

Class 7: Downward interfaces II, phonologization

To do

- Manam assignment due Friday (Feb. 2)
- Next reading (study question due Monday) is Hall 2006

Overview: Phonological processes often have a phonetic explanation. But they're somewhat abstracted from it—how does that happen?

1 First, I think we have time for one leftover

- Last time we talked about natural vs. unnatural phonological processes
 - the controversy being whether natural rules are really preferred by humans
 - ...or just more likely to arise diachronically
- So what about real phonology that is *unnatural*?

Bach & Harms 1972: "crazy rules"

- E.g., Japanese coronals undergo affrication before certain vowels:

ta	tʃi	tsu
da	dʒi	
sa	ʃi	su
za		zu

$$\left[\begin{array}{l} -\text{sonorant} \\ +\text{coronal} \\ \langle +\text{voice} \rangle \end{array} \right] \rightarrow \left[\begin{array}{l} +\text{del rel} \\ +\text{strident} \\ \alpha\text{anterior} \\ \langle \alpha\text{continuant} \rangle \end{array} \right] / _ \left[\begin{array}{l} \text{V} \\ +\text{high} \\ \alpha\text{back} \end{array} \right]$$

- Affrication before [u] seems very unnatural.
 - B&H propose the following series of events.

1. Somebody innovates a rule that's phonetically reasonable:¹

$$\left[\begin{array}{l} -\text{sonorant} \\ +\text{coronal} \end{array} \right] \rightarrow \left[\begin{array}{l} +\text{del rel} \\ +\text{strident} \\ +\text{anterior} \end{array} \right] / _ \left[\begin{array}{l} \text{V} \\ +\text{high} \\ -\text{back} \end{array} \right]$$

? What does the syllable inventory look like now?

¹ I hope this is right—I'm changing what I think was a typo from old notes; I don't have the chapter handy.

2. The rule gets generalized a little in a way that's structurally (if not phonetically) reasonable:

$$\begin{bmatrix} -\text{sonorant} \\ +\text{coronal} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{del rel} \\ +\text{strident} \\ \alpha\text{anterior} \end{bmatrix} / _ \begin{bmatrix} \text{V} \\ +\text{high} \\ \alpha\text{back} \end{bmatrix}$$

? What does the syllable inventory look like now?

3. Now a new, also reasonable rule is innovated...

$$\begin{bmatrix} -\text{sonorant} \\ +\text{strident} \\ +\text{voice} \\ +\text{anterior} \end{bmatrix} \rightarrow \quad [+continuant]$$

4. ...then generalized:

$$\begin{bmatrix} -\text{sonorant} \\ +\text{strident} \\ +\text{voice} \\ \alpha\text{anterior} \end{bmatrix} \rightarrow \quad [\alpha\text{continuant}]$$

5. And it all gets collapsed into the one "unholy" rule (p. 15).

- So each step is reasonable, but the result is rather unnatural.

? Let's discuss what constraints we'd need for an OT analysis—some of them might be phonetically unmotivated.

- The dream of a universal constraint set probably can't be completely fulfilled. We probably need to equip the learner with the ability to learn constraints (see Hayes & Wilson 2006).

2 Beautiful example from Hayes 1999

- Many factors affect how much aerodynamics favors voicing vs. voicelessness (see Ohala 1983, Westbury & Keating 1986) (Hayes p. 8)
 - place of articulation: fronter closure → bigger oral chamber → more room for the air → airflow across glottis encouraged for longer
 - closure duration: as time passes during the closure, more air pressure in oral chamber → airflow across glottis discouraged
 - being after a nasal: as we saw last time, nasal leak and velar pumping → encourage airflow
 - being phrase/utterance-final: subglottal pressure is lower → airflow across glottis discouraged
- Hayes constructs the following “difficulty landscape” using an aerodynamic model (Keating 1984)
 - 0 means there’s no problem effort needed to produce voicing
 - bigger numbers mean it’s more difficult

(2) Landscape of Difficulty for Voiced Stops: Three Places, Four Environments

	b	d	g
[-son] ____	43	50	52
# ____	23	27	35
[+son, -nas] ____	10	20	30
[+nas] ____	0	0	0

contour line: 25

(p. 9)

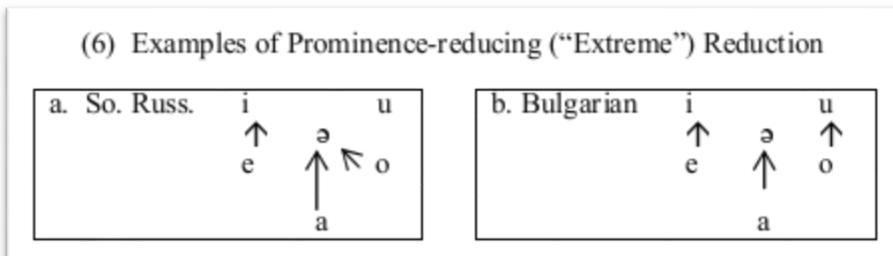
- The thing is, there is no language that draws the line at 25
 - instead, languages draw vertical or horizontal lines that partly contradict the phonetics
 - *g (as in Dutch): ignores the fact that initial [g] is easier than post-obstruent [d]
- This can lead to seeming markedness contradictions in the corners:
 - *p (as in Arabic): even in geminates, you get only [bb], not *[pp]
 - *VOICEDGEMINATE (as in non-loan Japanese): only [pp], not *[bb]

3 Hayes's proposed solution [assumes analytic bias]

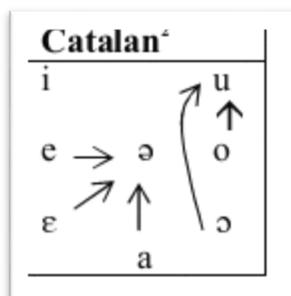
- The learner...
 1. ...compiles a difficulty map like the above
 2. ...constructs constraints according to certain templates (*[αF], *[αF][βG], *[αF,βG], etc.)
 3. ...evaluates constraints according to how often they correctly predict that one item in the map is harder than another
 - e.g., *g is correct about g/[-son]__ vs. d/[-son]__
 - but wrong about g/#__ vs. d/[-son]__
 - collect % of pairs for which prediction is correct
 4. ...to be accepted, a constraint must do better on the above test than all its “neighbors” that are equally or less complex
 - constraints are neighbors if they differ in just one symbol (whatever counts as a symbol in your theory)
 - e.g., *[coronal, +voice] and *[dorsal, +voice] are neighbors, equally complex
 - *g and *#g are neighbors; *g is less complex than *#g
- Result: The learner add complex constraints only if they justify themselves.
- Hayes ends up with constraints like *[+nasal][-voice] and *[dorsal, +voice], but nothing more complex.

4 Some other cases similar in spirit

- Crosswhite 1999: When stressed syllables have shorter duration, there's less time for jaw opening, so low vowels are disfavored.²
 - In some languages, result is neutralization with another V category, not just raising
 - Which category a V is neutralized with can be language-specific:



(Crosswhite 2000a, p. 4)



(Crosswhite 2000b, p. 3)

² That's not the only type of vowel reduction in unstressed syllables; Crosswhite also discusses the contrast-enhancement type.

⇒ Despite shared phonetic motivation, different faithfulness rankings. These patterns aren't just an automatic result of reduced jaw lowering

- Zhang 2000: languages with contour tones (falling, rising, dipping) often restrict where those contours can appear, including
 - long vowels only
 - stressed syllables only
 - final syllables only
 - monosyllables only

→ syllables that will canonically have longer duration in the sonorous portion of their rime are favored sites for contour tones

- Moreover, Zhang found that language-specific facts about, e.g., how much features of a coda consonant affect duration, affect where the contour tones can occur in that language.
- But the “**canonically**” is key: based on some typical speech rate and style, or averaged/normalized over speaking rates and style.

? What would be some of the (dubious?) predictions of a constraint like this: *CONTOUR/<200 msec

5 Incomplete neutralization

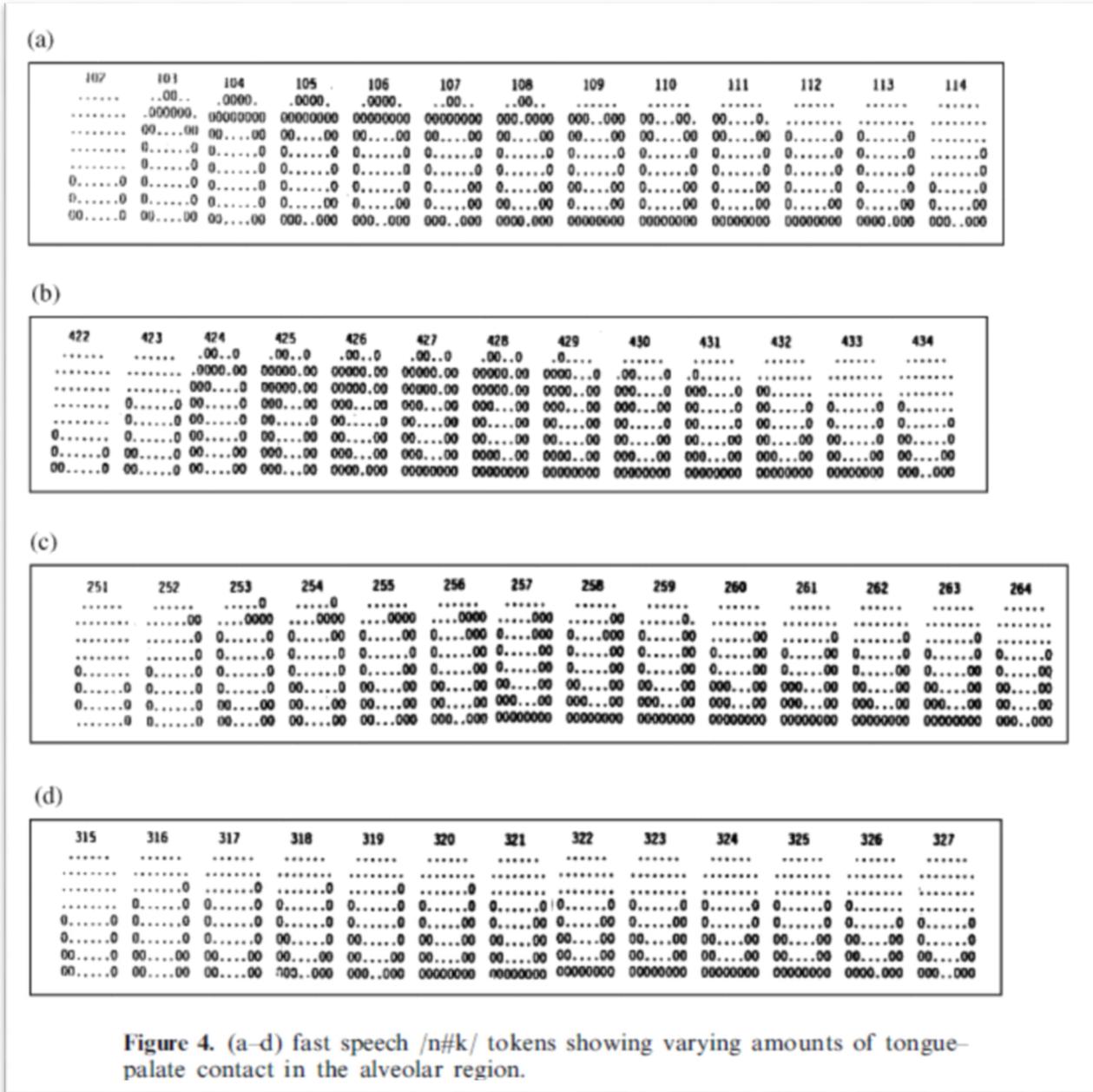
- Famously, phonetically driven “neutralization” isn't always real neutralization:
 - Warner et al. 2004 (and many others): final devoicing, as in Dutch, leaves behind (only partly reliable) durational differences
 - Zsiga 1995: the “[ʃ]” in *miss you* different from the one in *fish* or *impression*, both acoustically and articulatorily (electropalatography study)

A glimpse into phonologization in progress?

- Ellis & Hardcastle 2002 had speakers say sentences like these:

*It's hard to believe the **ban** cuts no ice*
*I've heard the **bang** comes as a big surprise* (p. 379)

- Subjects wore electropalates in their mouths—like a retainer, but electrodes in it record whether they’re being contacted (by the tongue).



(p. 381)

(there was also an EMA study)

- Some **tokens** of /n k/ had full alveolar contact
- Some tokens had partial alveolar contact
- Some tokens lacked alveolar contact but still showed evidence of a partial alveolar gesture
 - as seen by the tongue contact along the sides of the palate
- Some tokens had no evidence of an alveolar gesture at all

- Some **speakers** always or never lost the alveolar gesture; some varied
 - Even among those speakers who varied, there were different patterns of variation
 - Some speakers showed a smooth continuum from no assimilation to full assimilation
 - looks like gradient gestural overlap
 - Other speakers were bimodal: either no assimilation or full assimilation
 - looks like an optional phonological process
- ? Let's discuss what these speakers' grammars could look like.

To sum up

- Regardless of how phonetic bias works, we need to explain cases in which it's not direct—what do they tell us about the language apparatus?

Next time

- Structure below the segment: features, gestures, autosegmentalism in OT

References

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