1. Introduction

Place-specific restrictions on place assimilation

• Place assimilation in consonant clusters operates across the board in many languages.
• However, in some patterns, place assimilation shows place-specific restrictions on triggers and/or targets.
• **Korean** is a prime example
  • Whether place assimilation operates depends on the place of a potential trigger and its target.
  • Place assimilation shows sensitivity to a three-step scale for place: [Dorsal] > [Labial] > [Coronal].


Proposal preview

Place features have a gradient degree of activity (a) such that
a(Dorsal) > a(Labial) > a(Coronal)

• Employ Gradient Symbolic Representations (GSRs) (Smolensky & Goldrick 2016).
• Scale of activity for place features is the source of place-specific restrictions on place assimilation in Korean
• Provides an intrinsic mechanism for a parallel in scalar place-sensitive effects involving markedness constraints (governing triggers) and faithfulness constraints (governing targets).
• In the larger picture, gradient activity offers a means of analyzing other scales in phonology, and it has potential to facilitate a unified treatment of gradient and categorical phenomena.

1. Road map

2. Korean place assimilation pattern
3. Analysis
   • Scale of activity for place features
   • Analysis in Harmonic Grammar
   • M & F constraints for place features are general, not place-specific
4. Comparison with an alternative using hierarchically defined M and F constraint families for place.
5. Conclusion

2. Korean Place Assimilation
2. Korean Place Assimilation

Preview of place assimilation pattern

• In Korean stop clusters (C1C2), the first stop (variably) assimilates in place to the following stop. Participating stops are oral or nasal.
• The process is sensitive to place in the potential target C1 and trigger C2
  • Coronals are targeted by labials and dorsals
  • Labials are targeted by dorsals, but not coronals
  • Dorsals do not assimilate to coronals or labials.


• Assimilation has been characterized as occurring in speech that is informal or fast (Kim-Renaud 1974, Jun 1995).
• Experimental investigation has found that the assimilation is chiefly categorical in nature but variable (Kochetov & Pouplier 2008).
• The focus here is on deriving the variants with assimilation.

2. Korean Place Assimilation

Summary by place of target C1 and trigger C2

<table>
<thead>
<tr>
<th>Target</th>
<th>Markedness</th>
<th>Trigger</th>
<th>Markedness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dor</td>
<td>/kt/ [kt]</td>
<td>/kp/ [kp]</td>
<td>—</td>
</tr>
<tr>
<td>Lab</td>
<td>/pt/ [pt]</td>
<td>—</td>
<td>/pk/ [kk]</td>
</tr>
<tr>
<td>Cor</td>
<td>—</td>
<td>/tp/ [pp]</td>
<td>/tk/ [kk]</td>
</tr>
</tbody>
</table>

• Heterorganic clusters
  • green-shaded cells may assimilate in the output
  • red-shaded cells do not assimilate
• A dash is marked in white cells, where clusters are homorganic in the input.
• If place markedness is scaled as [Dorsal] > [Labial] > [Coronal] (e.g. de Lacy 2006), place assimilation can be characterized as operating only when the target is less marked than the trigger.

2. Korean Place Assimilation

<table>
<thead>
<tr>
<th>Assimilation</th>
<th>/Cor-Lab/</th>
<th>/Pat~pota/</th>
<th>/Son-patak/</th>
<th>/Son-mok/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[pap'oda]</td>
<td>[som'adak]</td>
<td>[sommok]</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>‘rather than the field’</td>
<td>‘palm’</td>
<td>‘wrist’</td>
<td></td>
</tr>
<tr>
<td>/Cor-Dor/</td>
<td>/pat~tkwa/</td>
<td>/Son-kala/</td>
<td>/Son-kalak/</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[pak'kwa]</td>
<td>[son'karak']</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>‘field’</td>
<td>‘finger’</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>/Lab-Dor/</td>
<td>/tk'op-k'al/</td>
<td>/Kam-ki/</td>
<td>/Lab-ki/</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[tk'okk'al]</td>
<td>[ka-ngi']</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>‘handsaw’</td>
<td>‘cold’</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>/Lab-Cor/</td>
<td>/pap-to/</td>
<td>/Sam-tok/</td>
<td>/Son-ek/</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[pap'to]</td>
<td>[sam'dak']</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>‘rice also’</td>
<td>‘three virtues’</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>/Cor-Dor/</td>
<td>/pakt'o/</td>
<td>/Kan-nal/</td>
<td>/Kan-nal/</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[pakt'o]</td>
<td>[kaŋn'al']</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>‘outside also’</td>
<td>‘market day’</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>/Lab-Dor/</td>
<td>/kuk-po/</td>
<td>/Taj-mjan/</td>
<td>/Lab-mjan/</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[ku:k'po]</td>
<td>[tjaŋmjan']</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>‘national treasury’</td>
<td>‘scene, spectacle’</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

No assimilation

Data from Kim-Renaud 1974: 231-5; assimilated variants shown only; C' represents a fortis C

2. Korean Place Assimilation

• Labial stops are pivotal in this pattern because they bifurcate the behavior of dorsal and coronal stops as targets and triggers.

1. Dorsals resist place assimilation from labials, but coronals do not, which suggests a place-sensitive difference in enforcement of faithfulness (Faith[Place]).
2. Dorsals trigger place assimilation in labials, but coronals do not, which suggests a place-sensitive difference in enforcement of markedness (assimilation imperative).

3. Analysis: Gradient Feature Activity
3.1 Overview

Aim for analysis

• Derive place assimilation only in those contexts where it may occur.

Formal issue

• Why do features further to the left on the place-feature scale potentially display a higher degree of markedness and faithfulness?

Proposal

• Parallels in strength of M and F for place originate in a scale of activity for place features, employing gradient symbolic representations.
• Activity values respect the relationship $a_{[Dor]} > a_{[Lab]} > a_{[Cor]}$.

3.2 Representations

Assumptions: Gradient Symbolic Representations (GSRs)

• Phonological symbolic representations have a specified activity $\alpha$, ranging from 0 – 1 (Smolensky & Goldrick 2016).
• Framework: Harmonic Grammar (Legendre et al. 1990, Smolensky & Legendre 2006)
• Activity factors into the calculation of penalties for violations
  • Elements with greater activity in output incur greater violation of markedness
  • Deletion of elements with greater activity in the input incurs a greater violation of Max.

3.3 Constraints

Penalty calculation

• Place feature activity defines the scale over which a scaling factor operates in constraints where place features are locus of violation
  • Argued to be necessary based on other patterns (Walker 2019).
• Scaling factor makes an additive contribution to the penalty assigned for violation (Coetze & Kawahara 2013, Gouskova & Linzen 2015, Hsu & Jesney 2016, 2018, Hsu 2019, a.o.).
• Penalty calculation is $(s * \alpha) + (w * v)$
  • $s$ = the scaling factor, $\alpha$ = the activity of $F \in \text{Place}$
  • $v$ = the number of violations
  • $w$ = the basic constraint weight, assigned for an offending place $F$
  • $s, v, w \geq 0, 0 \leq \alpha \leq 1$
• $s$ and $w$ are specified for each constraint. The Korean place assimilation pattern can be derived with:
  • $*C[xPl] C[yPl]$; $s = 20, w = 2$
  • Max[Pl]; $s = 20, w = 1$

The figure illustrates how penalty increases with activity.

$s$ determines the slope of each line

• $s$ is the same for both constraints; thus lines are parallel, holding a consistent relationship over $\alpha$ increments.
• $w * v$ is the y-intercept
  • $w * *C[xPl] C[yPl] > w * \text{Max[Pl]}$, so …
  • When $a(\text{trigger}) \geq a(\text{target})$, assimilation occurs, with $*C[xPl] C[yPl]$ enforced at the cost of Max[Pl].
  • When $a(\text{trigger}) < a(\text{target})$, assimilation is blocked, with Max[Pl] enforced at cost of $*C[xPl] C[yPl]$.
3.4 Tableaux

- Evaluation of candidates for schematic inputs with a heterorganic cluster containing a labial stop in C2 position.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>*C[xPI] C[yPI]</th>
<th>Max[Place]</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. /t,Pp/</td>
<td>a. (\rightarrow [pp]) assimilation</td>
<td>-1 = -(1 + 20 * .8)</td>
<td>-15</td>
<td></td>
</tr>
<tr>
<td>ii. /k,Pp/</td>
<td>a. (\rightarrow [pp]) assimilation</td>
<td>-1 = -(1 + 20 * .8)</td>
<td>-19</td>
<td></td>
</tr>
</tbody>
</table>

Assumption: Place-assimilated clusters share a single place feature linked across Cs

3.4 Tableaux

- Evaluation of candidates for schematic inputs with a heterorganic cluster containing a labial stop in C2 position.

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<th>Max[Place]</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. /t,Pp/</td>
<td>a. (\rightarrow [tt]) assimilation</td>
<td>-1 = -(1 + 20 * .8)</td>
<td>-15</td>
<td></td>
</tr>
<tr>
<td>ii. /k,Pp/</td>
<td>a. (\rightarrow [kk]) assimilation</td>
<td>-1 = -(1 + 20 * .8)</td>
<td>-19</td>
<td></td>
</tr>
</tbody>
</table>

/tp/ \(\rightarrow [pp]: \alpha(\text{trigger}) \gg \alpha(\text{target})\)
Violation of \(\*C[xPI] C[yPI]\) for [Labial] earns a lesser penalty than \(\*C[xPI] C[yPI]\) for [Coronal].

3.4 Tableaux

- Evaluation of candidates for schematic inputs with a heterorganic cluster containing a labial stop in C1 position.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>*C[xPI] C[yPI]</th>
<th>Max[Place]</th>
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</tr>
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<tbody>
<tr>
<td>i. /p,Pp/</td>
<td>a. (\rightarrow [pp]) assimilation</td>
<td>-1 = -(1 + 20 * .8)</td>
<td>-17</td>
<td></td>
</tr>
<tr>
<td>ii. /k,Pp/</td>
<td>a. (\rightarrow [kk]) assimilation</td>
<td>-1 = -(1 + 20 * .8)</td>
<td>-17</td>
<td></td>
</tr>
</tbody>
</table>

/pt/ \(\rightarrow [pt]: \alpha(\text{trigger}) \gg \alpha(\text{target})\)
Violation of \(\*C[xPI] C[yPI]\) for [Dorsal] earns a lesser penalty than \(\*C[xPI] C[yPI]\) for [Coronal].
3.5 Summary and extensions

Key points

- Place features are represented with scaled activity $\alpha_{\text{Dor}} > \alpha_{\text{Lab}} > \alpha_{\text{Cor}}$
- Intrinsic to this approach is the potential for features with greater activity to incur a greater violation of M and F constraints.
- Cashed out in Korean place assimilation
  - Place features with higher activity are stronger triggers for assimilation (markedness driven).
  - Place features with higher activity show stronger resistance to undergoing assimilation (faithfulness driven).
  - Derives assimilation that occurs only when $\alpha(\text{trigger}) \geq \alpha(\text{target})$.
- Constraints governing place assimilation refer to the entire class of Place rather than specific place features: *(ClPl) [ClPl], Max[Pl].

Extension: Other place assimilation patterns

- Gradient activity of place features extends to other assimilation patterns that are sensitive to place, e.g. sensitivity to whether a potential target is coronal (Walker 2019).

3.5 Summary and extensions

Extension: GSRs and other scales in phonology

- Representing scales with GSRs predicts scalar effects in markedness and faithfulness.

Some potential applications for patterns modeled with scaling factors:

- Loanword nativization: Periphery$_{a} >$ Intermediate$_{a} >$ Core$_{a}$
  - Core stratum has potential to show greater range of marked structures (lesser violation of M) or a smaller range of marked structures (lesser violation of F) in comparison to periphery (Hsu & Jesney 2017a, b, 2018).
- Prosodic Boundary Strength: Utterance$_{a} >$ PPh$_{a} >$ Pwd$_{a} >$ Syllable$_{a}$
  - Smaller PCats have potential to resist repair (lesser violation of M) or undergo repair (lesser violation of F) in comparison to larger PCats (Hsu & Jesney 2016).

- The tentative proposal here is that these scales be accounted for in terms of gradient activity in the representation.
  - i.e. $\alpha$ is what scaling factors operate over in these patterns

4. Alternative: Mirrored sets of M & F constraints

Families of constraints specified for subsets of place features (de Lacy 2002, 2006)

- Based on multi-valued [Place] feature.
- Relation between substrings of values of [Place] and assignment of violations is stated in schema for each constraint type.

\[ *(\text{Dor}) \begin{align*} & \text{IDEN} = \text{IO} (\text{Dor}) \\ & \text{IDEN} = \text{IO} (\text{Dor}, \text{Lab}) \\ & \text{IDEN} = \text{IO} (\text{Dor}, \text{Lab}, \text{Cor}) \end{align*} \]

- Place assimilation is driven by anti-heterorganic constraints over consonant sequences restricted by hierarchically derived place feature subsets.

- Ranking for Korean place assimilation (de Lacy 2002: 352)

\[ \begin{align*} & *(\text{Dor}, \text{Lab}, \text{Cor})(\text{Dor}) \\ & \text{IDEN} = \text{IO} (\text{Dor}, \text{Lab}) \\ & *(\text{Dor}, \text{Lab}, \text{Cor})(\text{Dor}, \text{Lab}) \\ & \text{IDEN} = \text{IO} (\text{Dor}, \text{Lab}, \text{Cor}) \end{align*} \]

4. Alternative

Comparison with gradient activity in features

- Activity-based approach leverages constraint weighting and scaling factors.
  - Place hierarchy is limited to feature representation alone
  - Eliminates subset-based constraint families, reducing the size of \text{CON}
- Role of the place feature scale in both M and F constraints is intrinsic to the architecture of the activity-based account (see Faust 2017, 2019, Zimmermann 2018, 2019 for related discussion).
  - Eliminates need to define the relationship between constraints and multi-valued features in each schema.
  - The activity-based approach addresses this systematically over M and F constraints using scaling factors.
- Activity-based approach has explanatory potential beyond feature hierarchies, such as
  - representing other scales in phonology
  - extending to a gradient and variable phenomena
5. Conclusion

Take-aways
• Gradient place feature activity captures scalar effects in place assimilation
  • specifically, segments with higher activity are more prone to be triggers and less prone to be targets
• Predicts scalar phenomena for markedness and/or faithfulness.
• Obviates subset-based M and F constraints for place features in CON.
• Provides a general mechanism for a representational treatment of scalar strength effects in phonology.
• This is a valuable area on which to focus future research.

6. Conclusion:

Appendix

• Evaluation of candidates for schematic inputs with a heterorganic cluster containing a coronal stop.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>( ^*C[xPI]\ C[yPI]) ( w = 2, s = 20 )</th>
<th>Max[Place] ( w = 1, s = 20 )</th>
<th>( H )</th>
</tr>
</thead>
<tbody>
<tr>
<td>/p,t_a/</td>
<td>[t_t]</td>
<td>-1 (=1(1+20*.8))</td>
<td>-17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. ( \rightarrow [p,t_a] )</td>
<td>-1 (=1(2+20*.7))</td>
<td>-16</td>
<td></td>
</tr>
<tr>
<td>/k,t_a/</td>
<td>a. [t_t]</td>
<td>-1 (=1(1+20*.9))</td>
<td>-19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. ( \rightarrow [k,t_a] )</td>
<td>-1 (=1(2+20*.7))</td>
<td>-16</td>
<td></td>
</tr>
<tr>
<td>/t,p_a/</td>
<td>a. [p,p_a]</td>
<td>-1 (=1(1+20*.7))</td>
<td>-15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. [t,p_a]</td>
<td>-1 (=1(2+20*.7))</td>
<td>-18</td>
<td></td>
</tr>
<tr>
<td>/k,p_a/</td>
<td>a. [k,p_a]</td>
<td>-1 (=1(1+20*.7))</td>
<td>-15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. [t,k_a]</td>
<td>-1 (=1(2+20*.9))</td>
<td>-20</td>
<td></td>
</tr>
</tbody>
</table>

Coronals never trigger place assimilation and always undergo it.

Appendix

• Evaluation of candidates for schematic inputs with a heterorganic cluster containing a dorsal stop.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>( ^*C[xPI]\ C[yPI]) ( w = 2, s = 20 )</th>
<th>Max[Place] ( w = 1, s = 20 )</th>
<th>( H )</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t,k_a/</td>
<td>a. ( \rightarrow [k,k_a] )</td>
<td>-1 (=1(1+20*.7))</td>
<td>-15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. [t,k_a]</td>
<td>-1 (=1(2+20*.9))</td>
<td>-20</td>
<td></td>
</tr>
<tr>
<td>/k,p_a/</td>
<td>a. [k,p_a]</td>
<td>-1 (=1(1+20*.9))</td>
<td>-17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. [p,p_a]</td>
<td>-1 (=1(2+20*.7))</td>
<td>-20</td>
<td></td>
</tr>
<tr>
<td>/k,t_a/</td>
<td>a. [t_t]</td>
<td>-1 (=1(1+20*.9))</td>
<td>-19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. ( \rightarrow [k,t_a] )</td>
<td>-1 (=1(2+20*.7))</td>
<td>-16</td>
<td></td>
</tr>
<tr>
<td>/k,p_a/</td>
<td>a. [k,p_a]</td>
<td>-1 (=1(1+20*.9))</td>
<td>-19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. ( \rightarrow [k,p_a] )</td>
<td>-1 (=1(2+20*.8))</td>
<td>-18</td>
<td></td>
</tr>
</tbody>
</table>

Dorsals always trigger place assimilation and never undergo.
References
Legendre, Géraldine, Yoshiro Miyata, & Paul Smolensky. 1990. Can connectionism contribute to syntax?
Harmonic Grammar, with an application. CLS 26, 237–252.