The Role of Anti-Harmony in Learning Neutral Vowels

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Abstract
Adult participants were exposed to a front/back harmony system with neutral vowel /a/. The neutral vowel never appeared with other vowels (e.g., only as /banam/), but either triggered a harmonic affix (/banamo/), disharmonic affix (/baname/), or a mixture of both harmonic and disharmonic affixes (/baname/ /dakago/). At test, participants exposed to disharmonic affixes, or a mixture of harmonic and disharmonic affixes, selected back-neutral-back responses at a rate greater than chance, consistent with a transparent /a/, suggesting that exposure to disharmonic affixes in training may help bias learners towards a transparent harmony system.

Background
- Vowel harmony languages typically have neutral vowels
  - **Transparent**: Harmony determined by ‘skipping’ the neutral vowel
  - **opaque**: Harmony domain ‘blocked’ by neutral vowel; neutral vowel starts new harmony domain
- Transparent and opaque neutral vowels common across vowel harmony languages, but generative accounts of transparent vowels often more complex (e.g., Bakovic & Wilson, 2000)
- Transparent vowels may be harder to learn than opaque vowels (Finley, 2015).
- **What factors might make transparent vowels easier to learn/represent?**
  - Anti-Harmony: stems containing only neutral vowels may trigger harmonic or disharmonic affix
  - Supports a ‘monotonic’ theory of vowel harmony, where neutral vowels ‘in between’ harmonic values (e.g., front/back) (Rebrus & Törkency, 2015)
- **Does exposure to anti-harmony, or stems that trigger disharmonic affixes increase bias towards transparent vowels in harmony?**

Participants: Adults fluent in American English (with no prior exposure to vowel harmony), participated for course credit.

Exposure: Artificial grammar learning for vowel harmony
Based on Finley (2015): CVCVC + CVCVC-e/o
- [-e] appeared with back vowel stems [u, o] (n=6)
- [-o] appeared with front vowel stems [i, e] (n=6)
- Stems with [-a] triggered [-e] or [-o] depending on condition
  - Anti-Harmony: 3 harmonic, 3 disharmonic
  - Disharmonic: 6 disharmonic ([e]-)
  - Harmonic: 6 harmonic ([o]-)
- 18 sets of stem-suffix pairs, repeated 10x in a random order.

Examples of Exposure

<table>
<thead>
<tr>
<th>Stem</th>
<th>Stem+Affix Anti-Harmony</th>
<th>Stem+Affix Harmonic</th>
<th>Stem+Affix Disharmonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front Vowel</td>
<td>pid age</td>
<td>pide age</td>
<td>pide age</td>
</tr>
<tr>
<td>Back Vowel</td>
<td>but on</td>
<td>but on</td>
<td>but on</td>
</tr>
<tr>
<td>Neutral Vowel</td>
<td>ban ame</td>
<td>daka gog</td>
<td>daka gog</td>
</tr>
</tbody>
</table>

2 Alternative Forced Choice Test:
- Compared a grammatical (harmonic) item to an ungrammatical (disharmonic) item ([e] vs. [o])
- 4 types of test items (10 of each type):

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Front Vowel Affix</th>
<th>Back Vowel Affix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old</td>
<td>ban ame</td>
<td>but on</td>
</tr>
<tr>
<td>New Harmonic</td>
<td>bip e no</td>
<td>kup a ge</td>
</tr>
<tr>
<td>Front Neutral</td>
<td>bit a mo</td>
<td>kupa ge</td>
</tr>
<tr>
<td>Back Neutral</td>
<td>bop a ne</td>
<td>mep a ne</td>
</tr>
</tbody>
</table>

Experiment Results: Means and Standard Errors:

- **Results**
  - Compared Front-Neutral and Back Neutral items to 50% chance using mixed effects logistic regression (lme4) in R, with random intercepts for subjects, items, and item number.
  - **Anti-Harmony:**
  - Front Neutral Significantly Different From Chance (β=0.32, SE = 0.10, z = 3.14)
  - Back Neutral Not Significantly Different From Chance (β=0.17, SE = 0.12, z = 1.35)
  - **Harmony:**
  - Front Neutral Not Sig. Different From Chance (β=0.016, SE = 0.16, z = 0.097)
  - Back Neutral Significantly Different From Chance (β=0.49, SE = 0.13, z = 3.78)
  - **DisHarmony:**
  - Front Neutral Significantly Different From Chance (β=0.33, SE = 0.13, z = 2.56)
  - Back Neutral Not Sig Different From Chance (β=0.16, SE = 0.13, z = 1.25)
  - Harmonic responses to Front Neutral Vowels significantly lower in the Harmony condition compared to Disharmony (β=0.33, SE = 0.15, z = 2.19) and Anti-Harmony conditions (β=0.34, SE = 0.16, z = 2.05).

Discussion
- When some or all neutral vowel stems triggered disharmonic affix, participants selected the ‘transparent vowel’ response for disharmonic stems with front vowels, but showed no bias towards disharmonic stems containing back vowels.
- When some or all neutral vowel stems triggered harmonic affix, participants selected harmonic response for disharmonic stems with front vowels, but showed no bias towards disharmonic stems containing front vowels.
- Exposure to neutral vowels that trigger disharmonic affix may help learners infer the more ‘difficult’ cases in a transparent vowel harmony system.

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References