Class 16: Nonlinear representations, part II

To do
- Hayes study questions (last ones!) due Tuesday, Nov. 24
- Holoholo assignment due this Friday, Nov. 20
- Have a second meeting with me about your paper by the end of this week

1. Geminate inalterability

First, note that the first half of a geminate often behaves differently from other consonants (see, e.g., Hayes 1986):

- Japanese: non-nasal coda is OK if first half of a geminate
- Persian:[1] v → w / V __ {C,#} unless first half of geminate

  /nov+ruːz/ → [no**w**ruːz] 'New Year'

  /dʒæv/ → [dʒæ**w**] 'barley'

  but [æ**v**væl] 'first', [qolo**v**v] 'exaggeration'

Japanese is explainable using a C-V skeleton, assuming a requirement that place features be associated to an onset (thought they can have additional associations):

```
C V C . C V V
| |  \  /  | |
g a    k   o o
```

Persian isn't explainable in the same way (why?)—might be explainable with linear representations if we allow the feature [long] (how?).

Hayes' proposal is that association lines in the structural description of the rule of v → w are interpreted <u>exhaustively</u>—that is, the association lines shown for [] and __ must be the <u>only</u> association lines between those melodic positions and the skeletal tier (this explains also why the rule doesn't apply after long vowels):

```
        σ
       / \
      V   C
      |   |
v → w / [ ] __
```

Schein & Steriade 1986 take a different view—they propose that any time there is a structure

```
  n
 / \
a   b
```

, a rule can alter *n* only if <u>both *a* and *b*</u> satisfy the structural description of the rule.

- Let's sketch out how this would work for Japanese, Persian

[1] aka Western Farsi, Indo-European language from Iran and surrounding countries with ~ 24 million speakers

2. Behavior of assimilated structures

Consider the linear versions of some optional rules from Toba Batak, from Hayes 1986b (aka Batak Toba, Austronesian language from Indonesia with 2 million speakers):

glottal formation $\begin{bmatrix} -\text{son} \\ -\text{cont} \\ -\text{voice} \end{bmatrix} \rightarrow$ ʔ / __ C

/ganup taɔn/	→	ganu**ʔ** taɔn	‘every year’
/dɔhɔt lali i/	→	dɔhɔ**ʔ** lali i	‘and the hen-harrier’
/halak batak/	→	hala**ʔ** batak	‘Batak person’
/lap piŋgɔl/	→	la**ʔ** piŋgɔl	‘wipe off the ear’
/maɲihut taɔn/	→	maɲihu**ʔ** taɔn	‘according to the year’
/halak kɔrɛa/	→	hala**ʔ** korɛa	‘Korean person’

n-h *rule* n h → k k

/maŋan halak i/	→	maŋa**k** **k**alak i	

denasalization $\begin{bmatrix} \text{C} \\ +\text{nas} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{nas} \\ -\text{voice} \end{bmatrix} / \_\_ \begin{bmatrix} \text{C} \\ -\text{voice} \end{bmatrix}$

/maɲinum tuak/	→	maɲinu**p** tuak	‘drink palm wine’
/manaŋ pulpen/	→	mana**k** pulpen	‘or a pen’
/holom saɔtik/	→	holo**p** saɔtik	‘somewhat dark’
/mananɔm piriŋ/	→	mananɔ**p** piriŋ	‘bury a dish’
/mamɛrɛŋ kalabbu/	→	mamɛrɛ**k** kalabbu	‘look at a mosquito net’

n-*assimilation* n C → 2 2
1 2

/maŋan baoa an/	→	maŋa**b** baoa an	‘that man is eating’
/baoa an pɛddɛk/	→	baoa a**p** pɛddɛk	‘that man is short’
/lɛan lali/	→	lɛa**l** lali	‘give a hen-harrier’
/soŋon gottina/	→	soŋo**g** gottina	‘in exchange’

h-*assimilation* [–voice] h → 1 1
1 2

/marisap hita/	→	marisap **p**ita	‘let us smoke’
/dɔhɔt halak/	→	dɔhɔt **t**alak	‘and a person’
/modom halak i/	→	modo**p** **p**alak i	‘the man is sleeping’
/dibɛrɛŋ halak i hɔrbɔ i/	→	dibɛrɛ**k** **k**alak i hɔrbɔ i	‘the man saw the buffalo’

- We'll need some ordering (though it seems a bit strange to have opaque ordering in the postlexical phonology).

- Glottal formation applies within morphemes—it's not a derived-environment rule—yet it doesn't apply to a morpheme-internal geminates. Can we patch up the linear account to explain this?

/diktatɔr/[2]	→	di**ʔ**tatɔr	'dictator'
/rɔtrɔt/	→	rɔ**ʔ**rɔt	'to knock down'
but			
/dɛkkɛ/	→	dɛ**k**kɛ	'fish'
/pittu/	→	pi**t**tu	'door'
and			
/aŋsa/	→	a**k**sa	'fish'

- What about these cases across a morpheme boundary?

/adat+ta/	→	ada**ʔ**ta	'our custom'
/suddut+ta/	→	suddu**ʔ**ta	'our generation'

Hayes's argument: yes, we can capture the Toba Batak facts with linear rules. But, in the linear theory a glottalization rule that fails to apply in just these environments...

- where denasalization has applied
- where *n*-assimilation has applied
- where *h*-assimilation has applied
- to a tautomorphemic geminate

} all are assimilation rules

...is not given a higher value than a rule that applied in some other combination of circumstances, and that's a mistake.

Hayes contends that treating tautomorphemic geminates and clusters that have undergone assimilation the same way—resistant to rules that would apply to the first half; compare to underlying C_i+C_i sequences or non-geminate CC sequences where no rule has applied—is a common, highly valued behavior. Therefore, we prefer the theory that can express this situation simply.

In order to reproduce Hayes' result, let's assume that the features are split onto two tiers:

- *central tier (lips and tongue): [sonorant, continuant, labial, coronal, dorsal, anterior, hi, ...]*
- *peripheral tier (velum and larynx): [nasal, voice, spread glottis, constricted glottis]*

- How could we write the rules autosegmentally?

- Why do they fail to apply just to underlying geminates and the result of assimilation?

[2] How do we know this is the underlying form? Because in careful speech, all these rules are optional.

Hayes's conclusion: assimilation creates a special relationship between two segments involved, which influences how they behave with respect to later rules. Autosegmental representations can capture this directly, but linear representations can't (w/ linear representations, a grammar that displays the phenomenon is valued no more highly than a grammar that doesn't).

3. Long-distance effects

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

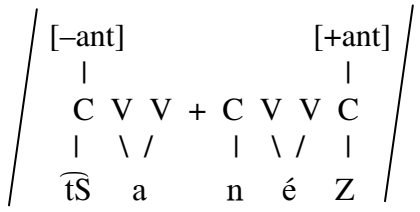
Simple version: two [+strident] segments within a word must agree in [anterior]—the feature [anterior] is contrastive only among stridents:

/sì+t͡ʃìd/[3]	→	**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**ʰé+**t͡ʃ**éːʔ	'amber'
/t͡ʃaː+néːz/	→	**t͡s**aː+néː**z**	'mule'

- Write a linear rule to account for this.

- The linear rule must skip over [–strid] segments, which happen to be, plausibly, just those segments that are 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

[3] How do we know this is the underlying form? In careful speech, all these rules are optional.

4. Phonetic basis of long-distance effects?

Some researchers have argued most long-distance assimilations are, articulatorily, local. See, for instance, Gafos 1999.

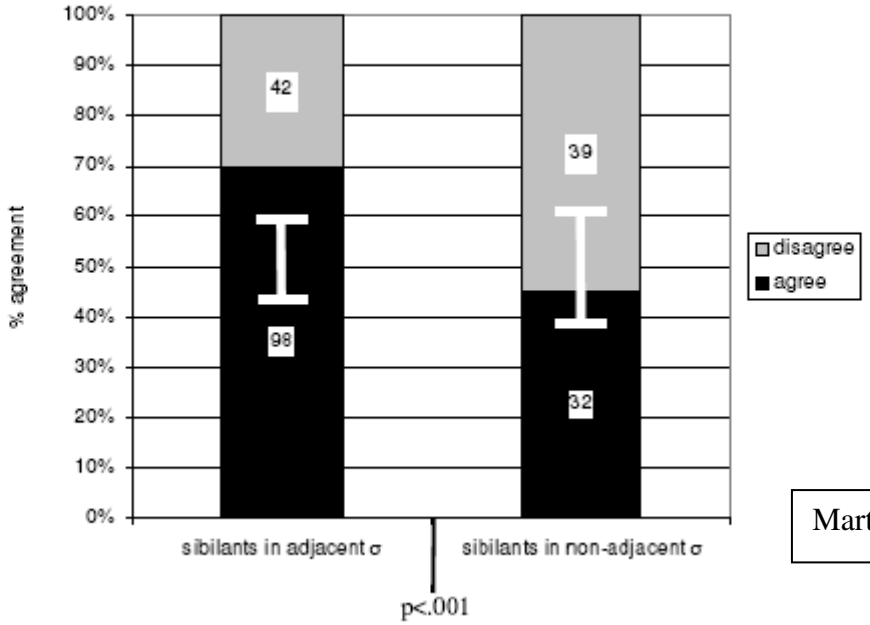
For instance, in a rounding-harmony system (V → [αround] / __ $C_0\begin{bmatrix} C \\ \alpha round \end{bmatrix}$), we could reasonably claim that (and test instrumentally whether) the *C*s that are skipped by the rule actually take on the lip-rounding value that spreads.

5. 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:

(13) Navajo sibilant pair agreement



Martin 2004, p. 23

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

6. 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), and for Hayes' division of central vs. peripheral tier.
- This clustering of feature behavior 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

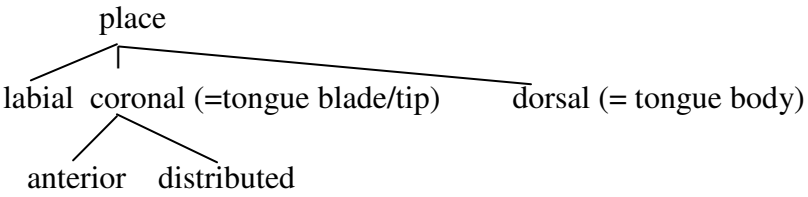
[anterior] can spread with just the other tongue-tip/blade feature
English t,d,n ([+anterior, –distributed])

→ dental / __ θ, ð ([+anterior, +distributed])
→ palatoalveolar / __ t͡ʃ, d͡ʒ, ʃ, ʒ ([–anterior, +distributed])
→ retroflex[4] / __ ɻ ([–anterior, –distributed])

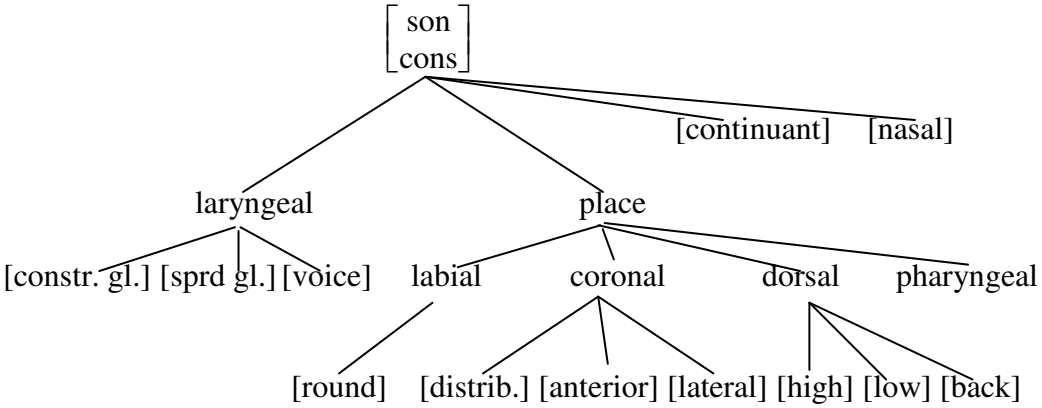
[anterior] can spread on its own
Navajo sibilant harmony

s → ʃ / __ X_0 ʃ
ʃ → s / __ X_0 s

This suggests a hierarchical organization of features:



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):



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

McCarthy's evidence for each grouping comes from

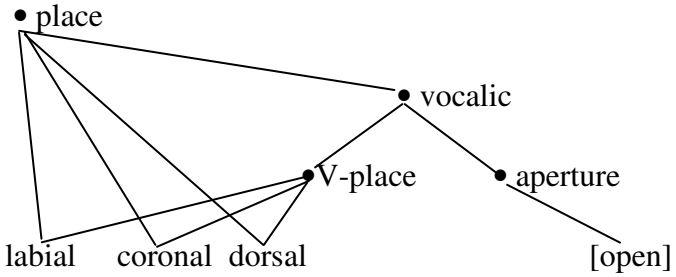
- assimilation as a group (=spreading; see examples above for *coronal* and *place*)
- deletion as a group (=delinking)
  debuccalization: Spanish dialects s → h / __]$_{syll}$
  English dialects, some Ethiopian languages C^{ʔ} → ʔ
  laryngeal neutralization: Korean obstruents have 3-way laryngeal distinction, collapsed to 1 value in codas
- Obligatory Contour Principle (OCP) effects: adjacent (-on-their-tier) identical elements are prohibited.
  The idea is that not only can you not get two Hs in a row on the tone tier, you can't get two +s in a row on the [anterior] tier, you also can't get two +s in a row on the *coronal* tier.
  How manifested? Restrictions on allowable sequences (no two labials in an Arabic root), or inalterability effects (as in Persian, Toba Batak: indicates a single node, multiply linked)

7. Vowels vs. consonants in feature geometry: Clements & Hume 1995

Do Vs and Cs share features? Sometimes Vs and Cs interact, sometimes they don't.

- Spreading: in many languages, velar and labial consonants can become coronal before front vowels (so are front vowels coronal?)
  Maltese: certain vowels become [i] before coronal consonants
- OCP: in many languages, sequences of featurally-similar Vs and Cs are prohibited
  Cantonese: round V can't occur after *k*^{w}, *k*^{hw}; round V can't be followed by a labial coda C.
- Yet vowel harmony generally skips right over consonants, suggesting that the consonants are underspecified for the features in question.

Clements & Hume propose something along these lines:



Explains why single consonantal features can skip vowels (as [anterior] in Navajo), but the whole Place node seems never to skip vowels (what would it look like to have a rule that did that?))

8. Terena

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’

9. If we have extra time (?): example of autosegmental [nasal]

Paraguayan Guaraní (Tupí language from Paraguay with 4,850,000 speakers). Data taken from Beckman 1999, originally from Lunt 1973, Rivas 1975.

Nasality is contrastive, but not freely distributed:[5]

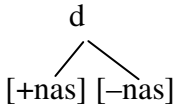
t̃ũˈp̃ã	‘god’	tuˈpa	‘bed’	*tuˈpã
p̃ĩˈr̃ĩ	‘to shiver’	piˈri	‘rush’	*piˈrĩ
mãˈʔ̃ẽ	‘to see’	ᵐbaˈʔe	‘thing’	*ᵐbaˈʔẽ, *ᵐbãˈʔ̃ẽ, *maˈʔe
h̃ũˈʔ̃ũ	‘to be bland’	huˈʔu	‘cough’	*huˈʔũ
ãˈk̃ɨ̃	‘to be tender’	aˈkɨ	‘to be wet’	*aˈkɨ̃
p̃õˈt̃ĩ	‘to be done for’	poˈti	‘to be clean’	*poˈtĩ

[5] Phonetics puzzler: What’s the articulatory difference between [p] and [p̃]? What’s the acoustic difference? Walker 1999 argues based on acoustic and nasal-airflow data that voiceless stops don’t actually get articulatorily nasalized in Guarani. So the real analysis will be more complicated...

- How do you explain the alternations in the prefixes?

nõ-ɾ̃õ-nũˈp̃ã**-i**[6]	'I don't beat you'
nõ-ɾ̃õ-h̃ẽⁱⁿdu-i	'I don't hear you'
ⁿdo-ro-haɨˈhu-i	'I don't love you'
ɾ̃õ-**ᵐbo**-ɣwaˈta	'I made you walk'
ɾ̃õ-**mõ**-p̃õˈɾ̃ã	'I embellished you'
ɾ̃õ-**mõ**-x̃ẽⁱⁿdu	'I made you hear'
ũˈmĩ-ʃa-ˈɣwa	'like those'
re-ˈ**xo**-t̃ã-ɾ̃ãˈmõ	'if you go'
ã-nẽ-ɾ̃ẽⁱⁿdu	'I hear myself'
ᵐ**ba**ˈ**ʔe**ᵐbiaˈʃɨ	'sadness'

Aside: How can we represent a prenasalized stop like [ⁿd]? Like a contour tone!



This explains why the segment behaves as [+nasal] on the left side and [–nas] on the right side.

- Let's develop an autosegmental analysis

Beckman, Jill N. 1999. *Positional Faithfulness: An Optimality Theoretic Treatment of Phonological Asymmetries*. Routledge.
Bendor-Samuel, J. 1970. Some problems of segmentation in the phonological analysis of Terena. In F. R Palmer & F. R Palmer (eds.), *Prosodic Analysis*, 214–21. London: Oxford University Press.
Bendor-Samuel, John T. 1966. Some prosodic features in Terena. In C.E. Bazell, J.C. Catford, M.A.K. Halliday, & R.H. Robins (eds.), *In memory of J. R. Firth*, 30-39. London: Longmans, Green and Co.
Clements, G. N & Elizabeth Hume. 1995. The internal organization of speech sounds. In John A Goldsmith (ed.), *The Handbook of Phonological Theory*, 245–306. Cambridge, Mass., and Oxford, UK: Blackwell.
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Lunt, Horace. 1973. Remarks on Nasality: the Case of Guarani. In Stephen R Anderson & Paul Kiparsky (eds.), *A Festschrift for Morris Halle*, 131–139. New York: Holt, Rinehart and Winston.
Martin, Andrew. 2004. The effects of distance on lexical bias: sibilant harmony in Navajo compounds. UCLA master's thesis.
McCarthy, John J. 1988. Feature geometry and dependency: A review. *Phonetica* 43. 84–108.
Rivas, Alberto M. 1975. Nasalization in Guaraní. In Ellen M Kaisse & Jorge Hankamer (eds.), *Proceedings of NELS 5*, 134-143. Cambridge, MA: Harvard University Linguistics Department.
Walker, Rachel. 1999. Guaraní voiceless stops in oral versus nasal contests: an acoustical study. *Journal of the International Phonetic Association* 29(1). 63-94.

[6] Actually, this last [i] is nasalized, but the nasality of final vowels is complicated and controversial in Guaraní so let's pretend it's not nasalized—see Beckman for more.