Doubly conditioned phonological processes in Cophonologies by Phase

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Introduction
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- Lexical item or class
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  - Loan vs. native words (Kiparsky et al., 1982; Itô and Mester, 1995)
  - Specific lexical item (Lightner, 1972; Pater, 2010)
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- Lionnet (2016, 2017) shows that some phonological alternations require two phonological triggers to be present:
  - Rounding harmony in Laal only occurs when both a round vowel and a labial consonant are present.
    
    a. /bûr-ú/ → bûr-ú ‘hooks’
    b. /tòb-ó/ → tòb-ó ‘fishes sp.’
    c. /dûlm-ú/ → dûlm-ú ‘types of houses’
    d. /pób-ó/ → pób-ó ‘cobras’
    e. /môlm-ó/ → môlm-ó ‘Koranic school teachers’
In this talk I distinguish phonological conditioning factors from extra-phonological ones.

- Lionnet (2016, 2017) shows that some phonological alternations require two phonological triggers to be present:
  - Rounding harmony in Laal only occurs when both a round vowel and a labial consonant are present.
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    - b. /tèb-ó/ $\rightarrow$ tòb-ó ‘fishes sp.’
    - c. /dîlm-ú/ $\rightarrow$ dûlm-ú ‘types of houses’
    - d. /pêb-ó/ $\rightarrow$ pób-ó ‘cobras’
    - e. /môlm-ó/ $\rightarrow$ mûlm-ó ‘Koranic school teachers’
  - Both triggers must be present for categorical rounding to surface:
    - f. /kàèm-á/ $\rightarrow$ [kàèm-á], ‘tree sp.-pl’
    - g. /gîn-ù/ $\rightarrow$ [gîn-ù], ‘net-pl’
Questions:

1. Are there phonological alternations or processes that require more than one extra-phonological trigger to be present?
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2. How can we model these doubly conditioned processes?
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2. How can we model these doubly conditioned processes?
   - Answer: Cumulative morpheme-specific constraint weight readjustments in Cophonologies by Phase (CBP).
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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

1. Introduction
2. The Model
3. Mayan vowel lengthening
   - Data
   - Analysis
4. Guébie vowel harmony
   - Language background
   - Data
   - Analysis
5. Alternative analyses
6. Conclusion
The Model
CBP assumes a modular grammar and relies on specific interactions between Syntax, Morphology, and Phonology.
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The model combines Distributed Morphology operations such as late insertion of vocabulary items with phonological evaluation via weighted constraints.
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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. \([pl] \leftrightarrow z\)
  2. \([pl] \leftrightarrow -en/\{\sqrt{OX}, \ldots\}\)
  3. \([pl] \leftrightarrow \emptyset/\{\sqrt{MOOSE}, \sqrt{DEER}, \ldots\}\)
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, $\mathcal{R}$
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, \( \mathcal{R} \)

- 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.
In Yapese, we see truncation in vocative contexts.

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Vocative name</th>
</tr>
</thead>
<tbody>
<tr>
<td>luʔag</td>
<td>luʔ</td>
</tr>
<tr>
<td>bajaad</td>
<td>baj</td>
</tr>
<tr>
<td>maŋɛfɛl</td>
<td>maŋ</td>
</tr>
</tbody>
</table>

In CBP this is analyzed as a vocative-specific phonological grammar.
(5) Yapese vocative $D^0$ before spell-out

\[
\begin{array}{c}
D \\
\quad \text{D, vocative} \\
\quad \text{N, proper} \\
\quad \sqrt{bajaad}
\end{array}
\]
(5) Yapese vocative $D^0$ before spell-out

\[
\text{D} \\
\text{D, vocative} \quad \text{N, proper} \\
\sqrt{bajaad}
\]

- 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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In the tree above, then, D is a phase head.

When a phase head is merged, it is spelled out together with its complement.
The noun itself is not associated with a constraint weight adjustment.

\[
(6) \quad [\sqrt{\text{BAJAAD}}] \leftrightarrow \begin{cases} 
F: & /bajaad/ \\
P: & [\omega X] \\
R: & \emptyset 
\end{cases}
\]

\[F: /bajaad/, P: [\omega X], R: \emptyset\]

1For more details on the Yapese analysis, see Sande et al. (Submitted).
CBP in action

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

\[
(6) \quad \sqrt{\text{BAJAAD}} \leftrightarrow \begin{cases} \mathcal{F} : /\text{bajaad}/ \\ \mathcal{P} : [\omega X] \\ \mathcal{R} : \emptyset \end{cases}
\]

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

\[
(7) \quad \text{Yapese default constraint weights}^1
\]

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{MAX}$</td>
<td>2</td>
</tr>
<tr>
<td>$\text{MAX}(\sigma,\text{L})$</td>
<td>1</td>
</tr>
<tr>
<td>$\omega = \sigma$</td>
<td>1</td>
</tr>
</tbody>
</table>

\(^1\text{For more details on the Yapese analysis, see Sande et al. (Submitted).}\)
(8) **Phonological evaluation of Yapese non-vocative D**

<table>
<thead>
<tr>
<th>/[ω bajaad]/</th>
<th>Max</th>
<th>Max(σ,L)</th>
<th>ω=σ</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [ω ba.jaad ]</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>b. [ω baj ]</td>
<td>3</td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>c. [ω jaad ]</td>
<td>2</td>
<td>2</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>
The vocative D head is associated with a constraint weight adjustment:

\[(9) \quad [D, \text{VOCATIVE}] \leftrightarrow \begin{cases} \mathcal{F} : & \emptyset \\ \mathcal{P} : & \emptyset \\ \mathcal{R} : & \text{MAX}^{-1.9} \end{cases}\]
CBP in action

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

\[(9) \quad [D, \text{ VOCATIVE}] \leftrightarrow \begin{cases} \mathcal{F} : \emptyset \\ \mathcal{P} : \emptyset \\ \mathcal{R} : \text{MAX}^{-1.9} \end{cases} \]

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

\[(10) \quad \text{Yapese constraint weights for vocative } D^0 \]

\[
\begin{array}{ll}
\text{Constraint} & \text{Weight} \\
\omega = \sigma & 1 \\
\text{MAX} : \sigma, \text{L} & 1 \\
\text{MAX} & 0.1 \\
\end{array}
\]
CBP in action

(11) *Phonological evaluation of Yapese vocative D*

<table>
<thead>
<tr>
<th>/[ω bajaad]/</th>
<th>ω=σ</th>
<th>Max:Root,L</th>
<th>Max</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [ω ba.jaad]</td>
<td>1</td>
<td>1</td>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>b. [ω baj]</td>
<td>3</td>
<td>3</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>c. [ω jaad]</td>
<td>2</td>
<td>2</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>d. [ω ba]</td>
<td>4</td>
<td>4</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>
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 $\text{Max}$ constraint.
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 $\textsc{Max}$ constraint.

- CBP can handle other cases of morphologically conditioned phonology in the same way (Sande and Jenks, 2018; Sande et al., Submitted).
Why CBP?

Previous work has shown that CBP can model the following:
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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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- Morpheme-specific effects that target prosodic constituents (Jenks, 2018)

In the rest of this talk, I show that it can straightforwardly model phonological processes that require two morphological triggers.
Mayan vowel lengthening
Sacapultec (Sakapultek, Sacapulteco) is a Mayan language said to be related to Quiche.

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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’
  - ni-tʃaːk ‘my work’
Vowel lengthening

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  - tʃaːk, ‘work’
  - ni-tʃaːk ‘my work’
- A subset of lexical items shows final-vowel lengthening only in the context of a possessive prefix.
Vowel lengthening

Nouns in Sacapultec can be preceded by a possessive prefix:
- tʃaːk, ‘work’
- 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
(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’iːʔ | ‘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-xaloːm | ‘my head’ |
| i. | tiʔb’al | ri-tiʔb’aːl | ‘its stinger’ |
| j. | otʃ’ | w-otʃ’ | ‘my possum’ |
| k. | am | w-am | ‘my spider’ |
| l. | weʔ | ni-weʔ | ‘my head hair’ |
| m. | tʃaːk | ni-tʃaːk | ‘my work’ |
| n. | tʃaːx | ni-tʃaːx | ‘my ashes’ |
Other prefixes fail to trigger vowel lengthening on the same lexical items.

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

- winaq ‘person’
  - in-winaq, ‘I am a person’
  - *in-winaːq*

- ak’ ‘chicken’
  - in-ak’, ‘I am a chicken’
  - *in-aːk’*
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.
The default phonology

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- \textbf{Dep}: Assign a violation for each segment in the output that does not have a corresponding input segment.
- \textbf{FinalLengthening}: Assign a violation when the final vowel in a phonological word is short.

These constraints are weighted as below:

\begin{center}
\begin{tabular}{l|c}
\textbf{Constraint} & \textbf{Weight} \\
\hline
\textsc{Dep} & 2 \\
\textsc{FinalLength} & .5 \\
\end{tabular}
\end{center}
Syntactic structure

D

D, possessive

N

√ak′
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: $[\omega \ ak']$. 
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**

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dep</td>
<td>2</td>
</tr>
<tr>
<td>\textsc{FinalLength}</td>
<td>2.5</td>
</tr>
</tbody>
</table>
(17) **Phonological evaluation of Sacapульtec possessive D**

<table>
<thead>
<tr>
<th>/[ω w-ak’]/</th>
<th>Dep</th>
<th>FinalLength</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [ω wak’]</td>
<td>1</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>b. [ω wa:k’]</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
This analysis makes the wrong predictions for non-alternating roots:

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

<table>
<thead>
<tr>
<th>/[ω w-am ]/</th>
<th>DEP</th>
<th>FINAL LENGTH</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [ω wam]</td>
<td>1</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>b. [ω wa:m]</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

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) \[D, 1\text{SG, POSSESSIVE}] \leftrightarrow \begin{cases} \mathcal{F} : \wedge & \\ \mathcal{P} : [\omega X] & \\ \mathcal{R} : \text{FINALLENGTH}^+ & \end{cases}

(20) \sqrt{ak'} \leftrightarrow \begin{cases} \mathcal{F} : \, & \\ \mathcal{P} : [\omega X] & \\ \mathcal{R} : \text{FINALLENGTH}^+ & \end{cases}

(21) \sqrt{am} \leftrightarrow \begin{cases} \mathcal{F} : \, & \\ \mathcal{P} : [\omega X] & \\ \mathcal{R} : \emptyset & \end{cases}
When a possessive prefix is present, but an alternating root is not, the adjusted weight of \text{FINALLENGTH} (0.5+1 = 1.5) is not enough to overpower the faithfulness constraint \text{DEP} (weight 2):

(22) \textit{Phonological evaluation of Sacapultec possessive D + non-alternating root}

\begin{table}[h]
\begin{tabular}{|l|c|c|c|}
\hline
\text{word} & \text{DEP} & \text{FINALLENGTH} & \text{H} \\
\hline
/\[\omega w- [\omega am ]/ & 2 & 1.5 & \\
\hline
a. \[\omega wam\] & 1 & 1.5 & \\
b. [\omega wa:m] & 1 & 2 & \\
\hline
\end{tabular}
\end{table}
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**

<table>
<thead>
<tr>
<th><code>/[ω in [ω ak’]/</code></th>
<th><strong>DEP</strong></th>
<th><strong>FINALLENGTH</strong></th>
<th><strong>H</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>a.  [ω inak’]</td>
<td>1</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>b.  [ω inaːk’]</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
Only in the presence of both an alternating root and a possessive D head do we see vowel lengthening:  
\[ \text{FINAL_LENGTH} = .5 + 1 + 1 = 2.5. \]

(24)  \textit{Phonological evaluation of a Sacapultec alternating root in possessive contexts}

\[
\begin{array}{|l|c|c|}
\hline
\text{/[ω w- [ω ak’]/} & \text{Dep} & \text{FINAL_LENGTH} \\
\hline
2 & 2.5 & H \\
\hline
a. [ω wak’] & & 1 & 2.5 \\
\hline
b. [ω wa:k’] & 1 & & 2 \\
\hline
\end{array}
\]
(25) *Lengthening only when both triggers are present*

<table>
<thead>
<tr>
<th></th>
<th>Alternating root</th>
<th>Non-alternating root</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possessive</td>
<td>✓</td>
<td>–</td>
</tr>
<tr>
<td>Non-possessive</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
Distribution of final-vowel lengthening

(25) Lengthening only when both triggers are present

<table>
<thead>
<tr>
<th></th>
<th>Alternating root</th>
<th>Non-alternating root</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Possessive</strong></td>
<td>✓</td>
<td>–</td>
</tr>
<tr>
<td><strong>Non-possessive</strong></td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

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
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?
Where is Guébie spoken?
Introduction
The Model
Mayan vowel lengthening
Data Analysis
Guébie vowel harmony
Language background
Data Analysis
Alternative analyses
Conclusion
References
Field elicitation
### Language background: Consonants

#### Consonant inventory

<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Labiodent.</th>
<th>Alveopal.</th>
<th>Palatal</th>
<th>Velar</th>
<th>Labiovelar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plosive</td>
<td>p</td>
<td>b</td>
<td>t</td>
<td>d</td>
<td>c</td>
<td>j</td>
</tr>
<tr>
<td>Nasal</td>
<td>m</td>
<td></td>
<td>n</td>
<td></td>
<td>ħ</td>
<td>j</td>
</tr>
<tr>
<td>Fricative</td>
<td>f</td>
<td>v</td>
<td>s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approx</td>
<td>ñ</td>
<td></td>
<td>l</td>
<td>j</td>
<td></td>
<td>w</td>
</tr>
</tbody>
</table>
Language background: Vowels

(27) Vowel inventory
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: li³ ‘eat’, no⁴ ‘mother’
- Though there are also a number of disyllabic roots.
  - Ex: bala³.3 ‘hit’, Ṇokpə³.1 ‘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.
A subset of morphemes, namely object-marking enclitics and plural suffixes, trigger full vowel harmony on roots.

(28) **Full vowel harmony**

a. \( \nu^3 \) bala\(^{3.3}\)
   3SG.NOM hit.PFV
   ‘He hit’

b. \( \nu^3 \) b\(\hat{\nu}\)l=\(\nu\)\(^{3.3.2}\)
   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**

<table>
<thead>
<tr>
<th></th>
<th>Human</th>
<th>Non-human</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Singular</td>
<td>Plural</td>
</tr>
<tr>
<td>1st</td>
<td>e³, Ø</td>
<td>a¹, aŋɛ¹.¹</td>
</tr>
<tr>
<td>2nd</td>
<td>e¹, mɛ²</td>
<td>a², aŋɛ².²</td>
</tr>
<tr>
<td>3rd</td>
<td>o²</td>
<td>wa²</td>
</tr>
</tbody>
</table>

**Language background**

**Data analysis**

**Alternative analyses**

**Conclusion**

**References**
Object markers trigger full harmony

<table>
<thead>
<tr>
<th>Verb</th>
<th>Object</th>
<th>Verb+Obj</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. jili$^{2.3}$</td>
<td>=ɔ$^2$</td>
<td>jɔl=ɔ$^{2.32}$, *jil=ɔ$^{2.32}$</td>
<td>‘steal him’</td>
</tr>
<tr>
<td>b. jili$^{2.3}$</td>
<td>=ɛ$^2$</td>
<td>jɛl=ɛ$^{2.32}$, *jil=ɛ$^{2.32}$</td>
<td>‘steal it’</td>
</tr>
<tr>
<td>c. jili$^{2.3}$</td>
<td>=ɪ$^2$</td>
<td>jɪl=ɪ$^{2.32}$, *jil=ɪ$^{2.32}$</td>
<td>‘steal them’</td>
</tr>
<tr>
<td>d. jɪla$^{3.2}$</td>
<td>=ɔ$^2$</td>
<td>jɔl=ɔ$^{3.2}$, *jɪl=ɔ$^{3.2}$</td>
<td>‘ask him’</td>
</tr>
<tr>
<td>e. jɪla$^{3.2}$</td>
<td>=ɛ$^2$</td>
<td>jɛl=ɛ$^{3.2}$, *jɪl=ɛ$^{3.2}$</td>
<td>‘ask it’</td>
</tr>
<tr>
<td>f. jɪla$^{3.2}$</td>
<td>=ɪ$^2$</td>
<td>jɪl=ɪ$^{3.2}$, *jɪl=ɪ$^{3.2}$</td>
<td>‘ask them’</td>
</tr>
<tr>
<td>g. bala$^{3.3}$</td>
<td>=ɔ$^2$</td>
<td>bɔl=ɔ$^{3.2}$, *bal=ɔ$^{3.2}$</td>
<td>‘hit him’</td>
</tr>
<tr>
<td>h. bala$^{3.3}$</td>
<td>=ɛ$^2$</td>
<td>bɛl=ɛ$^{3.2}$, *bal=ɛ$^{3.2}$</td>
<td>‘hit it’</td>
</tr>
<tr>
<td>i. bala$^{3.3}$</td>
<td>=ɪ$^2$</td>
<td>bɪl=ɪ$^{3.2}$, *bal=ɪ$^{3.2}$</td>
<td>‘hit them’</td>
</tr>
</tbody>
</table>
Additionally, there are two plural suffixes, /-i, -a/, which both trigger full vowel harmony.

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

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bele(^2).(^2)</td>
<td>bil-i(^2).(^2)</td>
<td>‘cow’</td>
</tr>
<tr>
<td>b. mεnε(^3).(^3)</td>
<td>man-a(^3).(^2)</td>
<td>‘animal’</td>
</tr>
</tbody>
</table>
There are other enclitics and suffixes that are phonologically identical to object enclitics or plural suffixes, but do *not* trigger full harmony.
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].
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 [ɔ2].

The passive suffix, which is phonologically identical, does not trigger harmony.

(31) No harmony in passive contexts

<table>
<thead>
<tr>
<th>Verb</th>
<th>Verb+Pass</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bala3.3</td>
<td>bal-ɔ̃3.2, *bala-ɔ̃3.3.2</td>
<td>‘be hit’</td>
</tr>
<tr>
<td>b. jila3.2</td>
<td>jil-ɔ̃3.2, *jila-ɔ̃3.2.2</td>
<td>‘be asked’</td>
</tr>
</tbody>
</table>
Additionally, morphemes that attach outside the object enclitic or plural suffix fail to undergo harmony:

\[(32) \quad \text{Root} + \text{Obj} + \text{Nominalizer} \]

<table>
<thead>
<tr>
<th>Root</th>
<th>=3SG.ACC</th>
<th>=NMLZ</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bala(^{3.3})</td>
<td>bOl=ɕ(^{3.2})</td>
<td>bOl=ɕ=li(^{3.2.2})</td>
<td>‘hit’</td>
</tr>
<tr>
<td>b. tulu(^{4.4})</td>
<td>tOl=ɕ(^{4.2})</td>
<td>tOl=ɕ=li(^{4.2.2})</td>
<td>‘chase’</td>
</tr>
<tr>
<td>c. jila(^{3.2})</td>
<td>jOl=ɕ(^{3.2})</td>
<td>jOl=ɕ=li(^{3.2.2})</td>
<td>‘ask’</td>
</tr>
</tbody>
</table>
Additionally, morphemes that attach outside the object enclitic or plural suffix fail to undergo harmony:

(32) \textbf{Root}+\textbf{Obj}+\textbf{Nominalizer}

<table>
<thead>
<tr>
<th>\textbf{Root}</th>
<th>\textbf{=3SG.ACC}</th>
<th>\textbf{=NMLZ}</th>
<th>\textbf{Gloss}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bala\textsuperscript{3.3}</td>
<td>bɔl=ɔ\textsuperscript{3.2}</td>
<td>bɔl=ɔ=li\textsuperscript{3.2.2}</td>
<td>‘hit’</td>
</tr>
<tr>
<td>b. tulu\textsuperscript{4.4}</td>
<td>tɔl=ɔ\textsuperscript{4.2}</td>
<td>tɔl=ɔ=li\textsuperscript{4.2.2}</td>
<td>‘chase’</td>
</tr>
<tr>
<td>c. jila\textsuperscript{3.2}</td>
<td>jɔl=ɔ\textsuperscript{3.2}</td>
<td>jɔl=ɔ=li\textsuperscript{3.2.2}</td>
<td>‘ask’</td>
</tr>
</tbody>
</table>

(33) \textbf{Root}+\textbf{Pl}+\textbf{Definite}

<table>
<thead>
<tr>
<th>\textbf{Singular}</th>
<th>\textbf{Plural}</th>
<th>\textbf{-Def}</th>
<th>\textbf{Gloss}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bele\textsuperscript{2.2}</td>
<td>bil-\textsuperscript{i}2.2</td>
<td>bil-\textsuperscript{i-a}2.2.2</td>
<td>‘cow’</td>
</tr>
<tr>
<td>b. mənɛ\textsuperscript{3.3}</td>
<td>man-a\textsuperscript{3.2}</td>
<td>man-a-a\textsuperscript{3.2.2}</td>
<td>‘animal’</td>
</tr>
</tbody>
</table>
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.
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\textsuperscript{2.2} ‘be fat’, which undergoes harmony, and jili\textsuperscript{2.2}, ‘fish’, which does not.
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 jili₂⁻² ‘be fat’, which undergoes harmony, and jili²⁻², ‘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, ṭ̣wokɔ⁴⁻⁴, ‘woman’, and ṭ̣okɔpɔ³⁻¹ ‘person’, undergo full harmony, while ṭ̣udi³⁻¹, ‘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 Cophononologies by Phase.
- The relevant constraints, IDENT-IO(V) and VHARMONY, have the default weights below.

(34) Default weights in Guébie

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDENT-IO(V)</td>
<td>3</td>
</tr>
<tr>
<td>VHARMONY</td>
<td>.5</td>
</tr>
</tbody>
</table>
Accounting for affix specificity

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

\[
\begin{align*}
\text{(35) Object marker vocabulary item} \\
[3sg.hum.acc] & \leftrightarrow \\
\mathcal{F} & : /\emptyset^2/ \\
\mathcal{P}_5 & : = X_\omega \\
\mathcal{R}_5 & : \ V\text{HARM}^{+1.5}, \text{IDENT-V}^{-0.5}
\end{align*}
\]

This constraint weight adjustments associated with \(\mathcal{R}_5\) add to the default weights to give us \([\text{Ident-IO(V)}]=2.5\) and \([\text{VHarm}]=2\).

On its own, this ranking is not enough to result in full harmony.
Accounting for affix specificity

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

\[
\begin{align*}
\text{(35) Object marker vocabulary item} \\
[3sg.\,\text{hum.}\,\text{acc}] &\leftrightarrow \\
\left\{ \\
&\mathcal{F} : /\ddot{c}^2/ \\
&\mathcal{P}_5 : = X_\omega \\
&\mathcal{R}_5 : \text{VHARM}^{+1.5}, \text{IDENT-V}^{-0.5} \\
\right\}
\end{align*}
\]

- This constraint weight adjustments associated with \( \mathcal{R} \) add to the default weights to give us \( \text{IDENT-IO(V)} = 2.5 \) and \( \text{VHARM} = 2 \).
Accounting for affix specificity

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

  \[(35) \quad \text{Object marker vocabulary item} \]

  \[
  [3sg.\text{hum.}\text{acc}] \leftrightarrow \begin{cases} \mathcal{F} : & /\varepsilon^2/ \\ \mathcal{P}_5 : & = X_\omega \\ \mathcal{R}_5 : & \text{VHARM}^{+1.5}, \text{IDENT-}V^{-0.5} \end{cases}
  \]

- This constraint weight adjustments associated with \( \mathcal{R} \) add to the default weights to give us \( \text{IDENT-IO}(V)=2.5 \) and \( \text{VHARM}=2 \).

- On its own, this ranking is not enough to result in full harmony.
(36) **Phonological evaluation of Guébie Non-alternating Verb+Object**

<table>
<thead>
<tr>
<th>/jula³.²−c²/</th>
<th>IDENT</th>
<th>VHARM</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>a. [[ω jula³.²]]</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b. [[ω jula³.²]]</td>
<td>1</td>
<td></td>
<td>2.5</td>
</tr>
</tbody>
</table>
Alternating root + object enclitic: Harmony?

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

<table>
<thead>
<tr>
<th>/bala$^{3.3}=\omega^2$/</th>
<th>IDENT</th>
<th>VHARM</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>a. $\odot [\omega\ bala^{3.2}]$</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b. $[\omega\ bala^{3.2}]$</td>
<td>1</td>
<td></td>
<td>2.5</td>
</tr>
</tbody>
</table>

**Data**

```
Alternating root + object enclitic: Harmony?

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

<table>
<thead>
<tr>
<th>/bala$^{3.3}=\omega^2$/</th>
<th>IDENT</th>
<th>VHARM</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>a. $\odot [\omega\ bala^{3.2}]$</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b. $[\omega\ bala^{3.2}]$</td>
<td>1</td>
<td></td>
<td>2.5</td>
</tr>
</tbody>
</table>
```
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**

\[
[\sqrt{hit}] \leftrightarrow \left\{ \begin{array}{l}
    \mathcal{F} : /bala^{3.3}/ \\
    \mathcal{P}_6 : [X_\omega] \\
    \mathcal{R}_6 : \text{VHARMONY}^+1, \text{IDENT-V}^{-1}
\end{array} \right. 
\]

These weights add to the default ranking in phases containing alternating items. On its own, the adjusted weights are \( Ident=2, VHarm=1.5 \). Again, on its own, this is not enough to result in full harmony.
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:

  \[
  \sqrt{hit} \leftrightarrow \left\{ \begin{array}{l}
  \mathcal{F} : \quad \text{/bala}^{3.3} \\
  \mathcal{P}_6 : \quad [X_\omega] \\
  \mathcal{R}_6 : \quad \text{VHARMONY}^+1, \text{IDENT-V}^-1
  \end{array} \right. \\
  \]

  These weights add to the default ranking in phases containing alternating items.
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:

\[
\text{(38) Alternating root vocabulary item} \\
[\sqrt{hit}] \leftrightarrow \begin{cases} 
\mathcal{F}: & /\text{bala}^{3.3}/ \\
\mathcal{P}_6: & [X_\omega] \\
\mathcal{R}_6: & \text{VHARMONY}^+1, \text{IDENT-V}^1
\end{cases}
\]

These weights add to the default ranking in phases containing alternating items.

On its own, the adjusted weights are IDENT=2, VHARM=1.5.
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:

\[
\begin{align*}
\sqrt{\text{hit}} & \leftrightarrow \begin{cases} 
F & : \ /bala^{3.3}/ \\
\mathcal{P}_6 & : \ [X_\omega] \\
\mathcal{R}_6 & : \ VHARMONY^{+1}, IDENT-V^{-1}
\end{cases}
\end{align*}
\]

- These weights add to the default ranking in phases containing alternating items.

- On its own, the adjusted weights are IDENT=2, VHARM=1.5.

- Again, on its own, this is not enough to result in full harmony.
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**

<table>
<thead>
<tr>
<th>Grammar</th>
<th>IDENT-IO(V)</th>
<th>VHARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>3</td>
<td>.5</td>
</tr>
<tr>
<td>Obj/Pl</td>
<td>-.5</td>
<td>+1.5</td>
</tr>
<tr>
<td>Alt. root</td>
<td>-1</td>
<td>+1</td>
</tr>
<tr>
<td><strong>Total weight</strong></td>
<td><strong>1.5</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>
Alternating root + object enclitic: Harmony

<table>
<thead>
<tr>
<th>[ω bala$^{3.3}$]=c$^2$</th>
<th>V\textsc{Harmony}</th>
<th>\textsc{Ident-V}</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [ω balc$^{3.2}$]</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>b. \text{[ω balc$^{3.2}$]}</td>
<td>1</td>
<td>1.5</td>
<td></td>
</tr>
</tbody>
</table>
Non-alternating root + object enclitic: No harmony

<table>
<thead>
<tr>
<th></th>
<th>IDENT-V</th>
<th>VHARMONY</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\omega \text{Ju}l,a^{3.2}\text{c}^2$</td>
<td>2.5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>a. $\text{J}u,l,\text{c}a^{3.2}$</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>b. $\omega \text{Ju}l,\text{c}a^{3.2}$</td>
<td>1</td>
<td></td>
<td>2.5</td>
</tr>
</tbody>
</table>
Alternating root + passive: No harmony

(42) No harmony without suffixal trigger

<table>
<thead>
<tr>
<th>[ω bala^{3,3}]-c^{2}</th>
<th>IDENT-V</th>
<th>VHARMONY</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>a. [ω balc^{3,2}]</td>
<td></td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>b. [ω balc^{3,2}]</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>IDENT-V</th>
<th>VHARMONY</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>([\omega \text{\textsuperscript{3.2}} \text{\textsubscript{3.d}} - \text{c}^2])</td>
<td>3</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>(\omega \text{\textsuperscript{3.2}} \text{\textsubscript{1.d}})</td>
<td>1</td>
<td>0.5</td>
<td>3</td>
</tr>
<tr>
<td>[\omega \text{\textsuperscript{3.2}} \text{\textsubscript{1.d}}]</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

*No harmony when both triggers are absent*
The combined effect of two subrankings 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 combined effect of two subrankings 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 result is a doubly morphologically triggered conditioned phonological alternation.

<table>
<thead>
<tr>
<th></th>
<th>Object enclitic</th>
<th>Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternating rt</td>
<td>Harmony</td>
<td>No harmony</td>
</tr>
<tr>
<td>Non-alternating rt</td>
<td>No harmony</td>
<td>No harmony</td>
</tr>
</tbody>
</table>
Alternative analyses
Alternative analyses

- **Underlying representations**
  - Requires ‘exceptional’ representations of both types of triggering morpheme:
    - All third person object enclitics and plural suffixes
    - All alternating lexical items
Alternative analyses

- **Underlying representations**
  - Requires ‘exceptional’ representations of both types of triggering morpheme:
    - 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.
Alternative analyses

- **Underlying representations**
  - Requires ‘exceptional’ representations of both types of triggering morpheme:
    - 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.
**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.
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.

- With constraints indexed to particular morphemes, violations are incurred only when said morpheme is present: \( \text{VHarm(Obj, Pl)} \), \( \text{VHarm(AlternatingClass)} \).
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.
- With constraints indexed to particular morphemes, violations are incurred only when said morpheme is present: $VHARM(\text{Obj, Pl})$, $VHARM(\text{AlternatingClass})$.
- Only when both indexed $VHARM$ constraints would otherwise be violated do we see harmony surfacing.
However, ICT assumes a single phonological grammar, which applies globally to a word, so when both triggering morphemes are present, we expect harmony everywhere.
Alternative analyses

- *However*, 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: $b\circ\bar{l}=\circ\bar{l}i^3.2.2$, Rt+Obj+NMLZ
Alternative analyses

- However, 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: *\( bɔl=ɔ=li^{3.2.2} \).
- In general, locality effects of morpheme-specific phonology are difficult to model with ICT.
Conclusion
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.
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Phase-based application of morphology and phonology results in domain-specific phonological effects, $bol=O=li^{3.2.2}$, $*bol=O=li^{3.2.2}$. 
Previous models have been built to account for morphological conditioning:
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- Exception features (Chomsky and Halle, 1968)
- Lexical Morphology and Phonology, Stratal OT (Kiparsky et al., 1982; Bermúdez-Otero, 1999; Kiparsky, 2000, 2008)
- Indexed constraints (Itô and Mester, 1995; Pater, 2010)
- Cophonology Theory (Orgun, 1996; Inkelas et al., 1997; Inkelas and Zoll, 2005)
- Generalized Non-linear Affixation (and other representational accounts) Bermúdez-Otero (2012); Zimmermann (2013)
Implications

- Previous models have been built to account for morphological conditioning:
  - Exception features (Chomsky and Halle, 1968)
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- CBP best accounts for doubly morphologically conditioned phonology.
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References III


References IV


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