24.961 Features-3: Underspecification

[1] Generative Phonology before OT:

- Economy of storage for lexical representations
- Predictable features assigned by rules
- Full specification at surface phonetics
- Default rules fill in redundant values


- English contrasts voiced and voiceless (bin vs. pin) and has predictable aspirated stops; thus [0spread gl] in lexicon
- Lexical contrast is [±voice] and aspiration ([spread gl]) assigned by rule
- Mandarin has contrast of [±spread gl]
- Default rules:
  
  \[
  \begin{array}{c|c}
  [-\text{sonorant}] & [-\text{spread gl}] \quad \text{English}^1 \\
  [-\text{sonorant}] & [-\text{voice}] \quad \text{Mandarin} \\
  [+\text{sonorant}] & [+\text{voice}] \quad \text{English and Mandarin}
  \end{array}
  \]

[3] feature geometry curtails scope of some default rules; [lateral] is only relevant for coronals and so it makes no sense to assign vowels and labials [−lateral]


- Russian obstruents

  Stops: \( p, t, k \) vs. \( b, d, g \)
  Fricatives: \( f, s, s', x \) vs. \( v, z, ʒ \)
  Affricates: \( ts, tʃ \)

- Contrastive Underspecification assigns /p/ [−voice] and /b/ [+voice] in the lexicon while /x/ is [0voice] and assigned [−voice] by default rule
- Radical Underspecification (Archangeli 1984, Kiparsky 1982,86) broadens the scope of the default rule to assign [−voice] to /p/ as well.


Russian voicing assimilation (Jakobson 1956, Hayes 1984, Kiparsky 1985)

\[1\] English also assigns [ + spread gl] to voiceless stops at the beginning of a stressed syllable.
• Obstruents trigger assimilation but sonorants neither trigger or undergo

<table>
<thead>
<tr>
<th>Obstruents</th>
<th>Obstruents</th>
</tr>
</thead>
<tbody>
<tr>
<td>bez mamy</td>
<td>bes papy</td>
</tr>
<tr>
<td>iz mamy</td>
<td>is papy</td>
</tr>
<tr>
<td>ot mamy</td>
<td>ot papy</td>
</tr>
<tr>
<td>bez dočeri</td>
<td>bez dočeri</td>
</tr>
</tbody>
</table>

• According to Jakobson (1956) sonorants are transparent to assimilation; better attested data in Polish (Rubach 1996)

<table>
<thead>
<tr>
<th>Polish</th>
<th>Polish</th>
</tr>
</thead>
<tbody>
<tr>
<td>od mzdy ‘from bribe’</td>
<td>is Mzenska ‘from Mzensk’</td>
</tr>
<tr>
<td>ot Anny ‘from Ann’</td>
<td>iz Ameriki ‘from America’</td>
</tr>
</tbody>
</table>

• Sonorants are [0voice] until later in/at the end of the derivation

<table>
<thead>
<tr>
<th>Obstruents</th>
<th>Obstruents</th>
</tr>
</thead>
<tbody>
<tr>
<td>o t m z</td>
<td>i z m t</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

- the [-voice] of /t/ may spread to /z/ across the /m/ without crossing association lines connecting the voice tier to the Laryngeal Articulator node
- the default rule assigning [+voice] to the sonorant [m] creates an illformed autosegmental relation requiring the multiply linked [-voice] associated with /s/ < /z/ and /t/ to be fissioned into separate [-voice] feature specifications

[6] Sanskrit n-retroflexion (nati) (Steriade 1987)

<table>
<thead>
<tr>
<th>Sanskrit</th>
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<th>Sanskrit</th>
</tr>
</thead>
<tbody>
<tr>
<td>retroflex</td>
<td>retroflex</td>
<td>retroflex</td>
</tr>
<tr>
<td>t</td>
<td>ċ</td>
<td>ţ</td>
</tr>
<tr>
<td>s</td>
<td>š</td>
<td>ś</td>
</tr>
<tr>
<td>n</td>
<td>ų</td>
<td>ų</td>
</tr>
<tr>
<td>r</td>
<td></td>
<td></td>
</tr>
<tr>
<td>anterior</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>distributed</td>
<td>–</td>
<td>+</td>
</tr>
</tbody>
</table>

- suffixal /n/ is retroflexed when root contains a retroflex [– anterior, – distr] consonant
Since the process applies across labials (cf. krp-a-ma:ña), the Place features are not binary but unary and on a separate autosegmental tier.

- even though the target is [+nasal] and the trigger [+contin], intervening coronal stops block the rule, as in mrd-na:
- this follows if the contrast between /d/ and /ɖ/ is recorded in the lexical representation as a binary [±anterior] rather than [0anterior] vs. [−anterior]
- but the behavior of /r/ is problematic; since there is no contrast between a retroflex and nonretroflex rhotic, the [−anterior, −distributed] features would be predictable and hence might not be expected to be present at the point the rule applies.
- one possible mitigating factor is that the single rhotic has the marked values for [anterior] and [distributed] and so they would be assigned by a rule that is not a default rule assigning the unmarked values of [+anterior, −distributed]
- another perspective: suppose the retroflex gesture is held after the retroflex consonant up until the next coronal consonant (not heard on vowel); it is blocked on a /t,s,n/ by faithfulness
- we will revisit this question when we look at vowel harmony in a couple of weeks.


nav-alis  rur-alis
sol-aris  lun-aris  milit-aris  flor-al-is

- Dissimilation applies across n and t but not [r];
• If [n] and [t] as well as [r] are [−lateral] as postulated by radical underspecification, then the default rule assigning [−lateral] must be split: before dissimilation for [r] in order to trigger dissimilation and after dissimilation for [n] and [t] to allow the dissimilation rule to see past them.

• Under Contrastive Specification this bifurcation does not arise since /r/ is [−lateral] in the lexicon by virtue of contrasting with /l/.

[8] Lyman’s Law (Mester & Ito 1989)

<table>
<thead>
<tr>
<th>Japanese Word</th>
<th>Reduksi</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>neko 'cat'</td>
<td>neko-jita</td>
<td>redaku</td>
</tr>
<tr>
<td>ori 'fold'</td>
<td>ori-gami</td>
<td>rendaku</td>
</tr>
<tr>
<td>kita 'north'</td>
<td>kita-kaze</td>
<td>Lyman /z/ is [+voice]</td>
</tr>
<tr>
<td>taikutsu + sinogi</td>
<td>takitutsu- sinogi</td>
<td>Lyman /n/ is [0voice] but g is [+voice]</td>
</tr>
<tr>
<td>onna 'woman' + kotoba 'speech'</td>
<td>onna-kotoba</td>
<td>Lyman /t/ is [0voice]</td>
</tr>
</tbody>
</table>

- here it appears we must treat voiceless obstruents as underspecified [0voice]
- this example is consistent with radical underspecification

[9] Kiparsky (1985) proposed that the default rule filling in contrastive feature applied in Lexical Component while noncontrastive features are assigned Post-Lexically; but this was easily and quickly falsified: predictable features like [sonorant] and syllabification are needed at the earliest stages of the lexical component for rules of prosody and redundant features like [−ATR] on low vowels is needed in some ATR harmony systems such as Kinande.

<table>
<thead>
<tr>
<th>Kinande vowel phonemes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>i u [ + high, + ATR]</td>
<td></td>
</tr>
<tr>
<td>i u [ + high, -ATR]</td>
<td></td>
</tr>
<tr>
<td>e o [−high, -ATR]</td>
<td></td>
</tr>
<tr>
<td>a [ + low, -ATR]</td>
<td></td>
</tr>
<tr>
<td>erí-sába erí-sab-fr-a</td>
<td>‘pray’</td>
</tr>
<tr>
<td>erí-síś-a erí-sis-fr-a</td>
<td>‘cut hair’</td>
</tr>
<tr>
<td>erí-súk-a erí-súk-fr-a</td>
<td>be trapped’</td>
</tr>
<tr>
<td>erí-síg-a erí-sig-fr-a</td>
<td>‘wager’</td>
</tr>
<tr>
<td>erí-libán-a erí-liban-fr-a</td>
<td>‘disappear’</td>
</tr>
</tbody>
</table>

- applied suffix –ir assimilates the [+ATR] of the preceding root vowel

- in erí-liban-fr-a the low vowel of the root liban must be [−ATR] to block spread of [+ATR] from the preceding high vowel even though this feature is not contrastive in low vowels and hence should only be assigned later.
Reduced vowels in American English

and rounding (and hence F2) dependent on segmental context – and both are distinct from schwa as observed in words like Rosa's.

3.4 Final schwas
The mean F1 of unsuffixed final schwa (e.g. Rosa) is higher than the possessive or plurals of these words (Rosa's, sofa's) (settable). Figure shows that F1 for word-final schwa varies across a wide range, extending to the vicinity of low vowels, although the mean of 659 Hz indicates a mid vowel.

4 Discussion
This study of reduced vowels reveals a fundamental distinction between word-final schwa and other reduced vowels: word-final schwas center around a mid vowel quality, while reduced vowels in other positions are generally high. This suggests that the minimal contrast in pairs like roses – Rosa's arises because the word-final vowel quality of Rosa is partially preserved on the addition of an inflectional suffix such as the possessive /-z/, while the reduced vowel in roses is the usual high, centralized vowel quality found in non-final unstressed vowels.

The difference between final and non-final reduced vowels can be related to differences between the unstressed vowel systems in these positions. While non-final schwa is not in contrast with other unstressed vowel qualities, there are four contrasting unstressed vowel qualities in word-final position: /i, ñ/, and the rhotic vowel /ɾ/~ (Hayes 1995:14f.). As shown in (7). The fact that all the final vowels in (7) are preceded by flaps provides evidence that they are in fact completely unstressed, because, in word-internal contexts, flapping only

Phonetic underspecification: SPE assumes full specification for all features at phonological output to instruct the articulators to implement the output of the grammar; but some data suggest that this is too strong a position

Cohn (1990) contrasts the behavior of vowel nasality in Sundanese and English.

- In Sundanese a vowel is obligatorily nasalized after a nasal consonant
- respiratory mask that measures nasal and oral airflow
- compare ḋobah vs. juliat
- steady state nasal airflow in vowel (at reduced rate compared to nasal consonant)
- sharp transition to oral in [b] vs. more gradual in [l]; inference that [l] is underspecified for [nasal] and transition is interpolation between [+nasal] of [ũ] and [-nasal] of [i]
- [b] would be specified for [-nasal] by virtue of contrast with [m]; but [l] could be distinguished from [n] by [lateral]

Marshallese (Bender 1968) and Choi (1992)

- vowels contrast for four degrees of height and consonants contrast for secondary articulations of palatalization and velarization
- front vs. back is underspecified on vowels and filled in by interpolation between the consonants: [tʃap] 'to return'

English word-medial reduced vowel varies similarly (Flemming & Johnson 2007) as in rapsody, probable, suffocate

Figure 4  Formant frequencies of all tokens of non-final reduced vowels (open squares) and barred-i from minimal pairs (filled triangles).

Flemming, Edward, and Stephanie Johnson. "Rosa’s Roses: Reduced Vowels in American English." Journal of the International Phonetic Association 37, no. 1 (2007): 83-96. © Cambridge University Press. This content is excluded from our Creative Commons license. For more information, see http://ocw.mit.edu/help/faq-fair-use/.
Privative features

- While some feature contrasts such as [± high] and [± back] readily show harmony for both values, for other features just one value is phonologically active and the other is largely inert: secondary articulations like labialization, palatalization, nasality, voicing.
- Some researchers hypothesize that this distinction is drawn in the representation: instead of [± round] we have just [round] and the absence of [round] is interpreted phonetically as no lip protrusion—the default state.
- More controversial is extension of this proposal to [voice], [nasal].
- Intervention effects and autosegments are used as a probe for such inert features: e.g. rendaku and voice in Japanese where rendaku arises from a floating [voice] and Lyman’s Law defined over [voice] not voiceless and voiceless is transparent.
- But reference to [−voice] is needed for the vowel length distinction in English writer-rider (cf. Bermudez-Otero 2014) and in many languages with right-to-left nasal harmony underlying /ama/ is realized as [ãm̩ba] where it appears that the [−nasal] of the second vowel is spread to the preceding nasal consonant to give a prenasalized stop.
- Can such cases be circumscribed under the heading of “phonetic enhancements” and not part of the phonology proper?
- Elan Dresher and Keren Rice at U Toronto have pursued these questions of contrast and underspecification in a number of publications.
- Another diagnostic of underspecification is various asymmetries in language processing.

Fowler and Brown (2000)

- baCə and bãNə recorded and cross spliced to give congruent [bata] and [bâna] and two incongruent stimuli [bana] and [bāta].
- Experimental task is to identify the medial consonant as quickly as possible; record accuracy and reaction time.
- Since this is the only source of vowel nasality in English, a nasal vowel implicates a following nasal consonant and an oral vowel implicates a following oral consonant.
- Results: congruent stimuli are faster than incongruent ones and incongruent [bāta] is faster than incongruent [bana].
- The vowel provides information for the identity of the following consonant and the nasal vowel has different status from oral: more salient (?) or “no match” if vowel nasality is underspecified and thus the oral [a] in [bana] provides no information about the upcoming consonant.

Hwang, Monahan and Idsardi (2010)

- Similar format to Fowler’s study: cross-splicing of [uts] and [udz] and time normalized.
- Subjects monitor for final [s] or [z].
• in English clusters there is voicing agreement; hence [t] implicates a following voiceless consonant and [d] a following voiced one
• under full specification both [utz] and [uds] are equally ill-formed while underspecification and/or unary [voice] draws a distinction
• results: accuracy: ds < dz, ts, tz; reaction time: ds < ts, tz < dz
• interpretation: the specified [voice] of d biases subjects to expect z while the underspecified t leads to no bias and hence ts and tz are equal in accuracy while dz is fastest and ds is slowest;
• the authors interpret this as a top-down effect from the lexicon as opposed to a statistical surface phonetic effect: in casual speech voicing fades out so /dz/ may be realized as [ds] but /tz/ is never realized as [tz]. Thus, [ds] should be more accurate and faster than [tz] since speakers have experience with the former but not the latter; however, the results are the opposite; ds is less accurate and slower

Steriade, Donca. 1987. Locality conditions and feature geometry. NELS 17, 595-618.