Class 15: Autosegmental/non-linear representations, part I

To do
- Autosegmentalism assignment due Friday, Nov. 26, but you can treat Tuesday, Nov. 23 as the due date if you prefer (you'll know everything you need by the end of next class)
- Hayes reading questions due Tuesday
- Paper abstract due Tuesday (see sample of class webpage)

Overview
SPE treats a phonological representation as a sequence of feature matrices. Goldsmith (1990, 1976, 1979, and others) argues that this is inadequate and we need to move tones and some other features onto their own "tiers". We'll also see some properties of the "skeletal" tier.

1. Tiers

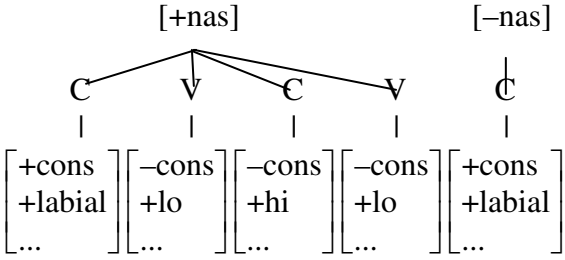
A "linear representation" (i.e., what we've been using till now) of [mãj̃ãb] might look like:

[	[	[	[	[
+nas	+nas	+nas	+nas	–nas
+cons	–cons	–cons	–cons	+cons
+labial	+lo	+hi	+lo	+labial
...]	...]	...]	...]	...]

but we could imagine a reasonable notation system where we write instead:

[				[
+nas				–nas
+cons	–cons	–cons	–cons	+cons
+labial	+lo	+hi	+lo	+labial
...]	...]	...]	...]	...]

If we add a "C-V skeleton" tier, as Goldsmith does, this might look like (arbitrarily putting the nasal tier on top):



We could even put every feature on its own tier:

[				[
+nas				–nas
[+cons	[	–cons		+cons]
[+labial]				[–labial]
	[+lo	[–lo	[+lo	]
	[–hi	[+hi	[–hi	]

2. How can we decide?

Changing the theory in this way is a good idea if the new theory does a better job than the old at correctly[1] 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) are highly valued. So, we're interested in

- rules that look relatively complicated (relative to other rules, that is) in the old theory but relatively simple in the new one—new theory predicts they are highly valued
- rules that look relatively simple in the old theory but relatively complicated in the new one—new theory predicts they are lowly valued

3. 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
ā, or sometimes just "a" = [a] with mid tone
â = [a] with falling tone (high then low) } contour tones
ǎ = [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.

4. 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)

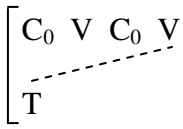
tò **rɔ̀r** ìrɛ́	'we looked at'	má **rɔ́r** ìrɛ́	'they looked at'
tò mò **rɔ̀r** ìrɛ́	'we looked at him'	má mó **rɔ̀r** ìrɛ́	'they looked at him'
tò mà **rɔ́r** ìrɛ́	'we looked at them'	má má **rɔ́r** ìrɛ́	'they looked at them'
tò **tòm** írɛ́	'we sent'	má **tóm** írɛ́	'they sent'
tò mò **tòm** írɛ́	'we sent him'	má mó **tòm** írɛ́	'they sent him'
tò mà **tóm** írɛ́	'we sent them'	má má **tóm** írɛ́	'they sent them'

- 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])?

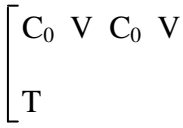
[1] As before, the evidence as to what is actually highly valued comes, in practice, mainly from typology—even though typological evidence can be problematic.

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):



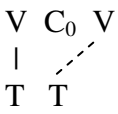
peninitial association

Yes, it is a rule! Its structural description is

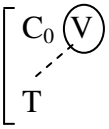


(i.e., everything except the dashed line), and the structural change it requires is insertion of the association line that is shown dashed.

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



association convention[2]



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.]

[2] For Goldsmith, association conventions actually derive from universal principles, and don't need to be specified on a language-particular basis.

5. Beginnings and ends of contour tones

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

	+falling	*+rising*	*+low*
falling+	falling +falling → falling+low	OK	OK
rising+	OK	rising+rising → rising+falling	rising+low → low+low
low+	low+falling → low+low	OK	OK

- 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?

6. Autosegmentalism in OT

Whether representations are linear or autosegmental is (pretty much) orthogonal to whether the grammar consists of rules or constraints or both.

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

$$* \left[\begin{array}{cccc} C_0 & V & C_0 & V \\ & | & & | \\ & T & & T \end{array} \right]$$

"*don't associate the first two vowels to two separate tones*"

7. 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

sál	sál-árì	'man'	-árì/-ărì = definite suffix
kùm	kùm-árì	'meat'	
ʔímî	ʔímj-árì	'water'	
kú	kw-árì	'goat'	
tágú	tágw-árì	'horse'	
tì	tj-ărì	'morning'	
hù	hw-ărì	'grave'	
úʔù	úʔw-ărì	'fire'	

- 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 segment-like entities, it makes sense to let MAX and DEP constraints refer to them, just as they refer to Cs and Vs:

/hu + ari/ L H L	ONSET	IDENT(syll)	MAX-Tone
a hu . ari | | | L H L	*!		
☞ *b* hwari /\ \ L H L		*	
c hwari | | H L		*	*!

8. Tones behaving as a block

Shona (Odden 1986, Odden 1980, Kenstowicz 1994b) Niger-Congo language with 7,000,000 speakers in Zimbabwe and Zambia

mbwá	'dog'	né-mbwà	'with a dog'
hóvé	'fish'	né-hòvè	'with a fish'
mbúndúdzí	'army worm'	né-mbùndùdzì	'with army worms'
hákátà	'diviner's bones'	né-hàkàtà	'with diviner's bones'
séndèrè	'place forbidden for farming'	né-sèndèrè	'with place forbidden for farming'
bénzíbvùnzá	'inquisitive fool'	né-bènzìbvùnzá	'with inquisitive fool'
bàdzá	'hoe'	né-bàdzá	'with a hoe'
chàpúpù	'witness'	sé-chàpúpù	'like a witness'

⇒ 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 *sé-*, and only consider outputs that do so:

- Why [né-hòvè] and not *[né-hóvé]? What must be the surface representation of [hóvé]?
- Why [né-bènzìbvùnzá] and not *[né-bènzìbvùnzà]?
- Richness of the base: what if there were an input like /hove / H H / ?

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 / H H / ... Will strata help?

9. What about East-Asian-type tone? (examples taken from Kenstowicz 1994, ch. 7)

Seems to be different from African-type[3] tone:

- often more than three levels (5 is typical)
- often transcribed with Chao numbers (Chao 1930): [ma^{214}] means tone starts lowish (2), then dips to the bottom of the range (1) then goes up nearly to the top (4)
- contour tones often behave as a unit.

Various proposals (see Yip 2007 for overview). A simple one: features [hi register] and [lo register].

register	*("contour") tone*	*resulting pitch*
high	H	5
	M	4
	L	3
mid	H	4
	M	3
	L	2
low	H	3
	M	2
	L	1

hence some phonetic tone levels are phonologically ambiguous; it's typically assumed that the register stays constant for the whole syllable,[4] so this can help disambiguate—e.g., V^{42} must be mid register.

= V^{53}

we had to skip this page

- Allows the register of an entire contour to change by just changing one feature, e.g. 53 → 31 (What is register, articulatorily? *Maybe* something like stiff vs. slack vocal folds)
- Sometimes register is also associated with voice quality.
- The feature [contour] has also been proposed—we have to then regulate whether [+contour] gets implemented as falling or rising.

Example: distribution of tones in **Songjiang** dialect of suburban Shanghai (Bao 1990, via Kenstowicz 1994; apparently a northern dialect of Wu Chinese, which in turn is a Sino-Tibetan language from China with 77 million speakers; example words from Chen 2000)

voiced onset, unchecked syll.	voiced onset, checked syll.	voiceless onset, unchecked syll.	voiceless onset, checked syll.
22 di^{22} 'younger brother'	**3** baʔ^{3} 'white'	**44** ti^{44} 'bottom'	**5** paʔ^{5} 'hundred'
31 di^{31} 'lift'		**53** ti^{53} 'low'	
13 di^{13} 'field'		**35** ti^{35} 'emperor'	

"checked" syllable = syllable that ends in a glottal stop

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

[3] So what about Mandarin 3rd tone, 214? See, Zhang & Lai 2006 (p. 79) for a 213 transcription.

Moving beyond tone: the skeletal tier and splitting up the features

10. Independence of length and features

- Bakwiri (aka Mokpwe, Niger-Congo language from Cameroon with 32,200 speakers) syllable-reversing language game (Bagemihl 1989, data from Hombert 1973):

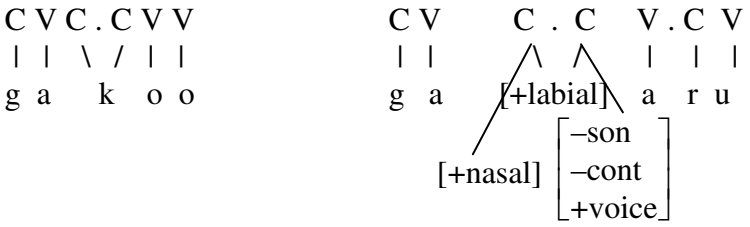
normal	*reversed*	
lìyé	yèlí	'stone'
lùùŋgá	ŋgààlú	'stomach'
ẓééyà	yááẓè	'burn'
ʔéẓèè	ẓeʔèè[4]	'is is not'
lìòβá	βààlíó	'door'

- Let's draw before-and-after representations with a skeletal tier

11. Licensing of a feature by one of its multiple associations

- Japanese: we saw that place features in a coda are OK only if they belong to a place-assimilated nasal or the first half of a geminate

Assume a requirement that place features be associated to an onset (though they can have additional associations):



12. Long-distance effects

Sibilant harmony in Navajo (Na-Dene language from the U.S. with about 149,000 speakers; discussion based on Martin 2004)

- Simple version: two [+strident] segments within a word must agree in [anterior]—the feature [anterior] is contrastive only among stridents:

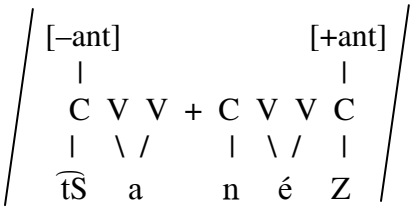
/sì+t͡ʃìd/[5]	→	**ʃ**ì+**t͡ʃ**ìd	'he is stooping over'
/sì+téːʒ/	→	**ʃ**ì+téː**ʒ**	'they two are lying'
/ji+s+léːʒ/	→	ji+**ʃ**+t͡ɬéː**ʒ**/	'it was painted'
/ji+s+tiz/	→	ji+**s**+ti**z**/	'it was spun'
/t͡sé+t͡ʃéːʔ/	→	**t͡ʃ**^{h}é+**t͡ʃ**éːʔ	'amber'
/t͡ʃaː+néːz/	→	**t͡s**aː+néː**z**	'mule'

- Write a linear rule to account for this.

[4] I don't know what's up with the tone on the first syllable; maybe it's a typo.
[5] How do we know this is the underlying form? In careful speech, all these rules are optional.

- The linear rule must skip over [–strid] segments, which happen to be just those segments that are plausibly unspecified for [anterior] in Navajo.
- But the rule gets no special credit for this—it is valued the same as a rule that skipped over all the [+voice] segments, say.
- This seems to miss something. Cross-linguistically, long-distance rules of assimilation seem to skip over segments that don't bear the feature in question, so we would like this kind of skipping to be valued more highly than other types.

Autosegmental representation of 'mule's UR, assuming underspecification of nonstridents for [anterior]—IPA symbols stand for the rest of the feature matrix (not including [anterior], which has been put on its own tier):



capitalization on this tier indicates agnosticism as to [ant]

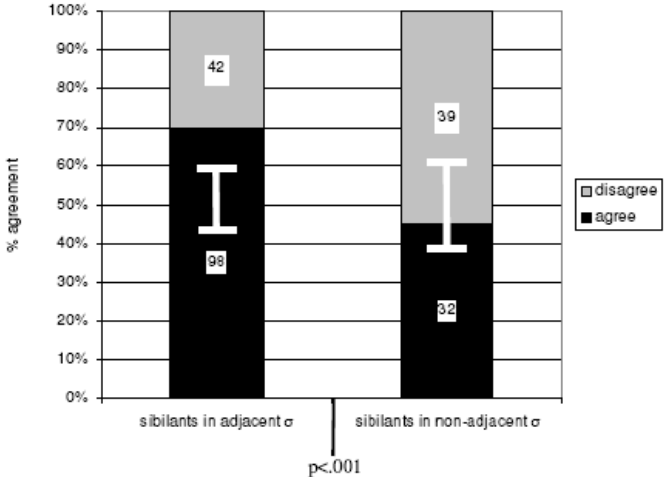
- Propose an autosegmental rule of strident harmony

13. Phonetic basis of long-distance effects?

- Some researchers have argued most long-distance assimilations are, articulatorily, local. See, for instance, Gafos 1999.
- For instance, in a rounding-harmony system (V → [αround] / __ C_0 [αround]), we could reasonably claim that (and test instrumentally whether) the *C*s that are skipped by the rule actually take on the lip-rounding value that spreads.

14. A problem: gradient long-distance effects

- The autosegmental account above predicts that it doesn't matter how much material intervenes between the two stridents—they are still adjacent as far as the [anterior] tier is concerned.
- But Martin found that, in compounds, agreement is *gradient*: the more material intervenes between the two sibilants, the more likely they are to agree:



Martin 2004, p. 23

(There is an additional twist that I'll refer you to the thesis and to Martin 2007 for; it concerns how much of the agreement in compounds comes from alternation and how much is already there in the underlying forms.)

15. Feature geometry; we're not covering it in this course, but at least you'll know what it is.

- We've seen, informally, that certain features seem to group together in their behavior.
- This is the justification for the abbreviation "place" ([labial, coronal, dorsal, anterior, distributed, hi, lo, back] and maybe some others).
- Such grouping gave rise to an elaborated theory of *feature geometry* in autosegmental representations. The idea was that not only features can spread and delink, but also **nodes** that dominate multiple features, or nodes that dominate intermediate nodes.

Example—from McCarthy 1988**, a systematic overview of feature geometry:**

- *[anterior] can spread with all the place features*

as in Malayalam (Dravidian language from India with about 36 million speakers)

n → m / __ bilabials
n̪ / __ dentals
n / __ alveolars
ɳ / __ retroflexes
ɲ / __ palatals
ŋ / __ dorsals

- *[anterior] can spread with just the other tongue-tip/blade feature*

English t,d,n ([+anterior, –distributed])

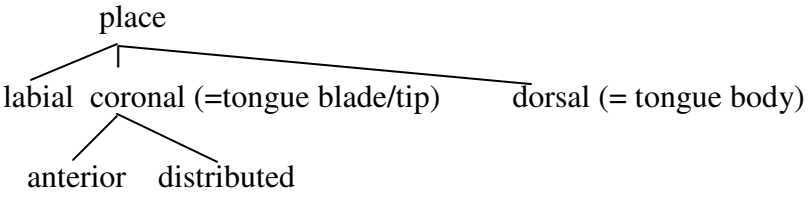
→ dental / __ θ, ð ([+anterior, +distributed])
→ palatoalveolar / __ t͡ʃ, d͡ʒ, ʃ, ʒ ([–anterior, +distributed])
→ retroflex[6] / __ ɻ ([–anterior, –distributed])

- *[anterior] can spread on its own*

Navajo sibilant harmony

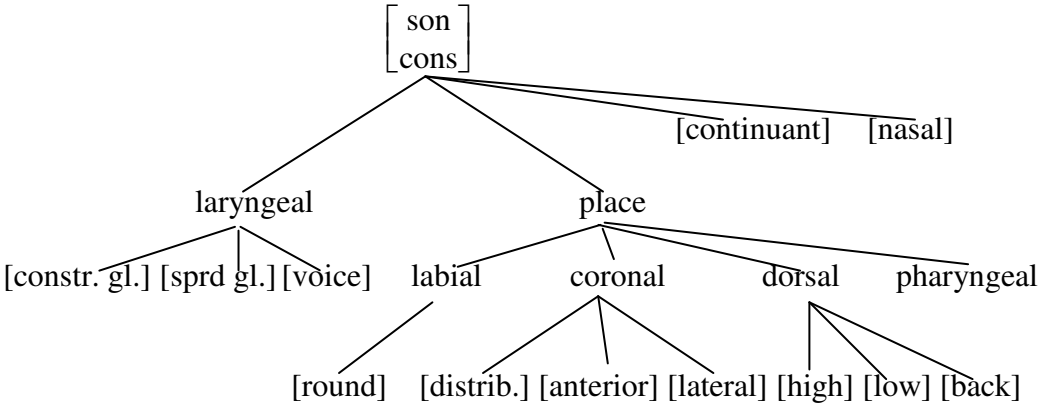
s → ʃ / __ X_0 ʃ
ʃ → s / __ X_0 s

This suggests a hierarchical organization of features:



[6] for speakers who have a retroflex *r*

Here's a proposed geometry, more or less the one in McCarthy 1988—the top, "root" node, is what attaches to the C-V skeletal tier (or to the syllable structure, for skeleton-less theories):



See also Clements & Hume 1995 on what to do about features that are shared by Vs and Cs.

16. Terena, if extra time

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

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

eˈmoʔu	'his word'	ẽˈmõʔũ	'my word'		
ˈayo	'his brother'	ˈãỹõ	'my brother'		
ˈowoku	'his house'	ˈõw̃õŋgu	'my house'		
ˈahyaʔaʃo	'he desires'	ãˈnʒaʔaʃo	'I desire'		
ˈpiho	'he went'	ˈmbiho	'I went'	ˈpihe	'you went'
ˈtuti	'his head'	ˈⁿduti	'my head'	ˈtiuti	'your head'
ˈnokone	'his need'	ˈnõᵑgone	'my need'	ˈnekone	'your need'
oˈtopiko	'he cut down'			yoˈtopiko	'you cut down'
ˈayo	'her brother'			ˈyayo	'your brother'
kuˈrikena	'his peanut'			kiˈrikena	'your peanut'
ˈpiho	'he went'			ˈpihe	'you went'
ˈnene	'his tongue'			ˈnini	'your tongue'
ˈxerere	'his side'			ˈxiriri	'your side'
ˈpaho	'his mouth'			ˈpeaho	'your mouth'

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