Class 13: Structure below the segment

To do
- Shona assignment (on last week's material) is due Friday
- Next reading is Steriade 1999 (due Tuesday)
- I feel up to date on projects, so how about meet with me again by end of *next* week?

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. Samoan reduplication—let's look at the spreadsheet and discuss

1. Tiers

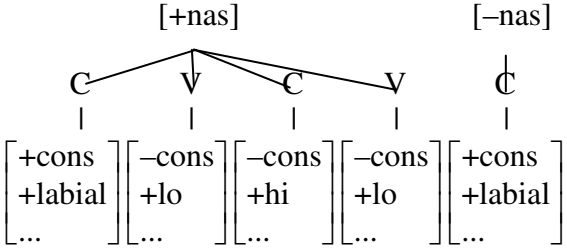
A "linear representation" (i.e., what we've been using till now) of [mãj̃ãb] might look like:

[	[	[	[	[
+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
...]	...]	...]	...]	...]

Adding a C-V skeleton tier, as Goldsmith does:



We could even put every feature on its own tier:

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

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

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

	m	ã	j̃	ã	b
lips	closed				closed
tongue tip/blade					
tongue body	low front		hi front	low front	
velum	down				up
glottis	voicing				

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[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 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
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.

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)

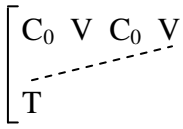
tò rɔ̀r ìré	'we looked at'	má rɔ́r ìré	'they looked at'
tò mò rɔ̀r ìré	'we looked at <u>him</u>'	má mó rɔ̀r ìré	'they looked at <u>him</u>'
tò mà rɔ́r ìré	'we looked at <u>them</u>'	má má rɔ́r ìré	'they looked at <u>them</u>'
tò tòm íré	'we sent'	má tóm íré	'they sent'
tò mò tòm íré́	'we sent <u>him</u>'	má mó tòm íré	'they sent <u>him</u>'
tò mà tóm íré	'we sent <u>them</u>'	má má tóm íré	'they sent <u>them</u>'

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

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

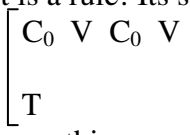
[1] As usual, the evidence as to what is actually highly valued comes, in practice, mainly from typology—even though typological evidence can be problematic.

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):



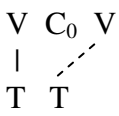
peninitial association

Yes, it is a rule! Its structural description is

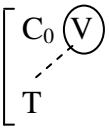


(i.e., everything except the dashed line), and the structural change it requires is insertion of the association line that is shown dashed.

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.

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:

	+*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?

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

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

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

- 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

sál	sál-árì	'man'	-árì/-ărì = definite suffix
kùm	kùm-árì	'meat'	
ʔímí	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 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:

/hu + ari/ L_1 H_2L_3	ONSET	IDENT(syll)	MAX-Tone
a hu . ari | | | L_1 H_2 L_3	*!		
☞ *b* hwari /\ \ $L_1H_2L_3$		*	
c hwari | | H_2 L_3		*	*!

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:

ọ̀nụ̀	'yam'	ọ̀nụ̄ [rèré èré]	'the yam [that is rotten]'
ázụ̀	'fish'	ázụ̄ [rèré èré]	'the fish [that is rotten]'
ánụ́	'meat'	ánụ́ [rèré èré]	'the meat [that is rotten]'
àkwhá	'eggs'	àkwhá [rèré èré]	'the eggs [that are rotten]'

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

/ aẓụ + + rere + ere/ H_1 L_2 H_3 L_4 H_5 L_6 H_7	NO UNATTACHED TONES	DEP-V	MAX-TONE	*>1TONE PERTBU	IDENT(tone)/ first syll of word	UNIFORMITY-TONE
a a ẽ ụ r e r e e r e | | | | | | | H_1 L_2 H_3 L_4 H_5 L_6 H_7						
b a ẽ ụ r e r e e r e | | \ | | | | H_1 L_2 H_3 L_4 H_5 L_6 H_7						
☞ *c* a ẽ ụ r e r e e r e | | | | | | H_1 $M_{2,3}$ L_4 H_5 L_6 H_7						
d a ẽ ụ r e r e e r e | | | | | | H_1 L_2 $M_{3,4}$ H_5 L_6 H_7						
e a ẽ ụ a r e r e e r e | | | | | | | H_1 L_2 H_3 L_4 H_5 L_6 H_7						
f a ẽ ụ r e r e e r e | | | | | | H_1 L_2 L_4 H_5 L_6 H_7						

[What prefers $M_{2,3}$ over $H_{2,3}$ or $L_{2,3}$? 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)

mbwá	'dog'	né-mbwà	'with dog'
hóvé	'fish'	né-hòvè	'with fish'
mbúndúdzí	'army worm'	né-mbùndùdzì	'with army worm'
hákátá	'diviner's bones'	né-hàkàtà	'with diviner's bones'
bénzíbvùnzá	'inquisitive fool'	né-bènzìbvùnzá	'with inquisitive fool'

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

Let's assume there is some reason why H → L after né-, and consider only outputs that do so:

- Why [né-hòvè] and not *[né-hòvé]? 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 /$\overset{\text{hove}}{\text{H H}}$/ ?

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 /$\overset{\text{hove}}{\text{H H}}$/ ... Will strata help?

11. 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^{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].

register	*tone (aka "contour")*	*resulting pitch*
[+hi register, –lo register] (H register)	h m l	5 4 3
[–hi register, +lo register] (L register)	h m l	3 2 1

example

h l
\ /
V = 53
|
H ←register

Allows the register of an entire contour to change by just changing one feature, e.g. 53 → 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)

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

- 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. Long-distance effects

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

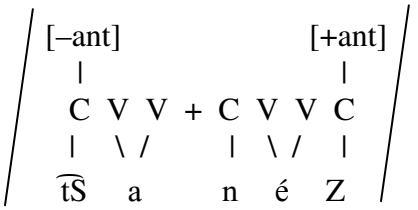
Simple version: two [+strident] segments within a word must agree in [anterior]—the feature [anterior] is contrastive only among stridents:

/sì + t͡ʃìd/	→	ʃì + t͡ʃìd	‘he is stooping over’
/sì + téːʒ/	→	ʃì + téːʒ	‘they two are lying’
/ji + s + léːʒ/	→	ji + ʃ + t͡ɬéːʒ/	‘it was painted’
/ji + s + tiz/	→	ji + s + tiz/	‘it was spun’
/t͡sé + t͡ʃéːʔ/	→	t͡ʃʰé + t͡ʃéːʔ	‘amber’
/t͡ʃaː + néːz/	→	t͡saː + néːz	‘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 features:



capitalization on this tier indicates agnosticism as to [ant]

- Propose an autosegmental rule of strident harmony
- How about in OT?

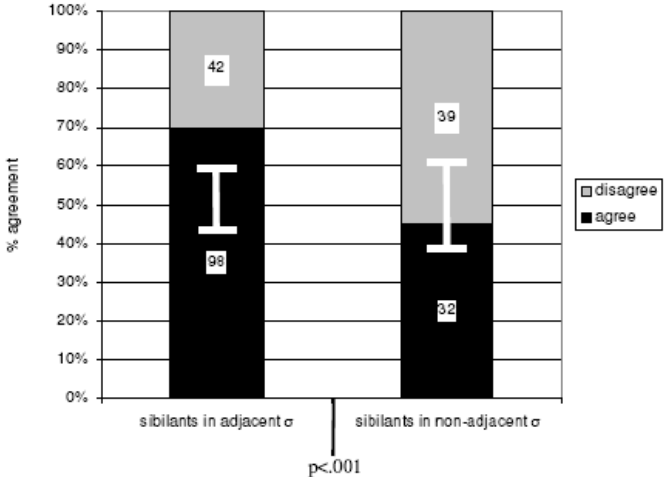
14. Phonetic basis of long-distance effects?

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.

15. 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: much of the agreement in compounds comes not from alternation but from the underlying forms!)

16. Feature geometry; we're not really using 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 / __ tʃ, dʒ, ʃ, ʒ ([–anterior, +distributed])
→ retroflex[4] / __ ɻ ([–anterior, –distributed])

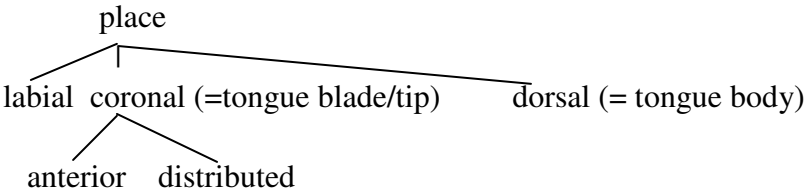
[4] for speakers who have a retroflex *r*

- *[anterior] can spread on its own*

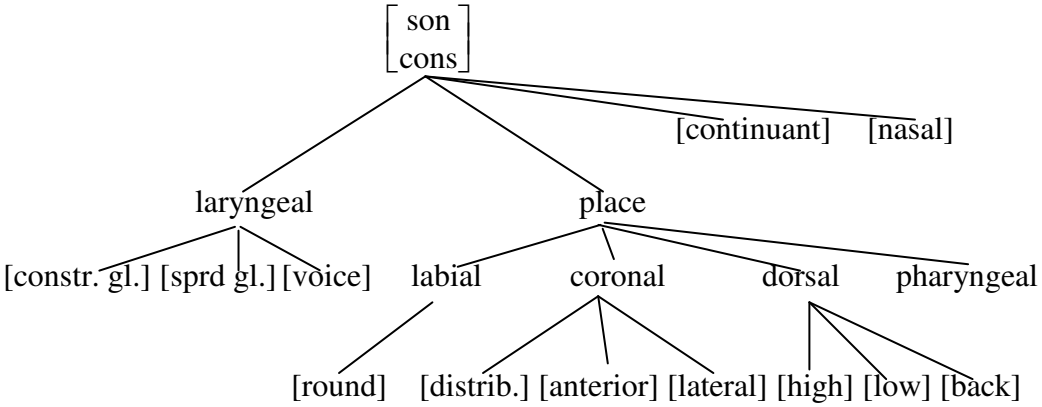
Navajo sibilant harmony

s → ʃ / __ X_0 {tʃ, dʒ, ʃ, ʒ}
ʃ → s / __ X_0 {ts, dz, s, z}

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):



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.
  - Not only is two Hs in a row on the tone tier bad, two +s in a row on the [anterior] tier is bad too, and so is two +s in a row on the *coronal* tier.
  - Manifested as restrictions on allowable sequences (no two labials in an Arabic root), behaving as a block

17. "Privative" features

One more thing to know about features is that some researchers think that for some features, there's no [–F] vs. [+F] vs. nothing, but rather only [+F] (or "[F]") vs. nothing. (The idea goes *way* back—see Steriade 1995 for review.)

E.g., no [–nas] in representations:

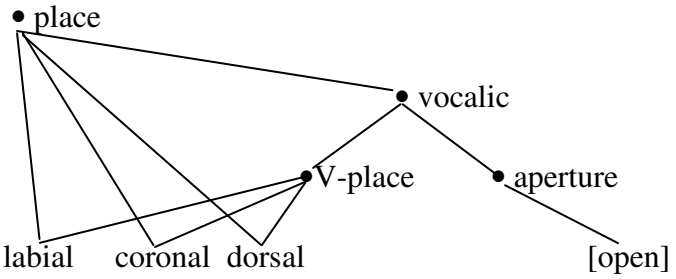
- In rule theory, means no autosegmental rules can insert, delete, or move it
- In OT, means no MAX([–nas]), DEP([–nas]), ALIGN([–nas])

18. 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 that look like?).

19. 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'

- Let's play with AGREE and ALIGN constraints

20. If we have extra time (?): Chaha (I stole this from an assignment for my 165A class)

Afro-Asiatic, Ethiopia, 130,00 speakers; Data from McCarthy 1983**,** Petros Banksira 2000.

he Ved	*he Ved him*	
dænæg	dænæg^{w}	‘hit’
nædæf	nædæf^{w}	‘sting’
k’ænæf	k’ænæf^{w}	‘knock down’
nækæb	**nækæb^{w}**	‘find’
s^{j}æfær	s^{j}æf^{w}ær	‘cover’
nækæs	næk^{w}æs	‘bite’
kæfæt	kæf^{w}æt	‘open’
bækær	**bæk^{w}ær**	‘lack’
k’æt’ær	k’^{w}æt’ær	‘kill’
bænær	b^{w}ænær	‘demolish’
mæsær	m^{w}æsær	‘seem’
æræs	æræs	‘build’
sædæd	**sædæd**	‘chase’
næt’ær	næt’ær	‘separate’

- Assume that the ‘he Ved’ form is the same as the underlying form of the verb root. Past tense and 3rd-person-singular-masculine subject don’t add any affixes.
- Assume the difference between C and C^{w} is that C^{w} is [+round].
- Decide what the underlying form is for the 3rd-person-singular-masculine object morpheme.
- Account for the **bold** words.

V! (masc. subject)	*V! (fem. subject)*	
nəmæd	nəmæd^{j}	‘love’
nək’ət’	nək’ət’^{j}	‘kick’
nəkəs	nəkəs^{j}	‘bite’
gəræz	gəræz^{j}	‘be old’
wət’æk’	**wət’æk’^{j}**	‘fall’
fəræx	fəræx^{j}	‘be patient’
bənær	bənær	‘demolish’
k’ət’ær	k’ət’ær	‘kill’
nəkəb	**nəkəb**	‘find’
bəkər	bəkər	‘lack’
sənæb	sənæb	‘spin’

- Assume that the ‘V!’ form is the same as the underlying form of the verb root. Imperative and masculine-subject don’t add any affixes.
  - (This is not totally true: as you may notice, imperative does change the vowels of the root. But ignore that.)
- Assume the difference between C and C^{j} is that C^{j} is [+hi].
- Decide what the underlying form is for the feminine subject morpheme.
- Assume a constraint *{r^{j}, b^{j}}

V! (masc. subject)	*V! (fem. subject)*	
g^{j}æk^{j}æt	g^{j}æk^{j}æt^{j}	‘accompany’
s^{j}əgær	s^{j}əgær	‘change’
t^{j}əf^{v}ær	t^{j}əf^{v}ær	‘scratch & mark’
g^{j}ək^{j}ær	g^{j}ək^{j}ær	‘straighten out’

- Adjust the analysis to accommodate these.

he Ved	*impersonal V*	
kæfæt	**kæf^{w}æt^{j}**	'open'
nækæs	næk^{w}æs^{j}	'bite'
t'æbæs	t'æb^{w}æs^{j}	'fry'
dæmæd	dæm^{w}æd^{j}	'join'
tæzrabæt'	tæzrab^{w}æt'^{j}	'have hope for'
bænær	**b^{w}ænær**	'demolish'
k'æt'ær	k'^{w}æt'ær	'kill'
s^{j}ægær	s^{j}æg^{w}ær	'change'
nækæb	**nækæb^{w}**	'find'
sænæb	sænæb^{w}	'spin'
t^{j}æf^{w}ær	t^{j}æf^{w}ær	'scratch & mark'
g^{j}æk^{j}ær	g^{j}æk^{j}ær	'straighten out'
bætæx	**bætæx^{w}**	'dig out'
ax^{w}ænæk'	ax^{w}ænæk'^{w}	'take off the clothes'
dænæg	dænæg^{w}	'hit'

- Again, assume that the 'he Ved' form is the same as the underlying form of the verb root.
- Decide what the underlying form is for the "impersonal" morpheme.

21. Next time: Relation of all this to phonetics. Phonetic locality continued, excrescent vowels, illusory deletion.

To sum up

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

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