where the difference increases by one between the perfective and imperfective. This consistent and phonologically predictable tone change is represented formulaically in (163), where FST stands for Final Subject Tone, and IVT stands for Initial Verb Tone. *n* represents some number, namely, the difference between subject and verb tone in perfective contexts.

(163) **Consistent arithmetic relationship between perfective and imperfective**

Perfective	**Imperfective**
FST - IVT = n	FST - IVT = n + 1

It is not always the case that the subject and verb tones are further from each other in the imperfective than in the perfective. For example, a subject with final underlying tone 3 followed by a verb with underlying tone 4 will surface as 3 followed by 3 in the imperfective, where subject and verb have the same tone. The difference between perfective and imperfective then is not that subject and verb are assimilating to or dissimilating from each other. Rather, a rising melody across the subject-verb juncture becomes less rising, a flat melody becomes falling, and a falling melody becomes a steeper falling melody, as shown in (164), where alternations for all possible tone levels following a tone-2 subject are shown.

(164) **Tone shift patterns for a subject with tone 2**

	Perfective	**Imperfective**	**Change in tone difference**
a.	2 4	2 3	Decrease
b.	2 3	2 2	Decrease (to equal)
c.	2 2	2 1	Increase
d.	2 1	3 1	Increase

A summary of the imperfective scalar tone shift in Guébie is this: the first tone height of a verb surfaces one step lower in the imperfective than elsewhere, unless the verb is already low, in which case the final subject tone raises one step in the imperfective. The imperfective shift could be said to show more of a pitch drop than the perfective or default counterpart; that is, the subject is relationally one step higher compared to the verb in the imperfective than it was in the input.

This scalar tone shift is situated within the larger context of Guébie grammatical tone phenomena. I provide an analysis of this particular scalar shift in section 4.3, and in section 4.4 I demonstrate that the proposed analysis extends to other instances of tonal and non-tonal morphology in Guébie.

4.3 Scalar shift in Distributed Morphology plus Cophonology Theory

This section first looks at syntactic structure of clausal word order in Guébie, which is followed by an analysis of the morphology/phonology interface in Guébie, relying on morpheme-specific phonological grammars or cophonologies, which accounts for scalar tone shift in imperfective contexts.

4.3.1 The syntax of verb movement in Guébie

This section lays out a syntactic analysis of word order alternations in Guébie, where we see SAuxOV order unless there is no auxiliary, in which case SVO order surfaces. I show that verb phrases are head-final in Guébie (OV), but that the verb moves to a head-initial T slot in the absence of an overt auxiliary. I argue against V-to-*v* and V2 (V-to-C) analyses of verb movement in Guébie, based on original data.

We see strong head-final properties in all domains below T in Guébie. Within verb phrases, we see OV order in all clauses except perfective and imperfective SVO constructions. The verb surfaces clause-finally, with the exception of heavy CPs, which can surface after the otherwise clause-final verb. This SAuxXOV order is unlike nearby Mande languages, where only direct objects surface before verbs: SAuxOVX (Dryer and Gensler, 2005; Creissels, 2005; Nikitina, 2009).

(165) **SAuxXOV order**

a. e^{4} ji^{3} a^{3}-no^{4} bag^{w}ɛ$^{3.1}$-a^{1} ɲɛ^{31}
1SG.NOM will 1SG.POSS-mother book-DEF give
'I will give my mother the book.'

b. e^{4} ji^{3} bag^{w}ɛ$^{3.1}$-a^{1} a^{3}-no^{4} ɲɛ^{31}
1SG.NOM will book-DEF 1SG.POSS-mother give
'I will give my mother the book.'

c. *e^{4} ji^{e} a^{3}-no^{4} ɲɛ^{31} bag^{w}ɛ$^{3.1}$-a^{1}
1SG.NOM will 1SG.POSS-mother give.PFV book-DEF
Intended: 'I will give my mother the book.'

We also see postpositions rather than prepositions, and Genitive-Noun order in Guébie, all of which correlate with head-finality cross-linguistically (Dryer, 2007). This pervasive head-final word order suggests that the verb-final order SAuxOV, rather than SVO, is the default clausal word order in the language. I propose that in the absence of an auxiliary, the head-final verb moves to the inflectional position, where the auxiliary usually sits. I call this position T (previously Infl, or I).

All inflection surfaces immediately after the subject in Guébie, in T. In most clauses, a single auxiliary surfaces in T and expones all of tense, aspect, mood, and polarity (TAMP). In the environment of certain TAMP combinations, specifically positive imperfective and positive perfective, no auxiliary surfaces. In such cases, an inflected verb surfaces in T, where inflection is marked by tone (default tone in perfective contexts and scalar tone shift in imperfective contexts, as in section 4.2.

An additional argument against a V-to*v* analysis is simply that the surface position of V in SVO clauses in Guébie is also the position of inflection-bearing auxiliaries in SAuxOV clauses. If this same position hosts tense, aspect, mood, and polarity, it cannot be as low as *v*.

In the rest of this section I argue against two alternative analyses to Guébie SVO order: 1) The verb surfaces lower than T in SVO constructions, namely *v*, and 2) The verb surfaces higher than T in SVO constructions, namely C.

4.3.1.1 Adverbs cannot intervene between Subject and Inflection

One alternative analysis of Guébie SVO clauses involves V-to-*v* movement, but not movement all the way up to T. That is, we could say that the verb moves to some position intermediate between V and T, say, *v* (see Kandybowicz and Baker 2003 for this such an analysis in Nupe). This intermediate position would have to be head-initial to result in the correct word order: S V O, despite that all other projections below T are head-final (postpositions, OV order, etc).

If the verb were lower than T, we would expect certain adverbs to be able surface preverbally as in English, 'I always eat apples', SAdvVO. However, the Guébie facts more closely mirror French word order facts, where it is impossible for an adverb to surface between the subject and inflected verb, **Jean souvent mange des pommes*, 'John always eats apples', *SAdvVO. Instead, the adverb must surface after the inflected verb, *Jean mange souvent des pommes*, 'John always eats apples'. Like in French, nothing can intervene between the subject (spec-T) and the inflected verb (T) in Guébie. The analytical difference between English and French is that verbs in English surface lower in the clause than they do in French, allowing space for adverbs to intervene between subjects and verbs (Emonds, 1976).

The grammatical SVAdvO order is shown in (166a,c), while the ungrammatical *SAdvVO order is shown in (166b,d).

(166) **Adverbs cannot intervene between subject and verb**

a. ɔ³ li³ a¹ diokʷə²³·¹
3SG.NOM eat.PFV already fufu
'He already ate fufu.'

b. *ɔ³ a¹ li³ diokʷə²³·¹
3SG.NOM already eat.PFV fufu
Intended: 'He already ate fufu.'

c. ɟaci²·³¹ ɟele³·³ daame¹·³·³ bagʷɛ³·¹ me³
Djatchi read.IPFV often book in
'Djatchi often reads books'

d. *ɟaci²·³¹ daame¹·³·³ ɟele³·³ bagʷɛ³·¹ me³
Djatchi often read.IPFV book in
Intended: 'Djatchi often reads books'

The verb must surface immediately after the subject, and not even temporal adverbs, which are presumably modifying the T head, can intervene. Thus, I set aside the possibility that V surfaces in *v* or another position lower than T in Guébie SVO clauses. I now turn to evidence that the verb does not surface higher than T, say, in C, in SVO clauses.

4.3.1.2 Strict Subj≫Verb order

The second alternative to a V-to-T analysis of Guébie SVO clauses is to say that verb movement is due to a V2 effect, where the verb moves up past T to C, as in Germanic languages like German, Dutch, and Frisian (Den Besten, 1977). In a canonical V2 analysis, V moves through T to C, and C requires some XP specifier. In this analysis, we see A-movement of the subject to spec-T, as well as A-bar movement of some XP–subject, object, adpositional phrase, adverbial phrase, etc.–to initial position, spec-C (Den Besten, 1977; Holmberg, 1986; Platzack, 1986; Vikner, 1995; Haeberli, 1999). Some version of this analysis has been articulated and defended for, mostly Germanic, Indo-European languages such as German and Dutch (Den Besten, 1977; Holmberg, 1986; Platzack, 1986; Travis, 1984, 1991; Zwart, 1997), Frisian (de Haan and Weerman, 1986), Yiddish (Vikner, 1995), Scandinavian (Holmberg and Platzack, 1995; Vikner, 1995; Sigurdsson, 1990), Middle Welsh (Willis, 1998), Modern Breton (Borsley and Kathol, 2000; Schafer, 1994, 1995), and a few non-Indo-European languages like Kashmiri (Bhatt, 1995), and Dinka (Andersen, 1991; Van Urk and Richards, 2015).

In the remainder of this section I argue that Guébie undergoes V-to-T movement, not V-to-C movement like Germanic V2 languages. A verb-second analysis is untenable for Guébie (and other Eastern Kru languages, which show similar word order properties to Guébie).

V-to-T and V-to-C analyses make the same predictions about word order in subject-initial, positive, declarative clauses of the kind discussed to this point. However, new data from non-subject initial clauses, embedded clause order, negation constructions, WH-questions, and Focus/Topic constructions in Guébie serve as evidence that the V-to-T analysis more appropriately accounts for Guébie data than a V2 analysis.

The Guébie facts are distinct from the Germanic ones in that the subject, and no other constituent, must surface immediately before the inflected verb. XVS word order, where X stands for any non-subject element, is strictly prohibited, as shown in (167a-b). The initial non-subject element is in bold, and the subject is underlined. (167c-d) show again that adverbs cannot intervene between the subject and verb or subject and auxiliary. The verb must be immediately post-subject.

(167) **Subject≫Verb**

a. ***ɟa**^{31} li^{3} ju^{4}
coconuts eat.PFV boy
Intended: 'A/the boy ate coconuts'

b. ***(k)uɓə**$^{3.1}$ li^{3} ju^{4} ɟa^{31}
yesterday eat.PFV boy coconuts
Intended: 'Yesterday a/the boy ate coconuts.'

c. *ju^{4} **a**^{1} li^{3} ɟa^{31}
boy already eat.PFV coconuts
Intended: 'The boy already ate coconuts.'

d. *ɟaci$^{2.31}$ **daame**$^{1.3.3}$ ɟele$^{3.3}$ bag^{w}ɛ$^{3.1}$ me^{3}
Djatchi often read.PFV book in
Intended: 'Djatchi often reads books.'

Any order where the subject does not immediately precede the inflected verb is ruled out in Guébie.

4.3.1.3 Embedded clause order

The Guébie facts differ from Germanic V2 facts further when we consider embedded clauses. In German and Dutch, verbs surface clause-finally in the presence of an overt C head in embedded clauses. In Guébie, though, the order of the subject, object, and verb in embedded clauses is identical to the order in main clauses. The SVO alternation with SAuxOV in Guébie holds in embedded contexts. Note that in the following examples we get an overt C, [gba] or [ne], but the highest verbal element still surfaces immediately after the subject and before the object. As a result, we get SVO order and not SOV as would be predicted by a V-to-C analysis.

(168) **Guébie embedded clause word order**

a. e^{4} jisa$^{2.3}$ [gba^{1} touri$^{1.1.3}$ **wa**^{2} ɟaci$^{2.31}$-ŋono$^{4.4}$]
1SG.NOM know that Touri like.IPFV Djatchi-woman
'I know.IPFV that Touri likes Djatchi's wife.'

b. e^{4} jira$^{2.3}$ [gba^{1} e^{4} **ka**^{3} lawɪɔ$^{3.2.1}$ lelo$^{2.3}$-a^{3} jokuni$^{2.3.3}$]
1SG.NOM want.IPFV that 1SG.NOM IRR visitor new-DEF PART
'I want to visit the new visitor.'

c. e^{4} ni^{4} ɲɔkpɔ$^{3.3}$ ɔ^{3} li^{3} a^{1} ne^{2} ji^{3}
1SG.NOM see.PFV man ESG.NOM eat.IPFV already REL PART
'I saw the man who was already eating.'

Example (168c) shows the same word order in relative clauses as in main clauses, except for the presence of a relative clause final particle. The overt complementizer [gba^{1}] surfaces in C in (168a,b). The presence of an overt C has no effect on verb movement in a V-to-T analysis; head movement of the verb to T and A-movement of the subject to spec-T are unaffected. In a V-to-C analysis, though, we would expect verb movement to be blocked in the presence of an overt C.

4.3.1.4 Movement blocked in the presence of an auxiliary

Another argument that the verb surfaces in T in SVO clauses comes from imperfective negation. We have seen that when a segmental auxiliary is present in T, no verb movement occurs. There is, however, a tonal auxiliary, with no segmental content, in negative imperfective contexts.

In most tense/aspect combinations, negation is marked by a negative auxiliary particle that expresses not only negation, but also tense/aspect/mood; only one auxiliary is allowed per clause. In these cases we see the expected SAuxOV word order, where the AUX expresses negation. Negation is ambiguous in that, no matter its scope or target, it always surfaces as an auxiliary in Guébie and other Eastern Kru languages (Koopman, 1984).

(169) **Negation in auxiliary position**

a. ɟaci$^{2.31}$ la^{3} touri$^{1.1.3}$ jokuni$^{2.3.3}$
Djatchi NEG.PERF Touri visit
'Djatchi has not visited Touri.'

b. ɔ^{3} ne^{4} a^{3} jokuni$^{2.3.3}$ kubə$^{3.1}$
3SG NEG.PFV 1.PL visit yesterday
'She/he did not come visit us yesterday.'

c. *ɟaci$^{2.31}$ jokuni$^{2.3.3}$ la^{3} touri$^{1.1.3}$
Djatchi visit NEG.PERF Touri
Intended: 'Djatchi has not visited Touri.'

Crucially, in the imperfective, negation is not marked with an auxiliary, but with a rising tone that docks on the final syllable of the subject. In these cases, there is no overt auxiliary between S and O, but we also do not see verb movement to the inflectional position. All verbal elements surface clause finally: SNegOV. The negation tone docks on the subject, and the verb cannot move up: *SNegVO. As in (170a), this blocking of verb movement results in SNegOV order with no segmental auxiliary in 2nd position. Verb movement being blocked by the presence of tonal negation appliesin both main and embedded clauses (170b,c).

(170) **Present tense negation**

a.

ɟaci$^{2.13}$	touri$^{1.1.3}$	jokuni$^{2.3.3}$
Djatchi.NEG.PRES	Touri	visit

‘Djatchi does not visit Touri (habitually).’ or ‘Djatchi is not visiting Touri.’

b.

ɔ^{13}	bagʷɛ$^{3.1}$	mɛɟalɛ$^{3.1.1}$
3SG.NEG.PRES	paper	read

‘She/he doesn’t read books.’

c.

e^{4}	jisa$^{1.3}$	gba^{1}	ɔ^{13}	ɟa^{31}	li^{3}
I	know	that	he.NEG	coconuts	eat.IMPERF

‘I know that he doesn’t eat coconuts.’

d.

*e^{4}	jisa$^{1.3}$	gba^{1}	ɔ^{13}	li^{3}	ɟa^{31}
I	know	that	he.NEG	eat.IMPERF	coconuts

Intended: ‘I know that he doesn’t eat coconuts.’

The lack of verb movement in (170) suggests that the rising tone in negative contexts is a vocabulary item, inserted in T in negative imperfective contexts. I analyze this tonal item as blocking movement from V-to-T due to the Head Movement Constraint (Travis, 1984). The tonal negation marker in (170) must dock somewhere, and because the verb cannot move up to join it in T, the tone leans left onto the subject: S.NEG O V. Note that this is a crucially distinct analysis from the imperfective scalar tone shift analyzed in this chapter, where the imperfective scalar shift does *not* involve a vocabulary item, and does not block verb movement to T. The analysis of imperfective scalar tone shift is discussed further in the following sections.

4.3.1.5 Wh, Focus, Topic order

The final argument in favor of a V-to-T analysis of Guébie SVO clauses comes from Wh-words, focused elements, and topics. All of these elements surface left-most in Guébie. They surface before the subject and inflected verb: FocSVO. I analyze this order as involving a head-initial C, which can host focus, topics, and Wh-words. A verb-second analysis predicts that when Wh-words, topics, and non-subject focussed elements are fronted, the verb should surface in second position. If the verb is in C and there is a single slot available in spec-C for a moved element, it should not be true that both the subject and fronted element surface linearly before the inflected verb. While this prediction seems to be correct for German, Dutch, and Frisian (Den Besten, 1977), it does not hold in Guébie. The following data show that despite the fronting of WH-words, focused elements, and topics, the inflected verbal element always follows the subject in Guébie. The result is that the verb is not always in second position (171a-b).

(171) **Verb-third in WH-interrogatives**

a. ɲɔkpa$^{3.3}$ touri$^{1.1.3}$ **ji**^{3} lɛtrɪ$^{3.2}$ kɔpa$^{3.23}$ na^{3}
who Touri will letter send Q
'To whom will Touri send a letter?'

b. bɛba$^{2.2}$ touri$^{1.1.3}$ **pa**^{23} ɟaci$^{2.31}$ kɔ^{3} na^{3}
what Touri send.PFV Djatchi PART Q
'What did Touri send to Djatchi?'

c. *ɲɔkpa$^{3.3}$ **ji**^{3} touri$^{1.1.3}$ lɛtrɪ$^{3.2}$ kɔpa$^{3.23}$ na^{3}
who will Touri letter send Q
Intended: 'To whom will Touri send a letter?'

The ungrammatical order in (171c), *WhVSO, is the grammatical order in V2 languages like German and Dutch, where V moves to C and the Wh-word is in spec-C. In Guébie, the Wh-word undergoes A'-movement to spec-C but this does not affect movement of the verb to T or the subject to spec-T. The grammatical realization is thus WhSVO or WhSAuxOV order, as shown in (171a-b).

(172) **Verb-third in focus constructions**

a. bag^{w}ɛ$^{3.1}$ ɔ^{3} kɔpa$^{3.23}$-ɔ^{2}
book he$_i$ send.PFV-him$_j$
'It's a BOOK he sent him (as opposed to a letter).'

b. bag^{w}ɛ$^{3.1}$ ɔ^{3} **ji**^{3} kɔpa$^{3.23}$-ɔ^{2}
book he$_i$ will send-him$_j$
'It's a BOOK he will send him (as opposed to a letter).'

c. *bag^{w}ɛ$^{3.1}$ **ji**^{3} ɔ^{3} kɔpa$^{3.23}$-ɔ^{2}
book will he$_i$ send-him$_j$
Intended: 'It's a BOOK he will send him (as opposed to a letter).'

The grammatical order for Focus constructions in German and Dutch is FocAuxSOV (Vikner, 1995). This order is ungrammatical in Guébie (172c), where the subject must always precede the verb. This order also holds for topics in (173).

(173) **Topic with V3 in Guébie**

a. ŋudi$^{3.1}$-a^{1} ɔ^{3} **wa**^{2} jɛrɛ$^{3.3}$-lili$^{2.2}$
man-DEF he like spice-food
'As for the man, he likes spicy food.'

b. (k)uɓə$^{3.1}$ kɔgʊlɪɲɔ$^{4.2.2.2}$ ɔ^{3} **pi**^{3} saka$^{3.3}$
yesterday farmer 3.SG cook.PFV rice
'Yesterday a/the farmer, he cooked rice'

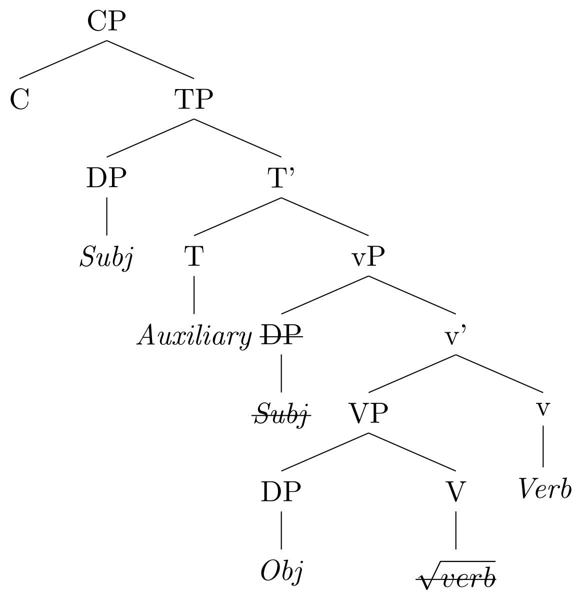
We see in the above examples that verbs in Guébie are not always in second position, but sometimes surface in third or even fourth position in a clause (cf. 173b). If the landing site of the highest verb is T, this leaves the C-domain open for fronted WH-words, foci, and topics, which surface before the subject and verb. However, if the verb is in C as in a verb-second analysis, there is no space at the front of the clause for multiple fronted elements and the subject, thus we would expect the data in (171-173), or at least (171-172) to be ungrammatical.

4.3.1.6 Word order summary

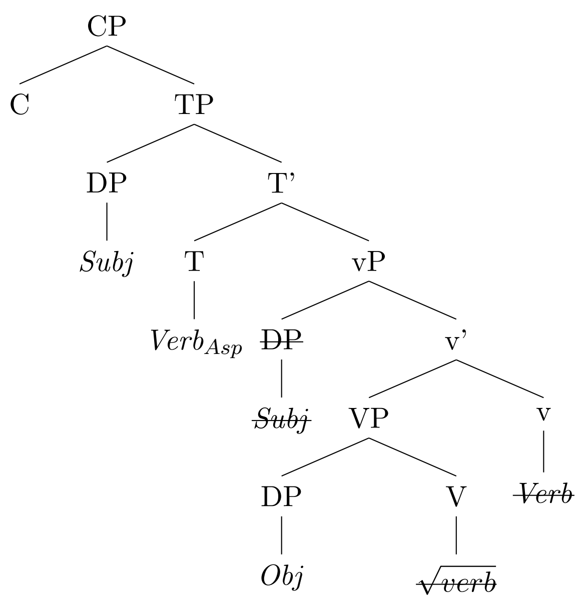
We have seen evidence from four word order patterns in Guébie that a V-to-T analysis is better suited to account for the data than a V-to-*v* or verb-second V-to-C analysis. As we saw in (167), the subject and no other XP must immediately precede the inflected verb. In (168) we saw that embedded-clause word order parallels that of main clauses, and is not blocked by an overt C-head. In (170) we saw that a negative imperfective tonal auxiliary blocks movement of the verb to second position, resulting in SNegOV order. Movement is not expected to be blocked in a V-to-*v* or V-to-C analysis. In (171, 172, 173) we saw that multiple elements can precede the verb in Guébie, specifically when wh-words, focused elements, and topics are present, so the verb is not always in second position but sometimes third or fourth.

Combined, these data strongly favor the V-to-T analysis over verb-second or V-to-*v*. I thus conclude that the landing site of V in Guébie SVO clauses is T, and that the subject moves to spec-T. The verb does not move into the C-domain, leaving the C-domain open for WH-words, focus, and topic to surface before the subject and the verb. These findings align with Koopman (1984)'s analysis of verb movement to T in Vata, another Eastern Kru language. Trees summarizing the proposed verb movement analysis in Guébie are given in (174), SAuxOV, and (175), SVO.

(174) **SAuxOV structure**



(175) **SVO structure**



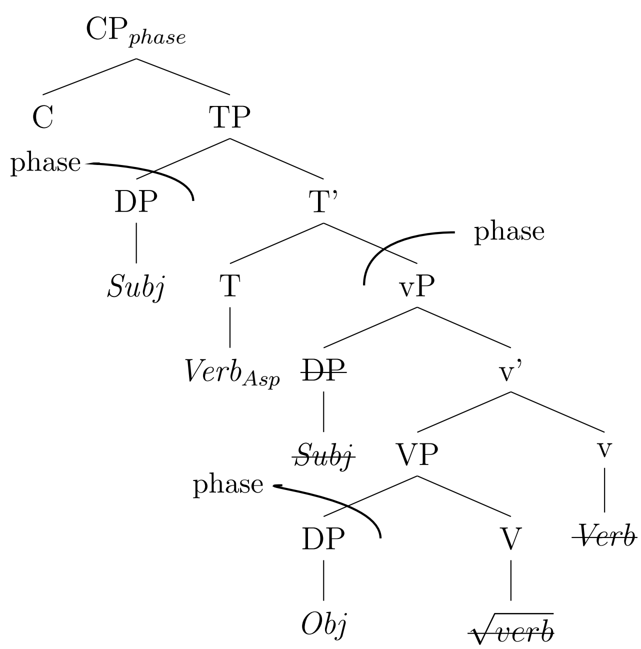
The morphophonological analysis of scalar tone shift detailed in the remainder of this section is interpreted from the syntactic structure in (174, 175).

4.3.2 The morphological component

This section presents a novel model of realizational morphology combining aspects of Distributed Morphology (DM) (Halle and Marantz, 1993, 1994) with multiple subgrammars of constraint-based evaluation (Lightner, 1965; Kiparsky, 1982; Orgun, 1996; Inkelas et al., 1997; Itô and Mester, 1999; Kiparsky, 2000; Anttila, 2002; Inkelas and Zoll, 2005, 2007; Kiparsky, 2008). Here I use the particular implementation of subgrammars found in Cophonology Theory (Orgun, 1996; Inkelas et al., 1997; Anttila, 2002; Inkelas and Zoll, 2005, 2007). I begin by describing my assumptions about the morphological component of the grammar, then talk about the output of morphology which I assume is the input to the phonological component.

Like DM, the model of the morphology/phonology interface presented here assumes that syntactic structure is the input to the morphological component. The syntactic structure of a regular transitive verb in Guébie, is given in (176), where the verb has head-moved through *v* to T, the inflectional position. T is the position of auxiliaries, when they surface, and of inflected verbs when there is no auxiliary present. Nothing can ever intervene between the subject and the inflectional position. Aspectual features such as IPFV, PFV are introduced in T, and neither is associated with a vocabulary item to be inserted. A hierarchical structure of the type in (176) is assumed to be both the output of syntax and the input to morphology.

(176) **The input to morphology**



Following DM, I assume that morphological operations apply to the hierarchical syntactic structure in (176). For more on the catalog of operations that apply during the morphological component, see Embick and Noyer (2001, 2007). Here I discuss only those morphological operations relevant in accounting for Guébie morphophonology, including vocabulary insertion and linearization.

I assume that the syntactic structure in (176) is spelled out, or sent to the morphological component, in small chunks. There are at least three current proposals in the Distributed Morphology literature for how often syntactic structure is spelled out, and which syntactic nodes determine that spell-out. The first is that morphophonological spell-out occurs at syntactic phase boundaries (Marvin, 2002; Embick, 2010; Jenks and Rose, 2015). The second is that morphological operations apply cyclically at every instance of syntactic merge (Bobaljik, 2000; Matushansky, 2006a). The third is that morphophonological domains do not align in any predictable way with syntactic domains (cf. Deal and Wolf, 2013).

For this purposes of this chapter, I adopt spell-out-by-phase, where relevant phases are at least DP, vP, and CP, as marked with phase boundaries in (176)[2]. The benefit of spell-out at each phase boundary for the purposes of this scalar tone phenomena is that everything below T will be spelled out in the vP phase, the subject will be spelled out in its own DP phase, but the verb in T is spelled out in the higher CP phase, which encompasses the lower vP and, crucially, the subject DP. In this way, morphology and phonology apply to the subject and verb together. This is a necessary feature of any model of Guébie imperfective scalar tone shift, which affects both subjects and verbs. The subject, a DP, was previously spelled out as a separate DP phase, but is still manipulable at higher phase evaluation as per McPherson and Heath (2016)'s violable Ident-Phase constraints[3], despite the notion of phase impenetrability at the morphological and phonological level (Kramer, 2010; d'Alessandro and Scheer, 2015). Modular phase impenetrability assumes that previously spelled-out material is no longer manipulable by morphological or phonological operations; however, following (McPherson and Heath, 2016), I assume that the phonological phase impenetrability condition is violable.

In this model, there is only one underlying form (vocabulary item) for each verb, unspecified for insertion context. The tonal difference between perfective and imperfective verb forms of each verb will fall out later, during the phonological component. The single vocabulary entry proposed for the verb 'eat' is given in (177).

(177) **Vocabulary entry for the Guébie verb *li*, 'to eat'**

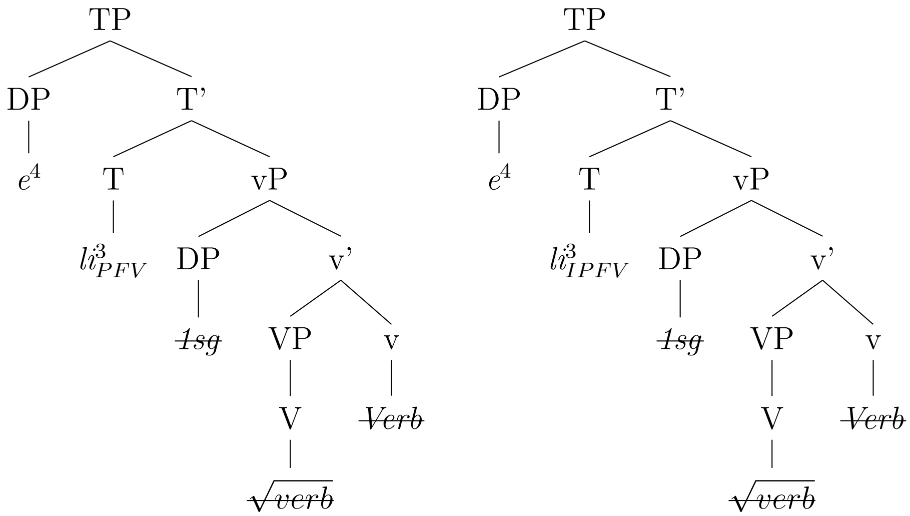
- $\text{li}^3 \longleftrightarrow$ V:eat

Due to its lack of specified insertion context, the vocabulary entry in (177) will be inserted in both perfective and imperfective contexts. For this reason, perfective and imperfective derivations will look (almost) identical during the morphological component, as shown in (178), where li^3 has been inserted in to both the perfective and imperfective structures. The only difference between perfective and imperfective derivations of the same verb is the presence of a PFV feature in one case, and an IPFV feature in the other.

[2] Note that the data presented here are also consistent with a theory of phases where the highest phrasal projection of categories N, P, A, and V, function as phases (Bošković, 2014).

[3] Ident-Phase is adopted in section 4.3.3, and is discussed in further detail there.

(178) **Morphological structure after vocabulary insertion**
Guébie perfective and imperfective *li*, 'to eat'
a. Perfective 'I ate' b. Imperfective: 'I eat'



After vocabulary items are inserted, they are linearized. Even at this point the imperfective and perfective derivations are identical except for the presence of an imperfective or perfective feature, (179).

(179) **Input to phonology for Guébie perfective and imperfective *li*, 'to eat'**

a. /e^4 $\mathrm{li}^3{}_{IPFV}$/
b. /e^4 $\mathrm{li}^3{}_{PFV}$/

After linearization, the string of vocabulary items and morphosyntactic features is evaluated by the phonological grammar. It is during the phonological component that the tone in imperfective contexts undergoes shift. Note that in this model, morphosyntactic features are preserved through morphology, including linearization, and are available to the phonology. This assumption contradicts Bobaljik (2000)'s proposed Rewrite Rule, which says that morphosyntactic features are erased upon insertion of vocabulary items; however, I follow the growing body of literature arguing against the Rewrite Rule (cf. Gribanova and Harizanov 2015; Winchester 2016, and Match Theory constraints which reference hierarchical structure in the phonological component, Selkirk 2011). We also needed this architectural feature of the grammar to account for phonological agreement across elements with morphosyntactic features in common in chapter 3.

One question that arises at the interface is how to translate the morphosyntactic features of terminal nodes to the phonological component. Jenks and Sande (forthcoming) propose that partial phonological constraint rankings are inserted via Vocabulary Insertion. For the imperfective in Guébie, there would be no Vocabulary Item according to Jenks and Sande, but a constraint ranking would be inserted in a DM-style morphology, which then applies during the phonological component to the CP phase containing that ranking. For our purposes, the crucial feature of such an interface model is that the phonological component be able to determine which constraint-based grammars are triggered in which spell-out domains.

With the morphological assumptions made in this section, summarized again here, we can account for process morphology in a model based in DM plus morpheme-specific constraint rankings. First, morphosyntactic features must remain in the derivation through morphological operations and be available to the phonology. Second, the phonological component assigns a phonological grammar to each spell-out domain based on the morphosyntactic features present in that domain. In this way, we need not say that all morphology is item-based, but rather that phonological processes are constraint-driven and sensitive to morphosyntactic context.

The specific constraints relevant for scalar tone shift in the imperfective grammar and to avoid scalar shift in elsewhere contexts are discussed in section 4.3.3.

4.3.3 Scalar tone cophonologies

I follow Orgun (1996); Inkelas et al. (1997); Anttila (2002); Inkelas and Zoll (2005) and Inkelas and Zoll (2007) in using Cophonology Theory to allow for multiple distinct morpheme-specific phonological grammars present in a single language. While not every morpheme triggers a distinct grammar, there are multiple morpheme-specific grammars, as well as an 'elsewhere' grammar. If the phase or spell-out domain being evaluated contains a morpheme for which there is a morpheme-specific phonological grammar, that grammar applies, as in the Guébie imperfective. Otherwise, the 'elsewhere' phonological grammar applies, as in the Guébie perfective. The question of how to handle multiple cophonologies triggered within a single phase is discussed in chapter 6.

The input to the phonological component is made up of vocabulary items and morphosyntactic features. The version of Cophonology Theory adopted here assumes that morphosyntactic features are primitive notions that need to be represented in the phonology. Here I mark only the relevant features (IPFV, PFV) in the input.

Possible outputs are evaluated by constraints ranked differently based on the morphosyntactic construction in question. For Guébie scalar tone shift, there are two relevant phonological grammars, one triggered by IPFV, which applies to the CP containing that IPFV feature, and an elsewhere grammar, which applies to all other CPs. The phonological constraints specific to the imperfective and elsewhere cophonologies are what determine the tonal difference between perfective and imperfective forms in Guébie ([e^4 li^3], 'I eat', vs [e^4 li^2], 'I ate').

One crucial aspect of a constraint-based analysis of Guébie tone shift is that candidates and inputs cannot only consist of a verb, because the imperfective tone shift also affects subjects, (159, 160). For this reason I evaluate multiword candidates of subject and verb together.

Support for the subject and verb being simultaneously evaluated in the phonology comes from the fact that they are in the same spell-out domain (phase). There is no distinction between words and phrases in DM, so there is no need to treat inflectional paradigms within words differently from those that span words within a syntactic phase. All elements that are spelled out together are evaluated together phonologically. Note that the same strategy was used to evaluate phonologically agreeing nouns and pronouns together within the same DP in chapter 3.

4.3.3.1 The imperfective cophonology

Beginning with the imperfective grammar in Guébie, we must ensure that the optimal output candidate is tonally different than the input. Thus, we need a constraint motivating the difference between input and output tone.

There are four possible ways in which a multiword candidate could be tonally unfaithful to the input, (180): Subject raising, subject lowering, verb raising, verb lowering. However, only two of these four possibilities are attested in Guébie.

(180) **Options for tonal realization of impefective**

	Raising	**Lowering**
Subject	✓	-
Verb	-	✓

While we see two of the four possible tonal antifaithfulness strategies for realizing the imperfective morpheme, we need to not only ensure that the others (verbal tone raising and subject tone lowering) never occur, but also that each of subject tone raising and verb tone lowering occur in the right context. One solution is to make use of Mortensen (2006)'s NoHigher and Higher constraints, indexed for specific syntactic category features. This assumes that our syntax is such that every DP has a D feature and every T has some inflectional feature[4].

(181) **NoHigher(T)** (Mortensen, 2006, 14)
For each element in T, assign one violation if its tone surfaces higher on the tone scale than the corresponding input tone.

(182) **Higher(D)** (Mortensen, 2006, 14)
For each tone of an element with a D feature in the output, assign one violation if it does not surface higher on the tone scale than the corresponding input tone.

These two constraints, ranked appropriately with faithfulness, could result in verb tone lowering and subject tone raising, in the right contexts. However, there is nothing built into the NoHigher(T) and Higher(DP) constraints which addresses the locality of the Guébie scalar tone shift; only the final subject tone and initial verb tone alternate. Instead, I restate the main idea from the above two constraints into a single constraint targeting the juncture between subject and verb: PitchDrop.

[4] Precedence for phonological constraints needing access to syntactic categories or structures comes from Match Theory (Selkirk, 2011), among others; however, it is possible that in a Cophonology Theory model we could do away with indexed constraints entirely, as suggested by Inkelas and Zoll (2005, 2007)

(183) **PitchDrop**
Assign one violation if the output subject tone is not relatively higher than the verb tone on the four-tone scale than it was in the input.

Input	**Output**
FST - IVT = n	FST - IVT = n + 1

In other words: Assign one violation if there is not more of a pitch drop between subject and verb in the output than in the input.

This PitchDrop constraint differs slightly from the Higher, NoHigher constraints in that it specifically targets the juncture between subject and verb as the site of a drop in pitch. Like Higher and NoHigher though, PitchDrop requires a tonal difference between input and output. Such a constraint could be phrased as antifaithfulness to the input tonal difference between subject and verb. With the addition of such a constraint, which motivates a difference between input and output, we need not also include more general antifaithfulness constraints such as RealizeMorph (Kurisu, 2001), Transderivational Antifaithfulness (Alderete, 2001), or Mortensen (2006)'s Diff. While a more general, say, RealizeMorph constraint might be present in the constraint inventory, its effects are vacuous in the presence of the more specific PitchDrop.

We can assess the value of an antifaithfulness constraint like PitchDrop or Higher, NoHigher by examining other instances of morphologically conditioned tone-height changes across languages. Mortensen (2006) uses Higher, NoHigher to account for tone-height and vowel-height scalar phenomena across a number of languages. Outside of Mortensen's scalar examples, in Esimbi, a Bantu language, the prefix vowel /a-/ surface one step lower on the four-vowel-height scale than the following underlying root vowel, as described by Hyman (1988) and discussed by Walker (1997). Another example of a morphosyntactically conditioned tone contour comes from Samoan. Yu and Özyildiz (2016) describe a particular pitch contour triggered in the environment of an absolutive feature in Samoan. Antifaithfulness constraints can be used to account for Esimbi prefix vowels and Samoan absolutive tone, just as they are used here for Guébie. Languages seem to require antifaithfulness to scalar input values in certain morphosyntactic contexts, which makes a constraint like PitchDrop typologically motivated.

Here, the imperfective feature is a morpheme with no input phonological content. However, it is realized via tonal changes to the subject and verb triggered by the PitchDrop constraint. I assume that markedness constraints such as Max, Dep are highly ranked here, ruling out segmental changes, and I only consider candidates which realize the imperfective morpheme via tonal changes.

Along with PitchDrop, we need an input-output faithfulness constraint. This identity constraint must be defined in a scalar manner, where the further along the scale an output element is from the original input, the more violations are incurred (cf. Kirchner 1997).

The scalar evaluation of Id-Tone is necessary to ensure that the optimal candidate only minimally differs on the tonal scale from the corresponding input tone (185c).

(184) **Id-Tone**
Assign one violation for each step on the tone scale that an output tone differs from its corresponding input tone.

The following tableau shows the ranking of PitchDrop and the tonal faithfulness constraint in the imperfective grammar. I set aside discussion of the elsewhere grammar for now, knowing that faithfulness must be undominated in the elsewhere (perfective) context. I return to the constraint ranking of the elsewhere grammar in (4.3.3.2).

(185) **PitchDrop ≫ Id-Tone**

e^4 li^3_{ipfv}	PitchDrop	Id-Tone
a. ☞e^4 li^2		*
b. e^4 li^3	*!	
c. e^4 li^1		**!

Because Ds are considered to be syntactic phase heads, and the subject is inside a DP but its tone can be manipulated in imperfective contexts, our model must allow for the phonological content of spelled out phases to be manipulable. I follow Michaels (2013); Surkalović (2013) and McPherson and Heath (2016) in saying that phonological content of phases is indeed manipulable after spell-out, but that Ident-Phase constraints protect previously phonologically determined content. While DP phases must be available to tonal shift after spell-out, we want to avoid our tonal shift affecting syntactic objects of the verb, and other content within the vP. This means that Ident-Phase(vP) must be highly ranked, while Ident-Phase(DP) is crucially outranked [5]. Here our constraints are distinguishing between syntactic categories, or phase-level category nodes. As in Smith (2011)'s work on the phonological differences between nouns and verbs within a given language, I have found that in Guébie the phonology must be able to reference the difference between at least elements in a noun phrase and elements in a verb phrase.

(186) **Ident-Phase(vP)** (adapted from (McPherson and Heath, 2016, 613))
Assign one violation if the phonological content of a vP phase is distinct in the output from the input.

(187) **Ident-Phase(DP)** (adapted from (McPherson and Heath, 2016, 613))
Assign one violation if the phonological content of a DP phase is distinct in the output from the input.

[5] While I follow **?** here in using Ident-Phase to account for different degrees of faithfulness to previously spelled-out elements versus those not yet evaluated by the phonology, it maybe be possible to use different variations of non-indexed input-output identity constraints instead. The latter analysis would follow Inkelas and Zoll (2007) in eliminating indexed constraints in a cophonology-based model.

While these IDENT-PHASE constraints are necessary to rule out tone shift affecting an object DP, I only consider intransitive verbs here for the sake of simplicity. Thus, I leave the IDENT-PHASE(vP) constraints out of the following tableaux. IDENT-PHASE(DP) remains though, because it must be crucially dominated in the case of imperfective subject tone raising.

(188) **PitchDrop ≫ Id-DP ≫ Id-Tone**

$e^4\ li^3_{ipfv}$	PITCHDROP	ID-DP	ID-TONE
a. $e^4\ li^3$	*!		
b. ☞$e^4\ li^2$			*
c. $e^4\ li^1$			**!
d. $e^5\ li^3$		*!	*
e. $e^4\ li^4$	*!		*
f. $e^3\ li^3$	*!	*	*

The constraints in (188) rule out a faithful imperfective candidate (188a), as well as those candidates which realize the imperfective morpheme by lowering the verb tone to too far (188c), raising the subject (188d), raising the verb (188e), or lowering the subject (188f). This ranking accounts for all cases where the input of the verbal tone is higher than 1.

To account for subject raising in cases where the verb is already low, we need to say something more in order to get the correct output (189).

(189) **PitchDrop ≫ Id-DP ≫ Id-Tone**

$e^4\ pa^1_{ipfv}$	PITCHDROP	ID-DP	ID-TONE
a. $e^4\ pa^1$	*!		
b. ☹ $e^4\ pa^0$			*
c. $e^5\ pa^1$		*!	*
d. $e^4\ pa^2$	*!		*
e. $e^3\ pa^1$	*!	*	*

The current set of constraints will always choose the candidate where the difference from input to output involves lowering the initial verb tone one step. This incorrectly predicts a superlow tone on the verb in (189). In order to ensure that the candidate with a superlow tone on the verb, candidate (b) in (189), does not win, I propose a markedness constraint *0 which ensures no superlow tones in the output. This constraint is highly motivated in Guébie because we never see a surface superlow tone. It is also typologically motivated, because superlow tones are quite uncommon cross-linguistically. They are less common than, say, superhigh tones (cf. Hyman's database of 662 tone languages worldwide, Hyman p.c.).

(190) ***0**
Assign one violation for every instance of a superlow tone in the output.

The addition of this constraint results in the desired optimal candidate, the subject raising candidate, (191d).

(191) ***0, PitchDrop ≫ Id-DP ≫ Id-Tone**

e^4 pa^1_{ipfv}	*0	PitchDrop	Id-DP	Id-Tone
a. e^4 pa^1		*!		
b. e^4 pa^0	*!			*
c. e^4 pa^2		*!		*
d. ☞e^5 pa^1			*	*
e. e^3 pa^1		*!	*	*

The tableaux in (191) and (188) show that the proposed constraint ranking accounts for tonal shift in the imperfective grammar. I include comparative markedness tableaux for the final rankings in (192), to show how the proposed constraints interact to result in the correct optimal candidates (Prince, 2000; McCarthy, 2003).

(192) **A comparative markedness representation**

	*0	PitchDrop	Id-DP	Id-Tone
/e^4 li^3_{ipfv}/				
a. e^4 li^3		W		
b. ☞e^4 li^2				L
c. e^4 li^1				L
d. e^5 li^3			W	L
e. e^4 li^4		W		L
f. e^3 li^3		W	W	L
/e^4 pa^1_{ipfv}/				
a. e^4 pa^1		W		
b. e^4 pa^0	W			L
c. e^4 pa^2		W		L
d. ☞e^5 pa^1			L	L
e. e^3 pa^1		W	L	L

In the comparative markedness tableau above, we can see that the *0 and PitchDrop constraints favor the winner in both verb lowering and subject raising contexts. Id-Phase(DP) must be ranked lower because in subject raising contexts, this constraint favors losing candidates, namely those that do not involve a tone change to the subject DP. Id-Tone must be ranked lowest of all because it favors a losing candidate, namely the faithful one, in both subject raising and verb lowering contexts. These four constraints, ranked as above in the imperfective cophonology, account for both initial verb tone lowering and final subject tone raising in imperfective contexts.

4.3.3.2 The elsewhere grammar

The elsewhere grammar, similar to Anttila (2002)'s categorical ranking of a language, is a ranking used when no alternative is triggered by a morpheme within the spell-out domain. In Guébie, the elsewhere grammar evaluates perfective constructions. In such contexts, the only crucial ranking is that faithfulness (ID-PHASE, ID-TONE) must outrank markedness (*0, PITCHDROP). This will result in the faithful candidate surfacing every time, as is true of perfective clauses in Guébie.

(193) **Elsewhere ranking**

ID-TONE, ID-PHASE
|
*0, PITCHDROP

The proposed analysis has the following benefits: it results in the correct optimal candidates, it uses constraints needed to account for scales and tonal overlays cross-linguistically (Mortensen, 2006; McPherson and Heath, 2016), and it captures the intuitive generalization about what is happening in the data: In imperfective contexts, the verb tone lowers if possible. If not, the subject tone raises.

4.3.4 Considering alternative analyses

In this section I consider alternative analyses to the one presented in section 4.3.3. I begin with an alternative constraint-based approach involving optimal paradigms. I then turn to item-based approaches to scalar tone shift, where I consider whether the imperfective could have an abstract underlying representation which triggers the shift. The final alternative I consider is Distributed Morphology style suppletive allomorphy. I conclude that all three alternatives are inferior to the DM plus cophonologies account presented above.

4.3.4.1 An Optimal Paradigms account

One might ask whether other constraint-based models could also account for the Guébie scalar tone data. Specifically, an account that specifically requires contrast within cells of an inflectional paradigm seems ideal for the Guébie imperfective tone shift. There are three reasons to prefer a cophonologies account over an optimal paradigms one.

First, one benefit of the Cophonology Theory account is that we need cophonologies to account for other phenomena in Guébie, including phonologically determined agreement discussed in chapter 3, vowel replacement in chapter 5, and other tonal phenomena, which are discussed in section 4.4. It is unclear that a paradigm-based analysis like Optimal Paradigms (McCarthy, 2005) can be leveraged to account for other phenomena in Guébie.

Second, a paradigm account seems to easily motivate contrast across cells of a verbal paradigm; however, in Guébie, there is a contrast between imperfective contexts and all other contexts, but verbs surface the same way in all non-imperfective contexts (perfective, imperative, future, irrealis, negative, etc.). There are only two tonal forms of a given verb, one that surfaces in imperfective contexts, and one that surfaces elsewhere. While an optimal paradigms approach could handle these data by evaluating 2-cell paradigms of 'imperfective' and 'elsewhere', there is no obvious empirical difference between a paradigm-based analysis with 'imperfective' and 'elsewhere' paradigms, and the imperfective and elsewhere cophonologies presented in this chapter. Both involve imperfective-specific phonologies.

Lastly, if the imperfective alternation in Guébie affected the surface form of verbs alone, perhaps we could consider a paradigm-based account where imperfective and perfective (elsewhere) forms of a given verb must contrast. However, it is not only verbs that are affected by the imperfective scalar tone shift. Subjects undergo tonal changes as well. This means that every combination of subject and verb would have to maintain contrast across an imperfective/perfective paradigm (I ate, I eat; You ate, You eat; The black dog ate, The black dog eats; etc.), and it is unclear what status this potentially infinite number of paradigms would have in the grammar of the language.

Despite the fact that an Optimal Paradigms analysis and constraints like (Padgett, 2003)'s *Merge could also adequately account for the Guébie facts, I propose that a Cophonologies account of Guébie is preferable for empirical and theoretical reasons. Cophonologies better predict the interaction between subject and verbs in imperfective contexts only, while all other verbal contexts show no alternation. Additionally, cophonologies account for morphologically conditioned phonological process across the language.

4.3.4.2 Underlying representations

In the proposed analysis, a morphosyntactic feature triggers scalar tone shift via constraint interaction. No abstract underlying representation of the imperfective feature is necessary. We could instead consider an analysis where the imperfective morpheme has an abstract underlying form, which itself triggers scalar shift. Because an abstract underlying representation is an extra layer of structure, it is less economical than the analysis proposed in section 4.3.3 unless it need not reference morphosyntactic features. This section shows that a phonological item itself is not enough to trigger scalar tone shift at the juncture between subject and verb, but reference to morphosyntactic features is still necessary. For this reason, a process-based analysis without an abstract underlying form is preferable.

There is a line of phonological research which analyzes all morphology as item-based, or affixal (Benua, 1997; Alderete, 2001; Wolf, 2007; Bermúdez-Otero, 2012; Gouskova and Linzen, 2015; Zimmermann, 2013; Trommer and Zimmermann, 2014). On such approaches, even process morphology such as tone shift, tone replacement, vowel alternations, and truncation are analyzed as items. We will see that the Guébie scalar tone shift data is not amenable to such an approach.

Here I will consider two item-based analyses of the Guébie imperfective scalar tone shift: 1) floating tones and 2) floating tone features. I show that both a floating tone and floating feature analysis require construction-specific rules/constraints, thus they do not fare better than the item-less analysis in section 4.3.3. The overarching challenge for all approaches is to capture the formula in (163), maintaining contrast between the perfective and imperfective forms of a given verb by manipulating the tone on subject and verb in a scalar manner.

4.3.4.3 Floating tones

Let us consider a floating 41 tone as a possible underlying form, or vocabulary item, in Distributed Morphology terms, for the imperfective morpheme. This is a reasonable candidate because, if situated between the subject and verb as in (194), the low second portion of the 41 tone could trigger lowering of the verb, while the high initial portion could trigger raising of the subject.

(194) **Floating tone representation**

Subj	*Aspect*	*Verb*
e^4	^{41}	li^3
1SG.NOM	IPFV	eat

The challenge for such a representation is to explain four things: 1) why we get verb tone lowering in the default case (i.e. the output of (194) should result in verb tone lowering from 3 to 2), 2) why the verb doesn't lower to superlow when it starts low, 3) under what conditions the subject raises, and 4) why 41 has a scalar effect in imperfective contexts, but not elsewhere. Verb lowering as the default operation and subject raising only if the verb is already low could be incorporated into the analysis via rules or constraints. However, these rules or constraints are also needed if we posit no underlying representation, and in the case of no UR, we avoid arbitrarily choosing an underlying form.

Additionally, a floating tone analysis would need to explain why that particular (i.e. falling 41) tone has a scalar effect in imperfective contexts, but not elsewhere. There are twelve possible two-tone contours given the four tone heights in Guébie, (148). Seven of these twelve contours and the four level tone melodies (heights 1-4) are found on Guébie roots and affixes. There is no instance of any of these contour or level melodies triggering raising or lowering of nearby tones. This weakens the argument that the imperfective morpheme is a floating tone, since there is no reason to believe that the presence of a given tone should trigger a raising or lowering process in this one context (imperfective), but nowhere else in the language. The analysis would need to make use of a grammar or constraint specific to imperfective contexts in order to get the desired result: scalar shift in the imperfective, but not elsewhere. Doing so would make the analysis complex in two ways: 1) it would involve a level of underlying abstraction, and 2) it would involve morpheme-specific constraints or grammars. The analysis proposed in section 4.3.3 requires only one such level of complexity.

In addition to the two challenges above, another difficulty for a floating tone analysis is determining whether the chosen floating tone is the right one. For example, we said that the underlying form of the imperfective could be a 41 tone. However, we could have chosen any other underlying form, and the rules or constraints to get the above four facts to fall out would be exactly the same. That is, the choice of underlying form makes no predictions about the surface alternations; the rules or constraints do the work. No matter which UR we choose, our rules or constraints must refer both to the underlying form, and to the imperfective context (ex: in imperfective contexts, 41 lowers the tone of the following verb one step). An analysis that avoids a non-predictive arbitrary UR is preferred.

4.3.4.4 Floating tone features

Instead of considering the imperfective morpheme to be a floating tone, we could consider it a floating feature instead. A number of tonal features for four-tone-height languages have been proposed, (195).

(195) **Proposed features for 4-tone systems**

a.

Yip (1980); Pulleyblank (1986)	4	3	2	1
Upper	+	+	-	-
High/Raised	+	-	+	-

b.

Clements (1983); Snider (1999)	4	3	2	1
Feature 1	H	H	L	L
Feature 2	H	L	H	L

c.

Bao (1999)	4	3	2	1
Stiff	+	+	-	-
Slack	-	+	-	+

In all proposed sets of binary features presented above, there is a single-feature difference between high (tone 4) and mid-high (tone 3) tones, and a single-feature difference between mid (tone 2) and low (tone 1) tones, but there are two feature values differentiating mid-high (tone 3) from mid (tone 2) tones. This means that the natural classes predicted by the above feature sets are {4,3}, {4,2}, {3,1}, {2,1}, but crucially not {3,2}. This feature set works nicely for those languages where the highest tone (tone 4) and mid-low tone (tone 2) pattern together, while the mid-high tone (tone 3) and low tone (tone 1) pattern together. Such relationships are found in a number of languages, including Gban, a Mande language spoken on the border of Kru languages in Côte d'Ivoire, near where Guébie is spoken (Zheltov, 2005, 25) (see Clements et al. 2011 and Hyman 2010 for further examples). However, for any language, like Guébie, where we see an alternation between tones 2 and 3, binary features become problematic.

While the tone shifts from tone 4 to 3 and from 2 to 1 in Guébie involve a single featural change, that same featural change could not be responsible for the shift from 3 to 2, because tones 3 and 2 differ in two features in all of the above sets. That binary features fail to account for scalar phenomena was perhaps first noted by Contreras (1969).

If we assume that Guébie scalar lowering in imperfective contexts is a unitary phenomenon, a binary floating feature account does not work[6].

[6]See McPherson (2016) for a recent binary feature account of a scalar tone shift in Seenku. A featural account works for Seenku because there are only two underlying tones which undergo shift: extra-low becomes low, and high becomes extra-high in plural contexts. A featural analysis becomes obsolete in a system with more than two underlying tones, like the four-tone system of Guébie.

4.3.4.5 Interim summary: Underlying representations lack insight for scalar shift

In the Guébie scalar tone shift pattern there is no assimilation to or dissimilation from a target. Instead, this is a relational shift in tone, where the difference between subject and verb tone changes between the perfective, or input, and the imperfective output. For this reason, there is no best underlying representation for the imperfective morpheme in Guébie. There is no single feature change or floating tone that would result in lowering one step in some contexts and raising one step in others. Instead, construction-specific constraint rankings that reference the input and output, requiring a difference between the two, best capture the scalar tone shift pattern (see section 4.3.3).

I propose that there is no adequate UR to account for Guébie scalar tone shift. An item and arrangement model would require reference to both an arbitrary abstract underlying form, and construction-specific processes. A non-item-based approach only need make use of a construction-specific process. This particular scalar phenomenon shows that it is not possible, or at least not desirable, to reduce all morphology to affixation.

Returning to the discussion of morphologically conditioned phonology (MCP) versus process morphology in section 4.1, I conclude based on the Guébie scalar tone shift data that a complete theory of morphology must allow for non-affixal as well as affixal morphology. Morphosyntactic-specific phonological processes occur alongside, and independent of, affixal morphology. For Guébie, I claim that the imperfective morpheme lacks an underlying phonological representation, and instead triggers a phonological process, as discussed in sections 4.3.2 and 4.3.3. I now turn to another set of alternative analyses in section 4.3.4.6, where I demonstrate that the current state of Distributed Morphology cannot satisfactorily handle productive morphologically conditioned phonological processes without substantial modification.

4.3.4.6 Extant Distributed Morphology tools

In DM, morphologically conditioned phonology, including process morphology like umlaut or scalar shift, is handled in one of two ways:

1. Suppletive Allomorphy (Halle and Marantz, 1993, 1994; Embick and Noyer, 2007; Embick and Halle, 2005; Harley, 2014; Siddiqi, 2009; Haugen and Siddiqi, 2013)

2. Readjustment rules (Halle and Marantz, 1993, 1994; Marantz, 1997; Embick and Noyer, 2001; Pfau, 2002; Embick and Halle, 2005)

Here I argue that neither suppletive allomorphy nor readjustment rules adequately accounts for morphologically conditioned phonology. Neither account captures the phonological predictability of the scalar tone shift; a construction-specific phonology (cophonology) is needed.

4.3.4.7 Suppletive allomorphy

Suppletive allomorphy involves separately listed lexical items or vocabulary items, each inserted into a derivation in distinct morphosyntactic environments before the phonological grammar applies[7,8]. In the early days of DM, allomorphy was only possible for functional morphemes. Now, though, most DM practitioners agree that both lexical and functional elements can have listed allomorphs (Siddiqi, 2009; Harley, 2014; Toosarvandani, to appear). For the verb 'eat' in Guébie, used frequently in examples throughout this chapter, there would be two lexically listed allomorphs on a suppletive allomorphy account, (196).

(196) **Vocabulary entries for the Guébie verb *li*, 'to eat'**

- $\text{li}^2 \longleftrightarrow$ V[IPFV]:eat
- $\text{li}^3 \longleftrightarrow$ V:eat

The tone 2 allomorph would be inserted in the environment of an imperfective feature, and the tone three allomorph would be inserted everywhere else. However, suppletive allomorphy does not imply that any regular phonological relationship holds between one form of a vocabulary item (VI) and another. Thus, on such an account it would be coincidental that every verb whose 'elsewhere' form does not have tone 1 would have two segmentally identical vocabulary entries, one inserted in imperfective contexts, whose initial tone level is exactly one step lower than in the allomorph underspecified for insertion environment.

While the suppletive allomorphy account is already uneconomical when considering only verbal vocabulary entries, we should also consider that every possible word that can end a subject noun phrase must also have two entries, one whose final tone is exactly one step higher than the other. This would get us the surface result of subject tone raising in contexts where the verb tone is low.

The problem with a suppletive allomorphy approach should be obvious; it results in an uneconomical lexicon. It fails to capture the generalization that the relationship between imperfective verbs and other forms of the same verb is phonologically predictable.

4.3.4.8 Readjustment rules

The alternative method used to account for morphologically conditioned phonology in Distributed Morphology involves readjustment rules (Halle and Marantz, 1993, 1994; Embick and Noyer, 2001). These are transformational rules that apply to single lexical items or subsets of lexical items in certain morphosyntactic contexts. However, the use of readjustment rules in the theory has been argued against for two main reasons: 1) There is no

[7]While vocabulary insertion is generally thought to occur before phonology, Trommer (2001); Wolf (2008) assume that vocabulary is inserted during the phonological component.

[8]Archangeli and Pulleyblank (forthcoming)'s Emergent Morphology is another example of a suppletive allomorphy approach, where all allomorphs are possible output candidates and the optimal one is chosen given the morphophonological environment. I return to Archangeli and Pulleyblank (forthcoming) in chapter 5, arguing that a purely suppletive approach is inferior to cophonologies.

theory of what a readjustment rule can look like; they are unconstrained (Siddiqi, 2009; Bye and Svenonius, 2012; Gribanova, 2015). 2) They involve transformational rules, which are otherwise absent from DM and the Minimalist Program in general (Siddiqi, 2009, 42).

There have been a number of suggestions for eliminating readjustment rules from the grammar. Siddiqi (2009) proposes root allomorphy as an alternative to readjustment rules. That is, for Siddiqi, all instances of readjustment rules can be restated as lexically listed suppletive allomorphy. We have already seen that such an approach would be highly uneconomical for Guébie.

A second suggestion for eliminating readjustment rules comes from Gribanova (2015). Gribanova argues that for Russian vowel alternations, with the right abstract underlying phonological representation we do not need readjustment rules. Instead, regular phonological rules or constraints act on the abstract UR to determine the optimal output. While this approach seems appropriate for Russian, we have already seen that there is no appropriate underlying representation for the Guébie imperfective morpheme.

The analysis proposed in the preceding sections accounts for the imperfective scalar tone shift in Guébie without requiring an abstract underlying phonological item, and it derives the phonological predictable scalar tone shift via constraints. Unlike the alternative analyses presented throughout this section, a DM plus cophonologies analysis economically captures the predictable scalar process we see in imperfective contexts in Guébie.

4.4 Other instances of tonal morphology in Guébie

The scalar tone shift presented in section 4.2 is situated within a larger system of tonal morphophonology. In addition to the imperfective scalar tone shift, there are other instances of tonal morphology involving scalar shifts and tone replacement (tonal overlays, in McPherson and Heath 2016's terms). In this section I discuss two such tonal phenomena. The first is another instance of scalar tone shift, and the second is a tonal overlay process which I show can be handled by the same structure as the scalar data. What the tonal processes in Guébie have in common is that they all involve a systematic tone change in the environment of a particular morphosyntactic feature.

4.4.1 Case marking via scalar tone shift

Just like the scalar tone shift in imperfective contexts, there seems to be a scalar tonal relationship between nominative and accusative pronouns in Guébie. Object pronouns in Guébie, those that surface immediately after the auxiliary or inflected verb, display default or lexical tone (198), while those in subject position surface one step higher.

(197) **Object pronouns in Guébie**

Human			**Non-human**		
	Singular	**Plural**		**Singular**	**Plural**
1st	e^{3}	a^{1}	**1st**	–	–
2nd	e^{1}	a^{2}	**2nd**	–	–
3rd	ɔ^{2}	wa^{2}	**3rd**	ɛ^{2},a^{2},ʊ^{2}	i^{2},wa^{2}

When they appear in subject position, pronouns surface immediately before the auxiliary or inflected verb, and systematically surface with tone one step higher than their object counterparts.

(198) **Subject pronouns in Guébie**

Human			**Non-human**		
	Singular	**Plural**		**Singular**	**Plural**
1st	e^{4}	a^{2}	**1st**	–	–
2nd	e^{2}	a^{3}	**2nd**	–	–
3rd	ɔ^{3}	wa^{3}	**3rd**	ɛ^{3},a^{3},ʊ^{3}	i^{3},wa^{3}

I assume that the featural difference between subject and object pronouns is nominative versus accusative case. We know that tone raising on accusative pronouns is not a generally applicable tonal overlay or tone shift initiated by the verb affecting subjects in general, because only pronouns show a difference in tone when in object versus subject position (except when affected by the imperfective scalar tone shift discussed in section 4.2). Full noun phrases do not show a tonal difference between subject and object position, (199). This is discussed further in chapter 5, where the accusative feature on object pronouns is shown to trigger a cophonology.

(199) **Full noun phrases do not show a case distinction**

a. ju^{4} ni^{4} =**ɔ**^{2} ji^{3}
child see.PFV =3SG.ACC PART
'The child saw him.'

b. **ɔ**^{3} ni^{4} ju^{4} ji^{3}
3SG.NOM see.PFV child PART
'He saw the child.'

The noun 'child' in (199) has the same tone in subject position (a) and object position (b). Just like in English, then, only pronouns show overt case distinctions. We could explain this by saying that pronouns contain a different amount of syntactic structure than other noun phrases in Guébie, or that the nominative case assigner in Guébie probes for a feature that only pronouns have, and that other nouns do not require case licensing (cf. Preminger 2011).

The analysis presented in section 4.3 easily extends to the nominative scalar tone shift. In the environment of a morphosyntactic nominative case feature, the nominative cophonology applies. In this cophonology, a tonal antifaithfulness constraint, perhaps HIGHER(DP), is highly ranked. IDENT-PHASE(DP) is crucially outranked, and IDENT-PHASE(vP) is undominated in order to avoid raising the tone of the object[9]. The optimal candidate is then the one where the tone of the nominative pronoun is one step higher than the input tone.

There is very little language-internal evidence for choosing either the nominative or accusative pronoun series as the default form. This is because pronouns in ellipsis contexts such as 'Me, no!', as the object of a postposition, and in focus constructions such as 'Him, I like' use the emphatic pronoun series (the emphatic pronoun paradigm is provided in chapter 3), rather than the nominative or accusative form of a pronoun.

There is, however, one main supporting argument for the claim that accusative pronouns show default tone, while the tone on nominative pronouns is derived. This is a typological argument: For languages that show case distinctions in Africa, it is normally nominative case which is marked (Creissels et al., 2008, 87-91) (see also König 2006 for more on marked nominative systems in East Africa). Thus, Guébie represents another case of a marked nominative language in Africa, conforming to the areal features of the Macro-Sudan Belt.

Additionally, the same constraints proposed in section 4.3.3 can be used in the case of case-marking scalar shift. Specifically, a tonal antifaithfulness constraint like HIGHER (Mortensen, 2006) would outrank the faithfulness constraint ID-TONE in the environment of a nominative feature in Guébie. The fact that these constraints are needed in multiple cophonologies supports the choice of such constraints in the Guébie grammar.

Unlike the tone on verbs, we cannot base our analysis of which form is default on the quality of the tones themselves (there is no superhigh tone on pronouns, for example). Because the inventory of pronouns is limited to those in (198, 197), we cannot further probe the pronoun system for evidence that accusative is the default case. Either way, the model presented in section 4.3.2 and the constraints in 4.3.3 (with few adjustments, if nominative is in fact the default form) can be used to account for both imperfective and nominative pronoun tone shift in Guébie.

4.4.2 Tone replacement in noun-noun compounds

The third instance of morphological tone discussed here involves a tonal overlay, also called REPLACIVE TONE, on the second noun of a genitive noun-noun compound. Noun-noun

[9] For space reasons I do not go into the syntax of pronouns versus other noun phrases here, but any model of nominative case in Guébie must account for the fact that only pronouns are affected by this nominative tone raising. If syntactic properties of pronouns indeed convince us that pronouns contain more syntactic structure than other noun phrases, this constraint might actually target something larger than a DP, say a KP (case phrase). Alternatively, we could say that nouns need not be licensed by case in Guébie (see Jenks and Sande To appear's analysis of case in Moro), and only pronouns are ever assigned case to begin with, so the nominative cophonology will only ever apply when a pronoun is in subject position. See the discussion in chapter 5 for more discussion of the syntax of (object) pronouns.

compounds in Guébie always have an associative, or genitive, meaning. No matter which noun surfaces as the first or second noun in the compound, the tone of the second noun is always replaced with a level 2 tonal melody.

The data in (200) shows the default lexical tone for a number of Guébie nouns. This is the tone used on nouns in object position, focused position, subject position (except when followed by a tone-1 imperfective verb), as the object of a postpositional phrase, and as the first noun in a noun-noun compound. The data in (201) then shows those same nouns in noun-noun compounds, where the second noun of the compound always has a level tone-2 melody.

(200) **Default tone**

	Noun with default tone	**Gloss**
a.	ɲito$^{3.1}$	'fiancé'
b.	ju^{4}	'child'
c.	mana$^{3.3}$	'meat'
d.	di^{3}	'cut'
e.	ɲo^{31}	'person'
f.	bitə$^{2.3}$	'house'
g.	wəli$^{3.2}$	'top'

(201) **Noun-noun compounds in Guébie**

a. ɲito$^{3.1}$ ju^{2}
fiancé child
'daughter in-law'

b. mana$^{3.3}$ di^{2}-ɲo^{2}
meat cut-AGT
'butcher'

c. bitə$^{2.3}$ wəli$^{2.2}$
house top
'top of house'

Much like the scalar tone phenomena in the environment of a nominative or imperfective feature, we can analyze this tonal overlay as a phonological change motivated by constraints in the environment of a particular morphosyntactic feature. Here the relevant features is genitive. Unlike the previous cases, the genitive feature does not trigger a scalar process, but a tonal overlay. For other instances of tonal overlays analyzed via constraints, see McPherson and Heath (2016).

To account for this tonal overlay in genitive constructions, we could imagine a genitive-specific phonological grammar that ensures tone replacement of the second noun in the compound. In this genitive-specific grammar, a constraint like the one in (202), in the style of McPherson and Heath (2016)'s tone overlay constraints, outranks Id-Tone, ensuring that the second noun of a compound surfaces with tone 2.

(202) **Noun Noun**^{2}
Assign one violation for every noun immediately following another noun that does not have a level tone melody of 2.

While there are instances of nouns followed immediately by other nouns in Guébie (indirect and direct objects in ditransitive constructions), the constraint above will be crucially outranked in the elsewhere grammar, and its effects will only apply in the genitive-specific phonology.

The Guébie genitive tonal overlay is predicted by Cophonology Theory plus tonal overlay constraints (McPherson and Heath, 2016). Thus, we see that three distinct instances of tonal morphologically conditioned phonological processes in Guébie can be accounted for with the proposed analysis: Phonology has access to morphosyntactic featural information and assigns a phonological grammar to each spell-out domain based on those morphosyntactic features.

4.5 Conclusion

In this chapter I have shown that morphologically conditioned phonological processes such as Guébie scalar tone can be modeled without underlying phonological representations. The availability of morphosyntactic features to the phonological component of grammar is enough to trigger phonological change in the appropriate contexts. I see this as a benefit because syntactic and morphological operations already need to refer to morphosyntactic features, and we now know that the same features can be utilized by the phonological domain. We need not posit an extra layer of abstraction using arbitrary underlying phonological representations. The model proposed here to account for both Guébie tone shift extends to other areas of morphologically conditioned phonology in Guébie, as discussed in chapters 3 and 5.

The contributions of this chapter to morphological theory are numerous. First, I have shown that existing DM mechanisms do not adequately account for morphologically conditioned phonology, and I have proposed a synthesis of existing theoretical tools to fill that gap. While I do not doubt the existence of root suppletion, a model relying on root suppletion to account for predictable morphologically conditioned phonology is inadequate. The analysis proposed here makes clear predictions about which cross-linguistic phenomena involve root suppletion and which involve phonological processes triggered by morphosyntactic features: If a change is phonologically predictable, independent of whether it is construction-specific (triggered by a particular morphosyntactic feature or syntactic position), it involves constraint-driven phonological changes tied to particular cophonologies. Only lexically conditioned alternations should be analyzed as involving root suppletion. For examination of a phenomenon that is both lexically and morphosyntactically conditioned, see the discussion of vowel replacement in chapter 5.

Second, the proposed analysis bears on the discussion of whether phonological content can be manipulated after spell-out. Recall that the ranking of IDENT-PHASE constraints (McPherson and Heath, 2016) allowed for a candidate to surface as optimal in imperfective subject raising contexts despite lack of identity with the already spelled out subject DP. This analysis is built on the assumption that identity to previously spelled out phases is violable.

Additionally, the scalar tone shift in Guébie represents a new type of tone scale, contributing to our understanding of the typology of phonologically scalar phenomena (Mortensen, 2006). In the Guébie tone shift, we see syntagmatic contrast maintained not just within words, but across multiple words within a morphosyntactic domain. By combining aspects of DM with Cophonology Theory, we get a model of realizational morphophonology that accounts for the predictability of morphologically conditioned phonological processes, including scalar tone shift, without requiring abstract underlying phonological representations. This model thus allows for both affixal and non-affixal morphology, with clear implications for purely item-based theories of morphophonology.

Chapter 5

Vowel alternations

There are two processes in Guébie that affect vowels and apply only to a subset of roots: 1) vowel reduction, 2) vowel replacement. Both reduction and replacement apply to the same set of roots, which make up 33.5% of the lexicon. Reduction is independent of morphosyntactic context, but replacement only occurs in particular morphosyntactic environments. This chapter addresses both the morphosyntactic conditioning of vowel replacement, as well as the question of how to distinguish replaceable and reducible (weak) roots from non-replaceable or reducible (strong) ones. I rule out diacritic and suppletive allomorphy analyses and argue in favor of an approach based on differences in phonological encoding strength.

5.1 Introduction

The third case study of morphophonological interaction in Guébie concerns two vowel alternations in roots: vowel reduction and vowel replacement. This phenomenon bears on questions of lexical specificity, because both processes take place in the same subset of the lexicon, in only 33.5% of roots, which I call *weak* roots (as opposed to invariant *strong* roots). Additionally, the vowel replacement process is morphosyntactically conditioned, only occurring in the context of third-person object enclitics and plural morphemes.

Vowel reduction, discussed in section 5.2, involves reduction of the initial vowel of a CVCV root, such that the root alternates between CVCV and CCV. For example, the weak root /bala$^{3.3}$/, 'hit', can also be pronounced /bla^{3}/. However, the strong root /ɓolo$^{2.2}$/, 'one', cannot be reduced to /ɓlo^{2}/.

Vowel replacement, detailed in section 5.3, involves replacing features of root vowels in morphological environments often marked by vocalic suffixes or enclitics. For example, the weak root /jɪla$^{3.3}$/, 'ask', in the context of a third-person singular human enclitic /ɔ^{2}/ surfaces as [jɔlɔ$^{3.2}$], 'ask him'. The number of root vowel features replaced differs with morphological construction, (203).

(203) **Types of replacement**

1. **Full replacement**: All root vowels are replaced by features of the suffix/enclitic vowel.
2. **Partial replacement**: Some, but not all, features of root vowels are replaced by features of suffix/enclitic vowel.
3. **No replacement**: Roots and suffixes/enclitics retain their own input features.

To address the morphosyntactic and lexical conditioning of these two vowel alternations, I develop a novel approach that combines two technologies: cophonologies (Orgun, 1996; Inkelas et al., 1997; Itô and Mester, 1999; Anttila, 2002; Inkelas and Zoll, 2005) and strength of segmental encoding (Inkelas, 2011; Smolensky et al., 2014; Inkelas, 2015; Moore-Cantwell, 2017; Pycha et al., 2017; Zimmermann, 2017). I invoke three distinct cophonologies, or morpheme-specific constraint rankings, to implement the three distinct levels of vowel replacement in (203). The role of strength of encoding is to capture lexical specificity effects (cf. category effects (Smith, 2011) and exceptions to lexical regularities (Zuraw, 2000)), accounting for the fact that weak roots undergo both vowel reduction and vowel replacement.

I propose a binary distinction between weak and strong segments, where weakly encoded vowels are subject to alternations (reduction and replacement), while strongly encoded vowels are not. The proposed analysis builds encoding strength into the grammar with a set of encoding-strength-sensitive faithfulness constraints, where strongly encoded segments are less likely to alternate than weakly encoded ones. An encoding-strength-based model captures the fact that both reduction and replacement apply to the initial vowel in the same set of Guébie roots. I propose that these reducible and replaceable vowels are weakly phonologically encoded.

I begin by describing vowel reduction and vowel replacement in Guébie in sections 5.2 and 5.3. Section 5.4 argues that the degree of phonological encoding of root vowels is what conditions (or prevents) vowel alternations. This is followed by an analysis in Cophonology Theory where constraints sensitive to encoding strength ensure strong faithfulness to strongly encoded segments, section 5.5. In section 5.6 I rule out two alternative analyses: root suppletion and sublexicons. I conclude in section 5.7.

5.2 Vowel reduction: CVCV to CCV

5.2.1 The vowel reduction phenomenon

Weak roots alternate between CVCV and CCV in Guébie. This reduction is optional, and is independent of morphosyntactic context. Usage factors seem to be relevant, where speakers are more likely to produce a reducible CVCV word than CCV in casual or fast speech than careful speech.

As discussed in chapter 2, there are no underlying consonant clusters in Guébie. Syllables have the structure CV, except for the occasional onsetless, V, syllable. On the surface, though, some CVCV roots surface as CCV. Many Kru languages show this surface alternation between CVCV and CCV. For some Kru languages, CVCV is said to be the underlying form, undergoing reduction in fast or casual speech. This is what I propose for Guébie. For others, CCV is claimed to be underlying, and sometimes produced CVCV in careful speech. In the latter case, the first vowel in the surface CVCV form is predictable given the second vowel (Zogbo, to appear, 9-10). This second analysis is reminiscent of Dorsey's Law in Winnebago (Miner and Dorsey, 1979; Miner, 1989; Hale and White Eagle, 1980; Hayes, 1995) where a vowel is inserted in a CLV word to break up the cluster. The epenthetic vowel matches the following one: /*prás*/ → [*parás*] (Miner and Dorsey, 1979, 27).

In Guébie, unlike Winnebago and certain other Kru languages, the first vowel in a CVCV word is not predictable given its CCV counterpart in Guébie. For example, *jɛla*$^{2.3}$, 'appear', and *jɪla*$^{2.3}$, ask', both surface as *jra*^{23} in their reduced form. Given the reduced form *jra*^{23}, we cannot predict what the inserted vowel should be, and in fact we find that it corresponds to two distinct CVCV forms, *jɪla*$^{2.3}$, *jɛla*$^{2.3}$. For this reason, I analyze all CCV forms as underlyingly CVCV in Guébie, where the initial vowel can optionally be elided.

In order to determine which CVCV words have the option of reducing to CCV, I extracted all 3554 di- and trisyllabic words, as well as all words pronounced with a CCV string, from the Guébie corpus. One Guébie speaker then sorted through all extracted, mark each CVCV string within each di- and trisyllabic word as reducible to a CCV string or not. For those that are reducible, he also provided the reduced form of the word. For the CCV words in the corpus, he provided the CVCV form of the word. His judgments were confirmed by a second Guébie speaker, who independently worked through just over half of the same set of words, judging them as reducible or not. The first speaker was trained on the CCV reduction phenomenon before making judgments, and the second speaker was asked naively whether he thought it was okay to reduce each CVCV string to CCV. Judgments across these two speakers were remarkably consistent, agreeing on the reducibility of about 97% of relevant words in the corpus. Of all the 1869 disyllabic words judged as reducible or not by both speakers, those two speakers agreed that 33.5% of them are reducible. This set of data is used as the basis for the reducibility generalizations throughout this chapter.

While all CCV words have a CVCV alternate pronunciation, not all CVCV words can be pronounced CCV, as shown by the (near-)minimal pairs in (204).

(204) **CVCV to CCV reduction**[1] (syl_20161207)

	CVCV	CCV	Gloss
a.	jili$^{2.2}$	jri^{2}	'be fat'
b.	jili$^{2.2}$	*jri^{2}	'fish'
c.	gɔlɔ$^{3.3}$	grɔ^{3}	'pain'
d.	gɔlɔ$^{2.3}$	*grɔ^{23}	'canoe'
g.	kpolo$^{3.1}$	kpro^{31}	'be clean'
h.	kpoke$^{2.4}$	*kpke^{24}	'crocodile'
i.	ɟulu$^{3.3}$	ɟru^{3}	'salt'
j.	ɟʊla$^{3.2}$	*ɟra^{32}	'take/borrow'

Note that the entire tone melody of the CVCV form of a word is retained in the corresponding CCV form, where the result is often a contour tone on a monosyllable (204d,g,h,j).

While this process of reduction from CVCV to CCV is most evident in disyllabic words, some tri- or quadrisyllabic words also show reduction, (205).

(205) **CVCV to CCV: Trisyllabic words** (syl_20161207)

	CVCV	CCV	Gloss
a.	wʊlʊɟɔ$^{3.3.23}$	<u>wr</u>ʊɟɔ$^{3.23}$	'come out of'
b.	duɓuɓuli$^{3.1.1.1}$	<u>dɓ</u>u<u>ɓr</u>i$^{3.1}$	'mourning'
c.	tɛkɛlɛ$^{3.3.1}$	*tɛ<u>kr</u>ɛ$^{3.1}$	'be small'

Because words longer than two syllables are far less common than disyllabic words, I consider only reducible disyllabic words here. However, it seems based on the limited data that CVCV strings within longer words tend to pattern the same way as CVCV words.

5.2.2 Phonological properties of reducible words

Reducible words tend to share certain phonotactic traits. In Bété de Guiberoua, an Eastern Kru language spoken northwest of Guébie, similar tone and vowel quality on the syllables of a CVCV word make it more likely to reduce (Werle and Gbalehi, 1976, 23). In Guébie, too, certain phonological properties of CVCV roots condition the option of reduction to CCV.

(206) **Factors contributing to the likelihood of reduction**

1. **The quality of the second consonant**: If the second consonant is /l, ɓ/ (or /n/ when C2 is nasal), reduction is more likely. (Recall from chapter 2 that /ɓ/ patterns as a liquid in Guébie and across Kru (Kaye et al., 1981).)
2. **The similarity of the tone on syllables 1 and 2**: If there is a level tone melody spanning across the two syllables, reduction is more likely to be possible.

[1] Recall from chapter 2 that there is an alternation between [l] and [r] in Guébie, where [r] is typically used in onset clusters (CCV), and [l] is used elsewhere. While all surface [l] and [r] consonants come from underlying /l/, I use [r] in clusters and [l] elsewhere to reflect production patterns.

3. **The similarity of V1 and V2**: If the vowels in syllables 1 and 2 are the same, or share features, reduction is more likely.

Recall from chapter 2 that that /l/ is the most common second consonant (C2) in disyllabic words. Specifically, /l/ occurs as the second consonant in 33% of CVCV words. Thus, the fact that /l/ is frequently the C2 in reducible words may not appear to be significant finding, because /l/ is the most common C2 in general. However, the proportion of reducible to non-reducible CVCV words where /l/ is the second consonant is significant. While 33.5% of all CVCV words are reducible to CCV, 53.5% of all CVCV words where /l/ is the C2 are reducible to CCV.

While the above factors tend to contribute to reducibility in general, (207a-i), note that even if a word shows all three of these properties, it may not be reducible, (207j). That is, these factors do not categorically determine reducibility.

(207) **Reducible words** (syl_20161207)

	CVCV	**CCV**	**Gloss**
a.	zala$^{2.2}$	zra^{2}	'tobacco pipe'
b.	wʊlʊ$^{3.3}$	wrʊ^{3}	'granary'
c.	tulu$^{4.4}$	tru^{4}	'chase'
d.	sala$^{2.2}$	sra^{2}	'return'
e.	pulu$^{3.3}$	pru^{3}	'pound'
f.	kɔlɔ$^{2.2}$	krɔ^{2}	'stay'
g.	kala$^{3.3}$	kra^{3}	'cut down'
h.	jɛlɛ$^{3.3}$	jrɛ^{3}	'pepper'
i.	bala$^{3.3}$	bra^{3}	'hit'
j.	ɓolo$^{2.2}$	*ɓro$^{2.2}$	'one'

When the first consonant of a CVCV word is nasal and the second is /n/, NVnV, reduction is also highly likely, (208). I analyze [n] in medial position of a word where the initial consonant is nasal as underlyingly /l/, which is consistent with the distribution of /n/ and /l/ throughout the lexicon, as discussed in chapter 2, and repeated in (209) below. The fact that NVnV words, (208), pattern as the /l/-medial words in (207), then, is expected.

(208) **CVCV to CCV: Nasal consonants** (syl_20161207)

	CVCV	**CCV**	**Gloss**
a.	ŋʷɔnɔ$^{4.4}$	ŋʷnɔ^{4}	'woman'
b.	ɲini$^{4.4}$	ɲni^{4}	'feces'
c.	munu$^{3.3}$	mnu^{3}	'bite/sting'
e.	mana$^{3.3}$	mna^{3}	'meat'

If we consider those CVCV words where [n] is the C2, and there is a nasal C1, we find that 49.1% of such words are reducible. That is, we find nearly the same proportion of reducible NVnV words (49.1%) as CVlV words (53.5%). This finding is not unexpected, given that [n] tends to pattern like /l/ in words beginning with a nasal. Certain /l/-initial affixes surface with an initial [n] following a root with nasal consonants, as discussed in chapter 2, so we see alternations between [l] and [n] in derived contexts. We also find a similar distribution of [l] in second-consonant position with a non-nasal initial consonant (CVlV) as for [n] in second-position with a nasal initial consonant (NVnV). A chart showing the co-occurrence distributions of consonants in C1 and C2 position is given in chapter 2, and is repeated in (209).

(209) **Distribution of C1 and C2 in CVCV words**

		p	b	t	d	c	ɟ	k	kp	kʷ	g	gb	m	n	ɲ	f	s	j	w	l	ɓ	Total
	0	0	8	0	0	0	4	0	1	0	2	2	7	30	17	1	0	8	0	3	24	107
p	7	24	1	3	0	0	1	5	0	0	2	0	7	0	2	0	4	0	2	39	0	97
b	2	0	5	16	7	0	4	6	0	6	7	0	1	1	0	0	2	2	0	78	0	137
t	5	2	2	18	0	0	2	4	8	3	0	0	3	0	1	0	0	0	0	26	0	74
d	8	0	6	1	24	0	0	28	1	2	0	4	12	5	3	0	0	3	1	20	2	120
c	20	0	0	0	0	6	0	2	0	1	0	0	0	0	0	1	0	2	0	3	0	35
ɟ	11	1	3	2	4	9	13	6	10	7	5	0	3	3	1	0	1	1	0	68	0	148
k	1	5	3	16	9	5	5	14	0	12	1	1	1	1	4	5	9	6	3	41	10	152
kp	0	0	0	0	0	0	0	3	4	0	0	0	0	1	0	3	2	0	1	24	0	38
kʷ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	26	0	27
g	2	1	5	1	6	0	3	2	0	0	8	2	7	3	1	0	2	8	4	38	2	95
gb	3	0	3	15	1	0	1	4	0	3	2	3	0	1	0	0	6	7	0	43	1	93
m	6	1	1	3	0	0	0	2	1	1	1	1	9	51	2	0	1	0	4	5	0	89
n	11	0	1	2	5	0	1	0	6	0	6	4	11	37	0	0	2	18	3	0	1	108
ɲ	6	9	0	7	0	0	0	2	22	0	1	2	9	10	3	0	2	1	2	3	1	80
ŋ	2	0	0	7	3	0	5	0	1	0	0	0	0	16	0	0	0	0	0	2	0	36
ŋʷ	1	0	0	1	1	0	0	0	0	0	0	0	0	15	0	0	3	0	1	0	0	22
f	3	0	0	4	0	0	0	0	0	2	0	0	5	0	0	7	0	0	0	2	0	23
s	11	3	9	0	4	0	0	20	4	0	0	4	5	3	3	0	6	7	2	36	0	117
j	2	1	3	0	0	1	1	14	0	4	3	0	1	4	0	1	9	3	0	86	6	139
w	4	0	0	5	1	0	1	0	0	0	1	0	1	8	0	0	0	3	6	66	2	98
l	12	14	8	0	1	0	5	2	7	4	2	8	12	6	0	0	4	7	2	33	11	138
ɓ	5	0	6	17	3	0	1	3	0	0	3	0	0	0	0	0	0	1	2	44	10	95
Total	122	61	64	118	69	21	47	117	65	46	44	31	94	195	37	18	53	77	33	686	70	2068

Many words with a subset of the above properties (same tone, same vowel, C2 is /l/) are also reducible, (210). For example, those words in (210a-h) are reducible despite having a consonant other than [l,n] in medial position. Those words in (210d-q) show different tones on the first and second syllables, but are still reducible. The words in (210b) and (210n-q) have different initial and final vowels, but are reducible.

(210) **CVCV to CCV: Roots with a subset of T1=T2, C2=l, V1=V2** (syl_20161207)

	CVCV	CCV	Gloss
a.	$\text{saka}^{3.3}$	ska^{3}	‘rice’
b.	$\text{kɔɓa}^{2.2}$	kɓa^{2}	‘be alone’
c.	$\text{ɲɛpɛ}^{3.3}$	$\text{ɲpɛ}^{3.3}$	‘breathe’
d.	$\text{ɲɛpɛ}^{4.1}$	ɲpɛ^{41}	‘lie down’
e.	$\text{ɲɔkpɔ}^{3.1}$	ɲkpɔ^{31}	‘person’
f.	$\text{mɛgbɛ}^{3.1}$	mgbɛ^{31}	‘go crazy’
g.	$\text{ŋudu}^{4.1}$	ŋdu^{41}	‘nail’
h.	$\text{gbətə}^{2.3}$	gbtə^{23}	‘sleeping mat’
i.	$\text{sala}^{3.2}$	sra^{32}	‘build’
j.	$\text{pʊlʊ}^{3.1}$	prʊ^{31}	‘be fast’
k.	$\text{gbələ}^{2.3}$	gbrə^{23}	‘door’
l.	$\text{gbala}^{2.4}$	gbra^{24}	‘climb’
m.	$\text{jala}^{3.1}$	jra^{31}	‘dream’
n.	$\text{jɛla}^{2.3}$	jra^{23}	‘appear’
o.	$\text{jɪla}^{2.3}$	jra^{23}	‘ask/request’
p.	$\text{wʊla}^{3.1}$	wra^{31}	‘look at’
q.	$\text{wulə}^{4.2}$	wrə^{42}	‘couple’

We also see reduction in a few words that do not have any of the above properties, (211).

(211) **CVCV to CCV: T1≠T2, C2≠l, V1≠V2** (syl_20161207)

	CVCV	CCV	Gloss
a.	$\text{ɟukpo}^{3.1}$	ɟkpo^{31}	‘bracelet’
b.	$\text{pɔwa}^{3.1}$	pwa^{31}	‘raise’
c.	$\text{lasɔ}^{2.3}$	lsɔ^{23}	‘floor/ground’
d.	$\text{sija}^{2.3}$	sja^{23}	‘be defeated’
e.	$\text{kuɓə}^{3.1}$	kɓə^{31}	‘yesterday’
f.	$\text{nito}^{2.3}$	nto^{23}	‘husband’
g.	$\text{ɲʊmɔ}^{2.3}$	ɲmo^{23}	‘wither’
h.	$\text{pɛja}^{3.1}$	pja^{31}	‘buy’

Of those words that are collapsible but do not have any of the three properties discussed above, most of them have the a glide /j,w/ as the second consonant (211b,d,h), or have identical C1 and C2, which is collapsed to a single consonant, (212).

(212) **CVCV to CCV: C1=C2** (syl_20161207)

	CVCV	CCV	Gloss
a.	nɔnɔ$^{2.2}$	nɔ^{2}	'crest'
b.	fɔfɔ$^{2.3}$	fɔ^{23}	'wind'
c.	fɔfɛ$^{3.1}$	fɛ^{31}	'body hair'
d.	kuk^{w}ə$^{2.3}$	k^{w}ə^{23}	'lion'
e.	gug^{w}ə$^{2.3}$	g^{w}ə^{23}	'remember'
f.	siso$^{3.1}$	so^{32}	'early/soon'
g.	pɔpa$^{3.3}$	pa^{3}	'yellow'
h.	pɔpɛ$^{2.2}$	pɛ^{2}	'leaf'
i.	pupi^{2}	*pi^{2}	'dust'

It is not the case that all C_iVC_iV roots, where the consonants are identical, are reducible. Note that (212g) and (212h) are reducible to *pa*^{3} and *pɛ*^{2}, but (212i) is not reducible to *pi*^{2}.

Adding these two criteria, identical C1 and C2, and C2 being a glide, to the list of features triggering vowel replacement, still does not result in a categorical distinction between those roots that are reducible versus those that are not. Recall from (204) that there are minimal pairs where one member of the pair is reducible and the other is not: *jili*$^{2.2}$, *jli*^{2}, 'be fat' versus *jili*$^{2.2}$, **jli*^{2}, 'fish'.

If we look across the lexicon, 33.5% of roots are reducible. If we consider only those disyllabic words which display the above factors (C2=l, T1=T2, V1=V2), the percent of reducible words is much higher than the language-wide 33.5% reducibility. We can see this in (213), where the first three columns show the amount of reduction for each of the above features on its own, the next set of three columns shows combinations of two of the relevant features, and the column labeled 'All' shows the number of reducible words that have all three of the above features. These are compared to the reducibility of those disyllabic words which show none of the above properties, the final 'None' column.

(213) **Factors influencing reducibility**

	T1=T2	**C2=l**	**V1=V2**	**T&C2**	**V&T**	**V&C2**	**All**	**None**
Reducible	269	287	328	145	208	199	127	157
Total	614	536	611	244	339	244	154	751
Percent	43.8	53.5	53.7	59.4	61.4	81.6	82.5	20.9
O/E	1.31	1.60	1.60	1.77	1.83	2.44	2.46	.624

The final row of the table above, O/E (cf. Pierrehumbert 1993; Frisch et al. 2004), calculates the proportion of observed reduction to the amount of reduction expected if every CVCV word had equal chance of reducing to CCV. Overall, 33.5% of CVCV words are reducible to CCV in Guébie. If these 33.5% of words were distributed evenly across the lexicon, we would expect to find 33.5% in every cell of the 'Percent' row in (213). However, we see that for those words where C2 is /l/, where V1 has the same features as V2, and/or where the tone on syllables 1 and 2 is the same, the observed amount of reduction is higher than the expected amount. O/E values higher than 1 signify that reducible words are observed more often than expected, and values approaching 0 mean that reduction is observed less frequently than expected. We can see the Observed/Expected values increasing as we look from left to right across the table, meaning that words with one of the three properties in question are slightly more likely to reduce than words without those properties, but having all three properties in (213) makes it very likely that a word will reduce. The only column whose observed value is less than expected is the 'None' column, representing those CVCV words with none of the properties in (206). Of words with none of these three properties, only 20.9% are reducible.

It seems that having the same vowel on both syllables (V1=V2) and having /l/ as the second consonant (C2=l) more strongly correlate with reduction than having the same tone on both syllables (T1=T2). We can see this because the percent of reducible words where T1=T2 is lower than either C2=l or V1=V2. We also see that words with both /l/ as the second consonant and identical vowels in both syllables (C2=l and V1=V2) are much more likely to reduce than words with identical tone on both syllables plus either of the other properties. That is, the percent of reducible C2=l and V1=V2 words is almost as high as for those words with all three properties (C2=l, V1=V2, and T1=T2).

In tri- and quadri-syllabic words, reduction is often possible in CVCV strings that share the same properties discussed here for reduction in disyllabic words. For example, in the loan word *tɛlɛfɔ̃*$^{4.4.1}$, 'telephone', reduction of the initial /ɛ/ is possible, as in (214), but not of the the second /ɛ/. The initial CVCV, /*tɛlɛ*$^{4.4}$/ shows all three properties discussed above; the vowels and tones on the first and second syllables are the same, and the intervening consonant is /l/. However, the second CVCV string, /*lɛfɔ̃*$^{4.1}$/ has none of these properties, and the /ɛ/ is not reducible. The ungrammaticality of *tɛlfɔ̃$^{4.1}$ could also be due to the particularly difficult [lf] cluster, which presumably would both be syllabified into the onset of the second syllable since codas are disallowed across the board in Guébie.

(214) **CVCV to CCV: Loan words** (syl_20161207)

CVCV	**CCV**	**Gloss**
tɛlɛfɔ̃$^{4.4.1}$	tlɛfɔ̃$^{4.1}$, *tɛlfɔ̃$^{4.1}$	'telephone'

Reduction of the initial /ɛ/ in *tɛlɛfɔ̃*$^{4.4.1}$ is expected given the properties discussed throughout this section, while reduction of the second /ɛ/ is not. Impressionistically, it seems that all CVCV strings within Guébie pattern similarly to the distribution for disyllabic words in (213). Further investigation into the reduction of tri- and quadri-syllabic words is needed to determine whether there are any additional factors affecting reduction.

5.2.3 A MaxEnt-HG model of the distribution of reduction in Guébie

There are a number of possible phonotactic factors that could play into whether a given word is weak (reducible) or not. In (213) I propose that three factors play a larger role than others:

T1=T2, C2=l, and V1=V2. A Maximum Entropy Harmonic Grammar (MaxEnt) model (Goldwater and Johnson, 2003; Jäger, 2007; Hayes and Wilson, 2008) of the distribution of reducibility across the Guébie lexicon can inform this choice of factors relevant for the analysis. If the predicted reducibility for each type of root in a MaxEnt model closely mirrors the observed facts, it can confirm whether or not the chosen variables are the relevant ones in characterizing the distribution of reduction.

In a MaxEnt model, input-output mappings are evaluated based on their Harmony scores (H), which are calculated by adding up each of their constraint violations multiplied by the weight of the associated constraint. For simplicity I assume naive constraints that prefer candidates where reduction to CCV has taken place in the presence of the three phonological properties described in section 5.2.2, T1=T2, C2=l, V1=V2, plus an input-output faithfulness constraint against deleting segments, Max.

(215) **Reduce(T1=T2)**
Assign one violation if the tone on two consecutive syllables is identical (reduce if T1=T2).

(216) **Reduce(C2=l)**
Assign one violation if a vowel intervenes between [l] and a preceding consonant (reduce if C2=l).

(217) **Reduce(V1=V2)**
Assign one violation if vowels in two consecutive syllables are identical (reduce if V1=V2).

(218) **Max**
Assign one violation for every input segment that lacks a corresponding output segment.

A candidate violates one of the Reduce constraints if it has not reduced, and shows the specified surface property, T1=T2, C2=l, or V1=V2. All candidates that are reduced, CCV, violate Max, because the initial input vowel fails to surface.

These constraints, with weights determined by the MaxEnt Grammar Tool (Hayes et al., 2009), provide a model of the distribution of reducibility in the Guébie lexicon. The observed (obs) value in (219) is the percent of words with the associated property that are reducible to CCV. The predicted (pred) value is the percent of words of that category that are predicted to be reducible by the model. Candidates are groups of roots that share some subset of the the three relevant phonotactic properties. We see that the predicted values quite closely mirror the observed values, with the largest difference (a 6.6% difference) appearing in those words where /l/ is the second consonant.

(219) **MaxEnt HG weights: Vowel reduction**

	Reduce(T)	Reduce(C2)	Reduce(V)	Max			
	.662	1.02	1.23	1.15	**H**	**Obs**	**Pred**
T1=T2							
CVCV	1				.662	57.2	61.9
CCV				1	1.15	43.8	38.1
C2=l							
CVCV		1			1.02	46.5	53.1
CCV				1	1.15	53.5	46.9
V1=V2							
CVCV			1		1.23	46.3	48.0
CCV				1	1.15	53.7	52.0
T, C2							
CVCV	1	1			1.682	40.6	36.9
CCV				1	1.15	59.4	63.1
T, V							
CVCV	1		1		1.892	38.6	32.3
CCV				1	1.15	61.4	67.7
C2, V							
CVCV		1	1		2.25	18.4	24.9
CCV				1	1.15	81.6	75.1
T, C2, V							
CVCV	1	1	1		2.912	17.5	14.6
CCV				1	1.15	82.5	85.4
None							
CVCV					0	79.1	75.9
CCV				1	1.15	20.9	24.1

The ranked order of the amount of reduction across root types remains the same across the predicted and observed percentages. The fact that the predicted amount of reduction for each type of root in the MaxEnt analysis in (219) so closely mirrors the observed pattern supports the analysis of the proposed parameters (T1=T2, C2=l, V1=V2) as those most relevant in determining whether a given root is reducible.

If a CVCV root contains all three of the properties discussed here, it almost categorically has the option to reduce to CCV. If a CVCV root has some but not all of the above properties, it may or may not be able to reduce to CCV. Certain phonological factors characterize this lexical class of reducible words, but reducibility is not entirely predictable given a CVCV form. That is, while the model in (219) predicts correctly what percent of T1=T2 words are reducible, it says nothing about which T1=T2 words reduce, and which do not. For this reason, some representational information about reducibility must be lexically encoded. Section 5.4 discusses how reducibility, or the difference between weak and strong roots, can be built into the phonological grammar.

5.3 Vowel replacement

I now turn to the second vowel alternation found in Guébie, *vowel replacement*. Vowel replacement involves a change in root vowel features, specifically in the initial vowel of a CVCV root, in particular morphosyntactic environments[2]. Specifically, vowel replacement only occurs in the environment of a third-person object enclitic or plural suffix. This is a phonological process that applies to the same subset of CVCV verbs (weak roots) that undergoes reduction, and is seen when weak roots do not reduce.

Before detailing the vowel replacement facts, I lay out some phonological background on the interaction of roots with suffixes.

First, all roots end in vowels, and some suffixes begin with vowels. In most cases, this potential vowel hiatus is resolved by deleting the first vowel (i.e. /ɓi^{31}-ə^{2}/, *finish*-CAUS, is pronounced [ɓə^{312}]). This final root vowel deletion occurs in all morphosyntactic contexts except the /-A/ plural context (discussed in section 5.3.2), and definite contexts. Because final root vowels fail to surface in the environment of a vowel-initial suffix or enclitic, we cannot determine whether features of monosyllabic roots undergo changes in vowel replacement contexts. Their underlying vowel simply fails to surface at all. For this reason, I do not consider monosyllabic verbs here, and instead I focus on disyllabic ones. Note that root-internal VV sequences surface faithfully (ex. /*troɓ**iə***$^{3.2.2}$/, 'eggplant'), but derived VV sequences are resolved, most frequently by deletion of the first V in the sequence.

Second, vowels in roots and suffixes agree in ATR quality. For example, the plural suffix /-A/ surfaces as /-ə/ when it appears on +ATR roots, but /-a/ on -ATR roots: *ɲɛɲɛ*$^{2.4}$-***a***^{32}, 'insects', but *ɟokʷi*$^{2.3}$-***ə***^{2}, 'birds'. This root-dominant ATR harmony fails to occur between a root and clitic. Clitics include 1) the definite enclitic in noun phrases, which can surface on the noun, or on the adjective or numeral following the noun (see the discussion in chapter 3 for more on noun phrase syntax in Guébie), 2) object enclitics, which surface on auxiliaries, or if there is no auxiliary, on the inflected verb, and 3) nominalizers, which occur on verbs, after all other verbal morphology.

Though we see harmony between roots and suffixes, where suffixes match the ATR quality of roots, suffix vowels do not typically affect internal vowels in roots. That is, root vowels tend to surface faithfully to their input features. However, in the environment of certain morphemes, root vowel features are replaced with an alternative set of features. This only for in that same 33.5% of roots which undergo reduction, section 5.2.

The chart in (220) shows the distribution of ATR harmony and vowel replacement across morphemes in Guébie. Nominal morphology is represented with shaded cells, while non-shaded cells represent verbal morphology.

[2] I analyze this *replacement* as complete vowel harmony; however, there is another harmony process, which targets only ATR features, that interacts with this replacement phenomenon. To avoid confusion between the two, I call complete harmony *replacement* and refer to ATR harmony as simply *harmony*.

(220) **Where ATR harmony and vowel replacement occur**

	Harmony	**No Harmony**
No replacement	Sg	Def
	Caus	1/2.Obj
	Pass	Nmlz
	Appl	
	Recip	
Replacement	Pl	3.acc

The details of the vowel replacement process and its interaction with other phonological properties are discussed throughout the remainder of this section. I start in section 5.3.1 with full vowel replacement in object enclitic contexts. Section 5.3.2 focuses on partial vowel replacement in plural contexts, and section 5.3.3 discusses those morphosyntactic environments where vowel replacement of root vowels is not triggered. The overall distribution of vowel replacement across the language is summarized in section 5.3.4.

5.3.1 Replacement in object contexts

The first case of vowel replacement is seen in the context of third-person object enclitics. There are many third-person object enclitic surface forms, since non-human object markers agree in phonological form with the noun they are replacing (cf. chapter 3). The object pronouns, discussed in chapters 2 and 3, are repeated in (221).

(221) **Object pronouns in Guébie**

Human			**Non-human**		
	Singular	**Plural**		**Singular**	**Plural**
1st	e^3, ø	a^1, $a\text{ɲ}\varepsilon^{1.1}$	**1st**	–	–
2nd	e^1, $m\varepsilon^2$	a^2, $a\text{ɲ}\varepsilon^{2.2}$	**2nd**	–	–
3rd	ɔ^2	wa^2	**3rd**	ε^2,a^2,ʊ^2	ɪ^2,wa^2

The third-person human and non-human pronouns trigger vowel replacement, as in the paradigm of objects with the verb *bala*, ‘hit’, in (222).

(222) **Vowel replacement throughout the object pronoun paradigm** (syl_20170315)

	Singular		**Plural**	
1	ɔ^3 $bala^{3.23}$	‘he hit me’	ɔ^3 $bal^3{=}a\text{ɲ}\varepsilon^{1.1}$	‘he hit us’
2	ɔ^3 $bala^{3.3}{=}m\varepsilon^2$	‘he hit you’	ɔ^3 $bal^3{=}a\text{ɲ}\varepsilon^{2.2}$	‘he hit you all’
3.Human	ɔ^3 $b\text{ɔ}l^3{=}\text{ɔ}^2$	‘he hit him’	ɔ^3 $b\text{ɔ}l^3{=}a^2$	‘he hit them’
3.NonHuman	ɔ^3 $b\varepsilon l^3{=}\varepsilon^2$/$bal^3{=}a^2$/$b\text{ʊ}l^3{=}\text{ʊ}^2$	‘he hit it’	ɔ^3 $b\text{ɪ}l^3{=}\text{ɪ}^2$/ $b\text{ɔ}l^3{=}a^2$	‘he hit them’

It seems that the first singular object enclitic has no effect on the vowels of the root, though the tone changes from *bala*$^{3.3}$ to *bala*$^{3.23}$. This could be due to a floating 23 tone, or a tonal process triggered in the environment of first person singular objects markers. The second person pronoun does not affect the tone or vowels on the root, but surfaces as an enclitic on the verb. In first and second person plural contexts, the first vowel of the pronoun coalesces with the final vowel of the root (/a+a/ surfaces as [a]), but otherwise there is no pronoun-internal change.

However, in third-person contexts, we see that the vowels of /*bala*$^{3.3}$/ surface with the features of the object marker. All third person pronouns, whether human or non-human, result in vowel replacement of root vowels for the reducible subset of the lexicon. The choice of which non-human pronoun vowel surfaces (in replacement contexts and otherwise) is dependent on agreement between the pronoun and its agreement-controlling noun, as discussed in chapter 3.

5.3.1.1 Phonological effects of object vowel replacement

For those roots that do not undergo replacement (or reduction), object markers surface as enclitics, following the auxiliary or inflected verb. Due to normal hiatus resolution in derived environments, the final vowel of the root fails to surface in object enclitic cases. This is shown in (223) with the human singular enclitic.

(223) **Object markers as enclitics on strong roots**

	Verb	**+Obj**	**Gloss**
a.	ɟʊla$^{3.2}$	ɟʊl^{3}=ɔ^{2}	‘take/borrow’
b.	tɛlɪ$^{3.3}$	tɛl^{3}=ɔ^{2}	‘carve’
c.	sijo$^{2.3}$	sij^{2}=ɔ^{32}	‘wipe’
d.	ɲɛpɛ$^{3.1}$	ɲɛp^{3}=ɔ^{12}	‘sweep’ (syl_20161207, syl_20170315)

The tone of the object enclitic form includes the full underlying tone melody of the verb, plus the tone 2 of the object enclitic, associated to tone bearing units from left to right across the word.

For roots that are subject to replacement, the initial vowel in the root surfaces as identical to the object enclitic vowel, (224). While the final vowel of a root is affected by the vowel-initial enclitic due to coalescence, non-final vowels of polysyllabic stems are typically unaffected by enclitic vowels. Vowel replacement of the type that affects the initial vowel in the stem is restricted to those roots which alternate between CVCV and CCV.

(224) **Vowel replacement of verb roots in the context of object markers**

	Verb	**+Obj**	**Gloss**
a.	bala$^{3.3}$, bra^{3}	bɔl^{3}=ɔ^{2}, br=ɔ^{32}	‘hit’
b.	jɪla$^{3.3}$, jra^{3}	jɔl^{3}=ɔ^{2}, jr=ɔ^{32}	‘ask’
c.	pɛja$^{3.1}$, pja^{31}	pɔj^{3}=ɔ^{12}, pj=ɔ^{312}	‘buy’
d.	tulu$^{4.4}$, tru^{4}	tɔl^{4}=ɔ^{2}, tr=ɔ^{42}	‘chase’ (syl_20161207, syl_20170315)

The roots in (224) can surface as CVCV or CCV in object enclitic contexts. Crucially, in their CVCV form, the initial vowel matches the vowel of the object enclitic. This is not true of strong roots like *ɟʊla*$^{3.2}$, 'take/borrow', which can neither surface as reduced, **ɟra*^{32}, nor with an unfaithful vowel in object enclitic contexts, **ɟɔl-ɔ*$^{3.2}$. We might expect given the vowel replacement facts in (224) that *ɟɔ lɔ*$^{3.2}$ would be allowed. However, *ɟʊla*$^{3.2}$, 'take/borrow', cannot reduce CCV; it only ever surfaces as CVCV. *ɟʊla*$^{3.2}$, 'take/borrow' is not of the weak class of roots. In the case of strong (non-reducible or replaceable) disyllabic verb stems, the vowel of the initial syllable is unaffected by the quality of suffix or enclitic vowels.

We see the same full vowel replacement effect in the environment of other object enclitics, (225).

(225) **Third-person enclitics trigger replacement** (syl_20170315)

	Verb	**Object**	**Verb+Obj**	**Gloss**
a.	jili$^{2.3}$	=ɔ^{2}	jɔl=ɔ$^{2.32}$, *jil=ɔ$^{2.32}$	'steal him'
b.	jili$^{2.3}$	=ɛ^{2}	jɛl=ɛ$^{2.32}$, *jil=ɛ$^{2.32}$	'steal it'
c.	jili$^{2.3}$	=ʊ^{2}	jʊl=ʊ$^{2.32}$, *jil=ʊ$^{2.32}$	'steal it'
d.	jili$^{2.3}$	=ɪ^{2}	jɪl=ɪ$^{2.32}$, *jil=ɪ$^{2.32}$	'steal them'
e.	jɪla$^{3.3}$	=ɔ^{2}	jɔl=ɔ$^{3.2}$, *jɪl=ɔ$^{3.2}$	'ask him'
f.	jɪla$^{3.3}$	=ɛ^{2}	jɛl=ɛ$^{3.2}$, *jɪl=ɛ$^{3.2}$	'ask it'
g.	jɪla$^{3.3}$	=ʊ^{2}	jʊl=ʊ$^{3.2}$*jɪl=ʊ$^{3.2}$	'ask it'
h.	jɪla$^{3.3}$	=ɪ^{2}	jɪl=ɪ$^{3.2}$	'ask them'
i.	bala$^{3.3}$	=ɔ^{2}	bɔl=ɔ$^{3.2}$, *bal=ɔ$^{3.2}$	'hit him'
j.	bala$^{3.3}$	=ɛ^{2}	bɛl=ɛ$^{3.2}$, *bal=ɛ$^{3.2}$	'hit it'
k.	bala$^{3.3}$	=ʊ^{2}	bʊl=ʊ$^{3.2}$, *bal=ʊ$^{3.2}$	'hit it'
l.	bala$^{3.3}$	=ɪ^{2}	bɪl=ɪ$^{3.2}$, *bal=ɪ$^{3.2}$	'hit them'

Vowel replacement in object enclitic contexts replaces all features of underlying root vowels. I call this phenomenon *full replacement*. We will see that in other morphosyntactic environments, some but not all features of vowels are replaced. Here though, no matter the height, backness, or ATR features of root vowels, if the root is weak, or replaceable, the initial vowel surfaces as identical to the enclitic vowel.

5.3.1.2 Neutralization due to vowel replacement

Because this vowel replacement process in object enclitic contexts replaces root vowels, it often results in neutralization of lexical contrasts.

(226) **Vowel replacement results in neutralization** (bor_20150603)

	Verb	**Verb=Object**	**Gloss**
a.	gbɔlɔ$^{3.3}$	**gbɔlɔ**$^{3.2}$	incubate.PFV
b.	gbulu$^{3.3}$	**gbɔlɔ**$^{3.2}$	crawl.IPFV

We see in (226) that the verbs *gbɔlɔ*$^{3.3}$ 'incubate' and *gbulu*$^{3.3}$ 'crawl' do not have the same surface forms in isolation, but in object enclitic contexts they are segmentally and tonally identical to each other due to vowel replacement.

5.3.1.3 The syntactic position of object markers

In order to understand the distribution of object markers on verb stems, I turn briefly to their syntactic properties. Object markers are enclitics, rather than suffixes. They differ from suffixes phonologically in that they do not undergo ATR harmony with the roots they attach to, but they also differ syntactically. Suffixes in Guébie attach to a root or stem of a particular category, while enclitics have a freer distribution. Specifically, object markers do not only attach to verb roots, but attach to whichever element is inflected. Namely, whichever element is in the inflectional syntactic position, T (recall the discussion of word order in chapter 4).

If there is an auxiliary present, (227a-c), it sits in T and the object pronoun is an enclitic on the auxiliary. If there is no auxiliary, the verb surfaces in the inflectional position, and the object pronoun surfaces as an enclitic on the verb (227d-f).

(227) **Auxiliary + Object pronoun**

a. e^{4} ja^{32}(/ji-a$^{3.2}$/) mɔ^{3}-mɛ^{2}
1SG.NOM FUT-3SG.ACC PART-go
'I will go to it.' (lau_20140606)

b. e^{4} jɔ^{32}(/ji-ɔ$^{3.2}$/) li^{3}
1SG.NOM FUT-3SG.ACC eat
'I will eat him.' (lau_20140606)

c. a^{2} kɔ^{32}(/ka-ɔ$^{3.2}$/) jigo$^{3.2}$ gbɛja$^{3.1}$ ne^{2} a^{2} fu^{2} ɔɓa$^{3.3}$
1PL.NOM IRR-3SG.ACC fire put.on REL 1PL.NOM press.IPFV 3SG.EMPH
'When we put it on the fire, we press it.' (lau_20140606)

d. e^{2} ɲɔ^{32}(/ɲɛ-ɔ$^{3.2}$/) ɔnɛ$^{2.3}$ da^{2}
2SG.NOM give.IPFV-3SG.ACC 3SG.POSS portion
'You give him his portions' (lau_20140606)

e. wa^{3} lɔ^{32}(/la-ɔ$^{3.2}$/) ɲalikpaŋɔnɔ$^{2.3.1.2.2}$
3PL.NOM call.IPFV-3SG.ACC Nali
'They call her Nali' (ser_20150606)

f. ɔ^{3} wɔ^{2}(/wa-ɔ$^{2.2}$/)
3SG.NOM love.IPFV-3SG.ACC
'She loves him' (ser_20150606)

Object pronouns always surface immediately after the inflected position. Other objects, free words or full noun phrases, can surface anywhere between the inflected verb and the clause-final verb (unless the verb has moved to the inflectional position, in which case they can surface anywhere after the inflected verb). I propose that this ordering difference between pronoun objects and other objects is due to a functional head immediately below T–perhaps little-v or some head in between little-v and T–which probes for a DP with a [+PROPER] feature. Support for a [+PROPER] feature comes from cross-linguistic findings that proper noun phrases pattern separately from other noun phrases, both phonologically and morphosyntactically (Matushansky, 2006b; Jenks and Sande, To appear; Broad et al., 2016). In Guébie the set of proper noun phrases would be those containing pronouns. We could think of the pronoun itself introducing the [+PROPER] feature within the DP.

5.3.1.4 Root vowel replacement with intervening affixes

As discussed in section 5.3.1.3, the object enclitic surfaces on the auxiliary or inflected verb. These inflected verbs can surface with other affixes as well. In such cases, the object marker surfaces outside other verbal morphology, and we can ask whether vowel replacement still occurs when suffixes intervene between an object enclitic and a weak root.

It is uncommon in natural speech for a given verb to surface with more than one suffix or enclitic; however, when asked about the grammaticality of such morphologically complex words, speakers have clear judgments. For some speakers, when the root is reducible and the object marker is present, all vowels in the verb stem are replaced by the object marker, even those vowels that are part of valency-changing suffixes (228b). For other speakers, vowel replacement does not occur across intervening suffixes (228c). Forms that are judged grammatical only by a subset of speakers are marked with a question mark in (228). For any individual speaker, the judgments on (228b,c) are not questionable; each speaker allows one or the other, but not both.

(228) **Vowel replacement with intervening suffixes** (syl_20170425)

a. e^{4} bala$^{3.3}$-lɪ^{2} ɟaci$^{23.1}$ nuni$^{2.3}$ mɛ^{3}
   1SG.NOM hit.PFV-APPL Jachi spoon with
   'I hit Jachi with a spoon'

b. ?e^{4} bɔlɔ$^{3.3}$-l=ɔ^{2} nuni$^{2.3}$ mɛ^{3}
   1SG.NOM hit.PFV-APPL=3SG.ACC spoon with
   'I hit him with a spoon'

c. ?e^{4} bala$^{3.3}$-l=ɔ^{2} nuni$^{2.3}$ mɛ^{3}
   1SG.NOM hit.PFV-APPL=3SG.ACC spoon with
   'I hit him with a spoon'

In (228a) we see the verb /*bala*$^{3.3}$/ with an applicative suffix. There is no effect of applicative suffixes on root vowels. When we add the object enclitic, which surfaces outside of the applicative suffix, we see two effects: 1) the final vowel of the applicative suffix fails to surface due to hiatus resolution, (228b,c), and 2) for some speakers, the object enclitic triggers vowel replacement on the root, despite the presence of the intervening applicative suffix, (228c).

For the first set of speakers, for whom (228b) is grammatical, we could say that the lexical feature of the root (ultimately, weak vs. strong) which conditions vowel replacement percolates up through the rest of the verbal word, triggering replacement on the root and all suffixes when an object enclitic is present. For those speakers who prefer (228c), where intervening suffixes block vowel replacement, replacement seems to be a strictly local process.

5.3.2 Vowel replacement in plural contexts

Outside of object enclitics, the only other morphosyntactic context where vowel replacement occurs is in the plural. There are two different plural morphemes. One is an /-A^{2}/ suffix, which surfaces after the final vowel of the root as [a] when suffixed on a noun with -ATR vowels, and [ə] on +ATR nouns. The second plural morpheme has no obvious underlying form, but in the environment of this second plural morpheme the final vowel of the stem always surfaces as [-BACK, -ROUND]. There is no way to predict whether a given noun will take the /-A^{2}/ plural suffix, or the [-BACK, -ROUND] plural morpheme. I assume that each noun is lexically specified for which plural morpheme it takes. This plural specification is unrelated to whether a noun undergoes vowel reduction and replacement.

5.3.2.1 /-A/ plural morpheme

On strong nouns, in the environment of the /-A^{2}/ plural suffix, we fail to see the normal hiatus resolution process where the final of the root fails to surface. Instead, we get a VV sequence with the final vowel of a root and the suffix vowel, (229a-d,) and (229g-j). When the final vowel of the root is /ə, a/, we get coalescence or simplification to a single vowel, (229e,f).

(229) **Strong nouns plus plural suffix /-A/**

	Final vowel	Singular noun	Plural noun	Gloss
a.	ɛ	ɲɛɲɛ$^{2.43}$	ɲɛɲɛ$^{2.4}$-a^{32}	‘insect’
b.	e	ɟe^{42}	ɟe^{4}-ə^{2}	‘egg’
c.	ɔ	ɲɔ^{31}	ɲɔ^{3}-a^{12}	‘person’
d.	o	dibo$^{3.1}$	dibo$^{3.1}$-ə^{2}	‘plantain’
e.	a	k^{w}ala$^{4.4}$	k^{w}ala$^{4.42}$	‘farm’
f.	ə	troɓiə$^{3.2.2}$	troɓiə$^{3.2.2}$	‘eggplant’
g.	ɪ	ɲɛɲɪ$^{3.2}$	ɲɛɲɪ$^{3.2}$-a^{2}	‘sin’
h.	i	ɟok^{w}i$^{2.32}$	ɟok^{w}i$^{2.3}$-ə^{2}	‘bird sp.’
i.	u	sukulu$^{1.1.3}$	sukulu$^{2.3}$-ə$^{1.1.32}$	‘school’
j.	ʊ	gbɔnʊ$^{3.1}$	gbɔnʊ$^{3.1}$-a^{2}	‘storm’

For weak nouns, those same nouns that undergo reduction as described in section 5.2, root vowels undergo a change in the presence of the /-A^2/ plural morpheme. In (230) we see weak roots, where the initial vowel of the CVCV root is replaced in the context of a plural suffix.

(230) **Weak nouns with plural suffix /-A/**

	Singular	Plural	Gloss
a.	mɛnɛ$^{3.3}$	mana$^{3.2}$	'meat'
b.	wʊlʊ$^{3.3}$	wala$^{3.3}$	'granary'

Note that unlike the bulk of the nouns in (229), we do not see a final VV sequence in (230). However, the plural nouns in (230) follow the same pattern as /a/- and /ə/-final nouns in (229), where we never see sequences of [ə+ə] or [a+a] on the surface.

Unlike object enclitics, which surface outside of other verbal morphology, nothing can intervene between a noun and plural morpheme in the nominal domain. Thus, we cannot tell whether plural morphemes trigger replacement on roots when other morphology intervenes.

5.3.2.2 [-back, -round] plural morpheme

The second plural morpheme, where the final vowel is always [-BACK, -ROUND] surfaces as a [i, ɪ] on strong nouns. Unlike the /-A^2/ plural suffix, here we do not see two consecutive final vowels (root vowel plus plural). In fact, there is no evidence that this second plural morpheme actually has an underlying phonological form, because we never see another vowel in addition to the root vowels, (231). Instead, it seems that the underlying final vowel of the root surfaces as high, front, and unrounded in plural contexts, but retains its underlying ATR feature. This second plural morpheme could be analyzed as an underlying /-I/, which surfaces as [i] or [ɪ] depending on the ATR quality of the root it attaches to. However, this latter analysis becomes more complicated when we turn to weak roots.

(231) **Strong nouns plus front, unrounded plural**

	Final vowel	Singular noun	Plural noun	Gloss
a.	ə	nunə$^{3.3}$	nuni$^{3.3}$	'story'
b.	a	fa^{42}	fɪ^{42}	'bone'
c.	u	su^{2}	si^{2}	'tree'
d.	ɪ	wʊlɪ$^{2.2}$	wʊlɪ$^{2.2}$	'word'
e.	i	ɓili$^{3.3}$	ɓili$^{3.3}$	'cow'
f.	ɔ	ɟɛlɔ$^{2.3}$	ɟɛlɪ$^{2.3}$	'bird sp.'
g.	o	co^{31}	ci^{31}	'month'
h.	e	nove$^{2.3}$	novi$^{2.3}$	'bee'
i.	ɛ	tɛlɛ$^{3.3}$	tɛlɪ$^{3.3}$	'snake'

For weak roots, the initial root vowel also undergoes featural changes in the context of the [-BACK, -ROUND] plural morpheme (232).

(232) **Weak nouns plus front, unrounded plural**

	Singular noun	Plural noun	Gloss
a.	wʊlɪ$^{4.4}$	wɪlɪ$^{4.4}$	'goat'
b.	gbɔlɔ$^{3.1}$	gbɛlɛ$^{3.1}$	'cola nut'
c.	ɲɔkpɔ$^{3.1}$	ɲɛkpɛ$^{3.1}$	'person'

In object enclitic cases, we saw that the object tone (tone 2) surfaces both in vowel replacement and non-replacement contexts. In plural contexts, the [-BACK, -ROUND] plural morpheme in (231) and (232) does not have its own tone melody. The /-a^2,ə^2/ plural suffix does have its own tone, tone 2. This tone surfaces in both non-replacement and replacement contexts, (229), (230).

Unlike the object enclitic case, when vowels are replaced in plural contexts, there is not necessarily an underlying plural suffix that surfaces and replaces the features of root vowels. Instead, root vowels are faithful to their underlying height and ATR features, but take the backness and rounding features of the suffix. For strong roots, the plural morphology in (231) triggers a change in the final vowel of the root. We see ATR harmony between the first and second vowels, but the final vowel always surfaces as [-BACK, -RD, +HIGH]. For weak roots, (232) all vowels agree in all features, where the ATR and height features come from the root, but backness and rounding from the plural morpheme, [-BACK, -RD]. The ten vowels in Guébie, distinguished by four binary features, are given in (233).

(233) **Vowel features in Guébie**

	i	ɪ	e	ɛ	ə	a	o	ɔ	u	ʊ
High	+	+	-	-	-	-	-	-	+	+
ATR	+	-	+	-	+	-	+	-	+	-
Back	-	-	-	-	+	+	+	+	+	+
Round	-	-	-	-	-	-	+	+	+	+

Interestingly, this seems to be a case of conflicting directionality in vowel harmony. The root vowel features in [-BACK, -ROUND] plural contexts influence ATR and height features of the surface vowels, while the plural morpheme influences the rounding and backness features, (232). The result is total harmony between the two, but where the root has contributed certain features, and the suffix others.

Because the vowel replacement process in the context of the [-BACK, -ROUND] plural morpheme replaces some, but not all, features of the initial root vowel (cf. 232), I refer to this as *partial replacement*. This differs from full replacement in object enclitic contexts in that the initial root vowel retains its own ATR and height features, and only the backness and rounding features are replaced by the features of the plural morpheme.

In section 5.5 I present an analysis where full replacement in object contexts and partial replacement in plural contexts are both derived from the same set of constraints, ranked or weighted differently in different morphosyntactic contexts to result in different degrees of root vowel faithfulness.

5.3.3 No replacement in other morphosyntactic contexts

The vowel replacement process discussed in sections 5.3.1 and 5.3.2 is not a phonological phenomenon that applies across the language, but is specific to particular morphosyntactic contexts. In fact, the only environments where vowel replacement occurs are in the contexts of object enclitics and plural morphemes. No other nominal or verbal morphology interacts with the quality of the initial vowel in a CVCV root. However, we do see other phonological alternations specific to particular affixal morphology, namely root-dominant ATR harmony.

In order to assess the best model of vowel replacement, we must contextualize the vowel replacement process within the full morphophonology of the language. We have already seen how vowel replacement triggers—object enclitics and plural morphemes—interact with roots. In the environment of an object enclitic, we do not see ATR harmony between strong or weak roots and enclitics. In weak root contexts, we saw replacement of the initial vowel of a weak CVCV root with the enclitic vowel. In plural contexts we saw suffix ATR alternations due to root-dominant ATR harmony, most visible in strong roots. In weak roots, we saw replacement of backness and rounding features of the initial vowel in CVCV roots, determined by the backness and rounding features of the plural morpheme.

This section examines the variation in those suffixes and clitics that do not trigger vowel replacement.

5.3.3.1 Passive and Causative: No replacement, with ATR harmony

The passive suffix /-O^{2}/ surfaces as [-ɔ^{2}] or [-o^{2}] depending on the ATR quality of the vowels in the root it attaches to. This is the same phonological shape as the third-person singular human object enclitic. However, the passive suffix does not trigger replacement like the object enclitic, (234).

(234) **Passive does not affect stem vowels** (syl_20151117)

	Active	**Passive**	**Gloss**
a.	ɓə^{31}	ɓ-o^{312}	'finish'
b.	pi^{3}	pi^{3}-o^{2}	'cook'
c.	bulu$^{2.2}$	bul^{2}-o^{2}, *bol-o$^{2.2}$	'fly'
d.	bala$^{3.3}$	bal$^{3.3}$-ɔ^{2}, *bɔl-ɔ$^{3.2}$	'hit'
e.	ɟʊla$^{3.2}$	ɟʊl^{3}-ɔ^{2}, *ɟɔl^{3}-ɔ^{2}	'take/borrow'

Other valency changing morphology on verbs also alternates with the ATR value of vowels in the roots they attach to, but they do not trigger replacement of root vowels. For example, the causative, (235) which alternates between [-a^{2}] and [-ə^{2}], shows the same pattern as the passive suffix.

(235) **Causative does not affect stem vowels** (syl_20131024)

	Verb	+Causative	Gloss
a.	si^{2}	sɪ^{2}-a^{2}	'be tired'
b.	wi^{3}	wi^{3}-ə^{2}	'cry'
c.	bulu$^{2.2}$	bul^{2}-ə^{2}	'fly'
d.	bala$^{3.3}$	bal^{2}-a^{2}	'hit'

Note that the CVCV roots in (234) and (235) are replaceable (weak) ones, where the initial vowel is replaced in object enclitic contexts. However, in passive contexts, the initial root vowel is faithful to its underlying form.

The alternation of the passive suffix between [-o] and [-ɔ] and the causative suffix between [-a] and [-ə] is due to ATR harmony with the root. The fact that we do not see the final root vowel surfacing in either context is due to derived environment hiatus resolution: $V_1+V_2 \rightarrow$ V2.

The passive and causative are examples of morphosyntactic environments where we see root-dominant ATR harmony, but no replacement of root vowels.

5.3.3.2 Definite and Nominalizer: No replacement, no ATR harmony

We have seen contexts where roots undergo replacement triggered by particular suffixes, and other contexts where there is no replacement, but there is ATR harmony between roots and affixes. The last set of morphemes are those that neither trigger replacement nor undergo ATR harmony with roots. In the nominal domain, the definite marker is one such example. On verbal roots, nominalizers and first- and second-person pronouns have these properties.

The definite marker on nouns surfaces outside of number marking morphology, and always surfaces as [-a]. This /-a/ suffix does not have its own underlying tone. Instead, the tone melody of the stem it attaches to spreads over the whole stem plus definite marker. There is no ATR-conditioned alternation of the definite marker, nor is vowel replacement of roots triggered in definite contexts (236).

(236) **Definite marker: No replacement, no ATR harmony** (lau_20150617)

	Indefinite	Definite	Gloss
a.	ju^{4}	ju^{4}-a^{4}	'child'
b.	ɟa^{31}	ɟa^{3}-a^{1}	'coconuts'
c.	goji$^{3.1}$	goji$^{3.1}$-a^{1}	'dog'
d.	ɲɔkpɔ$^{3.1}$	ɲɔkpɔ$^{3.1}$-a^{1}	'the person'
e.	mobii$^{1.3.1}$	mobii$^{1.3.1}$-a^{1}	'car'

No matter the ATR value of root vowels in (236), the definite marker always surfaces as [-a]. Additionally, we never see root vowel alternations in definite contexts. Note that definite contexts, like the /-A^{2}/ plural discussed in section 5.3.2, does not trigger the normal vowel hiatus resolution process we have seen throughout. Instead, both the final root vowel and definite vowel surface together, in a word-final VV sequence.

We see the same lack of harmony and vowel replacement with the nominalizing suffix, /-li^{2}/, on verbal roots.

(237) **Nominalizer: no replacement, no ATR harmony (syl_20160506)**

	Verb	Nominalized	Gloss
a.	jeɓe$^{3.1}$	jeɓe$^{3.1}$-li^{2}	‘knowing’
b.	sumu$^{2.2}$	sumo$^{2.2}$-li^{2}	‘boiling’
c.	gbala$^{2.4}$	gbala$^{2.4}$-li^{2}	‘climbing’
d.	bala$^{3.3}$	bala$^{3.3}$-li^{2}	‘hitting’

There is no interaction between roots and the nominalizing suffix /-li^{2}/. We see neither root alternations nor suffix alternations. In definite and nominalizing environments (along with first-and second-person object pronoun contexts), faithfulness to underlying forms is stronger than any pressure for surface vowels to agree in features.

5.3.4 Interim summary: The distribution of vowel replacement

We have seen three different patterns of root vowel replacement across Guébie morphology: full replacement, partial replacement, and no replacement. Third-person object markers trigger *full replacement*, where root vowels are wholesale replaced by the features of the enclitic vowel. Plural morphemes replace certain features of root vowels (backness and rounding), but root vowels retain their own height and ATR features, resulting in *partial replacement*. All other morphemes fail to trigger vowel replacement of any kind, resulting in *no replacement*. This three-way typology is summarized in (238).

(238) **Morphosyntactic conditioning of vowel replacement**

	Object	**Plural**	**Passive (and all others)**
Full replacement	X		
Partial replacement		X	
No replacement			X

The distribution of replacement is independent of the distribution of root-dominant ATR harmony between roots and affixal morphology.

(239) **Morphosyntactic conditioning of ATR harmony**

Harmony	**No Harmony**
Singular	Definite
Plural	Object enclitics
Causative	Nominalizers
Passive	
Applicative	
Reciprocal	

The distribution of ATR harmony, (239), mirrors affix order, where those morphemes that undergo harmony with roots surface nearer to roots than those that do not. Recall the order of nominal and verbal morphology discussed in chapter 2, repeated in (240) and (241).

(240) **Nominal morphology template**
$\textit{Root} - \underline{\textsc{Plural}} = \textsc{Definite}$

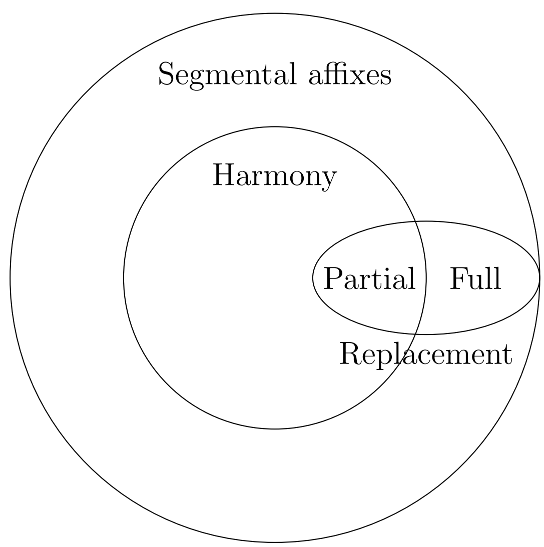
(241) **Verbal morphology template**

$$\textsc{particle} - \textit{Root} - \begin{bmatrix}\textsc{Caus}\\ \textsc{Pass}\end{bmatrix} - \textsc{Appl} - \textsc{Recip} = \begin{bmatrix}\underline{\textsc{Obj}}\\ \textsc{Nmlz}\end{bmatrix}$$

I refer to those morphemes that surface near the root and undergo ATR harmony as suffixes, while those morphemes that are further from the root and do not undergo ATR harmony are clitics. Interestingly, the two morphemes that trigger vowel replacement, plurals and third-person object markers, differ in their status as suffix or clitic. The plural morpheme and object enclitic are underlined in (240) and (241). The plural morpheme surfaces immediately after the root in nominal contexts, (240), and undergoes harmony. The object enclitic (where clitic boundaries are marked with =, and affixes with −), surfaces outside valency-changing morphology and does not undergo harmony.

A full diagram of the phonological properties of affixes and clitics is given in (242).

(242) **Phonological properties of segmental affixes**



(243) **Morphemes by phonological property** (repeated from 220)

	Harmony	**No Harmony**
No replacement	Sg Caus Pass Appl Recip	Def 1/2.Obj Nmlz
Partial replacement	Pl	
Full replacement		3.Obj

In (243), the shaded cells represent nominal morphology. The unshaded cells represent morphology which surfaces on verb roots. All of those morphemes in the left-hand column, which undergo harmony with the root, surface closer to the root than those in the *No Harmony* column. The abbreviation Nmlz here refers to all three nominalizing affixes, the event nominalizer /-li/, the event nominalizer /-Red+e/, and the agentive nominalizer /-ɲɔ/. For all of those suffixes in the Harmony column, we do not know the underlying ATR value of the suffix (if there is one), because the root to which those suffixes attach determines the surface ATR value of the suffix vowels. Harmony in (243) refers not just to ATR harmony in vowels between roots and affixes, but also to nasal harmony in consonants. All of the affixes in the harmony column are either vowel-initial or /l/-initial. The /l/-initial suffixes (appl, recip), undergo nasal harmony with the roots to which they attach. On the other hand, the nominalizing suffix /-li^2/ does not undergo either vowel harmony or nasal harmony, but always surfaces as [-li^2].

We see that while certain phonological properties correlate with distance from the root (i.e. vowel and consonant harmony), replacement is triggered in two distinct morphosyntactic environments that otherwise have nothing in common: plurals and third-person objects. While stratal analyses such as Lexical Morphology and Phonology (Kiparsky, 1982) and Stratal OT (Bermúdez-Otero, 1999; Kiparsky, 2000, 2008) could easily derive the harmony effects between roots and suffixes but not between roots and enclitics, it is unclear how such analyses would account for replacement in only plural and 3.Obj contexts. For this reason, I adopt Cophonology Theory (Orgun, 1996; Inkelas et al., 1997; Anttila, 2002; Inkelas and Zoll, 2005), which allows for morpheme-specific phonological grammars, independent of distance from the root. Section 5.5 provides an analysis of this morphosyntactic conditioning modeled via cophonologies. In section 5.4 I address the lexical specificity of vowel reduction and vowel replacement.

5.4 Lexical specificity of vowel reduction and replacement

5.4.1 Weak faithfulness to weakly encoded vowels

Recall that vowel replacement is conditioned by both lexical and morphosyntactic features, and the same set of lexical items that undergoes replacement also undergoes reduction. In this section I address the lexical conditioning of these two vowel alternations.

Both vowel reduction and vowel replacement in Guébie target the initial vowel in 33.5% of CVCV roots. I propose a representational difference between those vowels that alternate, and those that do not. Namely, initial vowels in roots that undergo both alternations are weakly phonologically encoded. This explanation follows the recent line of work on phonological activity or encoding strength that conditions phonological alternations (Inkelas, 2011; Smolensky et al., 2014; Inkelas, 2015; Moore-Cantwell, 2017; Pycha et al., 2017). The fact that the first vowel in certain CVCV roots is weakly encoded makes that vowel susceptible to replacement, section 5.3, and reduction, section 5.2.

Representational differences in vowels have been used to account for a number of alternations across languages. Zoll (1996) calls such segments *latent*, though they have also been called *ghost, floating*, or *defective* segments. Zoll (1996) comes to the same conclusion as is made here, that weak, or latent, segments are not predictable given the contexts in which they occur, so they must be present in the input; however, they undergo distinct phonological processes from full, strong segments, thus must have a distinct representation. Zoll represents such segments autosegmentally, as lacking a root node (Zoll, 1996). Here the difference between weak and strong segments is the degree of phonological encoding. Further discussion of weak or latent segments is found in Hyman (1985); Kenstowicz and Rubach (1987); Archangeli (1991); Clements and Keyser (1983); Szpyra (1992); Yu (2000).

Notations for weak vowels vary; capital letters are used by Szpyra (1992), while Yu (2000) underlines weak segments. Here I follow the notation used throughout Kru literature, where weakly encoded vowels are written as superscripts (Marchese, 1979; Zogbo, to appear): $b^{a}la^{3.3}$, 'hit'. By contrast, those segments which are not written as superscripts are considered to be *strongly encoded*. While the Guébie data require only a binary distinction between weakly and strongly encoded segments, one could imagine a more gradient model of strength, such as the one used by Inkelas (2011); Smolensky et al. (2014); Inkelas (2015); Moore-Cantwell (2017), if called for by the data.

The benefit of a representational account such as encoding strength is that it unifies the explanation vowel reduction and vowel replacement. Both alternations occur in roots with weak initial vowels, and not elsewhere. This prediction is preferable to something like a diacritic analysis (cf. sublexicons of Gouskova and Becker 2013; Becker and Gouskova 2016; Gouskova et al. 2015) or a suppletive allomorphy approach (cf. Distributed Morphology approaches, Halle and Marantz 1993, 1994; Harley 2014, or Emergent Phonology, Archangeli and Pulleyblank 2012, 2015a,b). In these alternative analyses, it is coincidental that the same set of roots undergoes both replacement and reduction. Section 5.6 provides a specific argument against such alternatives.

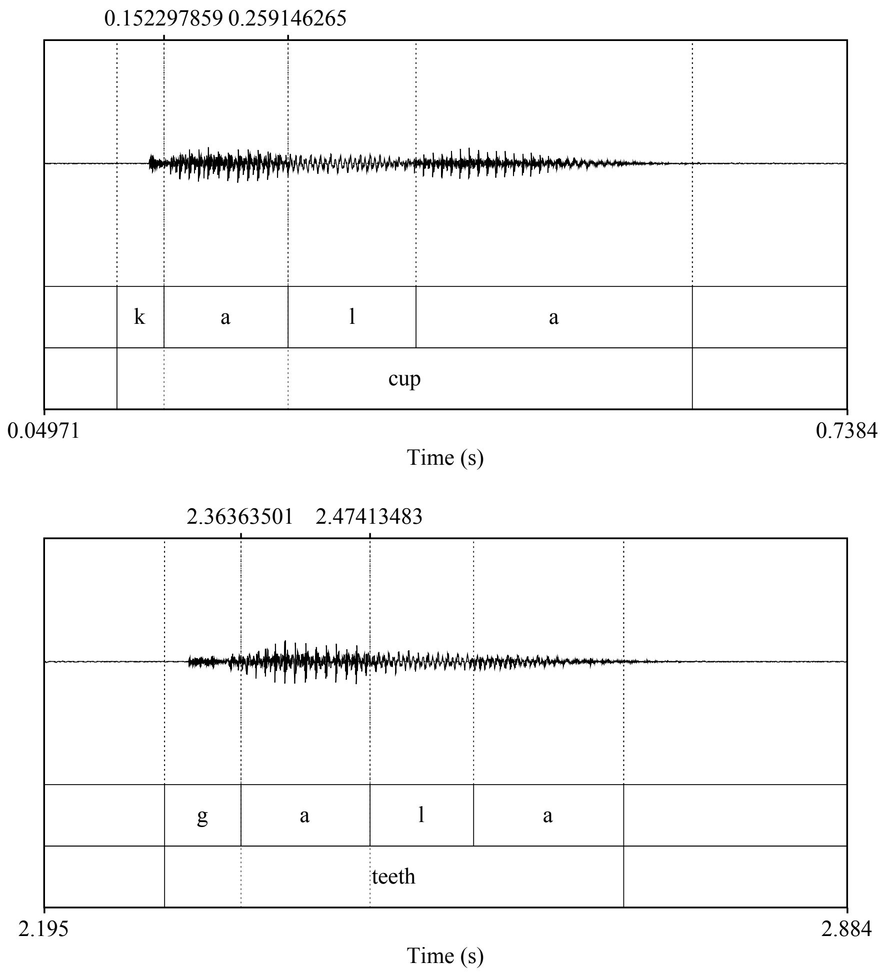
5.4.2 The phonetics and phonology of weak vowels

Roots with weak vowels share certain properties, phonological, phonotactic, and perhaps also phonetic. They share phonological properties in that they undergo both replacement and reduction while other roots do not. Recall from section section 5.2.2 that weak roots also tend to share certain phonotactic traits. Namely, roots are more likely to be reducible and replaceable if the second consonant is /l/, if the vowels in syllables one and two are identical, and if the same tone surfaces on both syllables.

One possibility is that weak vowels are not just phonologically weaker, in that they are susceptible to alternation, but also phonetically weaker. Phonetic weakness could be manifested in vowel duration or vowel centralization. A controlled phonetic experiment measuring vowels in weak versus strong roots in carrier phrases could inform whether a production difference of this type actually holds. Alternation in roots with shorter vowels could then be analyzed as less of an output-output faithfulness violation than an alternation in roots with longer vowels, because there is less phonetic change overall, across a paradigm (cf. (Braver, 2013)). That is, a change in features of a short vowel (reduction or feature replacement) is more acceptable than a change in features of a phonetically longer vowel.

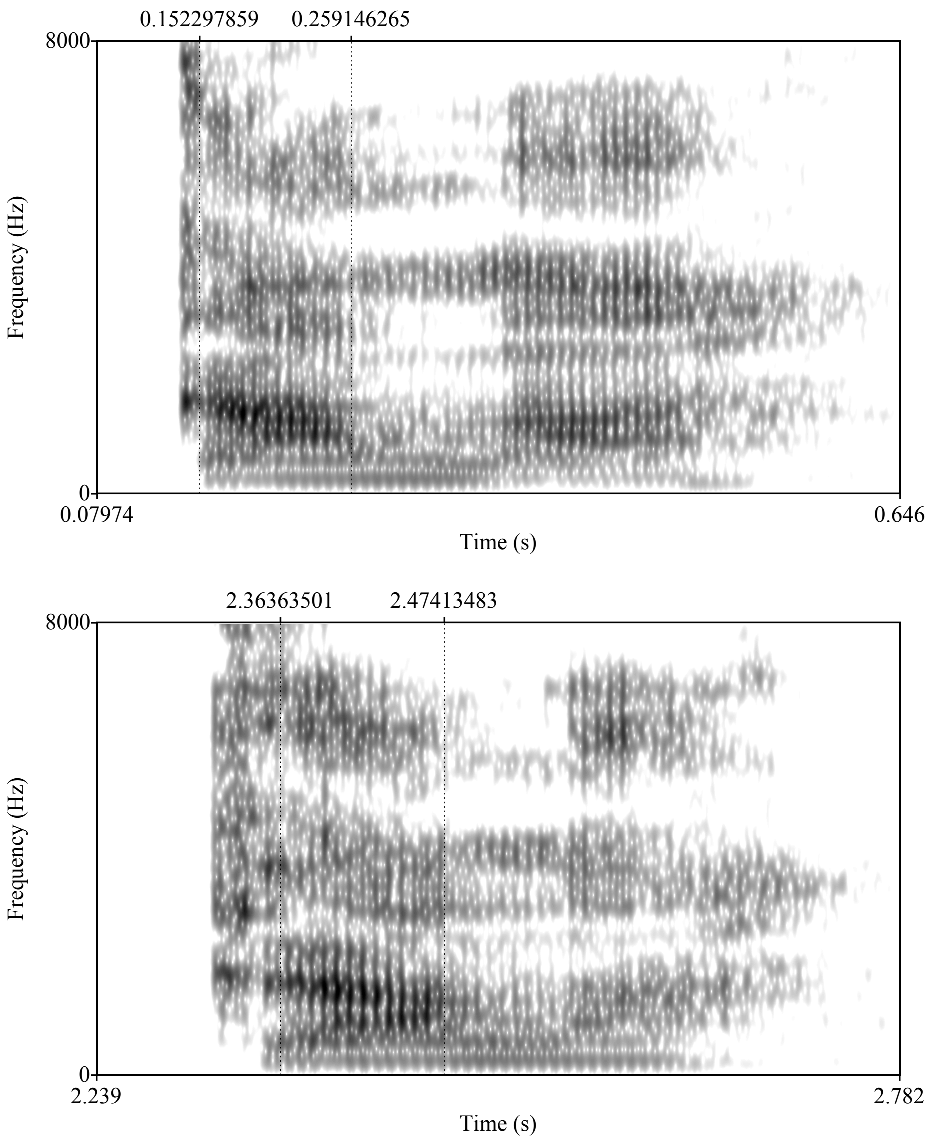
In a minimal pair between the strong-vowel root /kala$^{2.3}$/, 'cup', and the weak-vowel root /gala$^{3.3}$/, 'teeth', in (244), no significant difference in the length of the initial vowel was found. A speaker read a list of words, including both /kala$^{2.3}$/ and /gala$^{3.3}$/. The length of the initial /a/ in /kala$^{2.3}$/ was .107 seconds, and the initial /a/ in /gala$^{3.3}$/ was .111. The start and stop times of the first /a/ vowel in each word is given in (244).

(244) **No difference in duration of initial /a/ in weak and strong roots**



Similarly, there is no significant difference visible in the spectrogram, as shown in (245) where the spectral form for /kala$^{2.3}$/ is shown above the spectrogram for /gala$^{3.3}$/. Again start and stop times of the initial /a/ in both words are given.

(245) **No centralization of initial /a/ in weak or strong roots**[3]



In (245), the first, second, and third formants are very similar for the strong root /kala$^{2.3}$/ (690, 1260, 3000) and the weak root /gala$^{3.3}$/ (800, 1300, 3000), as measured in the middle of the initial vowel in each word.

A subfeatural approach to phonetics and phonology (Lionnet, 2016) might predict that weak vowels are subject to more centralization than strong vowels. For example, Lionnet

[3]Unfortunately the quality of the recording in (245) is not ideal due to the fact that this particular speaker prefers not to wear a headset microphone. Future work will be carried out under better recording conditions to explore these phonetic instantiations of weak vs strong roots more thoroughly.

(ch. 4) found that vowels less strongly specified for certain features tended to surface as more centralized than strongly specified vowels cross-linguistically. We do not see a clear difference in centralization in the strong root /kala$^{2.3}$/ versus the weak root /gala$^{3.3}$/ in (245); however, the words in (245) were spoken during a careful reading task. Perhaps in centralization effects, if they exist, would be more likely to surface in natural speech. Future work will illuminate whether such phonetic differences are present across speakers and contexts.

Though this initial comparison does not show a significant length or spectral difference between weak and strong vowels, more data from a controlled study is needed to know whether there is a phonetic difference in the two types of vowels across a larger sample of roots. The analysis proposed throughout this chapter is based on an abstract representational difference between weak and strong roots, and thus need not have any phonetic instantiation; however, a psycholinguistic difference between the two types of roots *is* predicted. A future psycholinguistic experiment investigating how speakers conceive of reducible and replaceable versus stable vowels could further inform the analysis presented here.

5.4.3 Neighborhood density effects

In addition to the phonological and phonotactic factors discussed above, neighborhood density seems to play a role in determining which words are reducible. Here neighborhood density is defined as the number of words different from the target word by one segment or suprasegmental melody. One-segment differences include any single segment whose features differ from the root in question (i.e. *gala*$^{3.3}$ is a neighbor of *bala*$^{3.3}$). Suprasegmental differences include any distinct tone melody from the melody of the word in question, where any difference in the tonal melody of the root constitutes a single change (i.e. *bala*$^{2.2}$ and *bala*$^{3.2}$ are both neighbors of *bala*$^{3.3}$). A word like *gala*$^{3.2}$ is not a neighbor of *bala*$^{3.3}$, because the two differ in two ways: the identity of the first consonant, and the tonal melody.

Using these criteria on a random sample of 570 di- and tri-syllabic words, we find that weak roots have a higher neighborhood density, on average, than strong ones. Specifically, reducible and replaceable (weak) words have an average neighborhood density of 1.42, while for strong words the average is .8. This difference was found to be significant using an unpaired t-test, where the p-value is less than 0.0001. Following Gahl et al. (2012), who found that commonly reduced words in English have a high neighborhood density, I conclude that reduction of high-density words is due to ease of production, where more neighbors facilitates production retrieval speed.

(246) **Neighborhood density of weak versus strong roots**

	n	**mean**	**min**	**max**	**std**
Weak	165	1.418	0	7	1.603
Strong	405	.8	0	6	0.99

In (246) *n* is the number of roots in each category. The mean is the average number of distance-one neighbors and *std* is the standard deviation. The *min* and *max* are the minimum and maximum number of neighbors for any single root in a category.

While I find that weak roots have a higher neighborhood density than strong ones, note that the opposite effect was found by Wright (1997, 2004), where reduced words had a lower neighborhood density than unreduced words. Gahl et al. (2012) point out a number of methodological differences between Wright's experiment and their own which could account for the differences: "Since word frequency and neighborhood density co-varied in [Wright's] stimulus set, the results do not indicate which of these variables was responsible for the observed effect" (792). Another possible difference in results comes from the fact that Wright's measures were taken from word lists while Gahl et al. (2012) used natural speech.

In Guébie, the neighborhood density of weak roots is on average higher than for strong ones. We could think of this neighborhood density effect as related to the strength of encoding of a given segment. If a given CVCV melody has very few distance-one neighbors, then the combination of C1, C2, and V2 with a given tone melody are perhaps only ever heard or produced with a single possible V1. Thus, the particular V1 triggered in that context is strongly encoded, not potentially confused with some other V1. However, in a dense neighborhood, a particular C1, C2, and V2 could be paired with a number of different tone melodies or V1s to produce a valid word. Because this particular word shape is quite common, speakers recall and produce the word quickly and easily, but the ease of production makes reduction more likely. This reduction, paired with the high density of distance-one neighbors that could be reduced in the same way makes initial vowels in high-density words less likely to be easily distinguishable from other vowels that could fill that slot. Thus, they are weakly encoded. This line of reasoning follows from work showing that having many neighbors facilitates word production (Stemberger, 2004; Vitevitch, 1997, 2002; Vitevitch and Sommers, 2003; Goldrick et al., 2010; Gordon, 2002; Gahl et al., 2012). In Guébie, it seems that ease of production trumps loss of information.

The neighborhood density measure used here is distinct from, but related to, functional load measurements (Gilliéron, 1918; Trubetzkoy, 1939; Martinet, 1952; Hockett, 1967; Surendran and Niyogi, 2006; Blevins and Wedel, 2009; Wedel et al., 2013a,b). The functional load hypothesis suggests that if a particular segment has a high information-transfer load, it is less likely to undergo sound change, and specifically merger. The number of minimal pairs a given phoneme distinguishes can be used as a simple measurement of the functional load of that phoneme. While questions of functional load tend to deal with diachronic change, it is plausible that synchronically, neutralization of contrasts with a high functional load is also avoided. Whether functional load can tell us anything additional about why some CVCV words undergo alternations that lead to neutralization, while others do not, is an interesting avenue for future work.

While I leave for future work the question of how functional load is related to weak root alternations in Guébie, we can think of the neighborhood density measure as a proxy for how activated a given word or set of words is (weak vs strong encoding).

5.4.4 Encoding strength summary

Using the encoding strength terminology to explore the distribution of replacement and reduction in Guébie, we see that only weak roots ever undergo these two processes. Reduction is possible for weak roots independent of morphosyntactic context, while replacement is sensitive both to strength of encoding and morphosyntactic environment, (247).

(247) **Replacement and reduction by encoding strength**

	Initial vowel strength	Reduction	Replacement
Plural	Weak	✓	✓
	Strong	–	–
3.Obj	Weak	✓	✓
	Strong	–	–
Sg, Pass, Caus, Appl, Recip	Weak	✓	–
	Strong	–	–
Def, 1/2.Obj, Nmlz	Weak	✓	–
	Strong	–	–

We can tell whether the initial vowel of a root is weak or strong by whether it undergoes replacement in plural and third-person accusative contexts, and whether it has the option of reduction across morphosyntactic environment. In plural contexts, certain vowel features of roots with a weakly encoded initial vowel are replaced, while we do not see replacement in roots with strongly encoded segments. In third-person accusative contexts, we see full replacement of weak root vowels with the vowel of the enclitic. This differs from strong roots, which do not undergo vowel replacement. In all contexts other than plural and object enclitic contexts, the only difference between weak and strong roots is seen in whether they can undergo reduction.

Recall that some morphemes also undergo ATR harmony with the root they attach to. Harmony, unlike replacement and reduction, does not vary with encoding strength of root vowels. Instead, only morphosyntactic context determines whether a morpheme varies with ATR value of the root it attaches to.

(248) **Distribution of ATR harmony by encoding strength**

	Strong vowels	Weak vowels
Object	No harmony	No harmony
Plural	Harmony	Harmony
Sg, Pass, Caus, Appl, Recip	Harmony	Harmony
Nmlz, Def, 1/2.Obj	No harmony	No harmony

We see in (248) that ATR harmony holds between a root and affix in plural, singular, passive, causative, applicative, and reciprocal contexts, no matter whether the root it attaches to contains strong or weak vowels. No vowel harmony is seen in other contexts.

Combining harmony and replacement, which are both sensitive to morphosyntactic context, we see the four-way distribution in (249).

(249) **The distribution of harmony and replacement in Guébie**

	Harmony	**No harmony**
Replacement	Plural	Objects
No replacement	Passive	Nominalizer

In section 5.5, encoding-strength sensitive faithfulness constraints are used to specify weaker faithfulness to weakly encoded than strongly encoded vowels, and a single set of constraints is ranked or weighted differently across four distinct phonological grammars to result in the four combinations of replacement and ATR harmony in (249).

5.5 A multiple-grammar constraint-based analysis

There are two obvious approaches to the morphosyntactic conditioning of vowel replacement facts: suppletive allomorphy, and multiple phonological grammars sensitive to lexical class and morphosyntactic construction. I argue for the latter. This section provides an analysis of vowel replacement using multiple phonological grammars, and section 5.6 argues against a suppletive approach.

The previous subsection attributes the lexical specificity of vowel replacement to encoding strength of the initial vowel in a CVCV root. This section accounts for the morphosyntactic conditioning of vowel replacement, using a multiple-grammar model of phonology (Lightner, 1965; Kiparsky, 1982; Orgun, 1996; Inkelas et al., 1997; Itô and Mester, 1999; Kiparsky, 2000; Anttila, 2002; Inkelas and Zoll, 2005, 2007; Kiparsky, 2008). The specific implementation of multiple-grammar phonology that I adopt is Cophonology Theory (Orgun, 1996; Inkelas et al., 1997; Anttila, 2002; Inkelas and Zoll, 2005, 2007).

Cophonology Theory allows for distinct morphosyntactic constructions to trigger distinct grammars, where here a grammar is a ranking of phonological constraints. This same model is adopted in chapters 3 and 4 to account for phonologically determined agreement and scalar tone shift in Guébie.

Only third-person object enclitics and plural morphemes trigger vowel replacement in Guébie, so I propose that there are distinct phonological grammars, cophonologies, triggered in the environment of morphosyntactic features 3.ACC (third-person accusative, the features associated with third-person object markers), and PL (plural). Other nominal morphology (singular, definiteness) and verbal morphology (passive, causative, reciprocal, applicative, nominalizers, other object markers), does not trigger a specific cophonology resulting in vowel replacement. Within the 3.ACC and PL cophonologies, the ranking of an encoding-strength-sensitive faithfulness constraint determines whether replacement occurs for a given root.

5.5.1 Object enclitic cophonology

I begin with the object enclitic cophonology, the grammar triggered by the 3.ACC feature. In order to ensure that root vowels surface as identical to the object enclitic vowel, I use Agreement-by-Projection (ABP) constraints (proposed by Hansson 2014, and illustrated in Lionnet 2016; Walker 2016) to account for vowel harmony. ABP constraints conflate the work of Agreement-by-Correspondence constraints CORR, (250) and CC-IDENT[F], (251) (Hansson, 2001; Rose and Walker, 2004) into a single constraint by evaluating only those segments with a particular feature (here +SYLLABIC), on a separate tier from the rest of the word or phrase under evaluation[4].

(250) **Corr-V** (Hansson, 2001; Rose and Walker, 2004)
Assign one violation for each set of vowels which is not in correspondence.

(251) **CC-Ident[Hi, Bk, Rd, ATR]** (Hansson, 2001; Rose and Walker, 2004)
Assign one violation for each set of corresponding segments which does not agree in the phonological features [HIGH, BACK, ROUND, ATR].

The proposed ABP constraint is $*[\alpha F][\beta F]_{[+syllabic]}$, which ensures identity between all output vowels (+syllabic segments) in a word.

(252) $*[\alpha \mathbf{F}][\beta \mathbf{F}]_{[+syllabic]}$
A segment with some feature value may not directly precede another segment with a different feature value in the ordered set of output segments that are [+syllabic] (i.e. vowels). Assign one violation for each pair of neighboring segments that meet the criteria.

This ABP constraint outranks input-output faithfulness in order for the optimal candidate to be one whose vowels are unfaithful to the features of the corresponding input vowels. More importantly, the optimal candidate's vowel features match those of the object enclitic vowel. In (254) and throughout, subscripts on vowels represent correspondence relationships, here input-output correspondence.

(253) **Ident-IO** (McCarthy and Prince, 1995a)
Assign one violation for each output segment whose features differ from the corresponding input segment.

(254) $*[\alpha \mathbf{F}][\beta \mathbf{F}]_{[+syllabic]} \gg$ **Id-IO**

/e b^{a_i}la$_j$=ɔ$_k$/	$*[\alpha F][\beta F]_{[+syllabic]}$	ID-IO
a. e ba$_i$lɔ$_k$	**!	
b. ☞e bɔ$_i$lɔ$_k$	*	*

[4]Note that 'tier' here is different from the autosegmental use of 'tier'. Here segments with a particular feature are evaluated by ABP constraints on a separate projection, or within a separate correspondence set, from the rest of the segments in that spell-out domain (Hansson, 2014).

Notice that both candidates (a) and (b) in (254) incur at least one violation of the ABP constraint $*[\alpha F][\beta F]_{[+syllabic]}$ because in both cases the subject pronoun /e/ fails to agree in features with the other vowels being evaluated. In order to ensure that a candidate like *[ɔ $bɔ_i lɔ_k$] does not win given the input in (254), I propose the use of Ident-Phase, a constraint that penalizes changing features of an already spelled-out element. Note that Ident-Phase was also necessary to account for phonological agreement in chapter 3 and scalar tone shift in chapter 4.

(255) **Ident-Phase(DP)** (adapted from (McPherson and Heath, 2016, 613))
Assign one violation if the phonological content of a DP phase is distinct in the output from the input.

(256) **Id-Phase, $*[\alpha\mathbf{F}][\beta\mathbf{F}]_{[+syllabic]} \gg$ Id-IO**

/e $b^{a_i}la_j$=$ɔ_k$/	Id-Phase	$*[\alpha F][\beta F]_{[+syllabic]}$	Id-IO
a. e $ba_i la_k$	*!	*	*
b. e $ba_i lɔ_k$		**!	
c. ☞e $bɔ_i lɔ_k$		*	*

The optimal candidate is one where root vowels are replaced by suffix vowels, rather than the other way around (256a) vs (256c). That is, directionally, we always see right-to-left harmony in object enclitic contexts. Id-Phase does the work of ensuring that subject vowels do not change, because they have been previously spelled out in a DP phase, and it also ensures that the object pronoun, which too has been spelled out in a DP phase, does not change features from input to output. Then, in order to see full surface identity between corresponding root and object vowels, root vowels change to share features with the faithful object vowel. We could imagine a positional faithfulness constraint like Ident-Root (McCarthy and Prince, 1995b; Beckman, 1995, 1997, 2013), which would be low-ranked in the 3.acc cophonology because root vowels do not surface faithfully to their inputs. However, Ident-IO does the same work that Ident-Root would do, so I do not consider it further.

Because tone is irrelevant for the vowel replacement process, and because the tone numbers clutter the representations, making them difficult to differentiate from co-indices, I leave tone marking out of the tableaux in (254) and (256). But note that a highly ranked Max-Tone constraint would rule out a candidate where the input tone of the subject or enclitic failed to surface in the output, (257) (i.e. /*bala*$^{3.3}$=$ɔ^{2}$/ → [bɔlɔ$^{3.2}$], * [bɔlɔ$^{3.3}$, *bɔlɔ$^{2.2}$])[5].

(257) **Max-Tone** (McCarthy and Prince, 1993)
Assign one violation for every input tone which lacks a corresponding output tone.

In addition to ensuring correspondence between output root and enclitic vowels, we need a constraint that prevents two vowels from surfacing next to each other across a morpheme

[5]This MaxTone constraint, while active, must be ranked below the PitchDrop constraint invoked in chapter 4, which results in scalar tone shift in imperfective contexts. I discuss this interaction further in chapter 6.

boundary. While root-internal vowel hiatus is not uncommon, there are only two morphosyntactic context which allow surface vowel hiatus across a morpheme boundary: the /-A^2/ plural morpheme and the definite marker[6]. In all other contexts, when a root-final and suffix-initial vowel would otherwise surface next to each other, we either see deletion of the final root vowel (the default case, and what happens with object enclitics), or glide insertion. Root VV sequences surface faithfully in the output, so this constraint against sequences of vowels is a derived environment effect (in particular environments).

(258) ***V+V**
Assign one violation for every instance of two consecutive output vowels that correspond to two distinct input morphemes.

Note that the wording of the constraint in (258) assumes that phonological constraints have access to morpheme boundaries, and that these boundaries are still present, even after the Linearization process in the Distributed Morphology style morphological component (see chapters 3 and 4 for more information on the morphological assumptions made in this study). A high ranking of *V+V rules out a candidate where all input vowels surface in the output, because a faithful candidate would result in derived vowel hiatus.

(259) ***V+V, Id-Phase, *[αF][βF] $\gg$ Id-IO**

/e b^{a_i}la$_j$=ɔ$_k$/	*V+V	Id-Phase	*[αF][βF]	Id-IO
a. e ba$_i$la$_j$ɔ$_k$	*!		**	
b. e ba$_i$la$_k$		*!	*	
c. e ba$_i$lɔ$_k$			**!	
d. e bɔ$_i$lɔ$_k$			*	*!
e. ☹ e ba$_i$la$_j$			*	

While *V+V rules out a candidate like (274a), where the final vowel of the root is immediately followed by the vowel of the object enclitic, there is also a problematic candidate, (274e). In (274e), we have no sequence of V+V, but we also fail to realize the object enclitic all together. I propose the use of RealizeMorph in order to ensure that the object enclitic is realized in the output. The ranking of RealizeMorph above *V+V gives us deletion of the root vowel in CVCV=V sequences, rather that deletion of the object enclitic vowel, in order to ensure surface realization of the object marker.

(260) **RealizeMorph(eme)** (Samek-Lodovici, 1993; Rose, 1997; Walker, 2000; Kurisu, 2001)
Assign one violation for each input morpheme that is not phonologically realized in the output.

[6]It is not the case, though, that all /-a, ə/ morphemes allow VV sequences. Take, for example, the third-person object enclitics /=a/, which causes the final vowel of the stem it attaches to to delete. It is also not the case that all nominal morphology allows VV sequences. For example, singular suffixes and the [-back, -round] plural morpheme do not allow derived vowel hiatus.

(261) **Realize, *V+V, Id-Phase, *[αF][βF] $\gg$ Id-IO**

/e b^{a_i}la$_j$=ɔ$_k$/	Realize	*V+V	Id-Phase	*[αF][βF]	Id-IO
a. e ba$_i$la$_j$ɔ$_k$		*!		**	
b. e ba$_i$la$_k$			*!	*	
c. e ba$_i$lɔ$_k$				**!	
d. ☞e bɔ$_i$lɔ$_k$				*	*
e. e ba$_i$la$_j$	*!			*	

The tableau in (261) ensures vowel replacement in the context of a third-person object enclitic, but it will incorrectly predict vowel replacement in *all* roots, (262). Recall that only 33.5% of disyllabic roots allow vowel replacement (the same set that allows CVCV reduction to CCV). The root in (262), *ɟʊla*$^{3.2}$, 'take, borrow', is not reducible to CCV, nor does it undergo vowel replacement. The true surface form is [*ɟʊlɔ*$^{3.2}$], where the final vowel of the root deletes due to the language-wide ban on sequences of vowels across morpheme boundaries. However, the initial vowel of the root does not undergo replacement, because it is strongly encoded. Note that the initial vowel in the input of /*ɟʊla*$^{3.2}$/ in (262) is not written as a superscript, in contrast with /*b*^{a}*la*$^{3.3}$/ in (261) to represent the contrast in their degree of encoding strength.

(262) **Realize, *V+V, Id-Phase, *[αF][βF] $\gg$ Id-IO**

/e ɟʊ$_i$la$_j$=ɔ$_k$/	Realize	*V+V	Id-Phase	*[αF][βF]	Id-IO
a. e ɟʊ$_i$la$_j$	*!			**	
b. e ɟʊ$_i$la$_j$ɔ$_k$		*!		***	
c. e ɟʊ$_i$lʊ$_k$			*!	*	*
d. e ɟʊ$_i$lɔ$_k$				**!	
e. ☹ e ɟɔ$_i$lɔ$_k$				*	*

The tableau in (262) predicts (262e) as the output, where vowel replacement of the initial root vowel has occurred. Instead, the output candidate should be (262d), where the final vowel of the root fails to surface, satisfying *V+V, but the strongly encoded initial vowel of the root retains its input features.

I propose an encoding-strength-sensitive constraint, (263), to ensure identity to strongly encoded input vowels (cf. Inkelas 2015's Faith-special constraints).

(263) **Ident-Strong**
Assign one violation for each output segment that corresponds to a strongly encoded input segment, and whose features differ from that corresponding input segment.

(264) **Id-Strong ≫ Realize, *V+V, Id-Phase, *[αF][βF] ≫ Id-IO**

/e ɟʊ$_i$la$_j$=ɔ$_k$/	ID-STRONG	REALIZE	*V+V	ID-PHASE	*[αF][βF]	ID-IO
a. e ɟʊ$_i$la$_j$		*!			**	
b. e ɟʊ$_i$la$_j$ɔ$_k$			*!		***	
c. e ɟʊ$_i$lʊ$_k$	*!			*	*	*
d. ☞e ɟʊ$_i$lɔ$_k$					**	
e. e ɟɔ$_i$lɔ$_k$	*!				*	*

The ranking in (264) results in the correct output for roots with strongly and weakly encoded vowels in the environment of a third-person object enclitic. IDENT-STRONG will be vacuously satisfied in vowel replacement contexts, because the vowel being replaced (or the unfaithful vowel) is weak, not strong. In non-replacive contexts, like (264), ID-STRONG can only be satisfied by violating *[αF][βF], where root vowels are not identical to the object enclitic vowel, but input strong vowels surface faithfully in the output.

5.5.2 Plural cophonology

The second morphosyntactic context where vowel replacement of roots occurs is in the environment of a plural morpheme on a noun. It is not the case, though, that the constraint ranking developed in section 5.5.1 derives the correct optimal output in plural environments, because the details of replacement differ in plural and object marking contexts. Plurals do not trigger wholesale replacement of root vowels with the features of an underlying plural suffix. Instead, the root vowel maintains its own height and rounding features in plural contexts, resulting in only *partial* vowel replacement (recall 230, 232). Here I present the constraint ranking for the plural cophonology, which uses the same constraints needed in the object enclitic grammar, with a single additional constraint-based mechanism, ranked to result in partial replacement.

In this model, where each plural morpheme triggers a separate cophonology, it is coincidental that both plural suffixes trigger vowel replacement. We could imagine a language, Guébie', where only one of the two plural morphemes triggers replacement. I take this as a benefit of the proposed model, because we see such a a split in object enclitic contexts. Only third-person object enclitics trigger vowel replacement, where first and second person markers do not.

Here I refer to the two plural cophonologies as Plural 1 and Plural 2, for the /-A/ and [-BACK, -ROUND] plural morphemes, respectively. In the following sections I present constraint-based analyses for each of the plural cophonologies in turn.

5.5.2.1 Plural 1

This section focuses on Plural 1, the underlying /-A/ suffix. Just as with object enclitics, we see two different surface processes triggered by the addition of plural /-A/. For all roots we see the addition of a stem-final /-A/, which agrees in ATR features with the vowels in the root it attaches to. For roots with weakly encoded initial vowels, we also see replacement of the first vowel with [a] or [ə].

To ensure ATR harmony between root and suffix in this /-A/ plural cophonology, I introduce an additional Agreement-by-Projection (ABP) constraint. Unlike $*[\alpha \mathrm{F}][\beta \mathrm{F}]_{[+syllabic]}$, proposed in section 5.5.1, the constraint $*[\alpha \mathrm{ATR}][\beta \mathrm{ATR}]_{[+syllabic]}$ is only violated when one vowel has a different ATR value than the preceding vowel in the word.

(265) $*[\alpha \mathbf{ATR}][\beta \mathbf{ATR}]_{[+syllabic]}$
A segment with some value of the feature ATR may not directly precede another segment with a different ATR value in the ordered set of output segments that are [+syllabic] (i.e. vowels). Assign one violation for each pair of neighboring segments that meets the criteria.

This ATR-specific ABP constraint evaluates sequences of segments on the same tier as $*[\alpha \mathrm{ATR}][\beta \mathrm{ATR}]_{[+syllabic]}$, namely, it only considers those segments that are [+syllabic] (i.e. vowels). Surface forms in the /-A/ cophonology never violate $*[\alpha \mathrm{ATR}][\beta \mathrm{ATR}]_{[+syllabic]}$, thus this constraint must be highly ranked. Within-language motivation for this constraint comes from the fact that six distinct suffixes in the language undergo vowel harmony with the root (recall 243).

The tableau in (267) considers the strong root /$\text{ɲɛ}_i\text{ɲɛ}_j$-ɑ_k/, which surfaces as [ɲɛɲɛ-a], where the final vowel of the root surfaces, as does the suffix vowel, and root vowels retain their own features. The suffix vowel ATR quality matches that of the root. Note that the *V+V constraint must be low-ranked in the /-A/ plural cophonology to allow sequences of vowels to surface across morpheme boundaries. Specifically, it must be ranked below a Max-Root constraint prohibiting input root segments from failing to surface in the output.

(266) **Max-Root** (adapted fromMcCarthy and Prince 1993)
Assign one violation for every input segment in the root that lacks a corresponding output segment.

(267) $*[\alpha \mathbf{ATR}][\beta \mathbf{ATR}]$**, Id-Strong** $\gg$ **Realize, MaxRt** $\gg$ $*[\alpha \mathbf{F}][\beta \mathbf{F}]$ $\gg$ ***V+V** $\gg$ **Id-IO**

/$\text{ɲɛ}_i\text{ɲɛ}_j$-A_k/	$*[\alpha \mathrm{ATR}][\beta \mathrm{ATR}]$	Id-Strong	Realize	MaxRt	$*[\alpha \mathrm{F}][\beta \mathrm{F}]$	*V+V	Id-IO
a. ☞$\text{ɲɛ}_i\text{ɲɛ}_j\text{a}_k$					*	*	
b. $\text{ɲɛ}_i\text{ɲɛ}_j\text{ə}_k$	*!				*	*	
c. $\text{ɲa}_i\text{ɲa}_j$-a_k		*!*				*	**
d. $\text{ɲɛ}_i\text{ɲɛ}_j$			*!				
e. $\text{ɲɛ}_i\text{ɲa}_k$				*!	*		

Note that Ident-Phase, which was needed to account for object enclitic faithfulness in section 5.5.1, is irrelevant in the plural cophonologies because there is no phase internal to a plural DP in Guébie, thus there is no previously spelled out material to be faithful to. For this reason, I leave Id-Phase out of (274) and the remaining tableaux in this section.

We can see in (267) that the ranking of two ABP constraints, one more specific than the other, simple identity constraints, and low-ranked *V+V gets us the right output for a -ATR strong root. The same is true for a +ATR root, (268).

(268) ***[αATR][βATR], Id-Strong $\gg$ Realize, MaxRt $\gg$ *[αF][βF] $\gg$ *V+V $\gg$ Id-IO**

/di$_i$bo$_j$-A$_k$/	*[αATR][βATR]	Id-Strong	Realize	MaxRt	*[αF][βF]	*V+V	Id-IO
a. di$_i$bo$_j$a$_k$	*!				**	*	
b. ☞di$_i$bo$_j$ə$_k$					**	*	
c. da$_i$ba$_j$-a$_k$		*!*				*	**
d. di$_i$bo$_j$			*!		*		
e. di$_i$bə$_k$				*!	*		

For roots that end in a central vowel, /-a, -ə/, we do not see both the root final vowel and the suffix vowel surfacing. So, we need an additional constraint to rule out an [aa] or [əə] sequence: /k^{w}ala$^{4.4}$+A^2/ → [k^{w}ala$^{4.2}$, *k^{w}alaa$^{4.4.2}$]. I propose a more specific version of our *V+V constraint, which specifically targets [+back, -round] vowels. This constraint is ranked with the others and /k^{w}ala$^{4.4}$+ɑ^2/ is evaluated in (270).

(269) ***A+A**
Assign one violation for every instance of two consecutive [+back, -round] output vowels that correspond to two distinct input morphemes.

(270) ***[αATR][βATR], Id-Strong, *A+A $\gg$ Realize, MaxRt $\gg$ *[αF][βF] $\gg$ *V+V $\gg$ Id-IO**

/k^{w}a$_i$la$_j$-A$_k$/	*[αATR][βATR]	Id-Str	*A+A	Real	MaxRt	*[αF][βF]	*V+V	Id-IO
a. k^{w}a$_i$la$_j$a$_k$			*!				*	
b. k^{w}a$_i$la$_j$ə$_k$	*!		*			*	*	
c. k^{w}a$_i$la$_j$				*!				
d. ☞k^{w}a$_i$la$_k$					*			

Even though it violates MaxRt, the winning candidate in (270) is [k^{w}a$_i$la$_k$], candidate (d.)

Let us now consider input roots with weak initial vowels, like /m^{ɛ}nɛ$^{3.3}$+ɑ^2/.

(271) ***[αATR][βATR], Id-Strong, *A+A $\gg$ Realize, MaxRt $\gg$ *[αF][βF] $\gg$ *V+V $\gg$ Id-IO**

/$m^{\varepsilon_i}n\varepsilon_j$-$A_k$/	*[αATR][βATR]	Id-Str	*A+A	Real	MaxRt	*[αF][βF]	*V+V	Id-IO
a. $m\varepsilon_i n\varepsilon_j a_k$						*	*	
b. $m\varepsilon_i n\varepsilon_j ə_k$	*!					*	*	
c. $ma_i na_j a_k$			*!				*	**
d. $m\varepsilon_i n\varepsilon_j$				*!				
e. $m\varepsilon_i na_k$					*!	*		
f. $ma_i na_k$					*!			*
g. ☞$ma_i na_j$								*

Note that candidates (f) and (g) in (271) are segmentally identical, but that the output segments correspond to distinct input segments. In candidate (f), a root vowel has been deleted, violating MaxRoot. In candidate (g), the suffix vowel has been deleted, which does not violate MaxRoot; however, Realize is still satisfied, because the output realization [mana] is distinct from the input [mɛnɛ].

With the constraints in (271) we get not only the right output for roots with weak initial vowels, but also for roots with strong vowels, as we saw in (267)-(270).

5.5.2.2 Plural 2

This section turns to the [-back, -round] plural suffix. Crucially, I assume that there is no underlying representation of this second plural morpheme (say, /-I/, for example). This choice is made for a few reasons. First, there is no segment that surfaces in all [-back, -round] plural contexts. Instead, the final vowel could surface as any front, unrounded vowel: [i, ɪ, e, ɛ]. Second, we never see the final root vowel occur with an overt vocalic suffix in this cophonology (i.e. *nunə$^{3.3}$-i^{2}). Instead, a root retains its CV shape, but the final vowel surfaces with the features [-back, -round]. Thus, I propose a cophonology specific to the [-back, -round] plural morpheme, which aligns [-back, -round] features to the right edge of the word.

This analysis involves process morphology, much like the constraint-driven scalar tone shift in chapter 4. Here we do not see an affixal item, but rather a vowel alternation in a particular morphosyntactic context. A purely item-based approach to morphophonology would posit an abstract underlying phonological item for this plural morpheme, where here we avoid such an abstraction and constraints drive the vowel alternation.

For transparency in constraint naming, I use FinalVowel=[-back, -round] for the constraint aligning back and round features to the right edge of a word. However, one could think of this constraint as an Align constraint (Prince and Smolensky, 1993).

(272) **FinalVowel=[-back, -round]**
Assign one violation if the final vowel of the stem is not [-back, -round].

This constraint is never violated in [-BACK, -ROUND] plural contexts. Adding this constraint to the ranking used in object enclitic contexts, we get the tableau in (273), where the initial vowel of /ɲᵓkpɔ$^{3.1}$/ is weakly encoded.

(273) **FinalVowel[-back, -round] ≫ Id-Strong, Realize, *V+V, Id-Phase, *[αF][βF] ≫ Id-IO**

/ɲ^{ɔ_i}kpɔ$_j$-PL/	FV=[-BK, -RD]	ID-STR	REALIZE	*V+V	ID-PHASE	*[αF][βF]	ID-IO
a. ɲɔ$_i$kpɔ$_j$	*!		*				
b. ☹ ɲɔ$_i$kpɔ$_j$i$_k$				*!		*	
c. ɲɔ$_i$kpi$_j$		*!				*	
d. ɲɛ$_i$kpɛ$_j$		*!					**
e. ɲi$_i$kpi$_j$		*!					**

We see in (273) that candidate (b) wins given the ranking above. However, the correct output candidate for /ɲɔkpɔ+i/ is [ɲɛkpɛ], (273d).

In order to rule out a candidate like (273b), REALIZE and *V+V must outrank ID-STRONG in the [-BACK, -ROUND] plural cophonology. Note that we could also use a DEP constraint penalizing output segments that have no corresponding input segments. However, we need a *V+V constraint in other replacement cophonologies anyway, so for simplicity I continue using *V+V here.

(274) **FinalVowel[-back, -round] ≫ Realize, *V+V ≫ Id-Strong ≫ *[αF][βF] ≫ Id-IO**

/ɲ^{ɔ_i}kpɔ$_j$-PL/	FV=[-BK, -RD]	REALIZE	*V+V	ID-STR	*[αF][βF]	ID-IO
a. ɲɔ$_i$kpɔ$_j$	*!	*				
b. ɲɔ$_i$kpɔ$_j$i$_k$			*!		*	
c. ɲɔ$_i$kpi$_j$				*	*!	
d. ☞ɲɛ$_i$kpɛ$_j$				*		**
e. ☹ ɲi$_i$kpi$_j$				*		**

The reranking in (274) rules out candidate (b), but results in a tie between candidates (d) and (e). Both candidates have [-BACK, -ROUND] final vowels; however, the vowels in candidate (d) remain faithful to the ATR and height features of the root, while in candidate (e) they are not. I propose a more specific input-output faithfulness constraint, specifying that root vowels in plural contexts are faithful to their input features.

(275) **Ident-IO[F]**
Assign one violation for each difference in feature value between an input segment and its corresponding output segment.

Every featural difference between input and output segments will incur a violation of the constraint in (275). Thus, a root vowel which retains more of its input features will fare better with respect to this constraint than an output vowel that has no features in common with the corresponding input vowel.

(276) **FV=[-bk,-rd], ≫ Realize, *V+V ≫ Id-Strong ≫ *[αF][βF]$_{[+syllabic]}$ ≫ Id-IO**

/ɲ^{ɔ_i}kpɔ$_j$-PL/	FV=[-BK,-RD]	REALIZE	*V+V	ID-STR	*[αF][βF]	ID-IO
a. ɲɔ$_i$kpɔ$_j$	*!	*				
b. ɲɔ$_i$kpɔ$_j$i$_k$			*!		*	
c. ɲɔ$_i$kpi$_j$				*	*!	****
d. ☞ɲɛ$_i$kpɛ$_j$				*		****
e. ɲi$_i$kpi$_j$				*		*****!***

Candidate (c)'s four violations of ID-ROOT are due to the surface [i] differing from the corresponding input /ɔ/ in four features: [ATR, ROUND, BACK, HIGH]. Candidate (e) violates ID-ROOT] eight times, because there are two instances of [i] with a corresponding input /ɔ/. The winning candidate, [ɲɛkpɛ], candidate (d), violates ID-IO four times, because each output [ɛ] differs in two features from the corresponding input vowels /ɔ/: [BACK, ROUND]. Candidate (d) is as faithful to input root segments as possible while still satisfying the requirement that the final vowel be [-BACK, -ROUND] in this particular cophonology, and ensuring that output vowels agree in features.

Thus, the constraints above derive the optimal output for weak roots in the [-BACK, -ROUND] plural cophonology in an intuitive way.

Recall that many weak roots have identical input vowels in both syllables: CV$_i$CV$_i$. We could think of these vowels as having a kind of inherent correspondence, where they correspond in the input, and must also correspond in the output. This could be one reason behind the fact that CVCV words with identical V1 and V2 are more likely to undergo replacement than are other CVCV words. See (Shih and Inkelas, 2015) for more on "input-based ('old') similarity and correspondence" (p. 19), where they suggest that phonological constraints could be sensitive to the difference between input correspondence and 'new' correspondence, in the style of constraint sensitivity to old versus new markedness constraints (Łubowicz, 2003; McCarthy, 2003).

I turn now to strong roots in the same context. Because the [-BACK, -ROUND] plural morpheme can trigger only a single cophonology, the same ranking must apply to both weak and strong roots, deriving partial replacement for one set of roots (as we saw in 276), but only affecting the final vowel in strong roots.

Let us consider the root /*nunə*$^{3.3}$/, 'story', which surfaces as [nuni$^{3.3}$] in plural contexts. With the ranking in (276) we get the incorrect output for strong roots like /*nunə*$^{3.3}$/, (277).

(277) **FV=[-bk,-rd], ≫ Realize, *V+V ≫ Id-Strong ≫ *[αF][βF]$_{[+syllabic]}$ ≫ Id-IO**

/nu$_i$nə$_j$-PL/	FV=[-BK,-RD]	REALIZE	*V+V	ID-STR	*[αF][βF]	ID-IO
a. nu$_i$nə$_j$	*!	*			*	
b. nu$_i$nu$_j$	*!			*		**
c. nu$_i$nə$_j$i$_k$			*!		**	
d. ni$_i$ni$_j$				**!		****
e. nu$_i$ni$_j$				*	*	**!
f. ☹ nu$_i$ne$_j$				*	*	*

We see in (277) that candidate (f), where the final vowel of the root surfaces as [-BACK, -HIGH, -ROUND, +ATR] [e], surfaces as optimal. This is the incorrect surface form, though. Instead, we want candidate (e), [nuni] to surface. The fact that the final vowel, [i], in [nuni] differs in more features from the input /ə/ than [e], the final vowel in [nune], prevents the right candidate from surfacing. If we look across all strong roots, though, we see that the final vowel always surfaces not only as [-BACK, -ROUND], as we saw in weak roots, but it also always surfaces as [+HIGH], (278).

(278) **Plural final vowel surfaces as [+high] in strong roots**

	Final vowel	Singular noun	Plural noun	Gloss
a.	ə	nunə$^{3.3}$	nuni$^{3.3}$	'story'
b.	a	fa^{42}	fɪ^{42}	'bone'
c.	u	su^{2}	si^{2}	'tree'
d.	ɪ	wʊlɪ$^{2.2}$	wʊlɪ$^{2.2}$	'word'
e.	i	ɓili$^{3.3}$	ɓili$^{3.3}$	'cow'
f.	ɔ	ɟɛlɔ$^{2.3}$	ɟɛlɪ$^{2.3}$	'bird sp.'
g.	o	co^{31}	ci^{31}	'month'
h.	e	nove$^{2.3}$	novi$^{2.3}$	'bee'
i.	ɛ	tɛlɛ$^{3.3}$	tɛlɪ$^{3.3}$	'snake'

Because the final vowel always surfaces as [+HIGH] in strong roots, I propose an additional alignment constraint, FINALVOWEL=[+HIGH], ranked as in (280).

(279) **FinalVowel=[+high]**
Assign one violation if the final vowel of the stem is not [+HIGH].

This FINALVOWEL=[+HIGH] constraint, along with FINALVOWEL=[-BACK, -ROUND], are the constraints we would expect to find at play in a language if there was historically a segmental /-i, -ɪ/ suffix in plural contexts. This historical /-i, -ɪ/ now surfaces as a change in final vowel in Guébie, where the [-BACK, -ROUND] features remain in all contexts where there used to be an [-i] or [-ɪ] suffix, and the [+HIGH] feature remains in certain contexts.

(280) **FV=[-bk,-rd], $\gg$ Realize, *V+V $\gg$ Id-Strong $\gg$ *[αF][βF] $\gg$ FV=[+hi] $\gg$ Id-IO**

/nu$_i$nə$_j$-PL/	FV[-BK,-RD]	REAL	*V+V	ID-ST	*[αF][βF]	FV[+HI]	ID-IO
a. nu$_i$nə$_j$	*!	*			*	*	
b. nu$_i$nu$_j$	*!			*		*	**
c. nu$_i$nə$_j$i$_k$			*!		**		
d. ni$_i$ni$_j$				**!			****
e. ☞nu$_i$ni$_j$				*	*		**
f. nu$_i$ne$_j$				*	*	*!	*

The addition of this constraint requiring the final vowel to be high in plural contexts, no matter how low ranked, gets us the correct optimal candidate for strongly encoded roots.

I now return to weak, replaceable roots, (cf. 276) where we find that our ranking of FINALVOWEL=[+HI] above ID-ROOT causes problems, (281).

(281) **FV=[-bk,-rd], $\gg$ Realize, *V+V $\gg$ Id-Strong $\gg$ *[αF][βF] $\gg$ FV=[+hi] $\gg$ Id-IO**

/ɲ^{ɔ_i}kpɔ$_j$-PL/	FV[-BK,-RD]	REAL	*V+V	ID-ST	*[αF][βF]	FV[+HI]	ID-IO
a. ɲɔ$_i$kpɔ$_j$	*!	*				*	
b. ɲɔ$_i$kpɔ$_j$i$_k$			*!		*		
c. ɲɔ$_i$kpi$_j$				*	*!		****
d. ɲɛ$_i$kpɛ$_j$				*		*!	****
e. ☹ ɲi$_i$kpi$_j$				*			********

In order for [ɲɛkpɛ$^{3.1}$] to surface we need ID-ROOT to outrank FINALVOWEL=[+HI], but for [nuni$^{3.3}$] to surface we need the opposite ranking. This is an instance where a weighted constraint analysis fairs better than ranked constraints. Weighted constraint models like Maximum Entropy (MaxEnt) harmonic grammar (Goldwater and Johnson, 2003; Jäger, 2007; Hayes and Wilson, 2008) allow for multiple violations of lower weighted constraints to rule out a candidate who might win based on a higher weighted constraint alone.

To determine the weight of the above constraints that results in both the correct strong and weak candidates surfacing as optimal, I used the MaxEnt Grammar Tool (Hayes et al., 2009). The resulting weights are included in the tableaux in (282) and (283), where the winning candidates are those with the lowest harmony scores. Harmony scores are calculated by multiplying the number of evaluations of a given constraint times the weight of that constraint, and then summing those values for a given candidate. We can see based on the fact that [ɲɛkpɛ$^{3.1}$] has the lowest harmony score in (282) and [nuni$^{3.3}$] in (283), that by weighting rather than ranking our constraints, we derive the optimal output for both weak and strong roots.

(282) **MaxEnt HG weights: Weak roots**

weight	20.03	19.98	30.8	14.6	16.77	10.36	4.39	**H**
/ɲ^{ɔ_i}kpɔ$_j$-Pl/	FV[-bk,-rd]	Real	*V+V	Id-St	*[αF][βF]	FV[+hi]	Id-IO	
a. ɲɔ$_i$kpɔ$_j$	1	1				1		50.37
b. ɲɔ$_i$kpɔ$_j$i$_k$			1		1			47.57
c. ɲɔ$_i$kpi$_j$				1	1		4	48.93
d. ɲɛ$_i$kpɛ$_j$				1		1	4	**42.52**
e. ɲi$_i$kpi$_j$				1			8	49.72

(283) **MaxEnt HG weights: Strong roots**

weight	20.03	19.98	30.8	14.6	16.77	10.36	4.39	**H**
/nu$_i$nə$_j$-PL/	FV[-bk,-rd]	Real	*V+V	Id-St	*[αF][βF]	FV[+hi]	Id-IO	
a. nu$_i$nə$_j$	1	1			1	1		67.14
b. nu$_i$nu$_j$	1			1		1	2	53.77
c. nu$_i$nə$_j$i$_k$			1		2			64.34
d. ni$_i$ni$_j$				2			4	46.76
e. ☞nu$_i$ni$_j$				1	1		2	**40.15**
f. nu$_i$ne$_j$				1	1	1	1	46.12

While this is the only case discussed in this study where constraint weighting results in a different output than constraint ranking, we could imagine that all of the constraints in the grammars discussed in chapters 3, 4, and 5 are weighted such that the weights decrease from left to right across the relevant tableaux. While I do not repeat each tableau with weights here, I assume that each cophonology in Guébie is a set of weighted, rather than ranked, constraints. For simplicity, I continue using constraint ranking for the remainder of this study, except where it derives the wrong output.

Unlike in the /-A^2/ plural case, in the [-back, -round] cophonology, ATR harmony within stems is not motivated by a an Agreement-by-Projection style constraint. Instead, surface ATR harmony results from faithfulness to root input features. Input ATR values persist, and the result is surface ATR harmony within stems due to faithfulness. The ranking of the ABP constraint *[αATR][βATR]$_{[+\text{syllabic}]}$ is then irrelevant in the Plural 2 cophonology.

The [-back, -round] morpheme discussed in this section triggers partial (feature-specific) replacement only in certain roots, where a requirement that the final vowel surface with the features [-back, -round] and an ABP constraint requiring output vowels to agree in features are both weighted more strongly than root faithfulness. In strongly encoded roots, Id-Strong, prevents the initial vowel from undergoing a featural change to agree with the [-back, -round] final vowel.

5.5.3 Morphemes that fail to trigger vowel replacement

Outside of third-person object enclitics and plural morphemes, we do not see vowel replacement in Guébie. Of the morphemes that do not trigger replacement, there are those that undergo ATR harmony with roots, like the causative, and those that do not undergo ATR harmony with roots, like the nominalizers. By reranking the same constraints we have seen in the object enclitic and plural cophonologies, where input-output faithfulness outranks the ABP constraint driving output vowel identity, we can derive the correct optimal surface form in no-replacement contexts.

A tableau with constraints ranked for the harmony and non-replacement cophonology is shown for the root 'finish', plus the causative suffix /-A/, /nɔŋ^{w}ɛ$^{3.3}$-A^{2}/, which surfaces as [nɔŋ^{w}a$^{3.2}$], in (284).

(284) ***[αATR][βATR], Real, *V+V, Id-St, Id-IO ≫ *[αF][βF]**

/nɔ$_i$ŋ^{w}ɛ$_j$-A$_k$/	*[αATR][βATR]	Real	*V+V	Id-St	Id-IO	*[αF][βF]
☞a. nɔ$_i$ŋ^{w}a$_k$						*
b. na$_i$ŋ^{w}a$_k$					*!	
c. nɔ$_i$ŋ^{w}ɛ$_j$a$_k$			*!			**
d. nɔ$_i$ŋ^{w}ɛ$_j$		*!				*
e. nɔ$_i$ŋ^{w}ə$_k$	*!					*

In the no-replacement cophonology for those suffixes which undergo harmony with the root, like the causative in (284), our ABP constraint requiring harmony, *[αATR][βATR], along with input-output identity constraints and the markedness constraint against derived VV sequences, *V+V, must all outrank the ABP constraint requiring vowels to agree in all features. This results in an optimal candidate whose final root vowel fails to surface, satisfying *V+V, but where the suffix vowel agrees in ATR quality with the root, and otherwise everything is faithful to corresponding input features.

For enclitics that do not trigger replacement, but also do not undergo harmony with the root, like the definite marker /-a/ or nominalizer /-li^2/, the appropriate ranking is faithfulness and *V+V above both ABP constraints: Identity, *V+V ≫ *[αATR][βATR], *[αF][βF]. This is shown for 'hit', /bala^3/, plus the nominalizing suffix /-li^2/ in (285).

(285) **Real, *V+V, Id-St, Id-IO ≫ *[αATR][βATR], *[αF][βF]**

/b^{a_i}la$_j$=li$_k$/	Real	*V+V	Id-St	Id-IO	*[αATR][βATR]	*[αF][βF]
a. ba$_i$la$_j$	*!					
b. bi$_i$li$_j$li$_k$			*!	**		
c. ba$_i$la$_j$=lɪ$_k$				*!	*	*
d. bi$_i$la$_j$=li$_k$				*!		**
☞e. ba$_i$la$_j$li$_k$						*

By reranking or reweighting the faithfulness constraints Id-Strong, Id-IO differently with respect to the Agreement-by-Projection constraints *[αATR][βATR], *[αF][βF], we get four logical output possibilities: full harmony where the root vowels surface with the features of the suffix, partial harmony where the root vowels retain some of their own features, ATR harmony only between root and suffix, and no harmony at all. All four possibilities are found by looking across Guébie morphophonological processes, as in the chart in (286), repeated from (249).

(286) **Four grammars of replacement and harmony in Guébie**

	Harmony	**No harmony**
Replacement	Plural	Objects
No replacement	Passive	Nominalizer

Cophonology Theory allows for the pattern we see in Guébie, where distinct sets of morphemes trigger distinct phonological grammars, here constraint rankings or weightings, in the same language.

5.6 Against an alternative approach

5.6.1 Suppletive allomorphy

An alternative to a multiple-grammar approach to Guébie vowel replacement (and the other morphophonological phenomena discussed in chapters 3-5) would be to list multiple lexical items for each root that undergoes vowel replacement, where each lexical item is used in a distinct context. Two such frameworks are found in Distributed Morphology suppletive vocabulary insertion (Halle and Marantz, 1993, 1994; Harley, 2014), and Emergent Phonology (Archangeli and Pulleyblank, 2012, 2015a,b).

A suppletive allomorphy analysis involves lexically listing surface allomorphs. In the nominal domain, such an analysis would need to list two forms of each noun that takes the [-BACK, -ROUND] plural morpheme, whether weak or strong, and two forms of each noun with a weakly encoded vowel that takes the /-a,ə/ plural suffix. In the model proposed here, we need only list one form of each noun, where the second form is phonologically predictable, derived via constraint interaction.

In the verbal domain, a suppletive analysis becomes even more inefficient. We would need to list at least six distinct forms of each verb that undergoes vowel replacement (cf. the bold forms in (287)). Note that there are six, rather than seven or eight surface forms of the verb, because one of the non-human third-person singular forms of the verb /*bala*$^{3.3}$/ is phonologically identical to the first- and second-person human forms, and the human third-person plural form is phonologically identical to one of the non-human third-person plural forms.

(287) **Vowel replacement for all third-person object pronouns**

		Singular		**Plural**	
	1	ɔ^{3} bala$^{3.23}$	'he hit me'	ɔ^{3} balaɲɛ$^{3.1.1}$	'he hit us'
Human	**2**	ɔ^{3} bala=mɛ$^{3.3.2}$	'he hit you'	ɔ^{3} balaɲɛ$^{3.2.2}$	'he hit you all'
	3	ɔ^{3} bɔlɔ$^{3.2}$	'he hit him'	ɔ^{3} bɔla$^{3.2}$	'he hit them'
Non-human	**3**	ɔ^{3} bɛlɛ$^{3.2}$/bala$^{3.2}$/bʊlʊ$^{3.2}$	'he hit it'	ɔ^{3} bɪlɪ$^{3.2}$/ bɔla$^{3.2}$	'he hit them'

Not only would a suppletive analysis have to list many forms of a single verb, but the listed forms would be predictable given the default form of that verb. For every weak verb, we would have to list a form that is segmentally identical to the default, except that its vowels are replaced with [ɔ], another whose vowels are replaced by [ɛ], another with [a], another with [ʊ], etc.

(288) **Lexically listed forms in an allomorphy approach**

	Unreduced	**Reduced**
Default	jɪla$^{3.3}$	jra^{3}
3sg.hum.obj	jɔlɔ$^{3.2}$	jrɔ^{32}
3sg.obj	jɛlɛ$^{3.2}$	jrɛ^{32}
3sg.obj	jʊlʊ$^{3.2}$	jrʊ^{32}
3sg.obj	jala$^{3.2}$	jra^{32}
3pl.obj	jɪlɪ$^{3.2}$	jrɪ^{32}

Because the allomorphy is predictable, a phonological approach which captures the generalization that the surface allomorphs of a given verb are due to agreement with nearby functional morphemes is preferable. Similar arguments were made in favor of a phonological analysis over a suppletive analysis for the predictable scalar tone allomorphy in chapter 4 and pronoun forms in chapter 3.

An alternative to a suppletive analysis where ever surface allomorph is listed, would be to list four underlying forms for each weak verb: /bala$^{3.3}$, bla^{3}, bVlV$^{3.3}$, blV^{3}/. On this analysis, the forms with underspecified vowels would surface in the presence of a plural or 3.ACC feature, and vowel features would be filled in via constraints, perhaps through agreement with suffix vowels. While the fully suppletive analysis (288), and the partially suppletive analysis with underspecified vowels could both derive the correct surface forms, they miss a generalization: The same roots that undergo reduction (*bala*$^{3.3}$, *bra*^{3}, 'hit') also undergo replacement (*bɔlɔ*$^{3.3}$, *brɔ*^{3}, 'hit him').

Listing all allomorphs for each weak verb fails to make any connection between roots that allow replacement. Instead, the fact that some verbs have multiple allomorphs and others do not becomes coincidental. In reality, verbs that undergo replacement share a set of phonological properties: their second consonant is likely /l, n, ɓ/ or is identical to the first consonant in the word. Their vowels are often identical and the tone is often a level melody across all syllables. There are also multiple processes that apply to the same set of roots: reduction and replacement. In the strength-of-encoding analysis proposed here there is a phonological feature (weak encoding of V1) that unites replaceable roots, and a single constraint, ID-STRONG, derives the difference in replaceability and reducibility between weak vs strong roots. A suppletive analysis does not predict any phonotactic similarity across replaceable roots, nor any connection between reduction and replacement.

5.6.2 Diacritics

A second alternative to strength of encoding plus cophonologies would be a diacritic analysis, where instead of a phonological representation differentiating weak from strong roots (i.e. encoding strength), there would be a lexically marked diacritic. This kind of analysis could take the form of a sublexicon, where selectional restrictions of particular morphemes or morphophonological processes are encoded diacritically in morphological realization rules (Gouskova and Becker, 2013; Becker and Gouskova, 2016; Gouskova et al., 2015).

A diacritic approach fares better than a suppletive one in one respect. Namely, in a diacritic approach, a single diacritic could trigger both reduction and replacement on roots. Thus, a diacritic approach, like the strength-of-encoding analysis, accounts for why the same subset of roots undergoes both reduction and replacement. However, there are other representational tendencies (differences) between the two sets of roots, none of which is captured by diacritics.

Recall from section 5.2.2 that roots which undergo reduction and replacement tend to share certain phonotactic properties. While MaxEnt-HG provides a model of the distribution of those words that undergo reduction and replacement versus not, and encoding strength provides a representational tool for such a distribution, a diacritic analysis does not predict that weak roots should be predictable based on phonotactics. That is, in a diacritic analysis, the set of roots that undergoes replacement and reduction could be entirely random, which it is not (recall the MaxEnt analysis in 219).

The most significant difference between the encoding strength analysis in sections 5.4, 5.5 and a substance-free diacritic is that the diacritic approach does not predict which roots will undergo the relevant alternations (receive the diacritic). On the other hand, the MaxEnt model in section 5.2.3 predicts which roots alternate, based on phonotactic properties. Thus, the strength of encoding diacritics (weak vs. strong) are based on lexical phonotactic patterns, while substance-free diacritics must simply be memorized.

5.7 Conclusion

There are two vowel alternations that both affect the same subset of roots in Guébie: vowel reduction and vowel replacement. Vowel reduction is unconditioned by morphosyntactic environment, and results in a CVCV root surfacing as CCV. Vowel replacement occurs in two particular morphosyntactic environments: plural and third-person accusative. Vowel replacement is thus both morphosyntactically conditioned and lexically specific. Here I have argued that the lexical subset of CVCV roots which undergoes vowel reduction and vowel replacement have a weakly encoded initial vowel, and that faithfulness is weaker to weakly encoded than strongly encoded segments. This combination of weakly encoded vowels that are only weakly faithful to their input features results in those weak vowels undergoing alternations that strongly encoded vowels fail to undergo, namely, reduction and replacement.

I derive the morphosyntactic conditioning of vowel replacement via Cophonology Theory, which allows for multiple distinct phonological grammars in distinct morphosyntactic environments. We see that the same correspondence, faithfulness, and markedness constraints ranked or weighted differently across cophonologies results in the difference between no vowel replacement (i.e. in passive contexts), partial vowel replacement in plural contexts, and full vowel replacement in object enclitic contexts. The distribution of morphosyntactically conditioned root-dominant ATR harmony is derived in the same way.

Faithfulness constraints sensitive to degree of encoding strength prevent polysyllabic words with strongly encoded vowels from undergoing vowel replacement. This results in the surface lexical specificity effects of vowel replacement, but is preferable to a suppletive allomorphy approach because weak encoding accounts for both vowel replacement, as discussed in section 5.3, and reduction, as discussed in section 5.2. The proposed model derives the phonologically predictable surface allomorphs via constraint interaction, rather than listing all of the allomorphs lexically.

In the [-BACK, -ROUND] plural context, we saw that ranked constraints could not derive the correct optimal output for both strong and weak roots. However, weighting the constraints instead of ranking them resulted in the desired outputs in all contexts. This suggests that cophonologies should be coupled with Harmonic Grammar to involve multiple morpheme-specific weighted constraint grammars, rather than distinct constraint rankings.

We saw in chapters 3 and 4 that the analysis proposed here for vowel replacement – morphosyntactically conditioned cophonologies – also accounts for other instances of morphologically conditioned phonology in the same language. Chapter 6 discusses the wider implications of the analyses proposed in this and the previous chapters, and will discuss any interaction amongst the morpheme-specific constraint rankings proposed in chapters 3, 4, and 5.

Chapter 6

Implications

The previous three chapters detail three instances of morphosyntactically conditioned phonology in Guébie (Kru). These include phonologically determined noun class agreement (chapter 3), imperfective scalar tone shift (chapter 4) and root vowel replacement (chapter 4). All three of these phenomena involve phonological processes triggered by particular morphosyntactic environments.

6.1 What Guébie tells us about process morphology

This section returns to the two questions raised in chapter 1: 1) Is there any fundamental difference between process morphology and morphosyntactically conditioned phonology? 2) Should all morphology be analyzed as item-base? I also examine the cophonologies proposed throughout chapters 3, 4, and 5, and discuss their interaction.

6.1.1 Process morphology is morphologically conditioned phonology

To account for all three instances of process morphology in chapters 3, 4, and 5, an analysis combining the tools of Distributed Morphology with Cophonology Theory was adopted. In this model, morphology is interpreted from syntactic structure at syntactic phase boundaries, after syntactic operations have taken place. Phonological forms (vocabulary items) are inserted late in the derivation, during the morphological component. Morphosyntactic features of terminal nodes persist along with vocabulary items through morphology and are available to the phonology. Phonological constraint rankings specific to the morphosyntactic features present in a given spell-out domain interact to result in morphosyntactically conditioned phonological processes.

On this model, morphologically conditioned phonology that co-occurs with the addition of segmental material (MCP) and phonological processes which are the sole exponent of some morpheme, are derived in the same way; namely, via phonological constraint interactions (cf.

Inkelas, 2014, ch. 3). These morphosyntactically conditioned processes can either co-occur with vocabulary items like affixes or clitics, or there may be no such relevant vocabulary item. That is, morphosyntactic features are associated with either, neither, or both of 1) a phonological form, and 2) a cophonology.

Guébie object enclitics, described in chapters 3 and 5, have both a (partially) specified phonological form (ex. $ɔ^2$ and V_{+ATR}), and they trigger a cophonology which results in root-vowel replacement via the interaction of Agreement-by-Projection and faithfulness constraints. The imperfective feature described in chapter 4, on the other hand, has no associated vocabulary item. However, it triggers a cophonology which results in scalar tone shift via the interaction of faithfulness and tonal antifaithfulness constraints.

Still other morphemes trigger no specific cophonology. Some of these are associated with phonological content, or vocabulary items, like Guébie lexical roots and valency changing morphemes. For example, a causative morpheme does not trigger a specific cophonology, but is associated with phonological content, namely a central vowel underspecified for ATR: /-A/. In causative contexts, if no other morpheme in the phase being evaluated triggers a particular cophonology, the *elsewhere* phonological grammar of the language applies.

The perfective feature in Guébie neither triggers a specific cophonology, nor has an associated vocabulary item. Perfective verbs surface in their default form, with no additional segmental morphology nor having undergone any morpheme-specific phonological process.

Whether a morphosyntactic feature is associated with a specific cophonology or not is independent of whether it is associated with a vocabulary item. We see all four possible combinations by looking across Guébie morphology, (289).

(289) **Cophonologies are independent of phonological items**

	Cophonology	**No Cophonology**
Vocabulary Item	Object enclitic	Causative
No Vocabulary Item	Imperfective	Perfective

All morphologically conditioned phonological processes are derived via constraint interaction, and some of these processes also happen to co-occur with underlying phonological items. In this way, the difference between MCP and process morphology is epiphenomenal.

6.1.2 Not all morphology is item-based

We saw in section 6.1.1 that some morphosyntactic features are associated with phonological forms, or vocabulary items in Guébie, while others are not. The imperfective feature, while it triggers a phonological process, is not associated with a vocabulary item. The same is true of the plural morpheme that triggers front, unrounded vowels in roots, discussed in chapter 5. These data, and the proposed analyses of them, have implications for approaches in which all morphology is item-based.

In chapter 4 we saw that whether or not we proposed an underlying phonological item for the imperfective morpheme, rules or constraints were still responsible for driving scalar tone shift in imperfective contexts. The addition of an abstract phonological item to the analysis is unnecessary and uneconomical. By allowing for morphemes to be associated with underlying items or not, as in the proposed analysis, we avoid complex analyses of highly abstract underlying forms, like the mora affixation analysis of subtractive morphology in Tohono O'Odham discussed in section 1.1.2.

In the proposed model, for those morphemes where we see the addition of new segmental or perhaps suprasegmental material, there is an associated vocabulary item. For those morphemes that do not involve new segmental material, there is no corresponding underlying item. In either case, there may also be a specific cophonology triggered, which results in a morphologically conditioned phonological process.

6.1.3 Interacting cophonologies in Guébie

In the proposed model, phonological evaluation occurs at syntactic phase boundaries, and is sensitive to the morphosyntactic features within each phase. It is possible under this view for two cophonologies to be triggered within a single phase. For example, in Guébie CPs, we could simultaneously have the imperfective cophonology trigger scalar tone shift and the 3.ACC grammar trigger vowel replacement. We can then ask how the phonological component resolves the pressure for distinct cophonologies to be triggered within the same phase.

It is possible for a verb in T, the inflectional position in Guébie, to be marked with both an IPFV feature and a 3.ACC object marker. If the verb has weakly encoded vowels, making it subject to alternation, then both imperfective scalar tone shift and vowel replacement take place. For example, the weak root *bala*$^{3.3}$, 'hit', plus the object enclitic ɔ^{2}, surfaces as *bɔlɔ*$^{2.2}$ in the imperfective, where we see both a tonal and vowel alternation.

We know that both scalar shift and vowel replacement can apply within the same spell-out domain, and we can ask how the relevant constraint rankings interact. The imperfective ranking is given in (290) and the object enclitic vowel replacement ranking in (291).

(290) **Imperfective scalar tone shift ranking**
*0, PITCHDROP, ID-PHASE ≫ ID-TONE

(291) **Object enclitic vowel replacement ranking**
ID-STRONG ≫ REALIZE, *V+V, ID-PHASE, *[αF][βF] ≫ ID-IO

The only constraint relevant for both imperfective scalar tone shift and object enclitic vowel replacement is ID-PHASE. For this reason, none of the ranking relationships in the tone shift (IPFV) cophonology interact with the object vowel replacement (3.ACC) cophonology. There is no conflict between the two cophonologies triggered within the CP phase.

More than one cophonology-specific phonological process can apply within a single phase (tone shift plus vowel replacement). To account for this, rather than proposing that a morphosyntactic feature triggers a fully-specified ranking of all possible phonological constraints, I adopt the view that each feature that triggers a cophonology in fact triggers a *partial* constraint ranking (cf. Anttila (2002)). These constraint rankings can be combined to result in a more complex set of rankings that together make up a phonological grammar. To determine the relative ranking of any constraints not referenced by those feature-specific rankings, the phonological grammar defaults to the *elsewhere* ranking in the language.

In Guébie, the rankings triggered by morphosyntactic features within the same phase do not conflict. However, we could imagine a language where there were, for example, two cophonologies triggered in a single CP, one of which required PitchDrop over Ident-Tone and the other which required the opposite. Because we have no evidence from Guébie as to how such a conflict would be resolved, I remain neutral on possible resolution strategies here. However, see Jenks and Sande (forthcoming) for a more specific implementation of cophonologies (partial rankings) applying at phase boundaries.

6.2 The interaction of phonology with syntax

6.2.1 Is syntax really phonology-free?

In addition to bearing on questions of morphology and phonology, the data presented here also bear on the interaction between syntax and phonology. Most current models of syntax and morphology, including Distributed Morphology, adopted here, assume that syntactic operations are not sensitive to phonological information. However, we have seen that much morphology in Guébie relies on a close relationship between syntax and phonology.

In particular, phonologically determined noun class agreement, as described in chapter 3, challenges the assumption that syntax is phonology-free. If noun class agreement is a syntactic operation, it should not be sensitive to phonological information. However, in Guébie we see that noun class agreement of non-human third-persons is determined by the phonological form of the noun. The proposed analysis maintains a phonology-free syntax by implementing noun class agreement in the morphological component rather than the syntax, and by requiring phonological agreement between morphologically agreeing elements via phonological constraints.

On this analysis we can maintain that syntax is phonology-free; however, the Guébie data contributes to an ever-growing literature on phenomena that appear to require syntactic sensitivity to phonology. This includes other instances of phonologically determined agreement, as described for other Kru languages (Kaye, 1981; Bing, 1987; Marchese, 1979, 1986b, 1988; Zogbo, 2017), Bainuk (Atlantic) (Sauvageot, 1967), Abu' (Arapesh) (Nekitel, 1986), Bə́ná (Adamawa) (Van de Velde and Idiatov, 2017), and Frò?ó (Gur) (Traoré and Féry, 2017). Other phenomena that seem to suggest syntactic sensitivity to phonology are those that involve prosody (Anttila, 2008; Anttila et al., 2010; Anttila, 2016; Bresnan et al., 2007; Richards, 2016, 2017a,b,c; McFadden and Sundaresan, 2015).

This collection of data suggests syntactic sensitivity to phonology. As this literature continues to grow, with the exploration of data from understudied languages or new analyses of extant data, we will need to reconsider the question of whether syntax is truly phonology-free.

6.2.2 Syntactic spell-out domains

In addition to the question of a phonology-free syntax, the Guébie data clearly show another kind of relationship between phonology and syntax; phonological operations must have scope over domains larger than a single word. Specifically, phonological evaluation in Guébie seems to take place at the level of each syntactic phase. We can see this phase-level interaction in a number of process discussed here, specifically phonologically determined agreement and scalar tone shift.

Phonologically determined agreement involves agreement between the final vowels of multiple words within a noun phrase, or DP. A noun, whose phonological features are fully specified in the input to phonology, determines the phonological features of the final vowel of any pronoun or adjective in the same syntactic domain, namely, the DP phase.

Scalar tone shift applies in the context of an imperfective feature, and affects not only the tone of the verb, but also the tone of the preceding word, the subject. When the imperfective cophonology applies, then, it must evaluate subject and verb together, in a domain larger than a single word. In chapter 4 I proposed that the relevant domain is CP.

Adopting phase-based spell-out domains allows for phrase-level morphologically conditioned phonological effects, like the ones seen here. It also allows for a straightforward account of category-specific phonology (cf. Smith, 2011).

6.3 Lexically and morphosyntactically conditioned phonological processes

We have clearly seen, in chapters 3, 4, and 5, summarized in sections 6.1 and 6.2, that certain phonological processes are sensitive to morphosyntactic context. In the case of vowel reduction and vowel replacement, discussed in chapter 5, we also saw that phonological phenomena can be lexically specific.

Vowel reduction and vowel replacement apply to the initial vowel in the same subset of 33.5% of CVCV roots in Guébie. We have seen that a model of cophonologies triggered by morphosyntactic features accounts for multiple distinct morphological conditioned phonological processes across Guébie; however, these two vowel alternations also require phonological alternations to show sensitivity to lexical class. The proposed solution is a representational one; roots that undergo vowel reduction and vowel replacement have weakly encoded initial vowels. This analysis follows a line of recent work on phonological alternations triggered by different degrees of phonological activation (Inkelas, 2011; Smolensky et al., 2014; Inkelas, 2015; Rosen, 2016; Moore-Cantwell, 2017; Zimmermann, 2017).

On a phonological activation account, a difference in phonological representation, and perhaps also in psycholinguistic reality, is responsible for a lexically specific change. In

Guébie, roots with weak vowels undergo vowel replacement and reduction, and roots with strong vowels do not. While these weak roots share a number of phonotactic traits, as discussed in section 5.2.2, there are other roots that share the same traits but fail to alternate. For this reason, phonological features of roots are not enough on their own to predict which roots undergo vowel reduction and vowel replacement. There must be some difference in representation between those roots that alternate and those that do not. Here, that difference is weak versus strong phonological encoding.

Combining the tools discussed in section 6.1 for deriving morphosyntactically conditioned phonological phenomena with phonological activation, we get a model of morphophonology capable of sensitivity to both morphosyntactic features and lexical features of roots.

6.4 Conclusion

Here I have presented original data from Guébie, a Kru language spoken in Côte d'Ivoire, which bear on questions of how morphology and phonology interact. The Guébie data are especially relevant for questions of morphophonological interaction because much of the morphology is exponed via phonological processes, rather than segmental affixation.

To account for the wide range of phonological processes seen in Guébie, I have proposed a novel combination of theoretical tools. The model adopted here accounts for process morphology and other instances of morphologically conditioned phonology via a single mechanism: morpheme-specific constraint interaction. In the proposed model, phonological processes are independent of the addition of (abstract) phonological items. Thus, the proposed model has serious implications for item-based theories of morphophonology. I conclude based on the Guébie data in chapters 2, 3, 4, and 5 that not all morphology is item-based; rather, following (Inkelas, 2014), all morphologically conditioned phonology is constraint-driven by morpheme-specific cophonologies.

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