Restrictions on Rounding Harmony

- Rounding harmony: rounding spreads from trigger vowel to target vowel(s)

  - Trigger height (nonhigh preferred)
  - Target height (high preferred)
  - Matching height of trigger and target
## Abridged Typology of Rounding Harmony

<table>
<thead>
<tr>
<th></th>
<th>Turkish(^1)</th>
<th>Yowlumne(^2,)*</th>
<th>Yakut(^3)</th>
<th>Arapaho(^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Within</strong> Height</td>
<td>o-o</td>
<td>o-o</td>
<td>o-o</td>
<td>o-o</td>
</tr>
<tr>
<td></td>
<td>u-u</td>
<td>u-u</td>
<td>u-u</td>
<td>u-u</td>
</tr>
<tr>
<td><strong>Cross</strong> Height</td>
<td>o-u</td>
<td>o-u</td>
<td>o-u</td>
<td>o-u</td>
</tr>
<tr>
<td></td>
<td>u-o</td>
<td>u-o</td>
<td>u-o</td>
<td>u-o</td>
</tr>
</tbody>
</table>

\(^1\) Clements & Sezer (1982)  
\(^2\) Kuroda (1967)  
\(^3\) Krueger (1962)  
\(^4\) Cowell & Moss (2008)
Gestural Uniformity
(Kaun 1995)

- Gestural Uniformity: autosegment should be uniformly executed throughout its span of association
- Feature [round] should be associated with vowels of uniform heights
Cross-Height Harmony Asymmetry

- Asymmetry in cross-height harmony restriction:

  ![Diagram](image)

  - Attributed to interaction of constraints against nonhigh round vowels and cross-height harmony (Kaun 1995, 2004; Walker 2017)
Proposals

- Constraint interaction analysis predicts cross-height harmony asymmetry in progressive (rightward) harmony only (e.g., Yakut)
- Asymmetry also holds in regressive (leftward) harmony (e.g., Arapaho)

Proposals:
1. Gestural Uniformity restriction on rounding harmony is split among two stringently defined constraints
2. More stringent constraint penalizes high-nonhigh vowel sequences only
Yakut
Yakut Rounding Harmony  
(Turkic; Russia; Kaun 1995; Sasa 2001, 2009; Walker 2017)

- **Vowel inventory:**

<table>
<thead>
<tr>
<th></th>
<th>Front Unround</th>
<th>Front Round</th>
<th>Back Unround</th>
<th>Back Round</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>i iː</td>
<td>y yː</td>
<td>u uː</td>
<td></td>
</tr>
<tr>
<td>Non-high</td>
<td>e eː</td>
<td>Øː</td>
<td>a aː</td>
<td>o oː</td>
</tr>
</tbody>
</table>

- Full backness harmony
- Cross-height rounding harmony only if target is high
Yakut Rounding Harmony
(Turkic; Russia; Kaun 1995; Sasa 2001, 2009; Walker 2017)

High vowels undergo harmony triggered by high or nonhigh round vowels:

a. [ox-u] ‘arrow (acc.)’
b. [børø-ny] ‘wolf (acc.)’
c. [murum-u] ‘nose (acc.)’
d. [tynnyk-y] ‘window (acc.)’

c.f. [aya-nu] ‘father (acc.)’
Yakut Rounding Harmony
(Turkic; Russia; Kaun 1995; Sasa 2001, 2009; Walker 2017)

Nonhigh vowels undergo harmony triggered by nonhigh round vowels:

a.  [่อยo-loɾ] ‘child (pl.)’
b.  [bɔɾo-łoɾ] ‘wolf (pl.)’

c.f.  [apa-λar] ‘father (pl.)’
Yakut Rounding Harmony
(Turkic; Russia; Kaun 1995; Sasa 2001, 2009; Walker 2017)

- Nonhigh vowels block rounding harmony triggered by high round vowels:
  a. [kus-tar] ‘duck (pl.)’
  b. [tynnyk-ler] ‘window (pl.)’

- Blocking occurs even when original trigger (initial syllable vowel) is nonhigh:
  c. [tobuk-ka] ‘knee (dat.)’
  d. [ørys-ter] ‘river (pl.)’
Yakut Rounding Harmony
(Turkic; Russia; Kaun 1995; Sasa 2001, 2009; Walker 2017)

- Rounding harmony creates:
  - Within-height sequences [o-o] and [u-u]
  - Cross-height sequence [o-u]

- Rounding harmony avoids cross-height sequence [u-o]
Constraints for Yakut Rounding Harmony

- **RoLO**: *[+round, -high]

- **UNIFORM**(round)

- **IDENT**(round)-IO

- **SPREAD**(round): For each feature [round] in a word, assign a violation for every vowel that is not associated to that [round].
Harmonic Grammar
(Legendre et al. 1990; Smolensky & Legendre 2006)

- Constraints are weighted rather than strictly ranked

- Cumulative constraint interaction (‘gang effect’): violation of two lower weighted constraints outweighs violation of single higher weighted constraint

- Yakut: interaction between constraints *ROLO and UNIFORM(round)
## Constraint Ranking for Yakut Rounding Harmony

<table>
<thead>
<tr>
<th>Input: /o-a/</th>
<th>SPREAD(rd) w=6</th>
<th>UNIFORM(rd) w=4</th>
<th>*RoLo w=4</th>
<th>IDENT(rd) w=1</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [o-a]</td>
<td>-1</td>
<td></td>
<td>-1</td>
<td></td>
<td>-10</td>
</tr>
<tr>
<td>b. [o-o]</td>
<td></td>
<td>-2</td>
<td>-1</td>
<td>-9</td>
<td></td>
</tr>
<tr>
<td>Input: /o-u/</td>
<td>c. [o-u]</td>
<td>-1</td>
<td>-1</td>
<td>-10</td>
<td></td>
</tr>
<tr>
<td>d. [o-u]</td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-9</td>
<td></td>
</tr>
<tr>
<td>Input: /u-a/</td>
<td>e. [u-a]</td>
<td>-1</td>
<td></td>
<td>-6</td>
<td></td>
</tr>
<tr>
<td>f. [u-o]</td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-9</td>
<td></td>
</tr>
<tr>
<td>Input: /u-u/</td>
<td>g. [u-u]</td>
<td>-1</td>
<td></td>
<td>-6</td>
<td></td>
</tr>
<tr>
<td>h. [u-u]</td>
<td></td>
<td></td>
<td></td>
<td>-1</td>
<td></td>
</tr>
</tbody>
</table>

Note: The values in the table represent ranking scores for various constraints and rules in Yakut language rounding harmony.
Arapaho
Cross-Height Harmony in Arapaho
(Algonquian; USA; Cowell & Moss 2008)

- **Vowel inventory:**

<table>
<thead>
<tr>
<th></th>
<th>Front/ Unround</th>
<th>Back/ Round</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>i i:</td>
<td>u u:</td>
</tr>
<tr>
<td>Non-high</td>
<td>e e:</td>
<td>o o:</td>
</tr>
</tbody>
</table>

- Two vowel harmony processes (progressive and regressive) affecting backness and rounding
Vowel Harmony in Arapaho
(Cowell & Moss 2008)

Progressive harmony: /i/ → [u] after trigger /o/

a. [ho:w-u-se:] ‘to walk downward’

c.f. [tʃeb-i-se:] ‘to walk (along)’

b. [nono:how-un] ‘you see me’

c.f. [beni:n-in] ‘you are giving it to me’

c. [bixo:x-u] ‘love me!’

c.f. [tʃih-biin-i] ‘give it to me!’
Vowel Harmony in Arapaho
(Cowell & Moss 2008)

Regressive harmony: /e/ → [o] before trigger /o/

a. [boːʔ-oːwu] ‘the water flows red’
b. [hoːk-ouniʔ] ‘it is dammed up’
c. [beːʔ-eː] ‘it is red’
d. [hetʃ-etiː] ‘close your mouth!’
## Vowel Harmony in Arapaho

(Cowell & Moss 2008)

<table>
<thead>
<tr>
<th>Progression</th>
<th>Within Height</th>
<th>Cross Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>o-o</td>
<td>u-u</td>
<td>o-u</td>
</tr>
<tr>
<td>u-u</td>
<td>u-o</td>
<td>u-o</td>
</tr>
</tbody>
</table>

- **Progressive harmony** creates cross-height sequence \([o-u]\)
- **Regressive harmony:**
  - Creates within-height sequence \([o-o]\)
  - Avoids cross-height sequence \([u-o]\)
- In avoided sequence \([u-o]\), \([u]\) would be derived, not \([o]\)
Vowel Harmony in Arapaho
(Cowell & Moss 2008)

UNIFORM(round) and *ROLO will not rule out /i-o/ $\rightarrow$ [u-o]:

<table>
<thead>
<tr>
<th>Input: /e-o/</th>
<th>a.  [e-o]</th>
<th>SPREAD(rd/bk) w=6</th>
<th>UNIFORM(rd) w=4</th>
<th>*ROLO w=4</th>
<th>IDENT(rd/bk) w=1</th>
<th>$\mathcal{H}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-10</td>
</tr>
<tr>
<td>b.  [o-o]</td>
<td></td>
<td></td>
<td>-2</td>
<td>-1</td>
<td>-1</td>
<td>-9</td>
</tr>
<tr>
<td>Input: /i-o/</td>
<td>c.  [i-o]</td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-10</td>
</tr>
<tr>
<td>d.  [u-o]</td>
<td></td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-9</td>
</tr>
<tr>
<td>Input: /o-i/</td>
<td>e.  [o-i]</td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-10</td>
</tr>
<tr>
<td>f.  [o-u]</td>
<td></td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-9</td>
</tr>
</tbody>
</table>
Split Gestural Uniformity
(Sasa 2001, 2009)

- Sasa’s two Gestural Uniformity constraints:
  - *H-L(round) penalizes [round]-linked [u-o] sequences
  - *L-H(round) penalizes [round]-linked [o-u] sequences

- Constraint *L-H[round] makes undesirable typological predictions, including reversal of cross-height rounding harmony asymmetry (Walker 2017)
**Issues with Simple Split Gestural Uniformity**

Reversal of cross-height rounding harmony asymmetry:

<table>
<thead>
<tr>
<th>Input: /o-a/</th>
<th>a. [o-a]</th>
<th>*L-H(rd) w=5</th>
<th>SPREAD(rd) w=3</th>
<th>*H-L(rd) w=1</th>
<th>IDENT(rd) w=1</th>
<th>$H$</th>
</tr>
</thead>
<tbody>
<tr>
<td>☞ b. [o-o]</td>
<td></td>
<td>-1</td>
<td></td>
<td></td>
<td></td>
<td>-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input: /o-u/</th>
<th>c. [o-u]</th>
<th>-1</th>
<th></th>
<th></th>
<th></th>
<th>-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>☞ d. [o-u]</td>
<td></td>
<td>-1</td>
<td></td>
<td>-1</td>
<td>-6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input: /u-a/</th>
<th>e. [u-a]</th>
<th>-1</th>
<th></th>
<th></th>
<th></th>
<th>-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>☞ f. [u-o]</td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input: /u-u/</th>
<th>g. [u-u]</th>
<th>-1</th>
<th></th>
<th></th>
<th></th>
<th>-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>☞ h. [u-u]</td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
</tbody>
</table>
Solution: Stringent Gestural Uniformity

Proposal: two Gestural Uniformity constraints in stringent relation (de Lacy 2002)

- \(*H-L(\text{round})\) penalizes \([\text{round}]-\text{linked} [u-o]\)
- \(\text{UNIFORM}(\text{round})\) penalizes \([\text{round}]-\text{linked} [u-o] \text{ and } [o-u]\)

\[
\begin{array}{c}
  \ast[\text{round}] \\
  \quad u \quad o \\
\end{array}
\]

\[
\begin{array}{c}
  \ast[\text{round}] \\
  \qquad V \quad V \\
  \quad \gamma_{\text{high}} \quad \beta_{\text{high}} \\
\end{array}
\]
Stringent Gestural Uniformity in Arapaho

Under stringent constraints, [u-o] sequences incur additional penalty and do not surface:

<table>
<thead>
<tr>
<th>Input: /e-o/</th>
<th>a. [e-o]</th>
<th>-1</th>
<th></th>
<th>-1</th>
<th>Η</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. [o-o]</td>
<td></td>
<td></td>
<td></td>
<td>-2</td>
<td>-3</td>
</tr>
<tr>
<td>Input: /i-o/</td>
<td>c. [i-o]</td>
<td>-1</td>
<td></td>
<td>-1</td>
<td>-6</td>
</tr>
<tr>
<td>d. [u-o]</td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-7</td>
</tr>
<tr>
<td>Input: /o-i/</td>
<td>e. [o-i]</td>
<td>-1</td>
<td></td>
<td>-1</td>
<td>-6</td>
</tr>
<tr>
<td>f. [o-u]</td>
<td></td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-3</td>
</tr>
</tbody>
</table>
Conclusion
Conclusion

- Cross-height rounding asymmetry accounted for by splitting Gestural Uniformity among two stringently defined constraints

- Generates asymmetry for both progressive harmony (e.g., Yakut) and regressive harmony (e.g., Arapaho)

- Avoids pathological predictions of splitting among two mirror-image constraints
Future Work

- Identify additional regressive cross-height rounding harmony systems

- What is the phonetic grounding of the cross-height rounding harmony asymmetry?

- How does the cross-height asymmetry relate to the typology of diphthongs?