Doubly conditioned phonological processes in Cophonologies by Phase

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  - Rounding harmony in Laal only occurs when both a round vowel and a labial consonant are present.

a.	/ɓɨr-ú/	→	ɓu̲r-ú	'hooks'
b.	/təb-ó/	→	to̲b-ó	'fishes sp.'
c.	/dɨlm-ú/	→	du̲lm-ú	'types of houses'
d.	/pəb-ó/	→	po̲b-ó	'cobras'
e.	/məlm-ó/	→	mo̲lm-ó	'Koranic school teachers'

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  - Both triggers must be present for categorical rounding to surface:

f. /kəəm-ə́/ → [kəəm-ə́], 'tree sp.-pl'
g. /gɨ́n-ù/ → [gɨ́n-ù], 'net-pl'

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     - Answer: Yes
  2. How can we model these doubly conditioned processes?
     - Answer: Cumulative morpheme-specific constraint weight readjustments in Cophonologies by Phase (CBP).
- **Phenomena:**
  - Vowel lengthening in Sacapultec Maya (DuBois, 1981, 1985)
  - Vowel harmony in Guébie (Sande, 2017)

Overview

The Model

Preview of Cophonologies by Phase

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- CBP assumes a modular grammar and relies on specific interactions between Syntax, Morphology, and Phonology.
- The model combines Distributed Morphology operations such as late insertion of vocabulary items with phonological evaluation via weighted constraints.
- Crucially, I adopt an enriched notion of Vocabulary Items (lexical representations) in a Distributed Morphology framework (Sande and Jenks, 2018).

Vocabulary items

- Traditional DM vocabulary items (Embick and Noyer, 2007, p. 298-299):

(1) [pl] $\longleftrightarrow$ z

(2) [pl] $\longleftrightarrow$ -en/$\{\sqrt{\text{OX}}, \ldots\}$

(3) [pl] $\longleftrightarrow$ $\varnothing$/$\{\sqrt{\text{MOOSE}}, \sqrt{\text{DEER}}, \ldots\}$

Vocabulary items

- In CBP, each vocabulary item contains three components:
  1. An underlying phonological representation, $\mathcal{F}$
  2. A prosodic subcategorization frame, $\mathcal{P}$
  3. **A constraint weight readjustment, $\mathcal{R}$**

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  2. A prosodic subcategorization frame, $\mathcal{P}$
  3. **A constraint weight readjustment, $\mathcal{R}$**
- The constraint weight adjustment adds to the default weight of that constraint for the language.
- Morpheme-specific weights only apply during phonological evaluation of the *phase* containing the triggering morpheme.

CBP in action

In Yapese, we see truncation in vocative contexts.

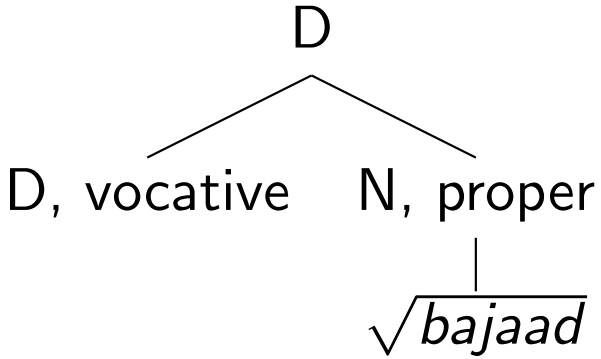
(4) *Yapese vocatives* (Jensen, 1977)

Name	*Vocative name*
luʔag	luʔ
bajaad	baj
maŋɛfɛl	maŋ

In CBP this is analyzed as a vocative-specific phonological grammar.

CBP in action

(5) *Yapese vocative D^0 before spell-out*



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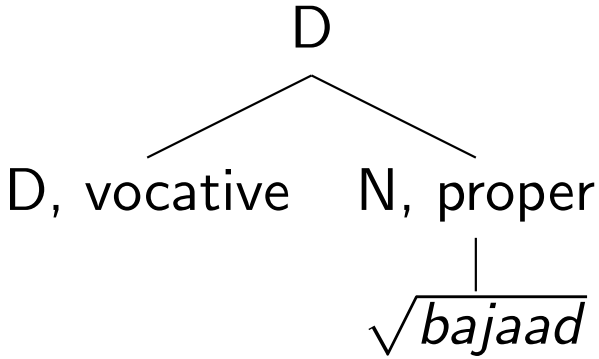

- For the purposes of this talk, I assume that phase heads include D, Voice, and C.
- In the tree above, then, D is a phase head.

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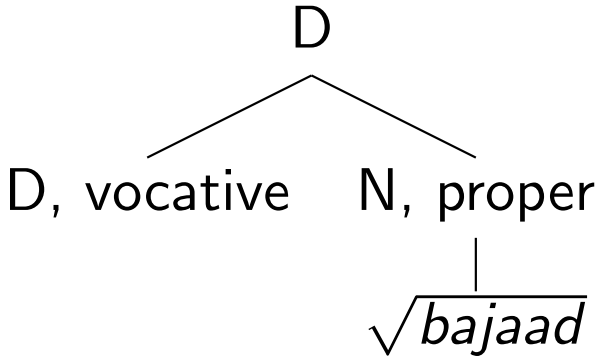

- For the purposes of this talk, I assume that phase heads include D, Voice, and C.
- In the tree above, then, D is a phase head.
- When a phase head is merged, it is spelled out together with its complement.

CBP in action

The noun itself is not associated with a constraint weight adjustment.

(6) $[\sqrt{\text{BAJAAD}}] \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & /\text{bajaad}/ \\ \mathcal{P}: & [\omega X] \\ \mathcal{R}: & \varnothing \end{Bmatrix}$

[1] For more details on the Yapese analysis, see Sande et al. (Submitted).

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So, in the absence of a vocative D head the default phonological grammar of the language applies:

(7) *Yapese default constraint weights*[1]

Constraint	Weight
MAX	2
MAX(σ,L)	1
ω=σ	1

[1] For more details on the Yapese analysis, see Sande et al. (Submitted).

CBP in action

(8) *Phonological evaluation of Yapese non-vocative D*

/[$_\omega$ bajaad]/	MAX 2	MAX(σ,L) 1	ω=σ 1	**H**
a. ☞[$_\omega$ ba.jaad]			1	1
b. [$_\omega$ baj]	3			6
c. [$_\omega$ jaad]	2	2		6

CBP in action

The vocative D head is associated with a constraint weight adjustment:

(9) $[\text{D, VOCATIVE}] \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & \varnothing \\ \mathcal{P}: & \varnothing \\ \mathcal{R}: & \text{MAX}^{-1.9} \end{Bmatrix}$

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The morpheme-specific constraint weights are added to the default weights of the language to result in a construction-specific grammar:

(10) *Yapese constraint weights for vocative D^0*

Constraint	*Weight*
$\omega{=}\sigma$	1
$\text{MAX:}\sigma\text{,L}$	1
MAX	0.1

CBP in action

(11) *Phonological evaluation of Yapese vocative D*

/[$_\omega$ bajaad]/	ω=σ 1	MAX:ROOT,L 1	MAX 0.1	**H**
a. [$_\omega$ ba.jaad]	1			1
b. ☞[$_\omega$ baj]			3	0.3
c. [$_\omega$ jaad]		2	2	2.2
d. [$_\omega$ ba]			4	0.4

CBP in action

- In Yapese, we only see truncation to the leftmost syllable in vocative constructions, when the $\mathcal{R}$ of the vocative D head adds to the default weights of the language, demoting the MAX constraint.

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- In Yapese, we only see truncation to the leftmost syllable in vocative constructions, when the $\mathcal{R}$ of the vocative D head adds to the default weights of the language, demoting the MAX constraint.
- CBP can handle other cases of morphologically conditioned phonology in the same way (Sande and Jenks, 2018; Sande et al., Submitted).

Why CBP?

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- Category-specific phonology (Sande and Jenks, 2018; Sande et al., Submitted)
- Cross-word (phrasal) morpheme-specific phonology (Sande and Jenks, 2018; Sande et al., Submitted)
- Morpheme-specific effects that target prosodic constituents (Jenks, 2018)

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In the rest of this talk, I show that it can straightforwardly model phonological processes that require *two* morphological triggers.

Mayan vowel lengthening

Language background

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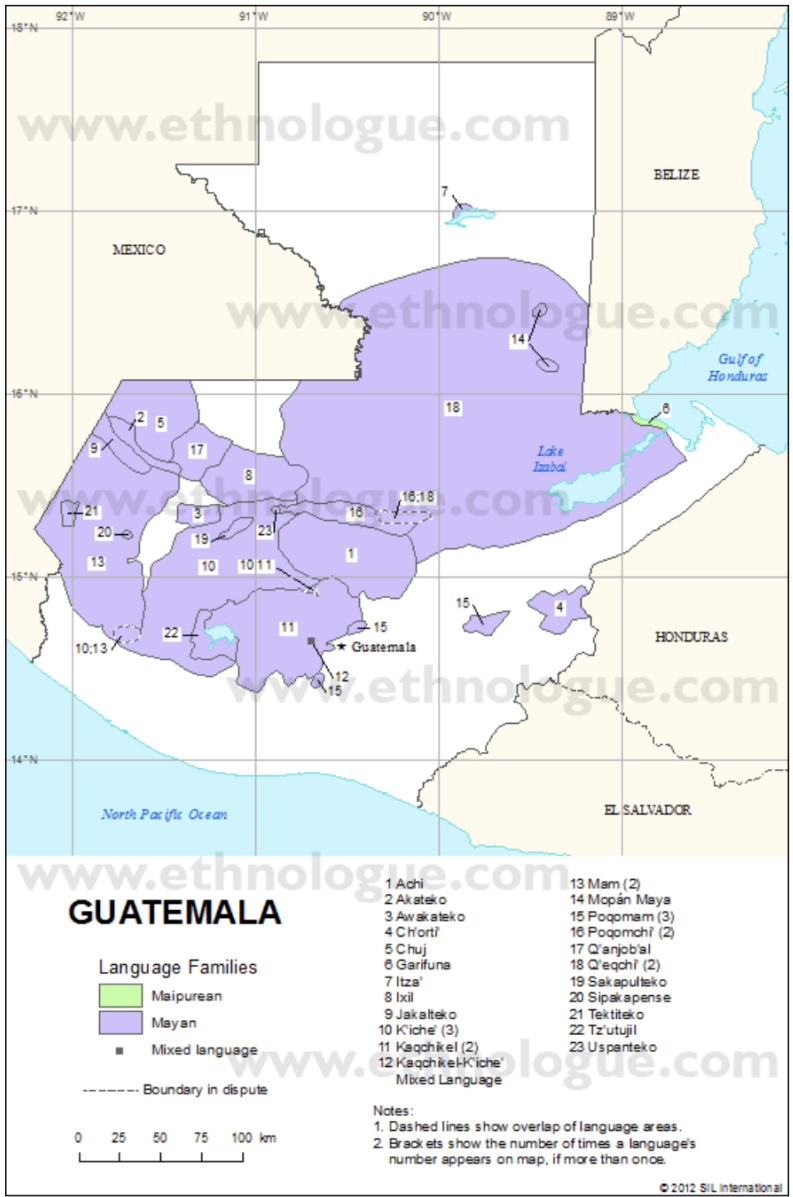
- Spoken by about 15,000 speakers in Guatemala.
- Data from DuBois (1981).

Language background



Vowel lengthening

- Nouns in Sacapultec can be preceded by a possessive prefix:
  - tʃaːk, ‘work’
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  - ni-tʃaːk ‘my work’
- A subset of lexical items shows final-vowel lengthening only in the context of a possessive prefix.
- **Two extra-phonological triggers:**
  1. Possessive prefix
  2. Alternating lexical item

Data

(12) **Sacapultec lengthening** (DuBois 1981:184-189)

a.	ak’	w-a:k’	‘my chicken’
b.	ab’ax	w-ub’a:x	‘my rock’
c.	ilib’-atʃ	w-ili:b’	‘my daughter-in-law’
d.	tʃ’eʔ	ni-tʃ’i:ʔ	‘my dog’
e.	mulol	ni-mulu:l	‘my gourd’
f.	tʃax	ni-tʃa:x	‘my pine’
g.	kumatʃ	ni-kuma:tʃ	‘my snake’
h.	xalom-ax	ni-xalo:m	‘my head’
i.	tiʔb’al	ri-tiʔb’a:l	‘its stinger’
j.	otʃ’	w-otʃ’	‘my possum’
k.	am	w-am	‘my spider’
l.	weʔ	ni-weʔ	‘my head hair’
m.	tʃa:k	ni-tʃa:k	‘my work’
n.	tʃa:x	ni-tʃa:x	‘my ashes’

Other prefixes

Other prefixes fail to trigger vowel lengthening on the same lexical items.

(13) **Stative predicate prefixes** (DuBois 1981:181-182)

winaq	'person'	in-winaq, *in-wina:q	'I am a person'
ak'	'chicken'	in-ak', *in-a:k'	'I am a chicken'

Summarizing the facts

In sum, both a lexical item of the alternating class and a possessive prefix must be present for final-vowel lengthening to apply in Sacapultec.

The default phonology

The constraints relevant in accounting for vowel harmony follow:

- DEP: Assign a violation for each segment in the output that does not have a corresponding input segment.
- FINALLENGTHENING: Assign a violation when the final vowel in a phonological word is short.

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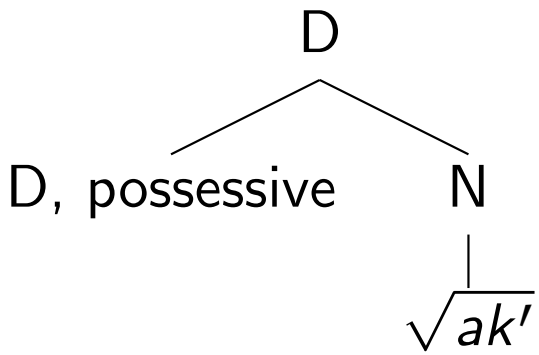
These constraints are weighted as below:

(14) *Default weights in Sacapultec*

Constraint	*Weight*
DEP	2
FINALLENGTH	.5

Syntactic structure



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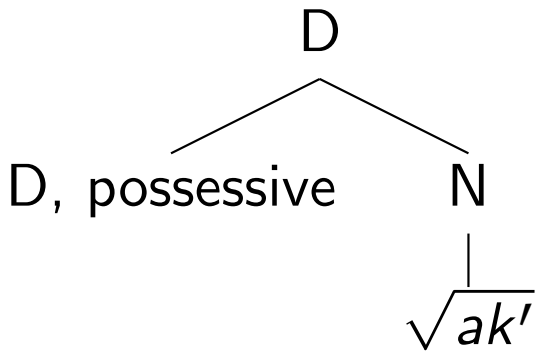

D is a phase head. Neither N nor the root is associated with a constraint reweighting, so the default grammar will apply when a non-possessive D head is present, resulting in a faithful, non-lengthened output: [$_{\omega}$ ak'].

D vocabulary item: Attempt 1

(15) $[\text{D, 1SG, POSS}] \longleftrightarrow \left\{ \begin{matrix} \mathcal{F}: & w- \\ \mathcal{P}: & [_{\omega}X- \\ \mathcal{R}: & \text{FINALLENGTH}^{+2} \end{matrix} \right\} : \_\_\text{V}$

In the context of a possessive D head, the resulting constraint weights show a reversal in strength of faithfulness and markedness from the default :

(16) **Possessive D constraint weights**

Constraint	*Weight*
DEP	2
FINALLENGTH	2.5

Phonological evaluation: Attempt 1

(17) *Phonological evaluation of Sacapultec possessive D*

/[ω w-ak']/	DEP 2	FINALLENGTH 2.5	**H**
a. [ω wak']		1	2.5
b. ☞[ω wa:k']	1		2

Problem!

This analysis makes the wrong predictions for non-alternating roots:

(18) *Phonological evaluation of Sacapultec possessive D + non-alternating root*

/[$_\omega$ w-am]/	DEP 2	FINALLENGTH 2.5	**H**
a. [$_\omega$ wam]		1	2.5
b. ☹ [$_\omega$ wa:m]	1		2

This model predicts the wrong output for the non-alternating root /am/, 'spider', which should surface as [wam], 'my spider', not *[wa:m].

Vocabulary items: Attempt 2

(19) $[\text{D, 1SG, POSSESSIVE}] \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & w- \\ \mathcal{P}: & [_\omega X- \\ \mathcal{R}: & \text{FINALLENGTH}^{+1} \end{Bmatrix}$

(20) $\sqrt{ak'} \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & ak' \\ \mathcal{P}: & [_\omega X] \\ \mathcal{R}: & \text{FINALLENGTH}^{+1} \end{Bmatrix}$

(21) $\sqrt{am} \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & am \\ \mathcal{P}: & [_\omega X] \\ \mathcal{R}: & \varnothing \end{Bmatrix}$

Updated constraint weight adjustments

When a possessive prefix is present, but an alternating root is not, the adjusted weight of FinalLength (.5+1 = 1.5) is not enough to overpower the faithfulness constraint Dep (weight 2):

(22) *Phonological evaluation of Sacapultec possessive D + non-alternating root*

/[ω w- [ω am]/	Dep 2	FinalLength 1.5	**H**
a. ☞[ω wam]		1	1.5
b. [ω wa:m]	1		2

Updated constraint weight adjustments

Similarly, when an alternating root is present, but a possessive prefix is not, the adjusted weight of FinalLength (.5+1 = 1.5) is not enough to overpower the faithfulness constraint Dep (weight 2):

(23) *Phonological evaluation of a Sacapultec alternating root in non-possessive contexts*

/[ω in [ω ak']/	Dep 2	FinalLength 1.5	**H**
a. ☞[ω inak']		1	1.5
b. [ω ina:k']	1		2

Updated constraint weight adjustments

Only in the presence of both an alternating root *and* a possessive D head do we see vowel lengthening: FinalLength = .5+1+1 = 2.5.

(24) *Phonological evaluation of a Sacapultec alternating root in possessive contexts*

/[ω w- [ω ak']/	Dep 2	FinalLength 2.5	**H**
a. [ω wak']		1	2.5
b. ☞[ω wa:k']	1		2

Distribution of final-vowel lengthening

(25) *Lengthening only when both triggers are present*

	Alternating root	*Non-alternating root*
Possessive	✓	–
Non-possessive	–	–

Distribution of final-vowel lengthening

(25) *Lengthening only when both triggers are present*

	Alternating root	*Non-alternating root*
Possessive	✓	–
Non-possessive	–	–

We achieve double morphological conditioning by associating a morpheme-specific constraint weight adjustment with both triggers. Only when they are both present, the final vowel surfaces as long.

Guébie vowel harmony

The Guébie language

- Guébie is an endangered Kru language spoken in southwest Côte d'Ivoire.
- The data presented here comes from original fieldwork on Guébie over the past 5+ years.
- 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, but has lots of fascinating grammatical patterns of interest to the theoretical literature.

Where is Guébie spoken?

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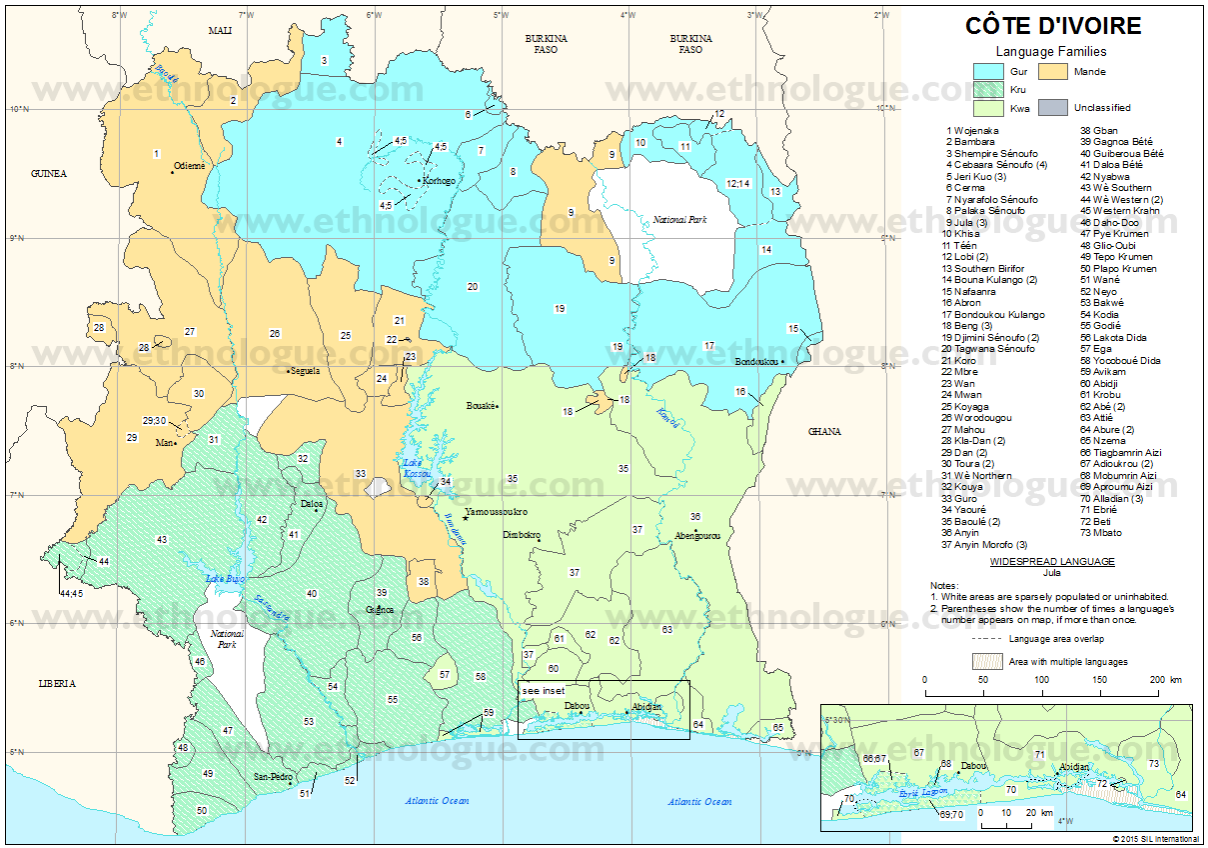


Gnagbodougnoa

Field elicitation

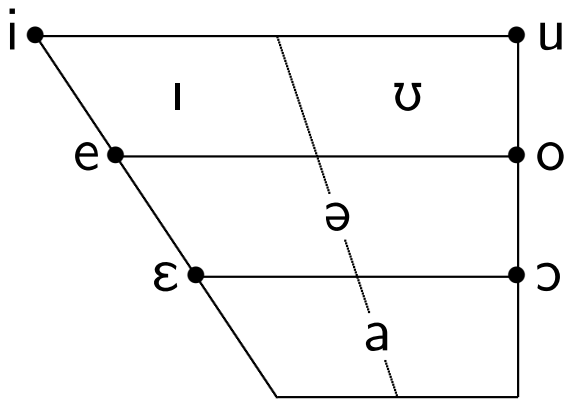
Language background: Consonants

(26) **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

(27) **Vowel inventory**



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’
- Though there are also a number of disyllabic roots.
  - Ex: bala$^{3.3}$ ‘hit’, ɲɔkpɔ$^{3.1}$ ‘person’

Doubly conditioned phonology

Like in Sacapultec, there is a phonological process in Guébie which only surfaces in the environment of 1) a subset of affixes, and 2) a subset of lexical items.

Affix-controlled vowel harmony

- A subset of morphemes, namely object-marking enclitics and plural suffixes, trigger full vowel harmony on roots.

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(28) **Full vowel harmony**

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

b. ɔ^{3} bɔl=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}	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$^{2.3}$	=ɪ^{2}	jɪl=ɪ$^{2.32}$, *jil=ɪ$^{2.32}$	'steal them'
d.	jɪla$^{3.2}$	=ɔ^{2}	jɔl=ɔ$^{3.2}$, *jɪl=ɔ$^{3.2}$	'ask him'
e.	jɪla$^{3.2}$	=ɛ^{2}	jɛl=ɛ$^{3.2}$, *jɪl=ɛ$^{3.2}$	'ask it'
f.	jɪla$^{3.2}$	=ɪ^{2}	jɪl=ɪ$^{3.2}$, *jɪl=ɪ$^{3.2}$	'ask them'
g.	bala$^{3.3}$	=ɔ^{2}	bɔl=ɔ$^{3.2}$, *bal=ɔ$^{3.2}$	'hit him'
h.	bala$^{3.3}$	=ɛ^{2}	bɛl=ɛ$^{3.2}$, *bal=ɛ$^{3.2}$	'hit it'
i.	bala$^{3.3}$	=ɪ^{2}	bɪl=ɪ$^{3.2}$, *bal=ɪ$^{3.2}$	'hit them'

Morphemes that trigger full vowel harmony

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

(30) **Full harmony in plural contexts**

	Singular	**Plural**	**Gloss**
a.	ɓele$^{2.2}$	ɓil-i$^{2.2}$	'cow'
b.	mɛnɛ$^{3.3}$	man-a$^{3.2}$	'animal'

Morphemes that trigger full vowel harmony

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- 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.

(31) **No harmony in passive contexts**

	Verb	**Verb+Pass**	**Gloss**
a.	bala$^{3.3}$	bal-ɔ$^{3.2}$, *bɔl-ɔ$^{3.3.2}$	'be hit'
b.	jɪla$^{3.2}$	jɪl-ɔ$^{3.2}$, *jɔl-ɔ$^{3.2.2}$	'be asked'

Outer morphemes

Additionally, morphemes that attach outside the object enclitic or plural suffix fail to undergo harmony:

(32) **Root+Obj+Nominalizer**

	Root	=3SG.ACC	=NMLZ	*Gloss*
a.	bala$^{3.3}$	bɔl=ɔ$^{3.2}$	bɔl=ɔ=li$^{3.2.2}$	'hit'
b.	tulu$^{4.4}$	tɔl=ɔ$^{4.2}$	tɔl=ɔ=li$^{4.2.2}$	'chase'
c.	jɪla$^{3.2}$	jɔl=ɔ$^{3.2}$	jɔl=ɔ=li$^{3.2.2}$	'ask'

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(33) **Root+Pl+Definite**

	Singular	*Plural*	*-Def*	*Gloss*
a.	ɓele$^{2.2}$	ɓil-i$^{2.2}$	ɓil-i-a$^{2.2.2}$	'cow'
b.	mɛnɛ$^{3.3}$	man-a$^{3.2}$	man-a-a$^{3.2.2}$	'animal'

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.

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  - However, no set of phonological traits exhaustively and exclusively picks out the correct set of roots.
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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

- 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.
- Both the triggering morpheme and alternating lexical item must be present for harmony to surface.

Combined effects of subrankings

- I analyze the interaction of morphological and lexical conditioning of full harmony in Cophonologies by Phase.
- The relevant constraints, IDENT-IO(V) and VHARMONY, have the default weights below.

(34) *Default weights in Guébie*

Constraint	*Weight*
IDENT-IO(V)	3
VHARMONY	.5

Accounting for affix specificity

- **Proposal:** plural and object markers are associated with a morpheme-specific constraint weight adjustment:

(35) **Object marker vocabulary item**

$$[3sg.hum.acc] \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & /ɔ^2/ \\ \mathcal{P}_5: & = X_\omega] \\ \mathcal{R}_5: & \text{VHarm}^{+1.5}, \text{Ident-V}^{-.5} \end{Bmatrix}$$

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- This constraint weight adjustments associated with $\mathcal{R}$ add to the default weights to give us $\textsc{Ident-IO(V)}$=2.5 and $\textsc{VHarm}$=2.
- On its own, this ranking is not enough to result in full harmony.

Non-alternating root + object enclitic: No harmony

(36) *Phonological evaluation of Guébie Non-alternating Verb+Object*

/ɟʊlaˣ=ɔʸ/	IDENT 2.5	VHARM 2	**H**
a. ☞[ω ɟʊlɔˣ]		1	2
b. [ω ɟɔlɔˣ]	1		2.5

Alternating root + object enclitic: Harmony?

(37) *Phonological evaluation of Guébie Alternating Verb+Object*

/bala$^{3.3}$=ɔ^{2}/	IDENT 2.5	VHARM 2	**H**
a. ☹ [$_{\omega}$ balɔ$^{3.2}$]		1	2
b. [$_{\omega}$ bɔlɔ$^{3.2}$]	1		2.5

Accounting for lexical specificity

- **Problem:** The object-specific constraint reweighting is not enough to trigger harmony, even on alternating lexical items.
- **Proposal:** Alternating roots are also associated with a constraint weight adjustment:

(38) **Alternating root vocabulary item**

$$[\sqrt{hit}] \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & /\text{bala}^{3.3}/ \\ \mathcal{P}_6: & [X_\omega] \\ \mathcal{R}_6: & \text{VHarmony}^{+1}, \text{Ident-V}^{-1} \end{Bmatrix}$$

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- These weights add to the default ranking in phases containing alternating items.
- On its own, the adjusted weights are $\textsc{Ident}=2$, $\textsc{VHarm}=1.5$.
- Again, on its own, this is not enough to result in full 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.

(39) **Cumulative effects of morpheme-specific cophonologies**

Grammar	IDENT-IO(V)	VHARM
Default	3	.5
Obj/Pl	-.5	+1.5
Alt. root	-1	+1
Total weight	1.5	3

Alternating root + object enclitic: Harmony

(40) **Harmony when both triggers are present**

$[_\omega$ bala$^{3.3}]$=ɔ^2	VHarmony 3	Ident-V 1.5	**H**
a. $[_\omega$ balɔ$^{3.2}]$	1		3
b. ☞$[_\omega$ bɔlɔ$^{3.2}]$		1	1.5

Non-alternating root + object enclitic: No harmony

(41) **No harmony without alternating root**

[ω ɟʊlaˈ3.2]=ɔ²	IDENT-V 2.5	VHARMONY 2	**H**
a. ☞[ω ɟʊlɔˈ3.2]		1	2
b. [ω ɟɔlɔˈ3.2]	1		2.5

Alternating root + passive: No harmony

(42) **No harmony without suffixal trigger**

[ω balaˈ$^{3.3}$]-ɔ^{2}	IDENT-V 2	VHARMONY 1.5	**H**
a. ☞[ω balɔˈ$^{3.2}$]		1	1.5
b. [ω bɔlɔˈ$^{3.2}$]	1		2

Non-alternating root + passive: No harmony

(43) **No harmony when both triggers are absent**

[ω ɟʊlaˈ]-ɔ²	IDENT-V 3	VHARMONY .5	**H**
a. ☞[ω ɟʊlɔˈ]		1	.5
b. [ω ɟɔlɔˈ]	1		3

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
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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 doubly morphologically triggered conditioned phonological alternation.

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

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- **Underlying representations**
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    - All third person object enclitics and plural suffixes
    - All alternating lexical items
  - Requires constraints/rules that tell the phonology what to do with these exceptional representations.
  - Thus, it requires both exceptional representations AND constraints to drive the exceptional phonology. CBP only requires constraint-weight adjustments.

Alternative analyses

- **Indexed constraints**
  - A weighted version of Indexed Constraint Theory (ICT), allowing for local constraint conjunction and/or 'gang' effects (Smolensky and Legendre, 2006; Pater, 2010; Shih, 2016) is perhaps the best possible alternative analysis.

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  - With constraints indexed to particular morphemes, violations are incurred only when said morpheme is present: VHarm(Obj, Pl), VHarm(AlternatingClass).
  - Only when both indexed VHarm constraints would otherwise be violated do we see harmony surfacing.

Alternative analyses

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  - Recall that harmony does not apply to all vowels within a word when both triggering morphemes are present, only to vowels inside the first phase domain: bɔl=ɔ=li$^{3.2.2}$, Rt+Obj+NMLZ
  - ICT would predict full harmony on all vowels in a word: *bɔl=ɔ=lɔ$^{3.2.2}$.
  - In general, locality effects of morpheme-specific phonology are difficult to model with ICT.

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Conclusions

- Across typologically diverse languages, we see a class of phonological alternations that only surface in the presence of *two* morphological triggers.
- With an enriched notion of vocabulary items in Distributed Morphology, morpheme-specific constraint weight adjustments accumulate within a spell-out domain to result in construction-specific phonologies with one or more morphological triggers.
- Phase-based application of morphology and phonology results in domain-specific phonological effects, bɔl=ɔ=li$^{3.2.2}$, *bɔl=ɔ=lɔ$^{3.2.2}$.

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  - Exception features (Chomsky and Halle, 1968)
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  - Indexed constraints (Itô and Mester, 1995; Pater, 2010)
  - Cophonology Theory (Orgun, 1996; Inkelas et al., 1997; Inkelas and Zoll, 2005)
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  - Generalized Non-linear Affixation (and other representational accounts) Bermúdez-Otero (2012); Zimmermann (2013)
- CBP best accounts for doubly morphologically conditioned phonology.

Thank you!

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References I

Bermúdez-Otero, Ricardo. 1999. *Constraint interaction in language change: quantity in English and Germanic*. University of Manchester.

Bermúdez-Otero, Ricardo. 2012. The architecture of grammar and the division of labour in exponence. In *The morphology and phonology of exponence*, ed. Jochen Trommer, volume 41, 8–83. Oxford University Press, Oxford.

Chomsky, Noam, and Morris Halle. 1968. *The sound pattern of English*. Harper & Row.

DuBois, John. 1981. The sacapultec language. Doctoral Dissertation, UC Berkeley.

DuBois, John W. 1985. Incipient semanticization of possessive ablaut in Mayan. *International journal of American linguistics* 51:396–398.

References II

Embick, David, and Rolf Noyer. 2007. Distributed morphology and the syntax/morphology interface. *The Oxford handbook of linguistic interfaces* 289–324.

Inkelas, Sharon, Orhan Orgun, and Cheryl Zoll. 1997. The implications of lexical exceptions for the nature of grammar. In *Optimality theory in phonology: A reader*, ed. J. J. McCarthy, 542–551. Oxford: Blackwell.

Inkelas, Sharon, and Cheryl Zoll. 2005. *Reduplication: Doubling in morphology*, volume 106. Cambridge University Press.

Itô, Junko, and Armin Mester. 1995. Japanese phonology. In *The handbook of phonological theory*, ed. John Goldsmith, 816–838. Oxford: Blackwell.

Jenks, Peter. 2018. Cophonologies by Phase and the Moro verb. *Princeton Symposium on Syntactic Theory (PSST)* .

Jensen, J. T. 1977. *Yapese reference grammar*. Honolulu: University of Hawaii Press.

References III

Kiparsky, Paul. 2000. Opacity and cyclicity. *The linguistic review* 17:351–367.

Kiparsky, Paul. 2008. Fenno-Swedish quantity: Contrast in Stratal OT. In *Rules, constraints, and phonological phenomena*, ed. Bert Vaux and Andrew Nevins. Oxford: Oxford University Press.

Kiparsky, Paul, et al. 1982. From cyclic phonology to lexical phonology. *The structure of phonological representations* 1:131–175.

Lightner, Theodore. 1972. Some remarks on exceptions and on coexistent systems in phonology. *The Slavic Word* 426–442.

Lionnet, Florian. 2016. Subphonemic teamwork: A typology and theory of cumulative coarticulatory effects in phonology. Dissertation, UC Berkeley.

Lionnet, Florian. 2017. A theory of subfeatural representations: the case of rounding harmony in Laal. *Phonology* 34:523–564.

References IV

Orgun, Cemil. 1996. Sign-based morphology and phonology with special attention to Optimality Theory. Unpublished dissertation, UC Berkeley.

Pater, Joe. 2010. Morpheme-specific phonology: Constraint indexation and inconsistency resolution. In *Phonological argumentation: Essays on evidence and motivation*, ed. Steve Parker, 123–154. London: Equinox.

Sande, Hannah. 2017. Distributing morphologically conditioned phonology: Three case studies from Guébie. Doctoral Dissertation, UC Berkeley.

Sande, Hannah, and Peter Jenks. 2018. Cophonologies by phase. *NELS 48 Proceedings* .

Sande, Hannah, Peter Jenks, and Sharon Inkelas. Submitted. Cophonologies by ph(r)ase .

References V

Shih, Stephanie S. 2016. Super additive similarity in Dioula tone harmony. In *West Coast Conference on Formal Linguistics (WCCFL)*, volume 33, 361.

Smith, Jennifer L. 2011. Category-specific effects. *The Blackwell companion to phonology* 4:2439–2463.

Smolensky, Paul, and Géraldine Legendre. 2006. *The harmonic mind: From neural computation to optimality-theoretic grammar*. Cambridge, MA: MIT press.

Zimmermann, Eva. 2013. Non-concatenative allomorphy is generalized prosodic affixation: The case of Upriver Halkomelem. *Lingua* 134:1–26.