Class 16: Structure below the segment—Autosegmental representations

To do
- Fijian assignment is due a week from tomorrow (Mar. 6)
- Be working on project

Overview: SPE treats a phonological representation as a sequence of feature matrices. Goldsmith (1990, 1976, 1979, and others): this is inadequate; we must move tones and some other features onto their own “tiers”. Next time we’ll look at how this relates to the phonetics.

0. A few remarks on Kalinga

1. Tiers
   - A “linear representation” (i.e., what we’ve been using till now) of [māj̃ãb] might look like:
     
     $\begin{array}{cccc}
     +\text{nas} & +\text{nas} & +\text{nas} & +\text{nas} \\
     +\text{cons} & -\text{cons} & -\text{cons} & -\text{cons} \\
     +\text{labial} & +\text{hi} & +\text{lo} & +\text{labial} \\
     \ldots & \ldots & \ldots & \ldots \\
     \end{array}$

   - but we could imagine a reasonable notation system where we write instead:
     
     $\begin{array}{cccc}
     +\text{nas} & -\text{nas} & +\text{cons} & +\text{cons} \\
     +\text{labial} & +\text{lo} & +\text{hi} & +\text{lo} & +\text{labial} \\
     \ldots & \ldots & \ldots & \ldots \\
     \end{array}$

   - Adding a C-V skeleton tier, as Goldsmith does:
     
     $\begin{array}{cccc}
     +\text{nas} & -\text{nas} \\
     +\text{cons} & -\text{cons} & -\text{cons} & -\text{cons} & +\text{cons} \\
     +\text{labial} & +\text{lo} & +\text{hi} & +\text{lo} & +\text{labial} \\
     \ldots & \ldots & \ldots & \ldots \\
     \end{array}$

   - We could even put every feature on its own tier:
     
     $\begin{array}{cccc}
     +\text{nas} & -\text{nas} \\
     +\text{cons} & -\text{cons} & -\text{cons} & -\text{cons} & +\text{cons} \\
     +\text{labial} & +\text{lo} & +\text{hi} & +\text{lo} & +\text{labial} \\
     -\text{hi} & +\text{hi} & +\text{hi} \\
     \end{array}$

2. This starts to resemble a “gestural score”—though not all features are gestures

   (Browman & Goldstein 1986; Browman & Goldstein 1989; Browman & Goldstein 1992)

<table>
<thead>
<tr>
<th></th>
<th>m</th>
<th>ā</th>
<th>j</th>
<th>ā</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>lips</td>
<td>closed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tongue tip/blade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tongue body</td>
<td>low front</td>
<td>hi front</td>
<td>low front</td>
<td></td>
<td></td>
</tr>
<tr>
<td>velum</td>
<td>down</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glottis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. **How can we decide?**

- Changing the theory in this way is a good idea only if the new theory does a better job than the old at correctly distinguishing highly valued from lowly valued grammars.
- As in SPE, the claim is that rules that can be expressed in a simple form (though we won’t spell out how rule simplicity is to be calculated in this new notation) are highly valued.
- So, we’re interested in cases were old theory says that Rule A is simpler than Rule B, but new theory says the reverse.

4. **Notation clarification**

- We often use acute (á) and grave (à) accent marks to mark primary and secondary stresses. In strict IPA usage, these marks are reserved for tone, and today we’ll use them only for tone.
  - á = [a] with high tone
  - à = [a] with low tone
  - à, or sometimes just “a” = [a] with mid tone
  - â = [a] with falling tone (high then low)
  - â = [a] with rising tone (low then high)

- When a language has no mid tone, often the highs (and contours) are marked, but not the lows.

5. **Tonal association**

- Kikuyu (Niger-Congo language from Kenya with about 5.3 million speakers; discussion here based on Goldsmith 1990, whose data come from Clements & Ford 1979)

<table>
<thead>
<tr>
<th>Kikuyu Form</th>
<th>English Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>tò rɔ̀r ìrɛ́</td>
<td>‘we looked at’</td>
</tr>
<tr>
<td>tò mò rɔ̀r ìrɛ́</td>
<td>‘we looked at him’</td>
</tr>
<tr>
<td>tò mà rɔ́r ìrɛ́</td>
<td>‘we looked at them’</td>
</tr>
<tr>
<td>tò tɔ̀m írɛ́</td>
<td>‘we sent’</td>
</tr>
<tr>
<td>tò mò tɔ̀m írɛ́</td>
<td>‘we sent him’</td>
</tr>
<tr>
<td>tò mà tɔ́m írɛ́</td>
<td>‘we sent them’</td>
</tr>
<tr>
<td>mā rɔ́r ìrɛ́</td>
<td>‘they looked at’</td>
</tr>
<tr>
<td>mā mú rɔ́r ìrɛ́</td>
<td>‘they looked at him’</td>
</tr>
<tr>
<td>mā má rɔ́r ìrɛ́</td>
<td>‘they looked at them’</td>
</tr>
<tr>
<td>mā tɔ́m írɛ́</td>
<td>‘they sent’</td>
</tr>
<tr>
<td>mā mú tɔ́m írɛ́</td>
<td>‘they sent him’</td>
</tr>
<tr>
<td>mā má tɔ́m írɛ́</td>
<td>‘they sent them’</td>
</tr>
</tbody>
</table>

- Take a minute to ascertain the basic facts—on what does the tone of the tense suffix ìrɛ́/írɛ́ depend? On what do the tones of the two verb roots (in **bold**) depend? On what do the tones of the object suffixes (underlined) depend?

- Ideas for how we can account for this with linear representations and rules (assume a feature [hi tone])?

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1 As usual, the evidence as to what is actually highly valued comes, in practice, mainly from typology—even though typological evidence can be problematic.
In the “autosegmental” notation proposed by Goldsmith, we can write a rule thus (Goldsmith 1990’s (9)—“T” stands for any tone, such as H [high] or L [low] in this language):

\[
\begin{array}{c}
C_0 \ V \ C_0 \ V \\
T
\end{array}
\]

peninitial association

- Yes, it is a rule! Its structural description is

\[
\begin{array}{c}
C_0 \ V \ C_0 \ V \\
T
\end{array}
\]

(i.e., everything except the dashed line), and the structural change it requires is insertion of the association line that is shown dashed.

- We need two more rules for the rest of the tones:

\[
\begin{array}{c}
V \ C_0 \ V \\
T \ T
\end{array}
\]

association convention

\[
\begin{array}{c}
C_0 \ V \\
T
\end{array}
\]

initial association

- The circle is part of the structural description, and means “not associated to anything on the other tier”.

  - Let’s apply this grammar fragment to derive ‘we looked at them’—what must we assume about the association status of tones in underlying forms?

- All three rules are typical of the kind of thing you see in tone languages, and all three rules are some of the simplest that could be written in this notation.

  - Compare this to the linear analysis we developed above: do the linear rules look simple compared to other, less plausible linear tone rules we could write? [It’s not whether the autosegmental rule looks simpler than the linear rule that matters.]

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2 For Goldsmith, association conventions actually derive from universal principles, and don’t need to be specified on a language-particular basis.
6. Beginnings and ends of contour tones

- Hakha Lai (Hyman & VanBik 2004); aka Haka Chin, Sino-Tibetan language from Chin State, Burma & adjacent areas of India & Bangladesh, w/ 130,000 speakers) forbids certain tone sequences:

<table>
<thead>
<tr>
<th></th>
<th>+falling</th>
<th>+rising</th>
<th>+low</th>
</tr>
</thead>
<tbody>
<tr>
<td>falling+</td>
<td>falling+falling → falling+low</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>rising+</td>
<td>OK</td>
<td>rising+rising → rising+falling</td>
<td>rising+low → low+low</td>
</tr>
<tr>
<td>low+</td>
<td>low+falling → low+low</td>
<td>OK</td>
<td>OK</td>
</tr>
</tbody>
</table>

- Let’s first try to treat this linearly: we’ll have to choose a feature system and then use it to express the constraint(s) at work.

- Let’s re-write these representations autosegmentally. Is it easier to express the constraint?

7. Autosegmentalism in OT

- Whether representations are linear or autosegmental is (pretty much) orthogonal to whether the grammar consists of rules or constraints or both. See Zoll (1996) for a framework; also Zoll 2003.

- For example, if we were to re-cast the analysis of Kikuyu in OT with autosegmental representations, we could have a constraint like

\[
* \begin{array}{c}
C_0 V C_0 V \\
T & T
\end{array}
\quad \text{“don’t associate the first two vowels to two separate tones”}
\]

- Within OT, how do we decide whether linear reps. or autosegmental reps. are better?
8. *Something else that autosegmentalism is good for: tonal stability*

- *Margi* (Hoffman 1963, via Kenstowicz 1994) aka Marghi Central, Afro-Asiatic language from Nigeria with 158,000 speakers
  
<table>
<thead>
<tr>
<th>Word</th>
<th>Tonal Pattern</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>sál</td>
<td>sál-ārì</td>
<td>‘man’</td>
</tr>
<tr>
<td>kùm</td>
<td>kùm-ārì</td>
<td>‘meat’</td>
</tr>
<tr>
<td>?ímí</td>
<td>?ímj-ārì</td>
<td>‘water’</td>
</tr>
<tr>
<td>kú</td>
<td>kw-ārì</td>
<td>‘goat’</td>
</tr>
<tr>
<td>tágú</td>
<td>tágw-ārì</td>
<td>‘horse’</td>
</tr>
<tr>
<td>tì</td>
<td>tj-ārì</td>
<td>‘morning’</td>
</tr>
<tr>
<td>hù</td>
<td>hw-ārì</td>
<td>‘grave’</td>
</tr>
<tr>
<td>úʔù</td>
<td>úʔw-ārì</td>
<td>‘fire’</td>
</tr>
</tbody>
</table>

- What’s the underlying form of the suffix?

- How could we describe the tonal alternation in rules?

- What about with constraints—what’s the problem with using IDENT(tone)?

- If we really are treating tones not as features (properties of segments) but as segments, then...
  - they have correspondence indices (that we sometimes write, sometimes don’t write)
  - it makes sense to have the MAX and DEP constraints refer to them:

<table>
<thead>
<tr>
<th>/hu + ari/</th>
<th>ONSET</th>
<th>IDENT(syll)</th>
<th>MAX-Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>hu . ari</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>hwari</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>hwari</td>
<td>*</td>
<td>*!</td>
</tr>
</tbody>
</table>

Ling 201A, Phonological Theory II. Winter 2015, Zuraw
9. **Something else autosegmental representations are good for: floating tones**

*Igbo* (Goldsmith 1976; Niger-Congo; 17,000,000 speakers; Nigeria)

- Subordinate clauses are preceded by a complementizer morpheme that is nothing but a H tone:

<table>
<thead>
<tr>
<th>word</th>
<th>autosegmental representation</th>
<th>meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ònù</td>
<td>'yam'</td>
<td>ònù [rèrè èrè]</td>
</tr>
<tr>
<td>ážù</td>
<td>'fish'</td>
<td>ážù [rèrè èrè]</td>
</tr>
<tr>
<td>ánú</td>
<td>'meat'</td>
<td>ánú [rèrè èrè]</td>
</tr>
<tr>
<td>àkwhá</td>
<td>'eggs'</td>
<td>àkwhá [rèrè èrè]</td>
</tr>
</tbody>
</table>

○ Fill in the tableau (gives you an idea of some typical OT autosegmental constraints)

<table>
<thead>
<tr>
<th>/ažù + + rere + ere/</th>
<th>No Unattached Tones</th>
<th>DEP-V</th>
<th>MAX-Tone</th>
<th>*&gt;1TONE</th>
<th>IDENT(tone)/first syll of word</th>
<th>Uniformity-Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>a ažù</td>
<td>H₁ L₂ H₃ L₄ H₅ L₆ H₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b ažù</td>
<td>H₁ L₂ H₃ L₄ H₅ L₆ H₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c ažù</td>
<td>H₁ M₂,₃ L₄ H₅ L₆ H₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d ažù</td>
<td>H₁ L₂ M₃,₄ H₅ L₆ H₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e ažù</td>
<td>H₁ L₂ H₃ L₄ H₅ L₆ H₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f ažù</td>
<td>H₁ L₂ L₄ H₅ L₆ H₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[What prefers M₂,₃ over H₂,₃ or L₂,₃? It seems like maybe we do need tonal features after all....]
10. Tones behaving as a block

- *Shona* (Odden 1980), via Kenstowicz; Niger-Congo; 7,000,000 speakers; Zimbabwe and Zambia)

<table>
<thead>
<tr>
<th>mbwá</th>
<th>‘dog’</th>
<th>né-mbwà</th>
<th>‘with dog’</th>
</tr>
</thead>
<tbody>
<tr>
<td>hóvé</td>
<td>‘fish’</td>
<td>né-hóvé</td>
<td>‘with fish’</td>
</tr>
<tr>
<td>mbündúdzí</td>
<td>‘army worm’</td>
<td>né-mbündúdzí</td>
<td>‘with army worm’</td>
</tr>
<tr>
<td>hákátà</td>
<td>‘diviner’s bones’</td>
<td>né-hákátà</td>
<td>‘with diviner’s bones’</td>
</tr>
<tr>
<td>bénzíbvùnzá</td>
<td>‘inquisitive fool’</td>
<td>né-bénzíbvùnzá</td>
<td>‘with inquisitive fool’</td>
</tr>
</tbody>
</table>

⇒ sequences of the same tone undergo a rule together, as though they were a single tone.

- Let’s assume there is some reason why H → L after né-, and consider only outputs that do so:
  - Why [né-hóvé] and not *[né-hóvé]*? What must be the surface representation of [hóvé]?
  - Why [né-bénzíbvùnzá] and not *[né-bénzíbvùnzà]*?

  - Richness of the base: what if there were an input like /hove/?

- The OCP (Obligatory Contour Principle) constraint says that adjacent identical elements (such as two Hs in a row) are not permitted. Does this help with the Richness of the Base question?

  - We’ll still have a puzzle if we add né- to hypothetical /hove/ ... Will strata help?
- Seems to be different from African-type\(^3\) tone:
  - often more than three levels (5 is typical)
  - often transcribed with Chao numbers (Chao 1930): [\(\text{ma}^{\text{213}}\)] means tone starts lowish (2), then dips to the bottom of the range (1) then goes up to the middle (3)
  - contour tones often behave as a unit rather than combination of H&L
- Various proposals—here’s a simple one (Yip 1989): add another tier with features [+hi register] and [-lo register].

<table>
<thead>
<tr>
<th>register</th>
<th>tone (aka “contour”)</th>
<th>resulting pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>[+hi register]</td>
<td>h</td>
<td>5</td>
</tr>
<tr>
<td>[-lo register]</td>
<td>m</td>
<td>4</td>
</tr>
<tr>
<td>[-hi register]</td>
<td>h</td>
<td>3</td>
</tr>
<tr>
<td>[+lo register]</td>
<td>m</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>l</td>
<td>1</td>
</tr>
</tbody>
</table>

- Allows the register of an entire contour to change by just changing one feature, e.g. 53 \(\rightarrow\) 31

  - What is register, articulatorily?
    - It’s been proposed to correspond to stiff vs. slack vocal folds. But often this is true only in the language’s history & not synchronically.
    - Can be associated with a voice quality difference, e.g. L is breathy
  - How do you know whether a 3 is H & l or L & h?
    - Normally the whole syllable has the same register tone. So if you see 53, 34, etc., it must be H; if you see 13, 32, etc., it must be L.
  - But what if it’s just 3 or 33?
    - You will have to use other facts about the language to deduce the right representation.

12. Example: distribution of tones in Songjiang
(Bao 1990, via Kenstowicz 1994; apparently a Shanghai-area dialect of Wu Chinese [Sino-Tibetan; China; 77 million speakers] example words from Chen 2000)

<table>
<thead>
<tr>
<th>voiced onset, unchecked syll.</th>
<th>voiced onset, checked syll.</th>
<th>voiceless onset, unchecked syll.</th>
<th>voiceless onset, checked syll.</th>
</tr>
</thead>
<tbody>
<tr>
<td>22  di(^{22}) ‘younger brother’</td>
<td>3 ba(^{\text{31}}) ‘white’</td>
<td>44 ti(^{\text{44}}) ‘bottom’</td>
<td>5 pa(^{\text{52}}) ‘hundred’</td>
</tr>
<tr>
<td>31  di(^{31}) ‘lift’</td>
<td>53 ti(^{\text{53}}) ‘low’</td>
<td>35 ti(^{\text{55}}) ‘emperor’</td>
<td></td>
</tr>
</tbody>
</table>

“checked” syllable = syllable that ends in a glottal stop

- Draw the representation of each tone.
- What markedness constraints can we develop to explain the inventory?

\(^3\) Of course these labels are very approximate, and there are many other regions of the world with lots of tone languages.

\(^4\) As Thomas points out, this is problematic for Mandarin 3rd tone, commonly claimed to be 214. See, e.g. Zhang & Lai 2006 (www2.ku.edu/~ling/faculty/Dr_Zhang/wug-mandarin-KWPL-2006.pdf) for a 213 transcription (p. 79).
13. Exercise: Terena

- Arawakan language from Brazil with 15,000 speakers. Bendor-Samuel 1970, 1966, which transcribe NCs differently.

  o Propose underlying forms for the first- and second-person affixes.

  - eˈmoʔu 'his word'
  - ẽˈmõʔũ 'my word'
  - 'ayo 'his brother'
  - ˈãỹo 'my brother'
  - 'owoku 'his house'
  - ˈow̃oŋɡu 'my house'
  - 'ahyaʔaʃo 'he desires'
  - ˈãnʒaʔaʃo 'I desire'
  - 'piho 'he went'
  - ˈmbiho 'I went'
  - 'tuti 'his head'
  - ˈnduti 'my head'
  - 'nokone 'his need'
  - ˈnõᵑɡone 'my need'
  - oˈtopiko 'he cut down'
  - yoˈtopiko 'you cut down'
  - 'ayo 'her brother'
  - 'yayo 'your brother'
  - kuˈrikena 'his peanut'
  - kiˈrikena 'your peanut'
  - 'piho 'he went'
  - ˈpihe 'you went'
  - 'nene 'his tongue'
  - ˈnini 'your tongue'
  - 'xerere 'his side'
  - ˈxiriri 'your side'
  - 'paho 'his mouth'
  - ˈpeaho 'your mouth'

  o Let’s play with AGREE and ALIGN constraints
14. Exercise: Tibetan compounds

- Data from Meredith (1990). (I am simplifying some of the tones!! For instance, 3 is really 2. Sorry for missing data; Meredith often doesn’t give concrete examples, just schematics)

  - Draw representations for tones 5, 53, 31 (there’s also 3 but worry about that later)
  - Look at the data and develop an analysis of the tone changes that occur in compounds
    - You’ll need to invent a constraint on tones in non-word-final syllables
    - You’ll need to invent a quite arbitrary constraint on tones in the second member of a compound.

<table>
<thead>
<tr>
<th>1st member</th>
<th>2nd member</th>
<th>compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
<td>5-5</td>
</tr>
<tr>
<td>53</td>
<td>5</td>
<td>5-5</td>
</tr>
<tr>
<td>yum 3</td>
<td>chêê 5</td>
<td>yum-chêê 3-5</td>
</tr>
<tr>
<td>31</td>
<td>5</td>
<td>3-5</td>
</tr>
<tr>
<td>5</td>
<td>53</td>
<td>5-53</td>
</tr>
<tr>
<td>thuu 53</td>
<td>caa 53</td>
<td>thuu-caa 5-53</td>
</tr>
<tr>
<td>3</td>
<td>53</td>
<td>3-53</td>
</tr>
<tr>
<td>31</td>
<td>53</td>
<td>3-53</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>5-5</td>
</tr>
<tr>
<td>see 53</td>
<td>yöö 3</td>
<td>see-yöö 5-5</td>
</tr>
<tr>
<td>phöö 3</td>
<td>mi 3</td>
<td>phöö-mi 3-5</td>
</tr>
<tr>
<td>ree 31</td>
<td>see 3</td>
<td>ree-see 3-5</td>
</tr>
<tr>
<td>cu 5</td>
<td>këê 31</td>
<td>co-pkëê 5-53</td>
</tr>
<tr>
<td>53</td>
<td>31</td>
<td>5-53</td>
</tr>
<tr>
<td>3</td>
<td>31</td>
<td>3-53</td>
</tr>
<tr>
<td>31</td>
<td>31</td>
<td>3-53</td>
</tr>
</tbody>
</table>
To sum up

- Many features seem to behave not as properties of segments but as entities in their own right.
- This can be captured by autosegmental representations (and, in OT, including autosegments in correspondence relations).

Next week

- Relation to phonetics: locality, gestural scores, feature geometry, excrecent vowels, illusory deletion...

References

Bao, Zhi-ming. 1990. On the Nature of Tone. MIT.


Meredith, Scott. 1990. Issues in the Phonology of Prominence. MIT.


