A unified analysis of conditioned phonological processes:
Three case studies from Guébie (Kru)

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Introduction

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  - Morpheme (/k/→[s] before /-ity, -ism/ in English)
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  - Lexical class (noun vs. verb, loan vs. native words)
- These conditioning factors have all been modeled in distinct ways.
  - **Syntactic domain effects**: Match Theory (Selkirk, 2009, 2011); Contiguity Theory (Richards, 2016)
  - **Morphological conditioning**: Lexical strata or levels (Kiparsky et al., 1982; Kiparsky, 2000, 2008)
  - **Lexical conditioning**: Indexed constraints (Itô and Mester, 1995); Cophonologies (Orgun, 1996; Inkelas et al., 1997; Inkelas and Zoll, 2005)

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- **Question:** Can we account for conditions on phonological processes in a single, unified model?
  - **Phenomena:** Multiple distinct instances of conditioned phonological processes in a single language.
  - **Language:** Original data from Guébie (Kru) [Côte d'Ivoire]
    - Scalar tone shift in imperfective contexts
    - ATR and nasal harmony within a syntactic domain
    - Lexically-specific vowel harmony

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- The model combines Distributed Morphology operations with phonological constraints.
- Crucially, I adopt an enriched notion of Vocabulary Items (lexical representations) in a Distributed Morphology framework (Sande and Jenks, 2017).

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- Each vocabulary item contains three components:
  1. An underlying phonological representation.
  2. A prosodic subcategorization frame.
  3. **A subranking of phonological constraints.**

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  1. An underlying phonological representation.
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  3. **A subranking of phonological constraints.**
- The subranking of constraints associated with a particular vocabulary item overrides the default phonological constraint ranking of the language, only during phonological evaluation of that particular phase.

Overview

Background

The Guébie language

The Guébie language

- The data presented here comes from original fieldwork on Guébie over the past five years.
- Guébie is an endangered language, with fewer than 7,000 speakers.
- Before I started working on Guébie in 2013, there was no extant documentation or description of the language.
- The Kru family in general is drastically understudied, especially compared to other subgroups of Niger-Congo.

Where is Guébie spoken?

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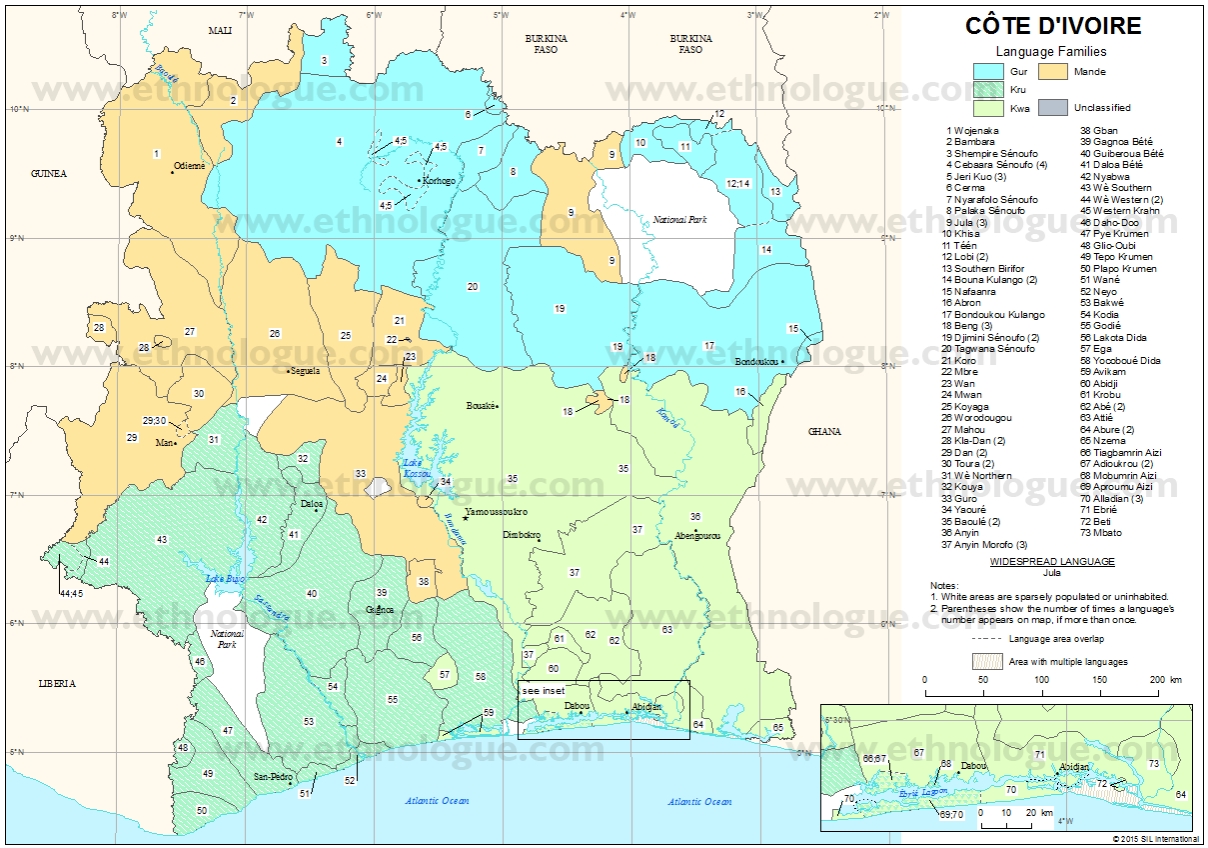

Gnagbodougnoa

Field elicitation

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- Carrying out fieldwork allows for exploration of morphological and phonological phenomena across the language.
  - No need to rely on data in grammars.
  - Ability to elicit specific judgments necessary for analyses.
  - Recordings available for acoustic analysis.
  - Relate distinct phenomena via theoretical models.

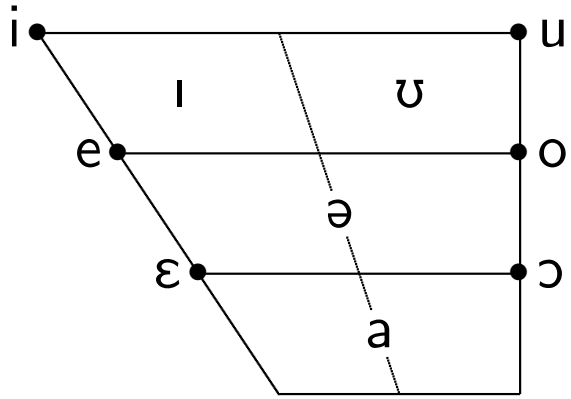
Language background: Consonants

(1) **Consonant inventory**

	Bilabial		Labiodent.		Alveopal.		Palatal		Velar		Labiovelar	
Plosive	p	b			t	d	c	ɟ	k	g	kp	gb
Nasal		m				n		ɲ		ŋ		
Fricative			f	v	s							
Approx		ɓ				l		j				w

Language background: Vowels

(2) **Vowel inventory**



- There is systematic root-conditioned ATR-harmony within words.

Language background: Tone

- Guébie is a tonal language, with four distinct underlying tone heights (here labeled 1-4, where 4 is high).
- There are five distinct heights on the surface, 1-5, where 5 is super high.

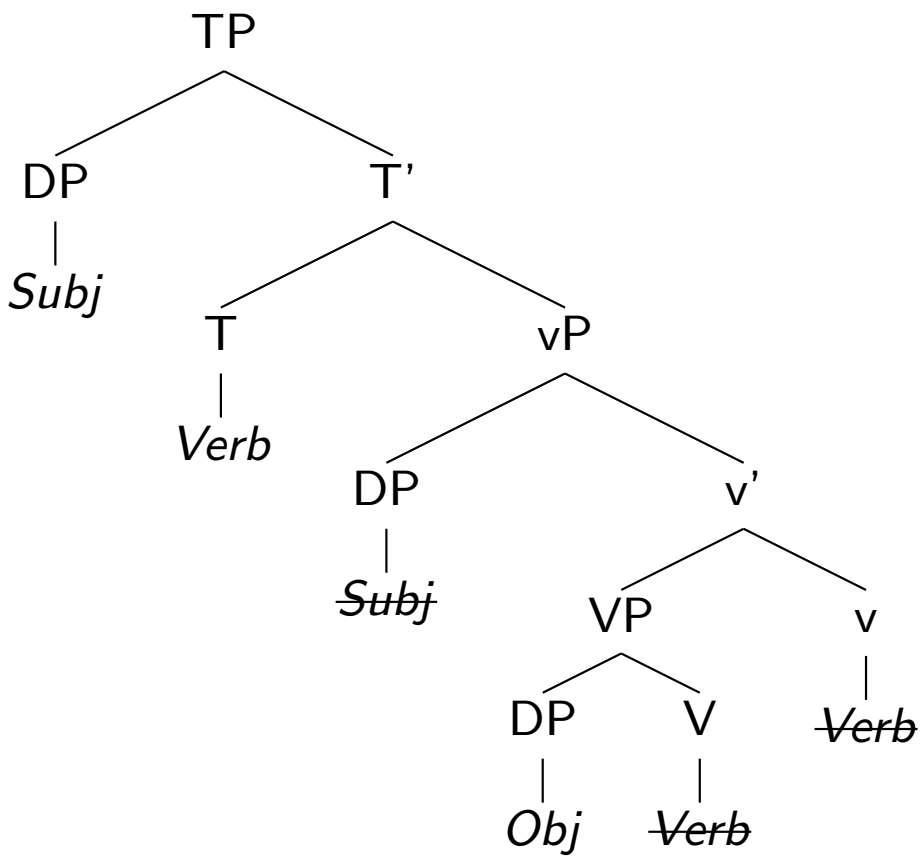
Language background: Syllables

- Syllables are maximally CV, and words tend to be monosyllabic.
  - Ex: li^3 ‘eat’, no^4 ‘mother’

Language background: Word order

- Word order alternates between SAuxOV and SVO.
  - When there is no auxiliary, the verb undergoes V-to-T movement, surfacing in the inflectional position (Sande, 2017).

(3)



Language background: Morphology

- While there are a few inflectional suffixes, and a number of derivational affixes, most morphology is processual:
  - Tone shift
  - Tone replacement
  - Vowel replacement/harmony

Tone shift

Scalar tone shift in Guébie

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- Tone is the sole exponent of imperfective aspect in Guébie.

Scalar tone shift in Guébie

- Tone is the sole exponent of imperfective aspect in Guébie.
- A given verb shows the same tone melody in all contexts but the imperfective, (4).

(4) a. *SAuxOV*

e^{4} ji^{3} ɟa^{31} li^{3}

1SG.NOM FUT coconuts eat

'I will eat a coconut.'

b. *Imperative*

li^{3}

eat.IMP

'Eat!'

c. *Perfective*

e^{4} li^{3} ɟa-ɓe$^{3.1}$ kubə$^{3.1}$

1SG.NOM eat.PFV coconuts-SG yesterday

'I ate a coconut yesterday.' (syl_20131024)

Tone on verbs lowers one step in the imperfective

- All imperfective verbs surface in SVO contexts, where the tone on the verb is one step lower than in all other contexts.

(5) *Imperfective*

e^{4}	li^{2}	ɲa^{31}	koko$^{4.4}$
1SG.NOM	eat.IPFV	coconuts	every.day

'I eat coconuts everyday.' (syl_20131024)

Scalar tone shift minimal pair

(6) a. *Perfective*

e^{4} li^{3} ɲa^{31}

1SG.NOM eat.PFV coconuts

'I ate coconuts.'

b. *Imperfective*

e^{4} li^{2} ɲa^{31}

1SG.NOM eat.IPFV coconuts

'I eat coconuts.' (oli_20160801)

Scalar tone shift minimal pair

(7) a. *Imperfective*

ɔ^{3} liɓe$^{1.3}$

3SG.NOM dine.IPFV

'I am dining'

b. *Perfective*

ɔ^{3} liɓe$^{2.3}$

3SG.NOM dine.PFV

'I dined' (oli_20160801)

Audio

Scalar lowering of the first verbal tone level

(8) 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
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boy climb.IPFV trees
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c. e^{4} na^{42}
1SG.NOM say.PFV
'I said'

d. e^{4} na^{32}
1SG.NOM say.IPFV
'I say' (syl_20140314)

Tone lowering summary

- The first tone level of a verbal tone melody surfaces one step lower in imperfective contexts than other contexts.

(9)

Default tone	≫	**Imperfective tone**
4		3
3		2
2		1
1		1

Scalar shift for low-toned verbs

- When the tone of a verb is already low we do not see lowering to super low (tone 0).

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- When the tone of a verb is already low we do not see lowering to super low (tone 0).
- But we also do not see neutralization between perfective and imperfective contexts.
- Instead, the scalar tone shift affects the final tone of the **subject**!

Subject tone raising

(10)

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

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

c. ɟaci$^{23.1}$ pa^{1}
Djatchi run.PFV
'Djatchi ran'

d. ɟaci$^{23.2}$ pa^{1}
Djatchi run.IPFV
'Djatchi runs' (oli_20160801)

pfv ipfv

Super high tones

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b. $\underline{\text{e}^{5}}$ pa^{1}
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b. $\underline{\text{e}^{5}}$ pa^{1}
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'I run' (syl_20140314)

- Super high tones are not found anywhere else in the language.

Subject raising

(12)

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

Scalar tone shift summary

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- 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.

Scalar tone shift summary

- This tonal shift affects the difference in tone height between the subject and verb.
- 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.
- A scalar shift affecting multiple words, like this one, is otherwise unattested cross-linguistically (Mortensen, 2006).

Theoretical assumptions

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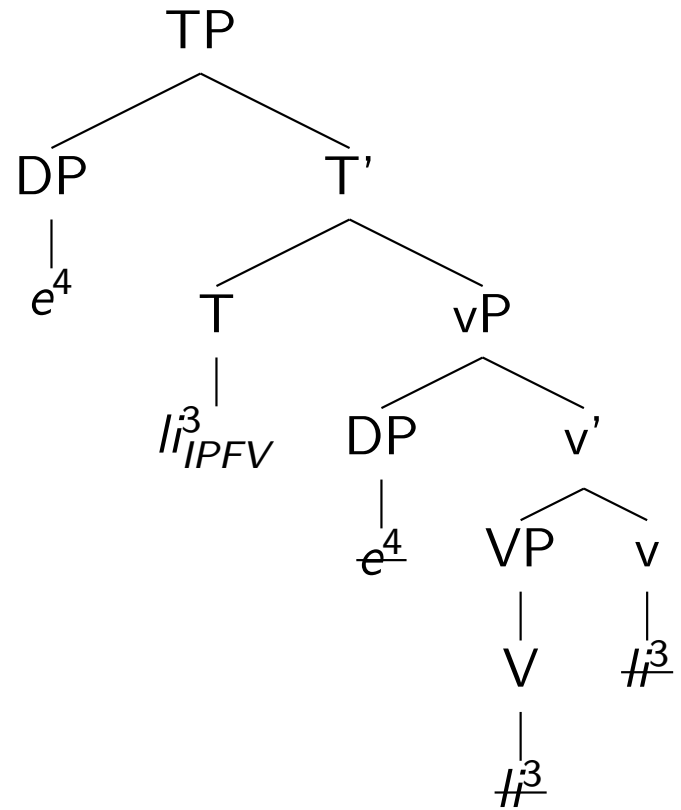
     - Phase heads include: v, C, and categorizing heads.
  2. The input to phonology includes linearized phonological underlying forms, as well as subrankings associated with vocabulary items (Sande and Jenks, 2017).

(13) *Vocabulary Item*: $[v] \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & /\text{ga}/ \\ \mathcal{P}: & [-X]_{\omega} \\ \mathcal{R}: & \text{B} \gg \text{A} \end{Bmatrix}$

Morphosyntactic structure

(14) **Imperfective structure** (adapted from Sande 2017)



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- It is not the case, though, that the final subject and initial verb tones always dissimilate from each other.

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

	Perfective	**Imperfective**	**Difference in tone**
a.	2 4	2 3	Decreases
b.	2 3	2 2	Decreases (to equal)
c.	2 2	2 1	Increases
d.	2 1	3 1	Increases

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3. PITCHDROP motivates the pitch drop between subject and verb from input to output (cf. Mortensen 2006's HIGHER and NOHIGHER)
4. Nouns are less likely than verbs to undergo change from input to output: IDENT-DP (Smith, 2011)

Default ranking

- The default ranking in the language for the four relevant constraints is:

  Ident-Tone, *0, Ident-DP ≫ PitchDrop

Crucial rankings in imperfective

- The necessary rankings of the above four constraints in the imperfective-specific grammar are given here:

(16)

*0, PitchDrop
|
Ident-DP
|
Ident-Tone

- The crucial difference from the default grammar is that Ident-Tone is outranked by Ident-DP which is outranked by PitchDrop.

Imperfective vocabulary item

(17) $[T, \textsc{ipfv}] \longleftrightarrow$

$$\left\{\begin{array}{ll} \mathcal{F}: & \varnothing \\ \mathcal{P}: & \varnothing \\ \mathcal{R}: & \textsc{PitchDrop} \gg \textsc{Ident-DP} \gg \textsc{Ident-Tone} \end{array}\right\}$$

Imperfective vocabulary item

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$$\left\{\begin{array}{ll} \mathcal{F}: & \varnothing \\ \mathcal{P}: & \varnothing \\ \mathcal{R}: & \textsc{PitchDrop} \gg \textsc{Ident-DP} \gg \textsc{Ident-Tone} \end{array}\right\}$$

(18) Linearized phonological underlying representation
e^4 li^3

Imperfective constraint ranking

- Default ranking: *0, IDENT-TONE, IDENT-DP ≫ PITCHDROP
- Reranking PITCHDROP over IDENT-DP over IDENT-TONE in the context of an imperfective vocabulary item results in the correct output.

(19) ***0, PitchDrop ≫ Ident-DP ≫ Ident-Tone**

e^4 li^3	*0	PITCHDROP	IDENT-DP	IDENT-TONE
a. e^4 li^3		*!		
b. ☞e^4 li^2				*
c. e^4 li^1				**!
d. e^5 li^3			*!	*
e. e^3 li^3		*!	*	*

Imperfective constraint ranking

- These four constraints also result in the correct output form in subject raising cases.

(20) ***0, PitchDrop ≫ Faith-DP ≫ Faith-IO**

e^4 pa^1	*0	PitchDrop	Faith-DP	Faith-IO
a. e^4 pa^1		*!		
b. e^4 pa^0	*!			*
c. e^3 pa^1		*!	*	*
d. ☞e^5 pa^1			*	*

The default ranking

- There is no sub-ranking associated with the perfective morpheme, so the default constraint ranking of the language applies.
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The default ranking

- There is no sub-ranking associated with the perfective morpheme, so the default constraint ranking of the language applies.
- Default ranking: *0, Ident-Tone, Ident-DP ≫ PitchDrop
- This ranking results in the faithful candidate always surfacing as optimal in all contexts outside of the imperfective.

Tone shift summary

- We can think of the proposed model as a version of Cophonology Theory (Orgun, 1996; Inkelas et al., 1997; Inkelas and Zoll, 2005, 2007), which applies at syntactic phase boundaries.

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- I'll henceforth refer to the model as *Cophonologies by Phase*.

Theoretical justification

- It is crucial that the constraint subranking of PitchDrop above Ident-Tone be associated only with the imperfective morpheme, since we only see this tonal alternation in imperfective contexts.
- Alternative models where only a single constraint ranking exists for the entire language would not be able to differentiate tone shift in imperfective from a lack of tone shift in other contexts.

Interim summary

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- The four constraints we have seen account for the morphologically-specific imperfective tonal alternation in Guébie.
- We see verb tone lowering, unless it is impossible, in which case the subject raises.
- The result is a pitch difference between subject and verb, **only in the environment of an imperfective morpheme**.

ATR and nasal harmony

Domain-sensitive root-controlled ATR harmony

- There are a number of verbal suffixes in Guébie, including valency-changing and nominalizing morphemes.

(21) **Verbal morphology template**

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

Domain-sensitive root-controlled ATR harmony

- A subset of verbal affixes show ATR harmony with roots

(22) **ATR harmony across verbal suffixes**

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

Domain-sensitive root-controlled ATR harmony

- Roots that contain +ATR vowels, [i, e, u, o, ə], co-occur with +ATR vowels in valency-changing affixes.
- Roots that contain -ATR vowels [ɪ, ɛ, ʊ, ɔ, a], co-occur with -ATR vowels in valency-changing affixes.

Domain-sensitive root-controlled nasal harmony

- Within the same domain that root-conditioned ATR harmony applies, we also see nasal harmony across sonorant consonants.

(23) **Nasal harmony across verbal suffixes**

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

Domain-sensitive root-controlled nasal harmony

- Sonorant consonants in suffixes surface as nasal after a nasal consonant in the root, [m, n, ɲ, ŋ].
- Sonorant consonants in suffixes surface as non-nasal after non-nasal consonants in the root.

Harmony with causative and applicative suffixes

	Root	**Root+Caus**	**Root+Appl**	**Gloss**
a.	li^{3}	li-ə$^{3.2}$	li-li$^{3.2}$	‘eat’
b.	sedi$^{3.1}$	sedi-ə$^{3.1.2}$	sedi-li$^{3.1.2}$	‘marry’
c.	bulu$^{2.2}$	bulu-ə$^{2.2.2}$	bulu-li$^{2.2.2}$	‘fly’
d.	sijo$^{2.3}$	sijo-ə$^{2.3.2}$	sijo-li$^{2.3.2}$	‘wipe’
e.	gug^{w}ə$^{2.3}$	gug^{w}ə-ə$^{2.3.2}$	gug^{w}ə-li$^{2.3.2}$	‘remember’
f.	sɪ^{2}	sɪ-a$^{2.2}$	sɪ-lɪ$^{2.2}$	‘tire’
g.	ɲɛpɛ$^{3.1}$	ɲɛpɛ-a$^{3.1.2}$	ɲɛpɛ-lɪ$^{3.1.2}$	‘sweep’
h.	ɟʊla$^{3.2}$	ɟʊla-a$^{3.2.2}$	ɟʊla-lɪ$^{3.2.2}$	‘take/borrow’
i.	kɔlɔ$^{2.2}$	kɔlɔ-a$^{2.2.2}$	kɔlɔ-lɪ$^{2.2.2}$	‘stay’
j.	pa^{1}	pa-a$^{1.2}$	pa-lɪ$^{1.2}$	‘run’
k.	ni^{4}	ni-ə$^{4.2}$	ni-ni$^{4.2}$	‘see’
l.	ɲɛ^{3}	ɲɛ-a$^{3.2}$	ɲɛ-nɪ$^{3.2}$	‘give’
m.	mana$^{2.2}$	mana-a$^{2.2.2}$	mana-nɪ$^{2.2.2}$	‘drink’

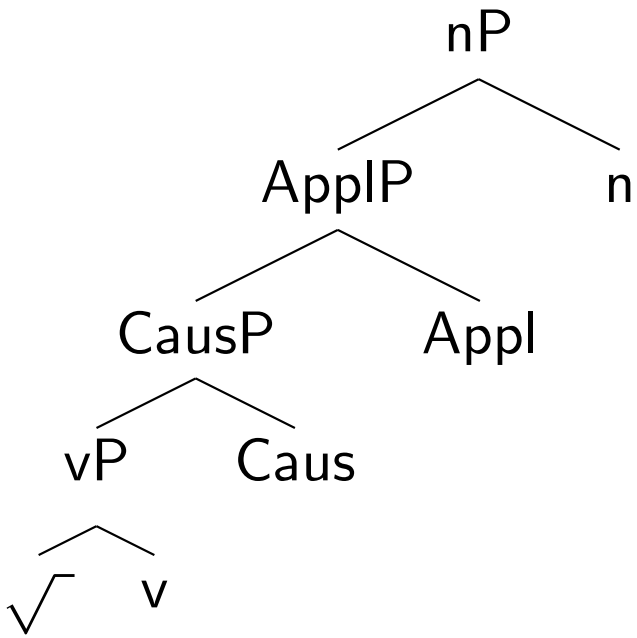
No harmony with nominalizing suffixes

	Root	**Root+Nz**	**Root+C+A+Nz**	**Gloss**
a.	li^{3}	li-l̲i$^{3.2}$	li-ə-li-l̲i$^{3.2.2.2}$	‘eat’
b.	bulu$^{2.2}$	bulu-l̲i$^{2.2.2}$	bulu-ə-li-l̲i$^{2.2.2.2.2}$	‘fly’
c.	gug^{w}ə$^{2.3}$	gug^{w}ə-l̲i$^{2.3.2}$	gug^{w}ə-ə-li-l̲i$^{2.3.2.2.2}$	‘remember’
d.	pa^{1}	pa-l̲i$^{1.2}$	pa-a-lɪ-l̲i$^{1.2.2.2}$	‘run’
e.	kɔlɔ$^{2.2}$	kɔlɔ-l̲i$^{2.2.2}$	kɔlɔ-a-lɪ-l̲i$^{2.2.2.2.2}$	‘stay’
f.	ni^{4}	ni-l̲i$^{4.2}$	ni-ə-ni-l̲i$^{4.2.2.2}$	‘see’
g.	ɲɛ^{3}	ɲɛ-l̲i$^{3.2}$	ɲɛ-a-nɪ-l̲i$^{3.2.2.2}$	‘give’
h.	mana$^{2.2}$	mana-l̲i$^{2.2.2}$	mana-a-nɪ-l̲i$^{2.2.2.2.2}$	‘drink’

Syntactic domain conditions domain of harmony

- I analyze the domain of ATR and nasal harmony across verbal affixes as due to a significant syntactic boundary between the valency-changing morphemes and the nominalizing suffix.

(24) Guébie nominalization structure



Category-defining heads as phase boundaries

- Categorizing heads like little-*n* are analyzed as phase heads (following Marantz (2001); Arad (2003); Anagnostopoulou and Samioti (2017)).

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- I posit that when the nominalizing head *n* is merged, its complement is spelled out.
- That complement is the domain of ATR and nasal harmony.

A subranking triggers ATR and nasal harmony

- ATR and nasal harmony always hold within the domain of the extended projection of the verb.
- Thus, I posit that there is a phonological constraint subranking which triggers ATR and nasal harmony and is associated with the little-v head.

A subranking triggers ATR and nasal harmony

- ATR and nasal harmony always hold within the domain of the extended projection of the verb.
- Thus, I posit that there is a phonological constraint subranking which triggers ATR and nasal harmony and is associated with the little-*v* head.

(25) $[v] \longleftrightarrow$

$$\left\{\begin{array}{ll} \mathcal{F}: & \varnothing \\ \mathcal{P}: & \varnothing \\ \mathcal{R}: & \textsc{Atr}, \textsc{NasalHarmony} \gg \textsc{Ident-IO} \end{array}\right\}$$

A subranking triggers ATR and nasal harmony

- ATR and nasal harmony always hold within the domain of the extended projection of the verb.
- Thus, I posit that there is a phonological constraint subranking which triggers ATR and nasal harmony and is associated with the little-*v* head.

(25) $[v] \longleftrightarrow$

$$\begin{Bmatrix} \mathcal{F}: & \varnothing \\ \mathcal{P}: & \varnothing \\ \mathcal{R}: & \text{ATR, NasalHarmony} \gg \text{Ident-IO} \end{Bmatrix}$$

- The little-*v* subranking overrides the default ranking of the language: Ident-IO $\gg$ ATR, NasalHarmony.

Harmony within the verbal domain

(26) **ATR, NasalHarmony ≫ Ident-IO**

ɲɛ^3-ə^2-li^2	ATRHarm	NasalHarm	Ident-IO
a. ɲɛ^3-ə^2-li^2	*!	*	
b. ɲɛ^3-a^2-lɪ^2		*!	**
c. ☞ɲɛ^3-a^2-nɪ^2			***

No harmony outside the verbal domain

(27) **Ident-IO ≫ ATR, NasalHarmony**

[ɲɛanɪ$^{3.2.2}$]-li^{2}	IDENT-IO	ATRHARM	NASALHARM
a. ☞ɲɛanɪ$^{3.2.2}$-li^{2}		*	*
b. ɲɛanɪ$^{3.2.2}$-lɪ^{2}	*!		*
c. ɲɛanɪ$^{3.2.2}$-nɪ^{2}	*!*	*	

Theoretical justification

- In a global constraint-based model such as parallel OT, we would expect harmony to apply across the board (including nominalizing suffixes).

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- In a global constraint-based model such as parallel OT, we would expect harmony to apply across the board (including nominalizing suffixes).
- Instead, applying morphological and phonological evaluation at each syntactic phase boundary predicts phonological effects sensitive to syntactic domain.

ATR and nasal harmony summary

- Within the phase containing the little-v head, ATR and nasal harmony apply.

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ATR and nasal harmony summary

- Within the phase containing the little-*v* head, ATR and nasal harmony apply.
- In the default ranking, IDENT-IO outranks the harmony constraints, resulting in ATR and nasal features surfacing faithfully to their underlying values.
- The result is ATR and nasal harmony **within the syntactic domain** of the extended verbal projection, but not outside of the phase containing the little-*v* head.
- Cophonologies by Phase can account for morphologically conditioned phonology (scalar tone shift) and syntactic-domain bounded phonology (ATR and nasal harmony).

Full vowel harmony

Affix-controlled vowel harmony

- The root-controlled ATR harmony we saw in section 4 is not the only vowel harmony process in Guébie.

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Affix-controlled vowel harmony

- The root-controlled ATR harmony we saw in section 4 is not the only vowel harmony process in Guébie.
- A set of morphemes, namely object-marking enclitics and plural suffixes, trigger full vowel harmony on roots.

(28) **Full vowel harmony**

a. ɔ^{3} bala$^{3.3}$
3SG.NOM hit.PFV
'He hit'

b. ɔ^{3} bɔlɔ=ɔ$^{3.3.2}$
3SG.NOM hit.PFV-3SG.ACC
'He hit him'

Morphemes that trigger full vowel harmony

- All third-person object-marking enclitics trigger full vowel harmony.

(29) **Guébie object markers**

	Human		**Non-human**	
	Singular	**Plural**	**Singular**	**Plural**
1st	e^{3}, ∅	a^{1}, $aɲɛ^{1.1}$	–	–
2nd	e^{1}, $mɛ^{2}$	a^{2}, $aɲɛ^{2.2}$	–	–
3rd	$ɔ^{2}$	wa^{2}	$ɛ^{2}$,a^{2},$ʊ^{2}$	$ɪ^{2}$,wa^{2}

Object markers trigger full harmony

	Verb	**Object**	**Verb+Obj**	**Gloss**
a.	jili$^{2.3}$	=ɔ^{2}	jɔlɔ-ɔ$^{2.3.2}$, *jili-ɔ$^{2.3.2}$	‘steal him’
b.	jili$^{2.3}$	=ɛ^{2}	jɛlɛ-ɛ$^{2.3.2}$, *jili-ɛ$^{2.3.2}$	‘steal it’
c.	jili$^{2.3}$	=ɪ^{2}	jɪlɪ-ɪ$^{2.3.2}$, *jili-ɪ$^{2.3.2}$	‘steal them’
d.	jɪla$^{3.3}$	=ɔ^{2}	jɔlɔ-ɔ$^{3.2.2}$, *jɪla-ɔ$^{3.3.2}$	‘ask him’
e.	jɪla$^{3.3}$	=ɛ^{2}	jɛlɛ-ɛ$^{3.2.2}$, *jɪla-ɛ$^{3.3.2}$	‘ask it’
f.	jɪla$^{3.3}$	=ɪ^{2}	jɪlɪ-ɪ$^{3.2.2}$, *jɪla-ɪ$^{3.3.2}$	‘ask them’
g.	bala$^{3.3}$	=ɔ^{2}	bɔlɔ-ɔ$^{3.2.2}$, *bala-ɔ$^{3.3.2}$	‘hit him’
h.	bala$^{3.3}$	=ɛ^{2}	bɛlɛ-ɛ$^{3.2.2}$, *bala-ɛ$^{3.3.2}$	‘hit it’
i.	bala$^{3.3}$	=ɪ^{2}	bɪlɪ-ɪ$^{3.2.2}$, *bala-ɪ$^{3.3.2}$	‘hit them’

Morphemes that trigger full vowel harmony

- Additionally, there are two plural suffixes, /-i, -a/, which both trigger full vowel harmony.

	Singular	**Plural**	**Gloss**
a.	ɓele$^{2.2}$	ɓili-i$^{2.2.2}$	'cow'
b.	mɛnɛ$^{3.3}$	mana-a$^{3.3.2}$	'animal'

Morphemes that trigger full vowel harmony

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Morphemes that trigger full vowel harmony

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- Recall that the shape of the 3SG.HUM object enclitic is [ɔ^2].

Morphemes that trigger full vowel harmony

- There are other enclitics and suffixes that are phonologically identical to object enclitics or plural suffixes, but do *not* trigger full harmony.
- Recall that the shape of the 3SG.HUM object enclitic is [ɔ^{2}].
- The passive suffix, which is phonologically identical, does not trigger harmony.

	Verb	**Verb+Pass**	**Gloss**
a.	bala$^{3.3}$	bala-ɔ$^{3.3.2}$, *bɔlɔ-ɔ$^{3.3.2}$	'be hit'
b.	jɪla$^{3.3}$	jɪla-ɔ$^{3.2.2}$, *jɔlɔ-ɔ$^{3.2.2}$	'be asked'

Lexically specific, suffix-controlled vowel harmony

- This full vowel harmony process only applies to a subset of Guébie roots.
  - About 33.5%, based on a corpus of 1839 disyllabic roots, where 614 of them are subject to full vowel harmony.

Roots affected by full vowel harmony

- The subset of roots affected by full vowel harmony does not form a semantic or phonological natural class.

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  - *Phonologically,* there is a tendency for roots that undergo full harmony to be of the shape CVCV, where the second C is /l/, and where the two vowels are identical.
  - However, no set of phonological traits exhaustively and exclusively picks out the correct set of roots.
    - For example, there are minimal pairs like jili$^{2.2}$ 'be fat', which undergoes harmony, and jili$^{2.2}$, 'fish', which does not.

Roots affected by full vowel harmony

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  - However, no set of phonological traits exhaustively and exclusively picks out the correct set of roots.
    - For example, there are minimal pairs like jili[2.2] 'be fat', which undergoes harmony, and jili[2.2], 'fish', which does not.
  - *Semantically,* there is no coherent feature of verbal or nominal roots that picks out all and only the roots that alternate.
    - For example, ŋ^{w}ɔnɔ[4.4], 'woman', and ɲɔkpɔ[3.1] 'person', undergo full harmony, while ŋudi[3.1], 'man', does not.

Full harmony data summary

- We have seen that certain morphemes (object enclitics and plural suffixes) condition full vowel harmony on roots.
- However, only 33.5% of roots in the language are affected by the process.

Analyzing full vowel harmony

- Full vowel harmony is both morphologically conditioned
  - It occurs only in the environment of particular morphemes (object enclitics and plurals),
- And lexically conditioned
  - It applies only to a subset of roots.

Combined effects of subrankings

- I analyze the interaction of morphological and lexical conditioning of full harmony in Cophonologies by Phase.

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- I analyze the interaction of morphological and lexical conditioning of full harmony in Cophonologies by Phase.
- In this case we see a combined effects of two independent subrankings of phonological constraints, inserted on Vocabulary Items.
- Relevant default ranking: $\textsc{Ident-IO(V)}$, $\textsc{Ident-IO} \gg \textsc{VHarmony}$

Accounting for morphological conditioning

- **Proposal:** plural and object markers are associated with a particular subranking.
  - **Object Vocabulary Item**

$$[3sg.hum.acc] \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & /ɔ^2/ \\ \mathcal{P}: & [=X]_\omega \\ \mathcal{R}: & \textsc{VHarmony} \gg \textsc{Ident-IO} \end{Bmatrix}$$

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- This ranking overrides the default to give us Ident-IO(V)$\gg$ VHarmony $\gg$ Ident-IO.

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- This ranking overrides the default to give us $\text{Ident-IO(V)} \gg \text{VHarmony} \gg \text{Ident-IO}$.
- On its own, this ranking is not enough to result in full harmony.

Accounting for lexical conditioning

- **Proposal:** Only the roots which undergo harmony are associated with a subranking:
  - *Alternating root Vocabulary Item*:

$$[\surd] \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & /\text{bala}^{3.3}/ \\ \mathcal{P}: & [X]_{\omega} \\ \mathcal{R}: & \textsc{VHarmony} \gg \textsc{Ident-IO(V)} \end{Bmatrix}$$

- This overrides the default ranking to give us $\textsc{Ident-IO} \gg \textsc{VHarmony} \gg \textsc{Ident-IO(V)}$.
- Again, on its own, this is not enough to result in full harmony, since a faithfulness constraint still outranks the harmony constraint.

Combined effects of subrankings

- However, when both the object/plural subranking and the lexical root subranking are present, the combined effects of the two subrankings are enough to result in harmony.

Combined effects of subrankings

- However, when both the object/plural subranking and the lexical root subranking are present, the combined effects of the two subrankings are enough to result in harmony.
  - Default: IDENT-IO(V), IDENT-IO $\gg$ VHARMONY

Combined effects of subrankings

- However, when both the object/plural subranking and the lexical root subranking are present, the combined effects of the two subrankings are enough to result in harmony.
  - Default: Ident-IO(V), Ident-IO $\gg$ VHarmony
  - Object/plural: VHarmony $\gg$ Ident-IO

Combined effects of subrankings

- However, when both the object/plural subranking and the lexical root subranking are present, the combined effects of the two subrankings are enough to result in harmony.
  - Default: Ident-IO(V), Ident-IO $\gg$ VHarmony
  - Object/plural: VHarmony $\gg$ Ident-IO
  - Alternating roots: VHarmony $\gg$ Ident-IO(V)

Combined effects of subrankings

- However, when both the object/plural subranking and the lexical root subranking are present, the combined effects of the two subrankings are enough to result in harmony.
  - Default: Ident-IO(V), Ident-IO $\gg$ VHarmony
  - Object/plural: VHarmony $\gg$ Ident-IO
  - Alternating roots: VHarmony $\gg$ Ident-IO(V)
  - Combined: VHarmony $\gg$ Ident-IO(V), Ident-IO

Combined effects of subrankings

- However, when both the object/plural subranking and the lexical root subranking are present, the combined effects of the two subrankings are enough to result in harmony.
  - Default: Ident-IO(V), Ident-IO ≫ VHarmony
  - Object/plural: VHarmony ≫ Ident-IO
  - Alternating roots: VHarmony ≫ Ident-IO(V)
  - Combined: VHarmony ≫ Ident-IO(V), Ident-IO

	Object enclitic	**Passive**
Alternating root	Harmony	No harmony
Non-alternating root	No harmony	No harmony

Alternating root + object enclitic: Harmony

(30) **VHarmony ≫ Ident-IO(V), Ident-IO**

bala$^{3.3}$=ɔ^{2}	VHarmony	Ident-IO(V)	Ident-IO
a. bala$^{3.3}$=ɔ^{2}	*!		
b. ☞bɔlɔ$^{3.3}$=ɔ^{2}		**	**

Alternating root + passive: No harmony

(31) **Ident-IO ≫ VHarmony ≫ Ident-IO(V)**

bala$^{3.3}$=ɔ^{2}	IDENT-IO	VHARMONY	IDENT-IO(V)
a. ☞bala$^{3.3}$=ɔ^{2}		*	
b. bɔlɔ$^{3.3}$=ɔ^{2}	*!*		**

Non-alternating root + object enclitic: No harmony

(32) **Ident-IO(V) ≫ VHarmony ≫ Ident-IO**

ɟʊla$^{3.2}$=ɔ^{2}	Ident-IO(V)	VHarmony	Ident-IO
a. ☞ɟʊla$^{3.2}$=ɔ^{2}		**	
b. ɟɔlɔ$^{3.2}$=ɔ^{2}	*!*		**

Non-alternating root + passive: No harmony

(33) **Ident-IO, Ident-IO(V) ≫ VHarmony**

ɟʊla$^{3.2}$=ɔ^{2}	IDENT-IO	IDENT-IO(V)	VHARMONY
a. ☞ɟʊla$^{3.2}$=ɔ^{2}			*
b. ɟɔlɔ$^{3.2}$=ɔ^{2}	*!*	**	

Full harmony summary

- The combined effect of two subrankings results in full vowel harmony only in when both of the following are present:
  1. A plural suffix or object enclitic
  2. An alternating root
- The result is **a morphologically and lexically conditioned phonological process**.

Conclusion

Implications

Implications

- Phonological phenomena can be conditioned by morphology, syntax, or lexical item.
  - Morphology: Guébie scalar tone shift in imperfective contexts, full harmony in object marking and plural contexts.
  - Syntax: Guébie ATR and Nasal harmony within the verbal projection.
  - Lexical item: Guébie full harmony on 33.5% of roots.

Implications

- An enriched notion of vocabulary items (lexical items) in the Distributed Morphology framework can account for all three types of conditioning in a unified way.

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  - Phase-based application of morphology and phonology results in domain-specific phonological effects.

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- An enriched notion of vocabulary items (lexical items) in the Distributed Morphology framework can account for all three types of conditioning in a unified way.
  - Phase-based application of morphology and phonology results in domain-specific phonological effects.
  - Associating a sub-ranking of constraints with a particular morpheme (functional or lexical) results in application of a phonological process only in the presence of that morpheme.

Implications

- Previous models have accounted for individual conditioning factors:
  - **Syntactic domain effects**: Match Theory (**?**Selkirk, 2011); Contiguity Theory (Richards, 2016)
  - **Morphological conditioning**: Lexical strata or levels (Kiparsky et al., 1982; Kiparsky, 2000, 2008)
  - **Lexical conditioning**: Indexed constraints (Itô and Mester, 1995); Cophonologies (Orgun, 1996; Inkelas et al., 1997; Inkelas and Zoll, 2005)
- Cophonologies by Phase accounts for all three kinds of conditioning in a single model, with very few modifications to existing theoretical tools.

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- Cophonologies by Phase accounts for all three kinds of conditioning in a single model, with very few modifications to existing theoretical tools.
  - Proposed modification: Vocabulary items may be associated with subrankings of constraints.

Thank you!

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- UC Berkeley undergraduate students Brittany Blankinship, Steven Ho, Andrea Eberle, Corrina Fuller, Phoebe Killick, and Emma Woolf, who have helped to maintain the online Guébie database.

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Appendix 1: Tone replacement

(34) **Default tone on nouns**

	Noun	**Gloss**
a.	mana$^{3.3}$	'meat'
b.	di^{3}	'cut'
c.	ɲo^{31}	'person'
d.	bitə$^{2.3}$	'house'
e.	wəli$^{3.2}$	'top'

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

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

b. bitə$^{2.3}$ wəli$^{2.2}$
house top
'top of house'

Phonologically determined agreement

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- Noun class agreement is phonologically determined in Guébie.

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Phonologically determined agreement

- Noun class agreement is phonologically determined in Guébie.
- Non-human pronouns and adjectives agree in phonological features with nouns.
- We will see that we need not specify any underlying phonological representation for non-human pronouns in Guébie.
- Instead, constraints in the noun-phrase specific cophonology result in phonological agreement.

Pronoun forms

- Guébie subject pronouns occur immediately before the auxiliary or inflected verb.

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- Object pronouns have the same segmental form as subject pronouns, with tone one step lower than their subject counterparts.

(36) **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**	e^3,$ə^3$,u^3	i^3,wa^3

Pronoun forms

- Guébie subject pronouns occur immediately before the auxiliary or inflected pronoun.
- Object pronouns have the same segmental form as subject pronouns, with tone one step lower than their subject counterparts.

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

	Human		**Non-human**	
	Singular	**Plural**	**Singular**	**Plural**
1st	e^4	a^3	–	–
2nd	e^2	a^2	–	–
3rd	$ɔ^3$	**wa**^{3}	**e**^{3}**,ə**^{3}**,u**^{3}	**i**^{3}**,wa**^{3}

Human pronouns

- Human pronouns always surface as [ɔ^{3}], singular, and [wa^{3}], plural.

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

a. ŋudi-ja$^{3.1.3}$ ɔ^{3} wa^{2} jɛrɛ-lili$^{3.2.2.2}$
man-DEF 3SG.NOM like.IPFV spice-food
'As for the man, he likes spicy food.'

b. # ŋudi-ja$^{3.1.3}$ e^{3} wa^{2} jɛrɛ-lili$^{3.2.2.2}$
man-DEF 3SG.NOM like.IPFV spice-food
Intended: 'As for the man, he likes spicy food.'
(syl_20151113)

Non-human pronouns

(39) **Phonologically determined object pronoun agreement** (syl_20140130)

Noun	**Gloss**	**Object pronoun**	**Gloss**
a. ɟi$\underline{e}^{2.2}$	'a prison'	e-^{4} ni-^{4} **e**^{2} ji^{3}	'I saw it (prison)'
b. k^{w}al$\underline{a}^{4.2}$	'a farm'	e-^{4} ni-^{4} **ə**^{2} ji^{3}	'I saw it (farm)
c. t$\underline{o}^{3}$	'battle'	e-^{4} ni-^{4} **u**^{2} ji^{3}	'I saw it (battle)'

Noun to pronoun mapping

- The backness of the noun determines its corresponding pronoun vowel.

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

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

Lack of semantic coherence for a given vowel

(41) **Words that take the front vowel pronoun, /e/**

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

Lack of semantic coherence for a given vowel

(42) **Words that take the central vowel pronoun, /ə/**

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

Lack of semantic coherence for a given vowel

(43) **Words that take the back vowel pronoun, /u/**

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'

Noun class agreement is phonologically determined

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

a. sukul**u**$^{1.1.3}$ kɔda.$^{3.21}$ e-^{4} ni-^{4}
school exist.IPFV 1SG.NOM see.PFV
u^{2} ji^{3}
3SG.ACC see
'There is a school. I saw it (the school).'

b. baraʒ**ɛ**$^{2.3.2}$ kɔda.$^{3.21}$ e-^{4} ni-^{4}
dam exist.IPFV 1SG.NOM see.PFV
e^{2} ji^{3}
3SG.ACC see
'There is a dam. I saw it (the dam)'
(syl_20140130)

Noun class agreement is phonologically determined

- Further evidence that agreement in Guébie is phonologically determined comes from suffixed nouns.

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a.	sukulu$^{1.1.3}$	'school'
b.	sukulu-a$^{1.1.3.3}$	'the school'

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- 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: ə, #e, #u

Noun class agreement throughout the noun phrase

- Adjectives also agree phonologically with nouns.

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

a. bitə$^{2.3}$ lelə$^{1.2}$ ɟɛlɑ$^{1.1}$
house new red
'A new red house'

b. fu^{3} lelo$^{1.2}$ ɟɛlɔ$^{1.1}$
sponge new red
'A new red sponge'