Doubly morphologically conditioned phonology in Cophonologies by Phase

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1 Introduction

Observation: Phonological alternations across languages may be sensitive to the presence of a morpheme or lexical item. Here I show that there are also alternations that apply only when *multiple* specific morphemes are present.

- I refer to such alternations as *doubly morphologically conditioned phonology*.

Challenge: Extant frameworks account for morphologically conditioned phonology, but have trouble preventing an alternation in the presence of just one of the two triggers.

Goals:

1. Describe two doubly morphologically conditioned phonological alternations in two typologically distinct languages.
   - Sacapultec (Mayan, Guatemala)
   - Guébie (Kru, Côte d'Ivoire)
2. Determine an ideal model to account for these and other cases of doubly morphologically conditioned phonology.
   - I show that Cophonologies by Phase (Sande and Jenks, 2018; Sande, 2019) can account for doubly conditioned alternations in a straightforward way.
     * Cophonologies by Phase (CBP): a model of constraint weight readjustments associated with particular morphemes (**cophonologies**) which scope over spell-out domains, or syntactic phases (**by phase**).

2 Doubly conditioned lengthening in Sacapultec

The data:

- The data presented comes from a descriptive grammar of Sacapultec (Sacapultek, Sacapulteco) (DuBois, 1981).
  - Three primary speakers, all male
  - Collected during fieldwork in Sacapulas in 1974 and 1977

2.1 The puzzle

- In Sacapultec, the final root vowel in some nouns lengthens when preceded by a possessive prefix (1a-h).
- Other nouns fail to show this lengthening process (1i-k).
- Some nouns have final long vowels by default (1l-m), and the lengthening process can lead to neutralization between roots with underlyingly short and long vowels, (1f) versus (1m).

(1) **Sacapultec lengthening** (DuBois, 1981, 184-189)

	Noun	**1sg.poss-Noun**	
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.	mulol	ni-mulu:l	‘my gourd’
e.	tʃ’eʔ	ni-tʃ’i:ʔ	‘my dog’
f.	tʃax	ni-tʃa:x	‘my pine’
g.	kumatʃ	ni-kuma:tʃ	‘my snake’
h.	xalom-ax	ni-xalo:m	‘my head’
i.	otʃ’	w-otʃ’	‘my possum’
j.	am	w-am	‘my spider’
k.	weʔ	ni-weʔ	‘my head hair’
l.	tʃa:k	ni-tʃa:k	‘my work’
m.	tʃa:x	ni-tʃa:x	‘my ashes’

- Lengthening fails to occur in the presence of other affixes (2).

(2) **Stative predicate prefixes** (DuBois, 1981, 181-182)

	Noun		**Stative-Noun**
a. winaq	‘person’	in-winaq, *in-wina:q	‘I am a person’
b. ak’	‘chicken’	in-ak’, *in-a:k’	‘I am a chicken’

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

(3) **Distribution of Sacapultec final vowel lengthening**

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

- Similar phonological processes in the presence of possession are seen across Mayan (Bennett, 2016).

2.2 The analysis

- I analyze doubly conditioned phenomena with a weighted constraint phonological grammar which applies at syntactic phase boundaries via Cophonologies by Phase.

- **Major assumptions of CBP**:
  - Spell-out, including phonological evaluation, applies at phase boundaries (Chomsky, 2000, 2001; Pak, 2008; Jenks and Rose, 2015; Sande, 2017; Kastner, 2019).
  - Phase heads include at least Voice, C, and D (Chomsky, 2000, 2001; Marvin, 2002).
    - **Prediction 1:** Morpheme-specific phonological specifications will only affect material spelled out within the same phase as the trigger morpheme, and not hierarchically higher material (Sande and Jenks, 2018).
    - **Prediction 2:** The domain of application of morpheme-specific phonology will align with phase boundaries (which could be smaller or larger than a word), and not stem or word boundaries (Sande, 2019; Sande et al., 2019).
  - Vocabulary items are inserted late in the derivation, as in Distributed Morphology (Halle and Marantz, 1993).
  - Phonological evaluation involves weighted constraints via Harmonic Grammar (Legendre et al., 1990; Smolensky and Legendre, 2006).
  - Vocabulary items can be associated with constraint-weight readjustments, $\mathcal{R}$, that affect the phonological evaluation of the phase containing them (Sande and Jenks, 2018; Sande, 2019).
    - **Prediction 3:** Multiple morpheme-specific constraint weight readjustments in the same phase can interact.

- The relevant constraints in accounting for Sacapultec lengthening are these:

(4) DEP: Assign a violation for each segment in the output that does not have a corresponding input segment. (McCarthy and Prince, 1993)

(5) FINALLENGTHENING: Assign a violation when the final vowel in a phonological word is short.

(6) **Default weights in Sacapultec**

Constraint	**Weight**
DEP	2
FINALLENGTH	.5

- The syntactic structure is provided in (7), where D is assumed to be a phase head.

(7) **Syntactic structure**

- When a non-alternating root is present, its vocabulary item is inserted.

(8) **Non-alternating vocabulary item**

– $\sqrt{am} \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & am \\ \mathcal{P}: & [_\omega X] \\ \mathcal{R}: & \emptyset \end{Bmatrix}$

- There is no $\mathcal{R}$ specification affecting the weights of constraints, so the default grammar applies to the phase domain containing $\sqrt{am}$, and the faithful candidate surfaces.

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

/am/	DEP 2	FINALLENGTH .5	**H**
a. ☞[$_\omega$ am]		1	.5
b. [$_\omega$ a:m]	1		2

- Possessive prefixes and alternating roots are associated with constraint weight readjustments as part of their vocabulary entry.

(10) **Sacapultec vocabulary items**

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

– $\sqrt{ak'} \longleftrightarrow \begin{Bmatrix} \mathcal{F}: & ak' \\ \mathcal{P}: & [_\omega X] \\ \mathcal{R}: & \text{DEP}^{-1} \end{Bmatrix}$

- When only one of the triggering morphemes is present in a phase, its $\mathcal{R}$ specification is not strong enough to have an effect.

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

/w-am/	DEP 2	FINALLENGTH 1.5	**H**
a. ☞[$_\omega$ wam]		1	1.5
b. [$_\omega$ wa:m]	1		2

(12) **Phonological evaluation of alternating root in non-possessive contexts**

/in-ak'/	DEP 1	FINALLENGTH .5	**H**
a. ☞[$_\omega$ inak']		1	.5
b. [$_\omega$ ina:k']	1		1

- Only when both are present in the same phase domain will their cumulative effects result in the lengthening candidate being optimal.

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

/ w-ak'/	DEP 1	FINALLENGTH 1.5	**H**
a. [$_\omega$ wak']		1	1.5
b. ☞[$_\omega$ wa:k']	1		1

- The result is final vowel lengthening only in the presence of both an alternating root and a possessive prefix.

3 Doubly conditioned harmony in Guébie

The data:

- The data presented here was collected with Guébie speakers in Gnagbodougnoa, Côte d'Ivoire from 2013 through 2018.
  - Six speakers, ages 19-76
  - One woman, five men
  - Combination of text and elicitation

3.1 The puzzle

- In Guébie, root vowels show complete vowel harmony with affixes.

(14) **Full vowel harmony**

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

b. ɔ^3 bɔl=ɔ$^{3.2}$
3SG.NOM hit.PFV-3SG.ACC
'She hit her'

- This process only applies in the presence of about certain enclitics or suffixes, namely third-person object markers on verbs, and plural suffixes on nouns.

(15) **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

(16) **All third-person object markers trigger 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'

(17) **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'

- Other phonologically identical affixes do not trigger 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 (18).

(18) **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'

- Morphemes that attach outside the object enclitic or plural suffix fail to undergo harmony.

(19) **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'

(20) **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'

- Harmony is also sensitive to the specific lexical item present.
  - Only about 33.5% of roots undergo harmony, based on a corpus of 1839 disyllabic roots, where 614 of them are subject to full vowel harmony.
  - The subset of roots affected by full vowel harmony does not form a semantic or phonological natural class.

    - *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.
    - *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 only applies in Guébie when both an alternating root and triggering morpheme are present in the same phase domain.

(21) **Distribution of doubly conditioned harmony**

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

3.2 The analysis

- By adopting the CBP, we can account for doubly conditioned harmony in Guébie in the same way as doubly conditioned lengthening in Sacapultec:
    - Via cumulative morpheme-specific constraint-weight adjustments within a syntactic phase domain.

- The relevant constraints are below, where harmony is motivated by an Agreement-by-Projection constraint (Hansson, 2014; Walker, 2016; Lionnet, 2016, 2017).

(22) IDENT-IO(V): Assign one violation if an output vowel's features differ from the corresponding input segment.

(23) *****[α**F**][β**F**]$_{[+syllabic]}$ (Abbreviated VHARM(ONY))
A segment with a given set of feature values may not directly precede another segment with a different set of feature values in the ordered set of output segments that are [+syllabic]. Assign one violation for each output form where at least one pair of vowels consonants meets these criteria.

(24) **Default weights for suffix-triggered harmony**

Constraint	Weight
IDENT-V	3
VHARM	.5

- When neither an alternating root nor triggering morpheme is present, the default grammar will apply, resulting in the faithful (non-harmony) candidate.

(25) **Non-alternating root + passive: No harmony**

/ɟʊla$^{3.2}$=ɔ^2/	IDENT-V 3	VHARMONY .5	**H**
a. ☞[$_\omega$ ɟʊl^3=ɔ^2]		1	.5
b. [$_\omega$ ɟɔl^3=ɔ^2]	1		3

- However, both object markers (and plural suffixes) and alternating roots are associated with $\mathcal{R}$ specifications.

(26) **Object marker vocabulary item**

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

(27) **Alternating root vocabulary item**

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

- When one of the two is present, the weight readjustments are not strong enough to result in harmony.

(28) **Alternating root + passive: No harmony**

/$_\omega$ bala$^{3.3}$=ɔ^2/	IDENT-V 2	VHARMONY 1.5	**H**
a. ☞[$_\omega$ bal^3=ɔ^2]		1	1.5
b. [$_\omega$ bɔl^3=ɔ^2]	1		2

(29) **Non-alternating root + object enclitic: No harmony**

/$_\omega$ ɟʊla$^{3.2}$=ɔ^2/	IDENT-V 2.5	VHARMONY 2	**H**
a. ☞[$_\omega$ ɟʊl^3=ɔ^2]		1	2
b. [$_\omega$ ɟɔl^3=ɔ^2]	1		2.5

- However, when both are present, the candidate showing full vowel harmony is optimal.

(30) **Alternating root + object enclitic: Harmony**

/$_\omega$ bala$^{3.3}$=ɔ^2/	VHARMONY 3	IDENT-V 1.5	**H**
a. [$_\omega$ bal^3=ɔ^2]	1		3
b. ☞[$_\omega$ bɔl^3=ɔ^2]		1	1.5

- The combined effect of two reweightings, both present in the same spell-out domain results in full vowel harmony only when both of the following are present:
  1. A plural suffix or object enclitic
  2. An alternating root
- The locality effects of outer affixes not undergoing harmony (19, 20) is accounted for by intervening phase boundaries.

4 Alternative analyses

This section considers three alternative approaches to morphologically conditioned phonology, and how they might account for (or fail to account for) double morphological conditioning.

- **Representational accounts**
  - Debate: Item-based versus process-based morphologically conditioned phonology Hockett (1954); Anderson (1992)
  - Item-based approaches assume that all morphemes are associated with an underlying representation from which the surface form is derived.
    - A strictly item-based approach might say that the possessive morpheme in Sacapultec, for example, is associated with a floating mora or vowel.
    - Then, phonological rules or constraints determine where that floating mora or vowel surfaces.
  - **Problem:** We would need to ensure that the floating mora is only present, or only has a surface effect, in the presence of *both* a possessive prefix and an alternating root.
- **Stratal OT**
  - Stratal OT is quite good at accounting for locality effects of word-internal morphologically conditioned phonology.
  - A stem-specific phonological grammar applies to the root plus stem-level affixes.
  - Then, word-level phonology applies to the stem plus word-level affixes.
    - **Problem:** Multiple grammars cannot target particular morphemes or lexical items, but can only be sensitive to stem- versus word- versus phrase-level phenomena.
    - If the possessive prefix in Sacapultec is a stem-level affix, we expect stem-level phonology (lengthening) to apply to all possessive stems, but it doesn't.
- **Indexed Constraint Theory**
  - 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.
    - 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.
  - **Problem**: ICT assumes a single phonological grammar, which applies globally to a word, so when both triggering morphemes are present, we expect harmony *everywhere*.

- 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.
- Also, CBP, unlike ICT, does away with the duplication effect, where there are multiple copies of each constraint in CON.

5 Conclusions

- Phonological alternations can be sensitive to the presence of more than one specific morpheme in a spell-out domain.
  - Doubly morphologically conditioned phonology seems to be a wide-spread phenomenon, though not previously been discussed in these terms.
    - Siouan ablaut (Jones, 1992; Rankin, 1995; Graczyk, 1996, 2007; Albright, 2002)
    - Panoan truncation (Emily Clem and Kelsey Neely, p.c.)
    - Ticuna truncation (Amalia Skilton, p.c.)
    - Dogon tonal overlays (Heath, 2015)
    - Seenku tone Sandhi (McPherson, 2019)
    - Ende reduplication (Lindsey, 2019)
- Cophonologies by Phase, developed to model cross-word morpheme-specific phonological effects and category-specific phonology, straightforwardly accounts for doubly conditioned phonology.
  - Predictions about locality: Only two elements introduced within the same syntactic phase should be able to trigger doubly conditioned phonology.

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