Coronal classes and features in Dhivehi

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1. Introduction

• This paper presents a case study of Dhivehi, a lesser-known Indo-Aryan language spoken in the Maldivian islands, south and west of India.
• What do the phonological patterns in this language tell us about natural classes involving coronal consonants? What features predict and best represent those classes?
• Evidence from Dhivehi suggests that posterior coronals are complex segments consisting of primary coronal features plus secondary vocalic features, and not simple coronals marked by the feature [–anterior] as traditionally assumed.

2. Theoretical Background

• Phonological inventories can distinguish up to 4 coronal places of articulation among stops.
• Maximal 4-way coronal systems are common in Australian and some Dravidian languages.
• These inventories include: dental, alveolar, retroflex, and ‘palatal’ (i.e., some form of laminal postalveolar, either alveolo-palatal or palato-alveolar).
• Standard approaches to feature theory assume two binary features: [±distributed] and [±anterior] as shown in (1) (e.g., Chomsky & Halle 1968, Sagey 1986, and numerous others).

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>t'</th>
<th>t̃</th>
</tr>
</thead>
<tbody>
<tr>
<td>[coronal]</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>[distributed]</td>
<td>+</td>
<td>−</td>
<td>+</td>
</tr>
<tr>
<td>[anterior]</td>
<td>+</td>
<td>+</td>
<td>−</td>
</tr>
</tbody>
</table>
• I advocate the ‘secondary articulation’ approach sketched in (2).

(2)

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>t</th>
<th>tʃ</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>[coronal]</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>[distributed]</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>[back]</td>
<td></td>
<td></td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

• Standard model: [±anterior] predicts the following natural classes:
  • [+anterior]: dental & alveolar
  • [–anterior]: palatal & retroflex
  • If front vowels and glides are [coronal] and [–anterior] (e.g., Lahiri & Evers 1991), then they should form a natural class with both palatal and retroflex consonants.

• Secondary Articulation model: [±back] predicts these natural classes:
  • [–back]: palatals & front vowels/glides
  • [+back]: retroflex & back vowels
  • Retroflexes do not form a natural class with palatals or front vowels/glides, and are incompatible with ‘palatalization’.

3. Dhivehi: Palatalization & Gemination (data from Cain 2000)

• Dhivehi has a 3-way coronal contrast: dental, palatal, retroflex.

(3) Inventory of Dhivehi consonant phonemes

<table>
<thead>
<tr>
<th>LABIAL</th>
<th>DENTAL</th>
<th>PALATAL</th>
<th>RETRO</th>
<th>VELAR</th>
<th>GLOTTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>t</td>
<td>tʃ</td>
<td>t</td>
<td>k</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>d</td>
<td>ʤ</td>
<td>d̂</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>m̄b</td>
<td>n̄d</td>
<td>n̄d̂</td>
<td>n̄g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>s</td>
<td>ʂ</td>
<td>ʂ</td>
<td>h</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>z</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>n</td>
<td>(ŋ)</td>
<td></td>
<td></td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>l</td>
<td>j</td>
</tr>
</tbody>
</table>
• When noun stems ending in /i/ are followed by a vowel-initial suffix:
  a. The vowel coalesces with a preceding segment, causing ‘palatalization’.
  b. The preceding consonant is geminated (i.e., compensatory lengthening).
• Palatalization is manifested in two ways:
  a. If the preceding consonant is labial or velar, palatalization produces an
     off-glide on the vowel of the preceding syllable (4).

(4) /j/ off-glide with gemination (VCi+V → VjCC+V)

<table>
<thead>
<tr>
<th>Noun</th>
<th>Noun-INDEF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labials</strong></td>
<td></td>
</tr>
<tr>
<td>loobi</td>
<td>loojbb-ek</td>
</tr>
<tr>
<td>a’mbi</td>
<td>ajmb-ek</td>
</tr>
<tr>
<td>nijami</td>
<td>nijajmm-ek</td>
</tr>
<tr>
<td>kurafi</td>
<td>kurajpp-ek</td>
</tr>
<tr>
<td>avi</td>
<td>ajvv-ek</td>
</tr>
<tr>
<td><strong>Velars</strong></td>
<td></td>
</tr>
<tr>
<td>boki</td>
<td>bojkk-ek</td>
</tr>
<tr>
<td>buraki</td>
<td>burajkk-ek</td>
</tr>
<tr>
<td>vaqi</td>
<td>vaqjgg-ek</td>
</tr>
<tr>
<td>fuqla9gi</td>
<td>fuqlajgg-ek</td>
</tr>
</tbody>
</table>

b. If the consonant is dental, it becomes palatal (5).

(5) Palatalization of dentals with gemination (ti+V → tfj+V)

<table>
<thead>
<tr>
<th>Dentals</th>
</tr>
</thead>
<tbody>
<tr>
<td>eti</td>
</tr>
<tr>
<td>rodi</td>
</tr>
<tr>
<td>doodi</td>
</tr>
<tr>
<td>fani</td>
</tr>
<tr>
<td>duini</td>
</tr>
<tr>
<td>duuni</td>
</tr>
<tr>
<td>ha9di</td>
</tr>
<tr>
<td>fali</td>
</tr>
</tbody>
</table>

• Palatalization and gemination are interdependent: the consonant can only
geminate if /i/ vacates its timing slot; /i/ can only vacate its timing slot if it
can pass its features to another segment (via palatalization).
• Thus, palatalization & gemination are both blocked if:
  a. The preceding syllable is closed (consonant is already geminate) (6).

  (6) No palatalization or gemination after closed syllables

  nappi  nappi-j-ek  ‘bad food’
  bimbi  bimbi-j-ek  ‘millet’
  batti  batti-j-ek  ‘light’
  buddi  buddi-j-ek  ‘mind’
  bonti  bonti-j-ek  ‘unopened frond’
  kulli  kulli-j-ek  ‘emergency’
  džinni  džinni-j-ek  ‘jinni’
  fungi  fungi-j-ek  ‘frond’

  b. The preceding consonant is retroflex (impervious to palatalization) (7).

  (7) No palatalization or gemination after retroflex consonants

  badži  badži-j-ek  ‘gun’
  faļi  faļi-j-ek  ‘slice’
  buri  buri-j-ek  ‘tier’

4. The Natural Classes

• What do these patterns tell us about natural coronal classes?
• Coronals form a natural class consisting of dentals, palatals, and retroflexes: labials & velars are transparent to palatalization, but coronals are opaque.

  (8) t  ũ  t
    A  A  A

• Dentals and palatals form a sub-class: t → ũ.

  (9) t  ũ  t
    A  A  A
    |    |    |
    B  B  B

• Palatals are marked in relation to dentals: they are derived from dentals by the addition of some feature(s) from /i/ (they are dentals plus something).
• Palatals and /i/ form a class: the spreading of some feature(s) from /i/ to a dental yields a palatal. Thus, the palatal and /i/ share some feature(s), and this feature is what distinguishes palatals from dentals.

• The class that unites palatals and /i/ excludes retroflexes: retroflexes resist palatalization. They are neither members of B nor C, and must be marked by something else. Assuming binary features, they might be marked by the antagonist to B, say D, and/or the antagonist to C, say E.

5. The Features
• What features correspond to A, B, C, D, and E?
• Class A corresponds naturally to the coronal articulator.
• The feature [+distributed] accurately predicts class B.
• Class C cannot be [–anterior] since this would include retroflexes.
• The feature [–back] accurately predicts class C.

• Class D cannot be [–anterior] since this would unite retroflexes with palatals (and potentially /i/).
• D could be [–dist]. This would reflect the fact that retroflexes are apical.
• E could be [+back]. This would reflect that fact that retroflexes are articulated with a retracted tongue body (e.g., Hamann 2003).

• If the palatalization feature is [–back], and retroflexes are inherently [+back], then we predict that retroflexes should block palatalization.

6. Retroflexion in Indo-Aryan

• Is there independent evidence for these features in other Indo-Aryan languages? Yes.
a. Loanword Adaptation: English apical alveolars are adapted as retroflex in Indo-Aryan languages, and never as dental (Ohala 1978, 1983; Arsenault 2006). This reflects the fact that they are [–dist].


\[
\begin{align*}
\text{a.} & \quad /t/ \rightarrow [t] / i \\
\text{b.} & \quad \rightarrow [t] / u, a \\
\end{align*}
\]

- This suggests that ‘retroflex’ phonemes are phonologically apical [–dist], and that the coarticulation of [–dist] with [+back] yields retroflexion.
- Note the following Parallelism: 
  \ [+dist] + [–back] = palatal
  \ [–dist] + [+back] = retroflex

7. Conclusion

- Together with evidence from other Indo-Aryan languages, the evidence from Dhivehi supports the ‘secondary articulation’ analysis of posterior coronals.
  a. There is no [–anterior] natural class consisting of palatals and retroflexes.
  b. There is strong evidence that palatals and /i/ share a palatalization feature [–back], that this feature distinguishes palatals from dentals, and is incompatible with retroflexion.
  c. Retroflexes are [–dist] and/or [+back].
- The feature [±back] is also used for other kinds of ‘secondary articulations’ including various kinds of secondary palatalization and velarization.
- If the analysis proposed here is on the right track, then these may be different phonetic implementations of the same phonological reality.
- These and other issues are the subjects on ongoing research. Comments and questions are welcome!
References


Dixit, R. Prakash, and James E. Flege. 1991. Vowel context, rate and loudness effects on linguopalatal contact patterns in Hindi retroflex $\mathrm{t\acute{a}}$. Journal of Phonetics 19.213-229.


