The obstruent sonority paradox as a markedness interaction effect

Jennifer L. Smith
University of North Carolina, Chapel Hill • jlsmith@email.unc.edu

Overview

§I Subdivisions in obstruent sonority vary by language
→ This has generally been treated as a language-particular ‘parameter’

§II Proposal: Sonority is an interaction between two markedness scales with the same prominence polarity

§III Typological predictions: Non-modal-voiced sonorants

§IV Theoretical implications

I. Subdivisions in obstruent sonority

(1) Sonority scale = continuum from...
   (see Parker 2002 for a thorough review)
   low (‘C-like’/prototypical onset) → high (‘V-like’/prototypical nucleus)

(2) Core sonority scale: obstruents < nasals < liquids < vocoids
   (Clements 1990)

(3) Evidence for a finer-grained sonority division is observed in many languages
   (a) vocoids: high < mid < low, etc. (Dell & Elmedlaoui 1985, 1988; Kenstowicz 1996)
   (b) liquids: laterals < rhotics (Einarsson 1949; Zec 1995)

(4) Evidence also supports a finer-grained division of the class of obstruents
   (a) voiceless obstruents < voiced obstruents
   (b) stops < fricatives
   (c) But: obstruent divisions are not cross-linguistically consistent
   • It seems to be a language-particular choice which is the primary distinction

(5) Specifically, there are two possibilities:
   (a) Subdivide by voicing first, then by continuancy within voicing category
      ( [ t ] > [ s ] ) > ( [ d ] > [ z ] )
      • Example: Pirahã (Everett & Everett 1984)
      - Heavy syllables are preferred over light syllables for stress (within last three syllables)
      - Then, voiceless onsets are preferred over voiced (lower sonority)

káá.gai ‘word’
pa.háí.bií (proper name)

bií.sái ‘red’
?i.baó.sáí ‘her cloth’

• acute accent = stress
• underline = high tone
• bold = σ to compare
(b) Subdivide by \textit{continuancy} first, then by \textit{voicing} within continuancy category

\[(t > d) > (s > z)\]

- Example: Imdlawn Tashlhiyt Berber (Dell and Elmedlaoui 1985: 113, 1988)
  - Any segment can be a nucleus (shown \textsc{capitalized}), but higher-sonority nuclei preferred
  - Voiceless fricatives are preferred over voiced stops
    \[/t–bxl=akk\,^w/\ , \,*\, tBx.lakk\,^w/\text{ ‘she even behaved as a miser’}\]
    \[c:\, /ma=ra–t–g–t//\ , ma.ra.tGt/\text{ ‘what will happen of you?’}\]

(6) Thus, when there are finer-grained distinctions among the obstruents:

(a) voiceless stops are always lowest in sonority
(b) voiced fricatives are always highest in sonority
(c) relative position of voiced stops and voiceless fricatives varies by language

(7) Unlike the subdivisions in the liquids and vocoids, these obstruent subdivisions appear to require a language-particular ‘parameter’ in the sonority scale (e.g., two distinct ‘subscales’ for obstruent sonority in de Lacy 2002)

- Abandons the idea of a single cross-linguistically consistent scale
- What is the motivation for these language-particular parameters or subscales?

II. Proposal: Two-dimensional sonority

(8) Insight: The ‘sonority scale’ is composed of two separate, interacting scales

“Some sounds are...more sonorous than others. \textbf{Voiced} sounds are more audible than unvoiced, for the obvious reason that to the oral noise they add the tone produced in the larynx. It is equally obvious that the more \textbf{open} a sound, the greater its volume.”

Bloomfield (1914: 42); emphasis added

“Perhaps the best way to look at lenition/fortition overall is in terms of two strength scales, one of \textbf{openness} and one of \textbf{sonority}: movement down the first involves \textbf{decreased resistance to airflow}, movement down the second an increase in the output of \textbf{periodic acoustic energy}.”

Lass (1984: 178); emphasis added

- Proposal here is to \textbf{implement this insight in constraint-based phonology}

(9) Two scales available to the phonological grammar

(a) \textbf{Aperture}—openness of vocal tract (oral+nasal) (term inspired by Saussure 1916)

The \textbf{aperture scale} stops < fricatives < nasals < liquids < vocoids

(b) \textbf{Resonance}—periodic energy

The \textbf{resonance scale} voiceless < voiced

→ The \textbf{scales are universal}, but their interaction is language-particular

(10) ‘Sonority’ constraint families are generated from a combination of these scales

(a) High-‘sonority’-preferring positions prefer \textbf{high aperture} and \textbf{high resonance}
(b) Low-‘sonority’-preferring positions prefer \textbf{low aperture} and \textbf{low resonance}
(c) Why would aperture and resonance pattern together? See §IV
A. Formal implementation in strict-dominance OT: Constraint lattice

(11) Constraints formed from a combination of these two scales make up a constraint lattice (Baertsch 1998, 2002; compare Gouskova 2004)

(a) Constraints on aperture levels: universally ordered by the aperture scale
(b) Constraints on resonance levels: universally ordered by the resonance scale
(c) But, the lattice also contains constraints that are not universally ordered (those that differ in both resonance and aperture)

(12) Example: onset as a context preferring low aperture and low resonance
- Lattice—when a line connects two constraints, the upper one is universally ranked higher

\[
\begin{align*}
*O_{NS/VOC}&VCD \\
*O_{NS/VOC}&VCLS & *O_{NS/LIQ}&VCD \\
*O_{NS/LIQ}&VCLS & *O_{NS/NAS}&VCD \\
*O_{NS/NAS}&VCLS & *O_{NS/FRIC}&VCD \\
*O_{NS/FRIC}&VCLS & *O_{NS/STOP}&VCD \\
*O_{NS/STOP}&VCLS
\end{align*}
\]

high sonority (*)

low sonority (○)

(13) This lattice makes the correct prediction for obstruent sonority levels:

(a) Stops < fricatives | Stops are better onsets
(b) Voiceless obstruents < voiced obstruents | Voiceless obstruents are better onsets
(c) But—no universal ordering between voiced stops and voiceless fricatives
- Result: The constraints on these two categories can be freely ranked

(14) Example: peak as a context preferring high aperture and high resonance
- Since both scales interact with sonority-preferring positions in the same way, if we consider a high-sonority-preferring context, the entire lattice inverts

\[
\begin{align*}
*P_{EAK/STOP}&VCLS \\
*P_{EAK/STOP}&VCD & *P_{EAK/FRIC}&VCLS \\
*P_{EAK/FRIC}&VCLS & *P_{EAK/NAS}&VCLS \\
*P_{EAK/NAS}&VCLS & *P_{EAK/LIQ}&VCLS \\
*P_{EAK/LIQ}&VCLS & *P_{EAK/VOC}&VCLS \\
*P_{EAK/VOC}&VCD
\end{align*}
\]

low sonority (*)

high sonority (○)

(15) Again, this lattice makes the correct prediction for obstruent sonority levels:

(a) Stops < fricatives | Fricatives are better peaks
(b) Voiceless obstruents < voiced obstruents | Voiced obstruents are better peaks
(c) But—no universal ordering between voiced stops and voiceless fricatives
B. Harmonic Grammar implementation

(16) In Harmonic Grammar (HG; Smolensky & Legendre 2006), constraints are weighted rather than ranked, and the weights of all assigned violations are cumulative.
   • This allows gang effects, where multiple constraints act together.

(17) In HG, *ONSET/aperture and *ONSET/resonance can be formalized as simple constraint families (no need for a lattice).
   (a) The *ONSET/Aperture family:
       *ONS/vocoid >> *ONS/liquid >> *ONS/nasal >> *ONS/fric >> *ONS/stop
   (b) The *ONSET/Resonance family: *ONS/voiced >> *ONS/voiceless
   • Gang effects can be used to model the interaction between these families.

(18) Example: onset as a context preferring low aperture and low resonance.
   • Each constraint’s weight is shown below the constraint name.
   • Constraint violations are notated ‘−1’ for each instance, rather than ‘∗’.
   • Each candidate’s harmony score = sum of (violation score)*(weight) for each constraint.

(19) Scenario (I): Voiceless fricatives < voiced stops

<table>
<thead>
<tr>
<th></th>
<th>*ONS/voc6</th>
<th>*ONS/liq5</th>
<th>*ONS/nas4</th>
<th>*ONS/fric3</th>
<th>*ONS/stop2</th>
<th>*ONS/vcd3</th>
<th>*ONS/vcls1</th>
<th>harmony score</th>
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</table>

• Voiceless fricatives are preferred over voiced stops as onsets.

(20) Scenario (II): Voiced stops < voiceless fricatives

<table>
<thead>
<tr>
<th></th>
<th>*ONS/voc6</th>
<th>*ONS/liq5</th>
<th>*ONS/nas4</th>
<th>*ONS/fric3</th>
<th>*ONS/stop1</th>
<th>*ONS/vcd2</th>
<th>*ONS/vcls1</th>
<th>harmony score</th>
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<td>−1</td>
<td>−1</td>
<td>2</td>
</tr>
</tbody>
</table>

• Voiced stops are preferred over voiceless fricatives as onsets.

(21) Generalization: Consider two constraint families A–B and X–Y, each with a fixed weight ordering such that \( w_a > w_b \) and \( w_x > w_y \).
   (a) Necessarily, \( w_a + w_x > w_b + w_x \) and \( w_a + w_y > w_b + w_y \).
   (b) Necessarily, \( w_a + w_x > w_a + w_y \) and \( w_b + w_x > w_b + w_y \).
   (c) Necessarily, \( w_a + w_x > w_b + w_y \).
   (c) But, no necessary ordering between \( w_a + w_y \) and \( w_b + w_x \).
C. Summary: Formalizing two-dimensional sonority

(22) Sonority as an interaction between an aperture scale and a resonance scale can be formalized in a constraint-based framework:
   (a) in strict-dominance OT, by means of a constraint lattice
   (b) in HG, by means of simple constraint families

III. Typological predictions

(23) The voiced/voiceless distinction should interact with other levels in the sonority scale just as it does with obstruents
   (a) **Voiceless sonorants** should behave as though they were lower in sonority than their voiced counterparts: \( R < R \)
   (b) Extension—If “resonance” is about having periodic acoustic energy (Lass 1984), then **glottalized sonorants** should also behave as though they were lower in sonority than their (modal-)voiced counterparts: \( R' < R \)
   (c) The language-specific sonority ordering we see between voiced stops and voiceless fricatives should occur with other adjacent pairs of aperture levels

A. Voiceless sonorants

(24) Kokota (Palmer 1999ab): \( R < R \)
   (a) Voiced and voiceless sonorants: nasals, laterals, rhotics (Palmer 1999b: 78)
       nomi ‘our (exc)’ nomi ‘hear (tr)’
       niyo ‘2sg undergoer’  niyo ‘finish’
       nonolo ‘be straight’ nono ‘bird sp.’
       ruta ‘swamp taro’ ruta ‘untangle’
   (b) Onset clusters are allowed (Palmer 1999a: 35, 323-326)
       prosa ‘slap self w. flipper (of turtles)’ pleku ‘be bent’
       fro ‘squeeze’ flalo ‘fly’
       vraha ‘vitex cofassus’ klahe ‘be bald’
       kraço ‘be dry’ glaba ‘moon’
       gruyu ‘night’
       bnakua ‘be slow’
       knaso ‘be empty’
   (c) However, onset clusters must be obstruent + voiced coronal sonorant
       \( \rightarrow \) Compatible with claim that **voiceless sonorants < voiced sonorants**
       • Onset clusters tend to prefer dispersed, rising sonority (Clements 1990)
(25) Norwegian (Rice 2003): $R < R$

(a) Imperative of verb = bare stem (data shows infinitive – imperative)

• **Singleton**
  - å spise – spis! ‘eat’
  - å gjøre – gjør! ‘do’
• **Geminate**
  - å legge – legg! ‘lay’
  - å finne – finn! ‘find’

• **Falling sonority**
  - å tenke – tenk! ‘think’
  - å fjerne – fjern! ‘remove’

• **Two obstruents**
  - å vokse – vok! ‘grow’
  - å fiske – fisk! ‘fish’

(b) Exception: Stems ending in an obstruent+sonorant cluster

  *.*.åpn. ‘open’  *.*.sykl. ‘bike’  *.*.klatr. ‘climb’

• One strategy used (if obstruent=voiceless): devoice the sonorant (Rice 2003: 35)

→ **Compatible with claim** that **voiceless sonorants < voiced sonorants**

• If the correct generalization is that coda clusters must not rise in sonority, this pattern suggests that obstruents and voiceless sonorants are patterning as one sonority level; this can be modeled as conflation (de Lacy 2002) of the T(S,D,Z)+$R$ categories

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B. Glottalized sonorants

(26) Kwakwala (Boas 1947; Zec 1988; Gordon 2000): $R' < R$

(a) Stress is weight-sensitive (data from Boas 1947; transcriptions after Zec 1988: 44-47)

• **Initial CV does not attract stress (indicated á)**
  - ná.pá ‘to throw a round thing’
  - w’á.dá ‘it is cold’
  - c’á.xá.lá ‘to be sick’
• **Initial CV: attracts stress**
  - qá:sa ‘to walk’
  - c’é:kwa ‘bird’
  - x’á:kwa.na ‘canoe’

(b) Coda sonority affects syllable weight

• **Initial CVO does not attract stress**
  - max’.c’á ‘to be ashamed’
  - c’á.t.xá ‘to squirt’
  - gas.xá ‘to carry on fingers’
• **Initial CVR attracts stress**
  - m’án.sa ‘to measure’
  - dól.xa ‘damp’
  - tól.q‘a ‘soft’

(c) Glottalized sonorant codas do not make a syllable heavy

• **Initial CVR’ does not attract stress**
  - gəm’.χá ‘to use the left hand’
  - k’ən’.χá ‘clams are spoiled’
  - məl’.qá ‘to repair canoe’

→ **Evidence for claim** that **glottalized sonorants < voiced sonorants**

• The obstruent pattern is a point in favor of seeing this as sonority-related
Kashaya (Buckley 1994: §2.3.3):  D < N’

(a) Voiced stops, glottalized nasals in complementary distribution
• [b, d] in onset; [m’, n’] in coda
  ca. dú ‘look’
  duh. lu dí: bi ‘start to pick off’
  mah. sa. dún ‘while taking it away’
  cán’ pí ‘if he sees’
  duh. lún’ ba ‘having picked it off’
  mah. sán’ qh ‘must have taken it away’

(b) This pattern has a sonority-relevant interpretation: onsets prefer lower sonority; codas prefer higher sonority (Clements 1990)
• Buckley (1995) specifically proposes that [d] < [n’] < [n] in his discussion of this alternation; he notes that the putative change /n'/ → *[n] would require fewer feature changes, so why [d], if not to reduce sonority?
• Problem: There is an independent prohibition on glottalized sonorants in onset position, unrelated to sonority; other languages do have /n’/ → [n] in (non-postvocalic) onsets (Howe & Pulleyblank 2001)
• So what Kashaya most directly supports is [d] < [n] (...which we knew...)

→ Compatible with claim that voiced obstruents < glottalized sonorants

Coda consonants in Hakha Lai (Hyman & VanBik 2002):  R ≠ { R’, T }

(a) Allow tonal contrast on syllable:  Sonorants /m n ŋ l r j w/
(b) No tonal contrast on syllable:  Glottalized sonorants /m’ n’ ŋ’ l’ r’ j’ w’/
   Obstruents /p t k/
• Glottalized sonorant codas also show special behavior in that the nucleus can only be a short vowel; sonorant, obstruent codas allow a vowel length contrast
• Is this example truly a sonority-based grouping of R’ with T?

→ Compatible with claim that glottalized sonorants < voiced sonorants, if this is a sonority-based pattern

C. Summary:  Non-nodal-voiced sonorants and the sonority scale

Large-scale predictions of the two-dimensional sonority approach for voiceless (a) and glottalized (b) sonorants (R=sonorants; Z/S=fricatives; D/T=obstruents)

(a) ... R \ Z \ S \ D \ T
(b) ... R’ \ Z \ S \ D \ T

The typological patterns reviewed above are consistent with:

(a) R < R  |  Kokota, Norwegian
(b) R’ < R  |  Kwak’wala, ??Hakha-Lai
(c) D < R’  |  Kashaya
D. Prediction: ‘Aperture-level swaps’

(31) Analogous to the ordering options we see between voiced stops and voiceless fricatives, the two-dimensional sonority model developed here predicts that there should be ordering options between any categories represented by constraints that differ in resonance and have aperture levels that are adjacent on the scale

(a) voiced liquids and voiceless/glottalized glides
(b) voiced nasals and voiceless/glottalized liquids
(c) voiced fricatives and voiceless/glottalized nasals
(d) ...etc. → No examples found yet

IV. Theoretical implications

(32) Are there positions that prefer high aperture but low resonance, or vice versa?

• Perhaps not, given the principle of prominence alignment (Prince & Smolensky 1993): High aperture and high resonance are functionally related, so will be attracted to or repelled from the same sets of positions—they have the same prominence polarity

(33) Do we ever see aperture or resonance constraint families acting individually?

• This might be difficult to distinguish empirically from traditional ‘sonority’ or [±voice]-related patterns

(34) What formalism is most appealing for implementing two-dimensional sonority?

(a) HG allows simple constraint families, rather than a lattice or other formal conjunction operation (see Pater, to appear, for related discussion)
(b) In strict-domination OT, an alternative approach for modeling sonority effects is stringency (Prince 1997; de Lacy 2002, 2004)

• Each constraint in the family bans a successively larger subset of the scale

*ONs/vocoid, *ONs/voc+liquid, *ONs/voc+liq+nasal, ...

• What predictions would this make under two-dimensional sonority?

(35) Implications for multiple sonority-sensitive processes in the same language

(a) If each constraint family or lattice operates independently, we predict the possibility of different sonority thresholds or subgroupings for different phenomena in the same language
(b) But this is a general prediction of approaches that use constraint families projected from the sonority scale (see Parker 2011 for related discussion)
(c) Alternative: Each language sets the relationships among scale levels

• Rankings between categories that are not universally ranked
• Conflation of levels into more general categories
Constraints are then projected from this adjusted scale
V. Summary and conclusions

(36) Two-dimensional sonority:
   (a) Makes explicit use of the insight that sonority has two distinct components, aperture and resonance
   (b) Can be implemented in OT or HG
   (c) Correctly captures cross-linguistic differences in obstruent sonority behavior
   (d) Makes predictions about non-modal-voiced sonorants that are, so far, not seen to be contradicted

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References


