Counterbled-Counterfeeding in Harmonic Grammar

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1. Introduction


In HG constraints are weighted and the optimum is candidate with the highest Harmony (H).

- To calculate H for a given candidate, that candidate’s violation score \( s_k \) for each constraint \( C_k \) \( (k = 1 \ldots K) \) is multiplied by the constraint’s weight \( w_k \) and the results are summed.

- This allows constraint violations to interact in a cumulative fashion.

\[ H = \sum_{k=1}^{K} s_k w_k \]

(1)

a. If \( u(A) > u(B) \), output-1 is selected as optimal

<table>
<thead>
<tr>
<th>/input-1/</th>
<th>A ( w = 3 )</th>
<th>B ( w = 2 )</th>
<th>C ( w = 2 )</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>output-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-3</td>
</tr>
</tbody>
</table>

b. If \( u(B) + u(C) > u(A) \), output-4 is selected as optimal

<table>
<thead>
<tr>
<th>/input-2/</th>
<th>A ( w = 3 )</th>
<th>B ( w = 2 )</th>
<th>C ( w = 2 )</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>output-3</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-3</td>
</tr>
<tr>
<td>output-4</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-3</td>
</tr>
</tbody>
</table>

Depending on the constraints, such “gang effects” can allow sets of candidates to be optimal...

- … under different configurations of the constraints than is possible in OT.
- … that can never to be optimal in OT.

This can allow for analyses using fewer and more basic constraints in HG.

\* Thanks to Rachel Walker and to the participants in LING 631 in Spring 2014 at USC for helpful feedback and general discussion.

For this talk, the focus is on a subset of patterns that are often analyzed using extrinsic rule ordering in SPE and related frameworks.

- Such patterns typically prove challenging for constraint-based models (but see Baković 2007).
- Proposed solutions generally introduce some form of hidden structure:
  - Crucial ordering of operations
  - Representational elements not contrastively present at the surface
e.g., Turbidity Theory – Goldrick 2000
  - Reference to related candidates
e.g., Output-Output faithfulness – Benua 1997; Sympathy Theory – McCarthy 1999.

Cumulative constraint interaction in HG allows certain complex patterns to be modeled using simple constraints without reference to hidden structure.

Benefits:

- Fewer constraints are needed, ultimately reducing the size of the predicted typology.
- Reference to hidden structure is not necessary, decreasing the learning challenge.
- Instances of duplication in the expression of conditions on rules are eliminated, and conspiracies are effectively captured.

Structure of the talk:

§2 Ponapean assimilation and nasalization in HG
§3 Blocking and the role of cumulativity
§4 Complexity and ordered-rule accounts

2. Ponapean assimilation and nasalization in HG

2.1 Ponapean consonant system

(3) Ponapean inventory (based on Rehg & Sohl 1981)

<table>
<thead>
<tr>
<th></th>
<th>stop</th>
<th>fricative</th>
<th>affricate</th>
<th>nasal</th>
<th>liquid</th>
<th>glide</th>
</tr>
</thead>
<tbody>
<tr>
<td>bilabial</td>
<td>p</td>
<td>m</td>
<td>w</td>
<td></td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>velarized bilabial</td>
<td>pʰ</td>
<td>mʰ</td>
<td>wʰ</td>
<td></td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>dental</td>
<td>t</td>
<td>n</td>
<td>r</td>
<td></td>
<td>j</td>
<td></td>
</tr>
<tr>
<td>palatalized alveolar</td>
<td>s̚</td>
<td>(n̚)</td>
<td>j̚</td>
<td></td>
<td>j</td>
<td></td>
</tr>
<tr>
<td>retroflex</td>
<td>k</td>
<td>t̚</td>
<td>(n)</td>
<td></td>
<td>j</td>
<td></td>
</tr>
</tbody>
</table>
Coronal contrasts: Throughout the grammar, dental, alveolar and retroflex segments all behave as coronal.

- [t̟] is a voiceless retroflex affricate
- [s̟] is a voiceless palatalized alveolar fricative; [t̟] is also slightly palatalized
- [n̟] appears only before [s̟]; [n̟] appears only before [t̟].

Phonotactics: Consonant-consonant sequences are very limited in Ponapean.

(4) Licit intervocalic consonant sequences (Rehg & Sohl 1981)

| mm | l̟ | mp |
| m̟ | r̟ | m̟ p̟ |

(Geminate obstruents are restricted to loanwords and exclamations.

Complex codas are allowed only word-finally. There they are limited to glide-consonant or homorganic nasal+obstruent.

Sequences of homorganic nasal+obstruent are allowed word-initially, but are syllabified as separate syllables.

2.2 Place Assimilation

Ponapean has a productive pattern of coronal nasal place assimilation that applies within words and between words in rapid speech.

- Changes within the coronal place (5a).
- Changes from coronal to bilabial or velar place (5b).

(5) a. Assimilation within the coronal place (Rehg & Sohl 1981: 57-60; Goodman 1995:160)

/ˈn̟an-ʃeʃ/ [ˈn̟an-ʃeʃ] ‘in the ocean’

/ˈteŋ-ʃeŋ/ [ˈteŋ-ʃeŋ] ‘hung up’

/ˈt̟un-ʃuən/ [ˈt̟un-ʃuən] ‘tie together’

b. Assimilation to labial and velar place

/ˈn̟an-ʃaɾ/ [ˈn̟an-par] ‘trade wind season’

/ˈn̟an-ʃep/ [ˈn̟an-ʃep] ‘inlet’

/ˈn̟an-ˈpəɾaɾa/ [ˈn̟an-ˈpəɾaɾa] ‘between them’

/ˈn̟an-mət̟aɾ/ [ˈn̟am-mət̟aɾ] ‘ocean, beyond the reef’

Labial and velar nasals resist assimilation. Repair = vowel epenthesis (6)

(6) Resistance to assimilation by input labials/velars (Goodman 1995: 166-168)

/ˈliŋ-ʃiɾ/ [ˈliŋ-ʃiɾ] ‘slices, chips’

/ˈliŋ-ʃiɾ/ [ˈliŋ-ʃiɾ] ‘heaps, piles’

/ˈliŋ-kaɾ/ [ˈliŋ-kaɾ] ‘sheaves’

/ˈliŋ-paɾ/ [ˈliŋ-paɾ] ‘times’

This type of pattern is easily captured in Harmonic Grammar (and OT) using very general constraints – following de Lacy 2002:

(7) AGREEPLACE: Assign a violation mark to any sequence of two coronals that disagree in place

IDENTPLACE: Assign a violation mark to any input segment that differs in Place relative to its output correspondent

IDENTPLACE-KP: Assign a violation mark to any input velar or labial segment that differs in Place relative to output correspondent

DEP-V: Assign a violation mark to any output vowel that lacks an input correspondent

Coronal nasals assimilate in place to a following consonant if the following weighting conditions hold:

- w(AGREEPLACE) > w(IDENTPLACE) ... assimilation is preferred to place disagreement
- w(DEP-V) > w(IDENTPLACE) ... assimilation is preferred to epenthesis

(8) Assimilation is preferred in the case of coronals

<table>
<thead>
<tr>
<th>/ˈn̟an-par/</th>
<th>AGREEPLACE</th>
<th>DEP-V</th>
<th>IDENTPLACE</th>
<th>IDENTPLACE-KP</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ꙡn̟anpar</td>
<td>-1</td>
<td>-3</td>
<td>2</td>
<td>2</td>
<td>-4</td>
</tr>
<tr>
<td>Ꙡn̟ampar</td>
<td>-1</td>
<td>-3</td>
<td>2</td>
<td>2</td>
<td>-2</td>
</tr>
<tr>
<td>Ꙡn̟ampar</td>
<td>-1</td>
<td>-3</td>
<td>2</td>
<td>2</td>
<td>-3</td>
</tr>
</tbody>
</table>

Assimilation is blocked and epenthesis triggered with non-coronal nasals:

- w(AGREEPLACE) > w(DEP-V) ... epenthesis is preferred to place disagreement
- w(IDENTPLACE) + w(IDENTPLACE-KP) > w(DEP-V) ... epenthesis is preferred to assimilation when both IDENTPLACE and IDENTPLACE-KP would be violated

(9) Epenthesis is preferred in the case of non-coronals

<table>
<thead>
<tr>
<th>/ˈliŋ-tip/</th>
<th>AGREEPLACE</th>
<th>DEP-V</th>
<th>IDENTPLACE</th>
<th>IDENTPLACE-KP</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ꙡliŋtip</td>
<td>-1</td>
<td>-3</td>
<td>-1</td>
<td>-1</td>
<td>-4</td>
</tr>
<tr>
<td>Ꙡliŋtip</td>
<td>-1</td>
<td>-3</td>
<td>-1</td>
<td>-1</td>
<td>-3</td>
</tr>
</tbody>
</table>

Direction of assimilation can be modeled by adding a positional faithfulness constraint (Beckman 1998).

(10) IDENTPLACE/ONSET: Assign a violation mark to any input segment that differs in Place relative to its output correspondent in the onset of a syllable

w(IDENTPLACE/ONSET) must be greater than w(IDENTPLACE-KP) to ensure that assimilation is regressive even for inputs like /ˈn̟an-par/ → Ꙡn̟anpar, "n̟anpar"
2.3 Obstruent nasalization


• Here we will focus just on those arising through reduplication.

(11) Nasalization in obstruent-obstruent contexts (Rehg & Sohl 1981: 59)

/pap-pap/ [papap] ‘swim’  
/p"up"-p"up"/ [p"ump"-p"ump"] ‘fall’  
/sas/-s\̂as/ [s'an's/as] ‘stagger’  
/tat-tat/ [tatatat] ‘write’  
/t[t̂]-t[t̂]/ [t[t̂]t[t̂]] ‘build a wall’ 
/kak-kak/ [kanjkan] ‘able’

I attribute the nasalization pattern here to a preference for falling sonority sequences across syllable boundaries (e.g., Murray & Venneman 1983, Gouskova 2004).


(12) SYLLABLECONTACT: For any sequence of two intervocalic consonants:

• assign 2 violation marks if sonority rises from coda to onset

• assign 1 violation mark if sonority is level from coda to onset

• assign 0 violation marks if sonority falls from coda to onset

Nasalization targets sequences like those in (11) if the following weighting conditions hold:

• \( u(SYLL\,CON) > u(IDENT\,NASAL) \) ... nasalization is preferred to violating \( SYLL\,CON \)

• \( u(DEP-V) > u(IDENT\,NASAL) \) ... nasalization is preferred to epenthesis

(13) Nasalization applies across syllable boundaries

<table>
<thead>
<tr>
<th>/tat-tat/</th>
<th>SYLL,CON ( w = 4 )</th>
<th>DEP,-V ( w = 3 )</th>
<th>IDNASAL ( w = 2 )</th>
<th>( H )</th>
</tr>
</thead>
<tbody>
<tr>
<td>tatatat</td>
<td>-1</td>
<td></td>
<td></td>
<td>-4</td>
</tr>
<tr>
<td>t\̂tat\̂tat</td>
<td>-1</td>
<td>-1</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>tatatat</td>
<td>-1</td>
<td></td>
<td></td>
<td>-3</td>
</tr>
</tbody>
</table>

3. Blocking and the role of cumulativity

Nasalization is blocked, under two conditions.

• In HG, these are easily captured through cumulative interaction of the simple constraints already defined.

• In OT, analysis with these same constraints leads to a ranking paradox.

Condition 1: The obstruents in the cluster have non-identical place specifications (14)

(14) Nasalization blocked when place is not identical (Rehg & Sohl 1981: 61, 75)

/\̂pet\̂-\̂pet\̂/ [peonpet] ‘to kick’  
/s\̂et\̂-s\̂et\̂/ [s\̂et\̂s\̂et\̂] ‘to be squeezed’  
/rot-rot\̂/ [rotorot] ‘dark’

This blocking is a result of cumulative constraint interaction, relying on the following weighting condition:

• \( u(IDENT\,PLACE) > u(IDENT\,NASAL) > u(DEP-V) \)

(15) Nasalization is blocked when obstruent place is not identical

<table>
<thead>
<tr>
<th>/\̂pet\̂-\̂pet\̂/</th>
<th>AGR,PLACE ( w = 4 )</th>
<th>SYLL,CON ( w = 4 )</th>
<th>DEP,-V ( w = 3 )</th>
<th>ID,PLACE ( w = 2 )</th>
<th>ID,NASAL ( w = 2 )</th>
<th>( H )</th>
</tr>
</thead>
<tbody>
<tr>
<td>pe\̂pet\̂</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-4</td>
<td></td>
</tr>
<tr>
<td>pe\̂pet\̂</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-4</td>
<td></td>
</tr>
</tbody>
</table>

This blocking of nasalization relies on comparison of mappings:

• Homorganic nasal + obstruent sequences are allowed

• Nasalization and assimilation are both allowed

• BUT... Epenthesis is preferred when both processes would need to apply to render the sequence licit.

This cannot be captured using these same constraints in OT.

• DEP\,-V \( >> \) IDENT\,PLACE is required for assimilation in /n\̂ap-par → [nampar]

• DEP\,-V \( >> \) IDENT\,NASAL is required for nasalization in /pap-pap → [pampap]

BUT... If these rankings hold the combination of nasalization + assimilation is preferred even in forms like /\̂pet\̂-\̂pet\̂/ where place is not identical.

(16) Ranking paradox in OT with simple constraints

<table>
<thead>
<tr>
<th>W ( \approx ) L</th>
<th>DEP,-V</th>
<th>IDENT,PLACE</th>
<th>IDENT,NASAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>nampar – nanapar</td>
<td>W</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>papap – papap</td>
<td>W</td>
<td>W</td>
<td>L</td>
</tr>
<tr>
<td>pe\̂pet\̂ – pe\̂pet\̂</td>
<td>L</td>
<td>W</td>
<td>W</td>
</tr>
</tbody>
</table>

Condition 2: The sonority profile of the input consonant sequence is rising (17)

(17) Nasalization blocked given rising sonority profile (Rehg & Sohl 1981: 61)

/\̂set\̂-\̂set\̂/ [\̂set\̂set\̂] ‘smell’  
/\̂pus\̂-\̂pus\̂/ [\̂pus\̂pus\̂] ‘jump’  
/rot-rot\̂/ [rotorot] ‘dark’
This blocking is a result of cumulative constraint interaction, relying on the following weighting condition:

- \( w(\text{SYLLCON}) + w(\text{IDENTNASAL}) > w(\text{DEP-V}) \)

(18) Nasalization is blocked given a rising input sonority profile

<table>
<thead>
<tr>
<th>/net-net/</th>
<th>SYLLCON ( w = 4 )</th>
<th>DEP-V ( w = 3 )</th>
<th>IDENTNASAL ( w = 2 )</th>
<th>( H )</th>
</tr>
</thead>
<tbody>
<tr>
<td>netnet</td>
<td>-2</td>
<td>-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nennet</td>
<td>-1</td>
<td>-1</td>
<td>-6</td>
<td></td>
</tr>
<tr>
<td>epnetnet</td>
<td>-1</td>
<td>-3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This blocking of nasalization again relies on comparison of mappings:

- Geminate nasals are admitted in Ponapean
  - e.g., /mem-mem/ \( \rightarrow \) [memmem] ‘sweet’
- Nasalization of obstruents is allowed in Ponapean (see 11)
- BUT… Epenthesis is preferred to changing nasalization when the result would be a non-ideal sonority sequence.

This cannot be captured using these same constraints in OT... even if SYLLABLECONTACT is split into two stringently related constraints.

(19) SYLLCON-PLR: Assign a violation mark for any sequence of two intervocalic consonants where sonority plateaus or rises from coda to onset

SYLLCON-R: Assign a violation mark for any sequence of two intervocalic consonants where sonority rises from coda to onset

- SYLLCON-R \( \gg \) DEP-V is required for repair in /net-net/ \( \rightarrow \) [netnet]
- DEP-V \( \gg \) IDENTNASAL is required for nasalization in /pap-pap/ \( \rightarrow \) [pampap]
- DEP-V \( \gg \) SYLLCON-PLR is required for sonorant geminates to be admitted in /mem-mem/ \( \rightarrow \) [memmem]

BUT… If these rankings hold the combination of nasalization is preferred even in forms like /net-net/ where the input sonority rises.

(20) Ranking paradox in OT with these constraints

<table>
<thead>
<tr>
<th>( W \sim L )</th>
<th>SYLLCON-R</th>
<th>DEP-V</th>
<th>SYLLCON-PLR</th>
<th>IDENTNASAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>netnet - netnet</td>
<td>W</td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>papapap - papapap</td>
<td>W</td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>memmem - memmem</td>
<td>W</td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>netnet - nennet</td>
<td>L</td>
<td>W</td>
<td>W</td>
<td></td>
</tr>
</tbody>
</table>

OT solutions that have been proposed for this interaction of nasalization or assimilation rely on some type of hidden structure. E.g.,

- Reference to input morae (Goodman 1995)
- Sympathy theory (Davis 2000)

4. Complexity and ordered-rule accounts

As numerous authors have pointed out nasalization, assimilation and epenthesis all conspire to ensure that the phonotactics of the language are respected (McCarthy & Prince 1986, Itô 1986, 1989, Kennedy 2003, etc.)

Rehg & Sohl (1981) describe the nasalization and assimilation rules as follows:

- **Assimilation**: “When \( n \) and a following consonant come together in speech, \( n \) may become a nasal that agrees in position of articulation of the following consonant.”
  (56)
- **Nasalization**: “When two identical voiceless consonants come together as a consequence of reduplication, the first will become a nasal that agrees in position of articulation with the second”
  (58)

(21) Assimilation: [+nasal, +coronal] \( \rightarrow \) [\( \alpha \text{Place} \)] / __ \( \rightarrow \) [\( \alpha \text{Place} \)]

Nasalization: [−voice, \( \alpha \text{Place} \)] \( \rightarrow \) [+nasal] / __ \( \rightarrow \) [−voice, \( \alpha \text{Place} \)]

… Epenthesis is expressed as a repair that applies in a range of contexts that do not satisfy the language’s restrictions on clusters.

- Even expressed in these terms, epenthesis must follow the assimilation and nasalization rules, or it would (wrongly) act to repair illicit sequences.
- Epenthesis must counterbleed assimilation and nasalization.

The rules in (21) duplicate the consequences of each other, conspire to prevent nasalization and assimilation from both applying.

- A more general expression of either of the rules shows that they have the potential to feed one another... which does not occur.

**Illustration** – general expression of Nasalization (cf. SYLLABLECONTACT):

<table>
<thead>
<tr>
<th>/( k )/</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Nasalization: C( \alpha \rightarrow ) [+nasal]</td>
</tr>
<tr>
<td>Assimilation: [+nasal, +coronal] ( \rightarrow ) [( \alpha \text{Place} )] / __ ( \rightarrow ) [( \alpha \text{Place} )]</td>
</tr>
<tr>
<td>( \eta k )</td>
</tr>
<tr>
<td>( \eta k )</td>
</tr>
</tbody>
</table>

This general nasalization rule must be blocked from applying either before or after assimilation. Two requirements:

- ordering Assimilation before General Nasalization
- ordering Epenthesis between General Nasalization and Assimilation
• Epenthesis in the case of place disagreement must bleed the second of the two rules in a counterfeeding relationship... and counterbleed the first.

• Assimilation and nasalization are never permitted to jointly apply; and so the epenthesis rule must intervene.

• The product of the counterfeeding relationship is counterbled by epenthesis.

A second epenthesis rule must also apply before nasalization to block nasalization in forms like /ŋet-net/ → [netenet]

(24) /t̪/ /ŋk/ /t̪k/

Epenthesis: Ø → V /[-αPlace] __ [αPlace]  --  --  t̪Vk
Assimilation (applies to coronals nasals)  n̪  --  --
General Nasalization (applies to all C_o)  n̪  --  --

[ŋ̪] [ŋk] [t̪Vk]

• Epenthesis in the case of syllable contact violations must bleed nasalization

(25) Rule interactions given General Nasalization

Assimilation

counterbleeding

Epenthesis

[–son][+son]

counterfeeding

Epenthesis

[–αPlace] __ [αPlace]

bleeding

General Nasalization

bleeding

Neither of these scenarios is problematic in HG because of the possibility of cumulative constraint interaction.

- With /t̪k/ → [t̪Vk], *[ŋk] violation of IDENTNASAL is blocked due to the simultaneous violation of IDENTPLACE

This is a type of cumulative faithfulness effect (Farris-Trumble 2008)

- With /t̪n/ → [t̪Vn], *[nn] violation of IDENTNASAL is blocked due to the simultaneous violation of SYLLABLECONTACT

This is a type of cumulative faithfulness + markedness effect, allowing marked structures only when they are not derived through faithfulness violation.

Summary:
Cumulative constraint interaction in HG allows certain complex interactions to be effectively captured using simple constraints.

Analysis in OT with similar constraints encounters ranking paradoxes

- Solution: Reference to hidden structure

Analysis in rule-based frameworks requires duplication within the rules’ contexts

- Some generalization is possible, but only with complex ordering relationships

HG avoids this complexity by relying on optimization coupled with cumulative constraint interaction.

References


