1. INTRODUCTION

- Consonant harmony is often categorical
- Some languages show gradient patterns
- Challenge for standard OT accounts, including Agreement by Correspondence (Rose and Walker 2004)
- This poster presents a case in Oromo
  - Restrictions on the distribution of laryngeal features are not absolute
  - There is a clear bias towards agreement
  - Maxent solution
  - Weighted constraints capture statistical nature of patterns
  - Novel perspective on laryngeal harmony
  - Statistical trends mirror categorical patterns in other languages
  - A unified account of gradient and categorical patterns

- GOAL: Demonstrate the existence of statistical laryngeal harmony in Oromo and provide a Maxent analysis

2. BACKGROUND

- Oromo (Cushitic)
  - Ethiopia
  - 25 million speakers
  - Focusing on eastern (Harar) dialect
- Laryngeal harmony
  - Often no alternations
  - Can be statistical (Brown 2008)
  - Often regressive
    - E.g. Ngizim: *T[..., D, but D...T okay
  - Four classes of stops/aффricates
    - Plain voiceless: t, tfa, k
    - Plain voiced: b, d, ď, g
    - Ejective (voiceless): p', t', tf', k'
    - (Implosive: d')
  - No morpheme-internal stop-stop clusters except geminates
  - Looking at CV(C)CV morphemes

3. DATA

(1a) All combinations of voiced/voiceless attested

<table>
<thead>
<tr>
<th></th>
<th>goja: 'animal skin'</th>
<th>boka: 'rain'</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1.46</td>
<td>0.57</td>
</tr>
<tr>
<td>C2</td>
<td>0.38</td>
<td>1.58</td>
</tr>
</tbody>
</table>

(1b) All combinations of ejective/plain attested

<table>
<thead>
<tr>
<th></th>
<th>k'at'ale: 'smart'</th>
<th>k'otu: 'to farm'</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1.53</td>
<td>0.35</td>
</tr>
<tr>
<td>C2</td>
<td>0.22</td>
<td>2.00</td>
</tr>
</tbody>
</table>

- This difference is significant:
  - Voice: \( \chi^2(1, N = 89) = 23.73, p < 0.0001 \)
  - Ejective: \( \chi^2(1, N = 78) = 42.77, p < 0.0001 \)

- Greater representation of voiced-voiceless pairs than voiceless-voiceless (see 2a))

- Linear regression shows this difference approaches significance (3)

(3)

<table>
<thead>
<tr>
<th>Estimate</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.6375</td>
</tr>
<tr>
<td>C2.category</td>
<td>0.9117</td>
</tr>
</tbody>
</table>

- SUMMARY: Oromo has non-categorical trends towards ejective and voicing harmony, with a directionality effect in voicing harmony:
  - ++ and -- : common
  - +- somewhat rare
  - -+ rarest

5. MAXENT ANALYSIS

- Maximum Entropy (Maxent; Hayes and Wilson 2008) is a model for capturing phonotactic patterns in a language
- Takes as input a list of lexical items, a feature inventory, feature specifications for all segments, and projection tiers
- Outputs a list of constraints of form \(*M_iM_j...M_n\) where:
  - \(n\) is an integer greater than or equal to 1
  - Each \(M_i\) is a feature matrix of form \([\alpha F_1, \beta F_2, ..., \gamma F_m]\), where:
    - \(m\) is an integer greater than or equal to 1
    - Greek letters are + or –
    - Each \(F_i\) is a feature

- This work used a stop tier to allow stops to see each other non-locally
- Constraints on the stop tier are non-local between stops
- The algorithm learned 3 harmony constraints:

  - \[*[-voi]+voi*, stop tier, weight = 1.423
  - \[*[-voi]+voi*, stop tier, weight = 1.404
  - \[*[-cg]+cg*, stop tier, weight = 0.89

  - Crucially, \[*[-voi][-voi] and \[*[-cg][-cg] were not part of the model

  - A directionality asymmetry was learned by the model

  - Interesting because all types of disagreement are under-represented

  - Other non-harmony distributional constraints were part of the grammar

6. IMPLICATIONS

- Directionality
  - Learned only regressive constraints (with the marked feature)
  - Other theories require bidirectional harmony of marked feature or regressive harmony of both values
  - Makes incorrect predictions

- Integrating Maxent with Agreement by Correspondence

  - ABC correspondence constraints can be re-interpreted as mirroring projection from the Maxent model

- Maxent gives us insight into statistical patterns in Oromo

  - Can also be extended to categorical patterns