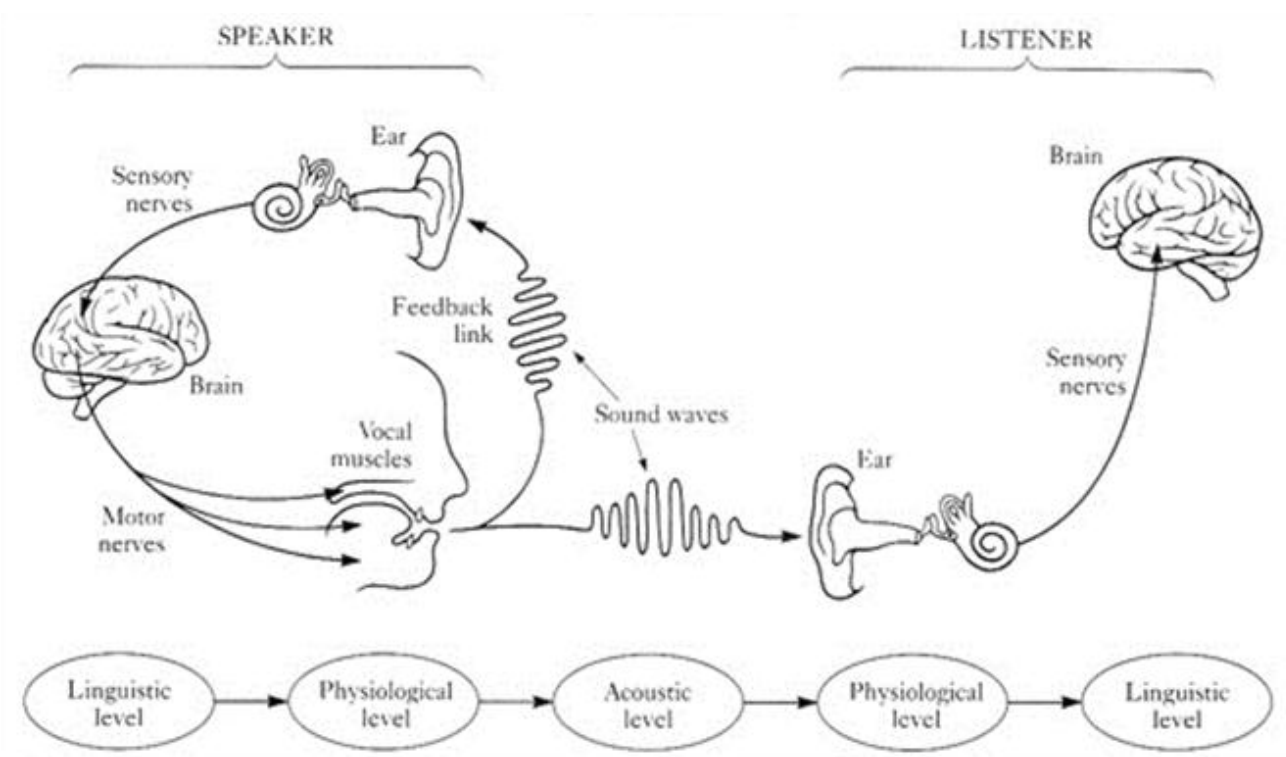


Chap 14

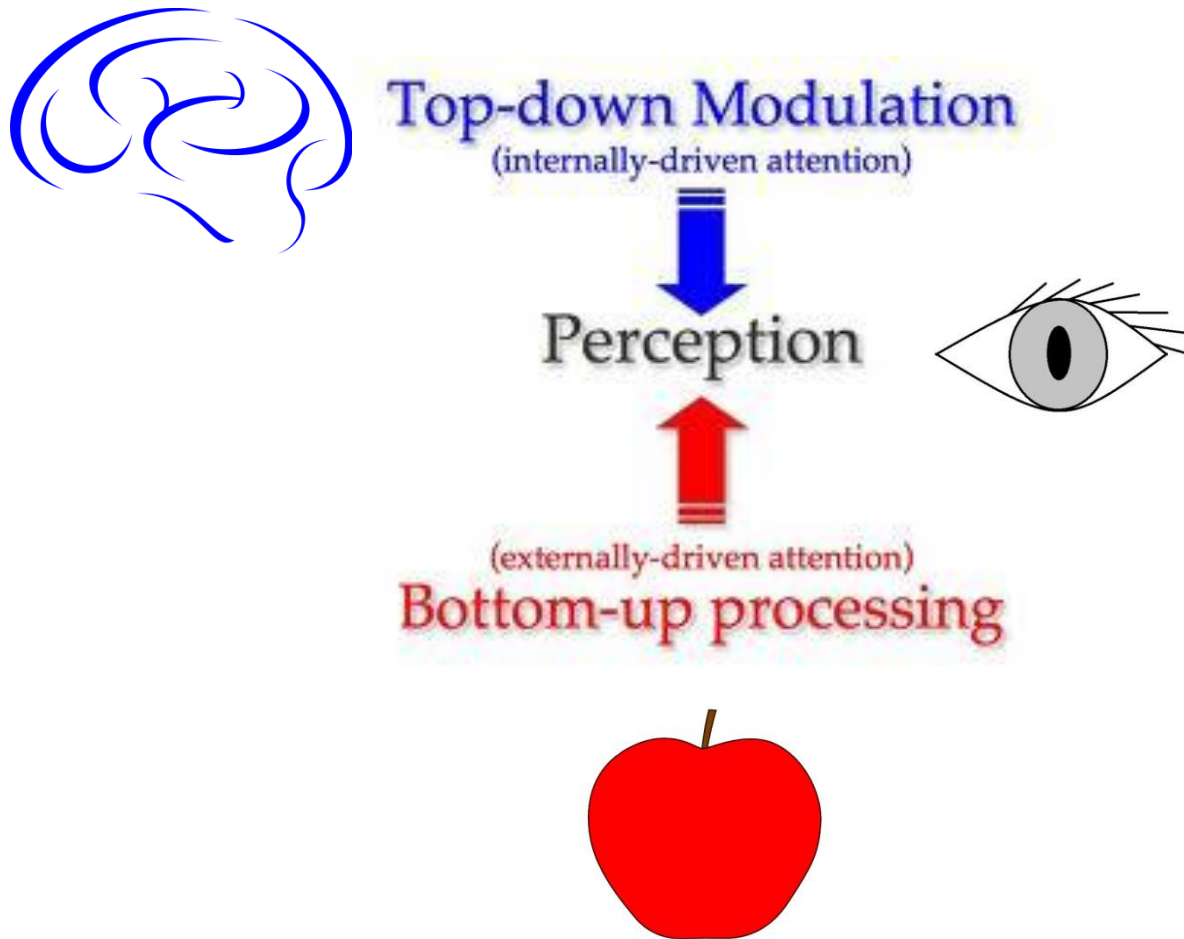
Perceptual and linguistic phonetics

1. Staging speech perception
2. Lack of invariance
3. Cues and cue trading
4. Categorical perception
5. Ease of articulation vs. perceptual distinctiveness

The speech chain



Bottom up/ top down



Lack of invariance



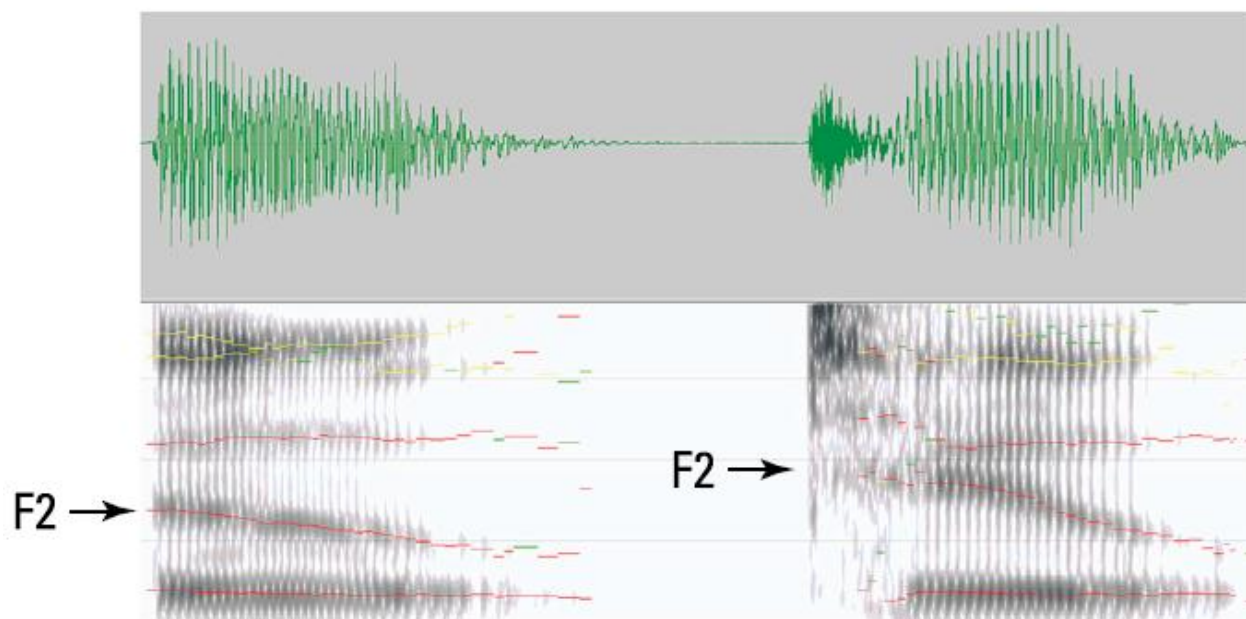
- Each person produces different physical signals
- Much variance!
- A computer has a hard time decoding this
- Human listeners do not
- How do we explain this?

Lack of invariance - example

/u/

vs.

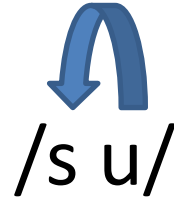
/t^hu/



... /u/ F2 starts much higher here!

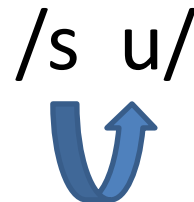
Coarticulation

- Anticipatory
(= “right to left”)



lip-rounding affects /s/

- Perseverative
(= “left to right”)



/s/ frication carries over onto /u/

Anticipatory coarticulation

- Index of speech planning
- Language dependent
- For instance, lip rounding in English extends roughly 250 msec (~ 1 syllable)
- In French, can extend up to ~ 6 syllables

“sinistr(e) structure”

LIP ROUNDING
ALREADY HERE!



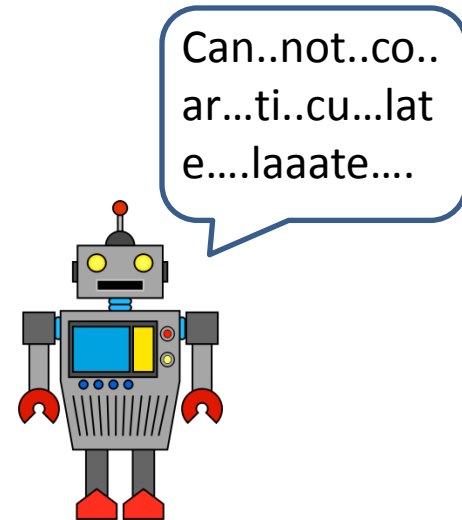
Perseverative coarticulation



- Measure of biomechanical, inertial properties of speech
- An example is *tongue twisters*
- Contain sounds with many close features
- Left to right coarticulation causes speech errors

More coarticulation facts

- All people coarticulate in all speech!
- Lack of coarticulation (e.g., in poor speech synthesis) sounds “robot-like”
- Coarticulation mastered early by children
- Seems to break down in some disorders, including apraxia of speech (AOS)

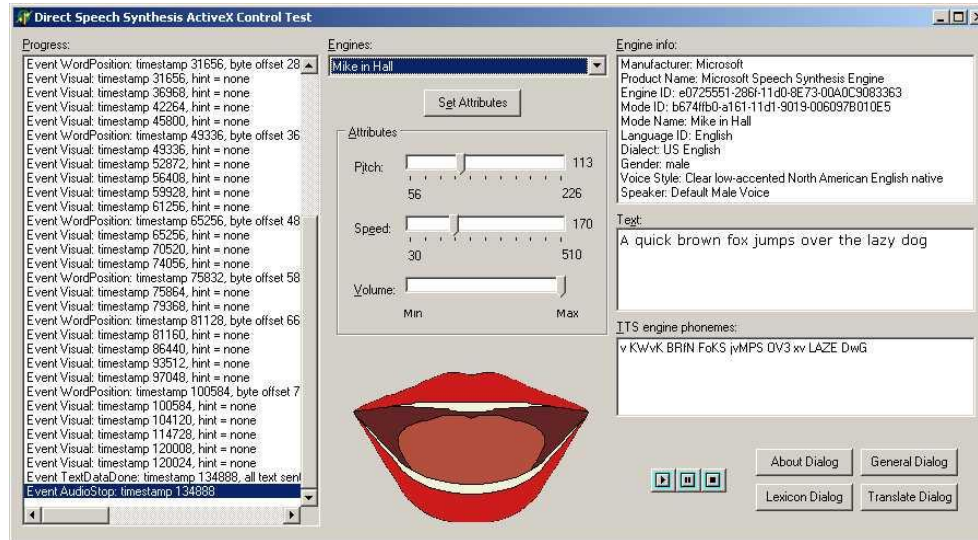


More than one way to signal a phonetic feature....

Example:

- VOT and bursts can cue a stop consonant
- Redundancy!
- Cues can also trade off (see next slide)

Synthesized Speech

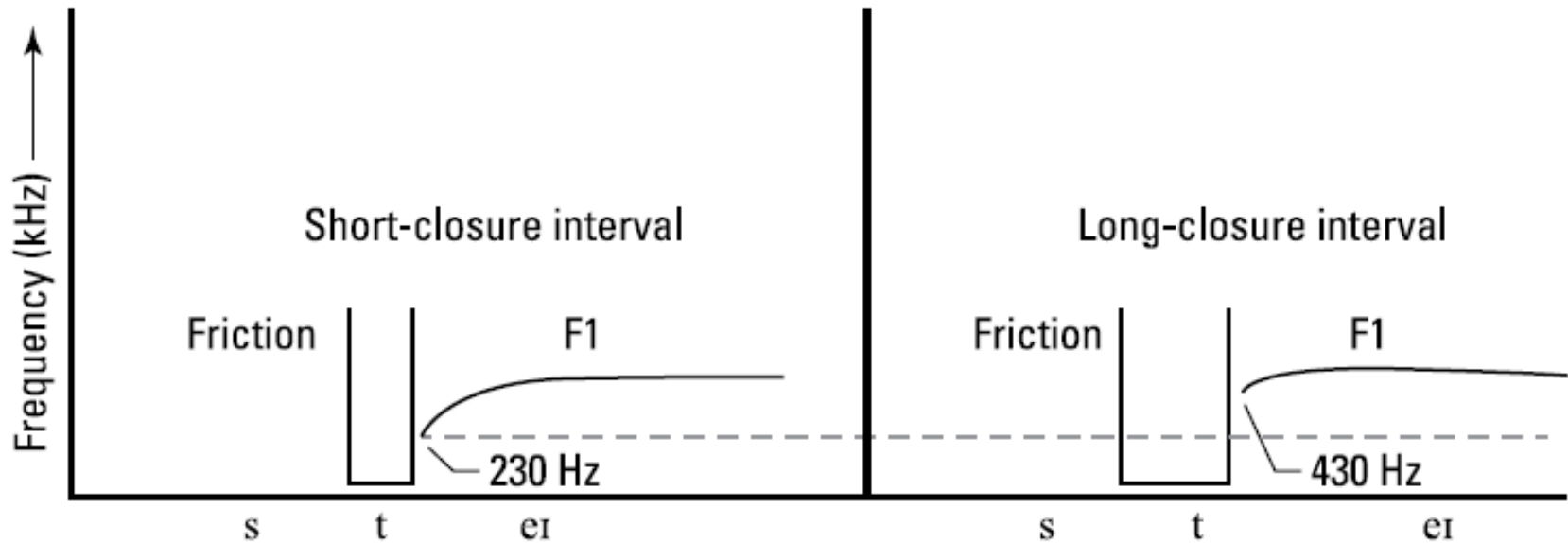


- Allows for precise control of sounds
- Valuable tool for investigating perception

For samples in English, German, French and other languages:

<http://www.ims.uni-stuttgart.de/institut/mitarbeiter/moehler/synthspeech/>

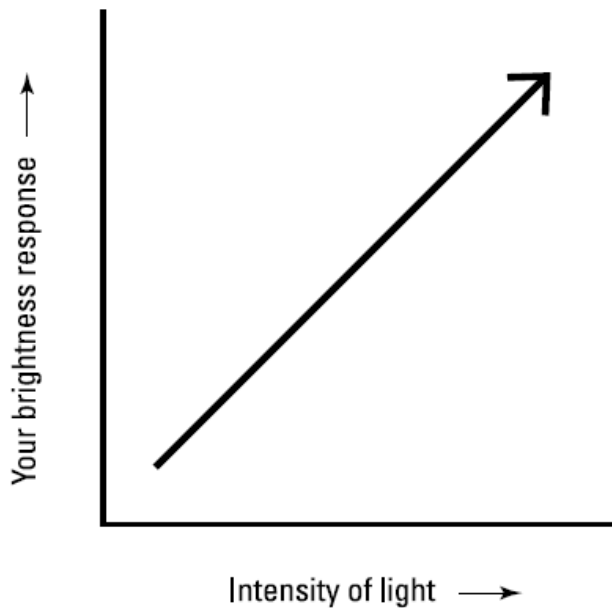
Cue trading in action



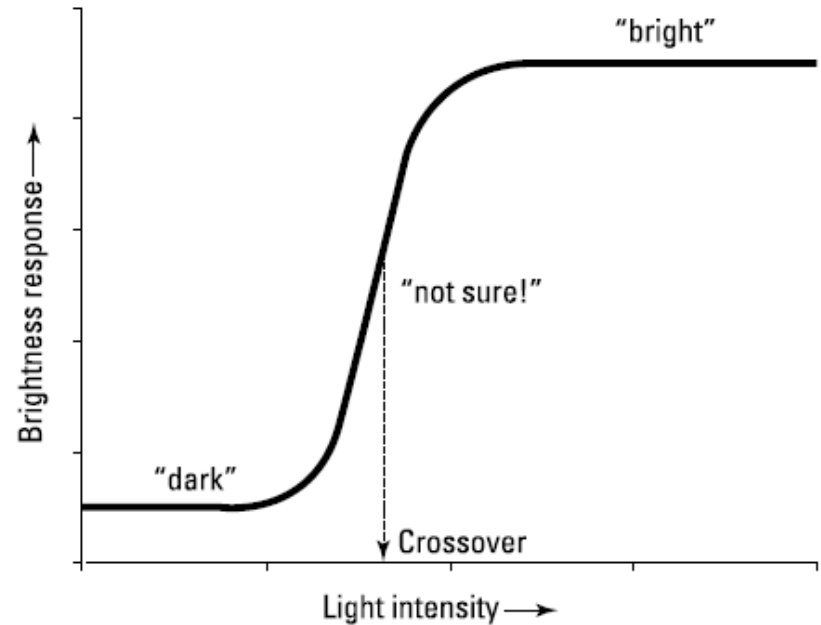
Pg. 225

Two types of perception

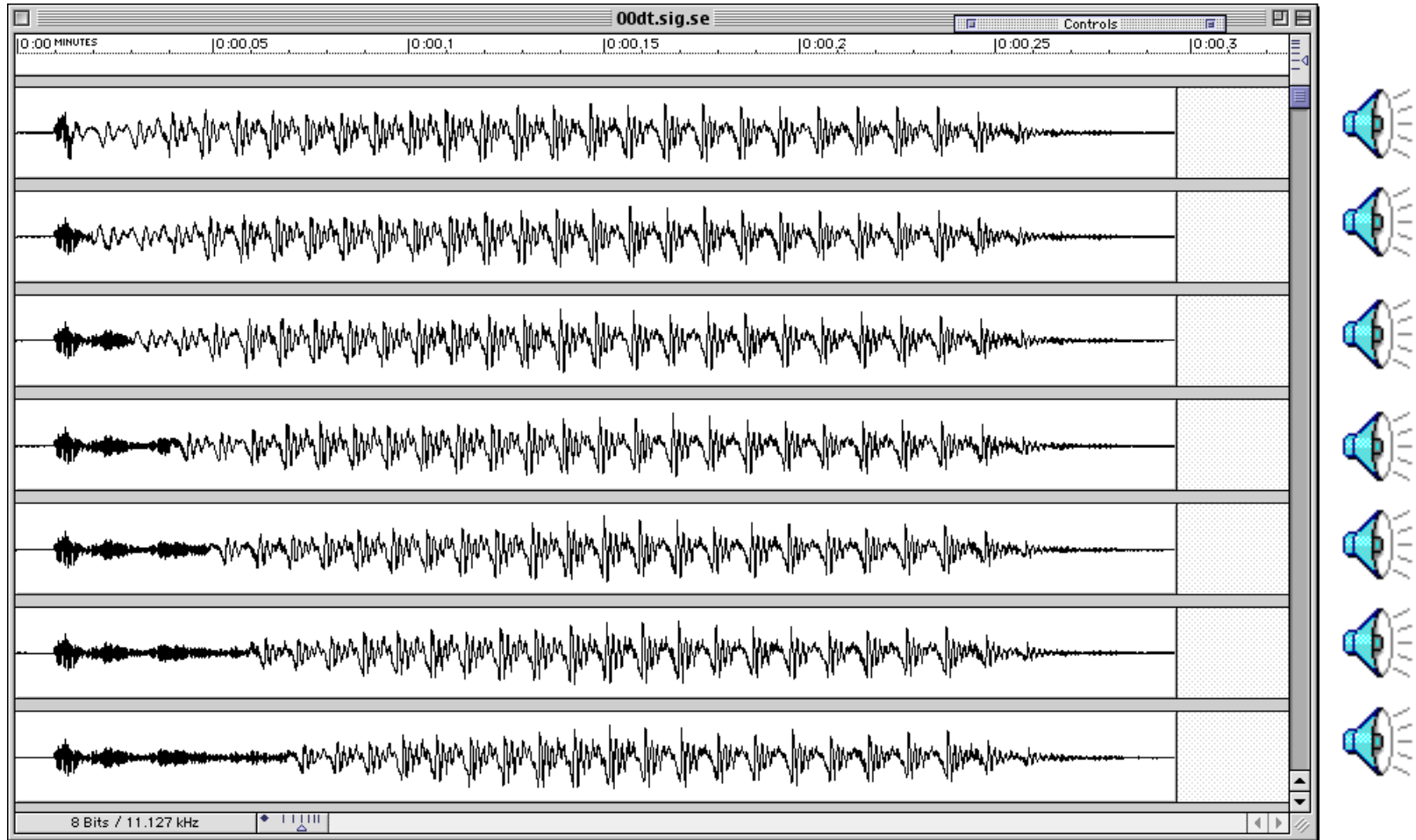
Graded (usual)



Categorical (Speech)

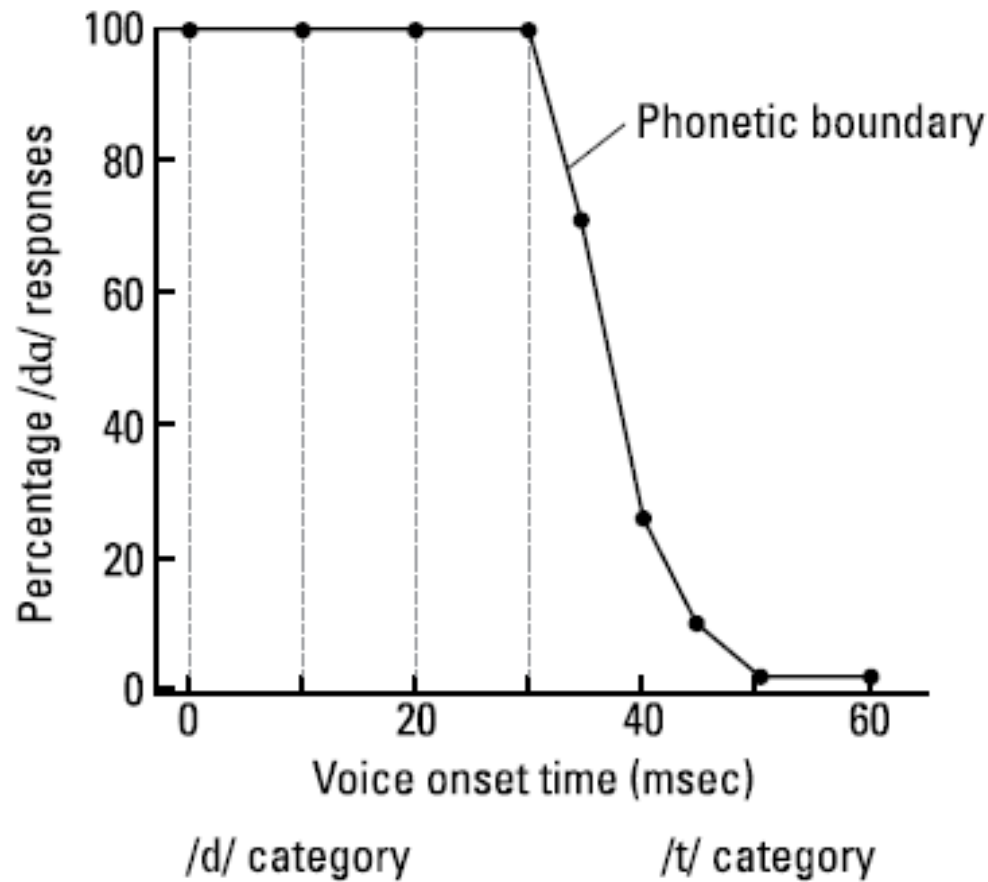


Voice Onset Time (VOT)

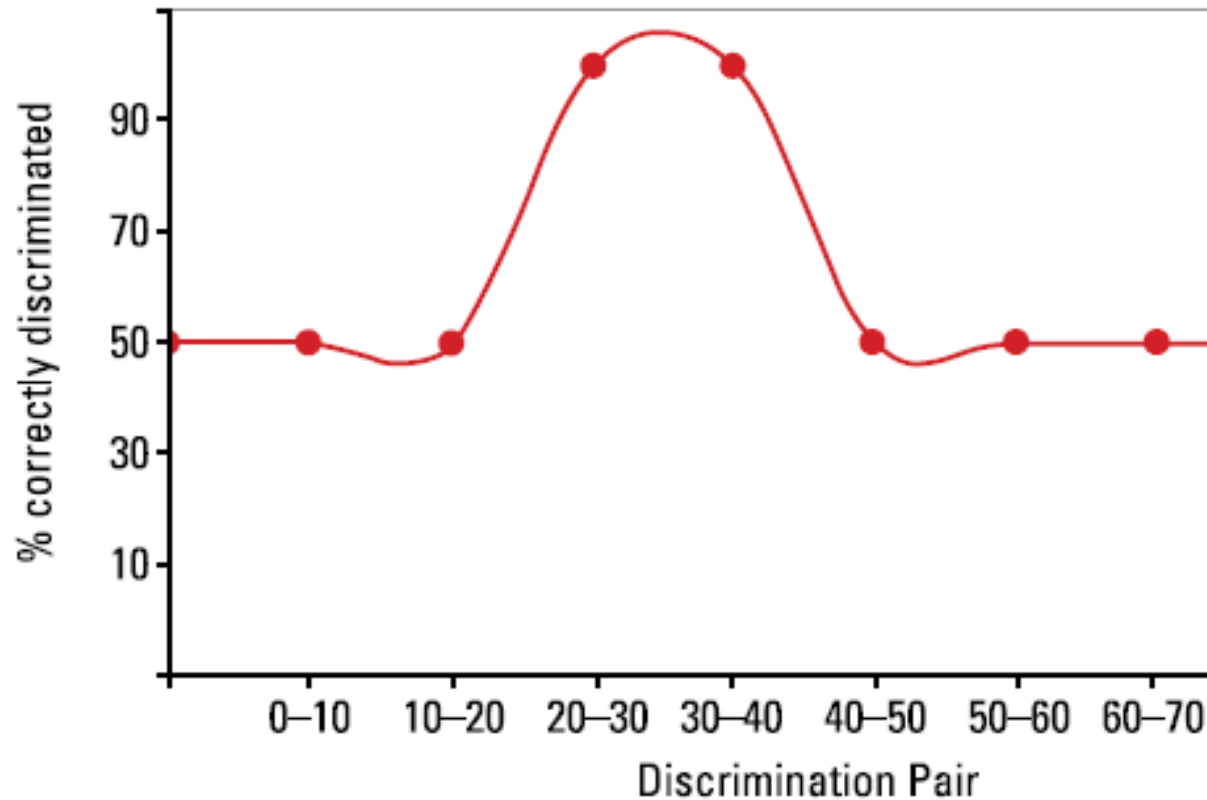


60 msec

/da/ vs. /ta/ identification



/da/ vs. /ta/ discrimination



English VOT production

- Not uniform
- 2 categories

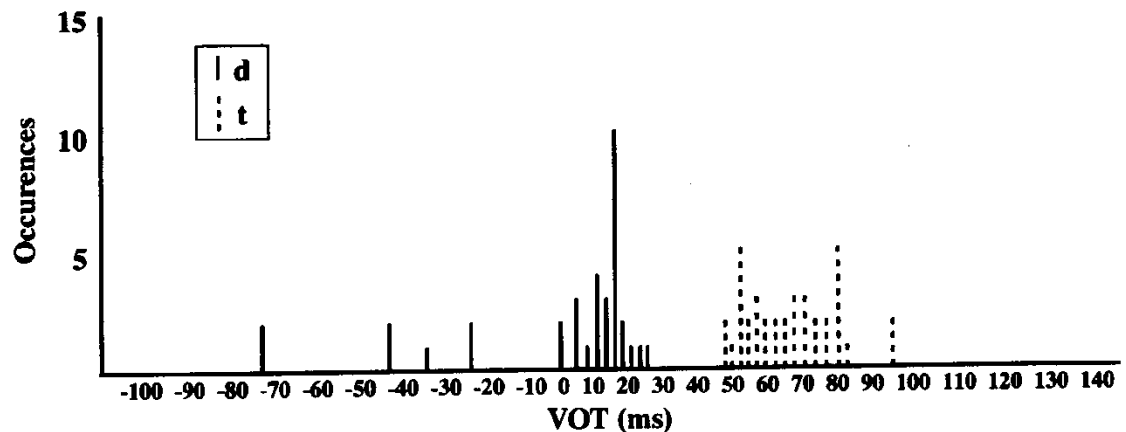
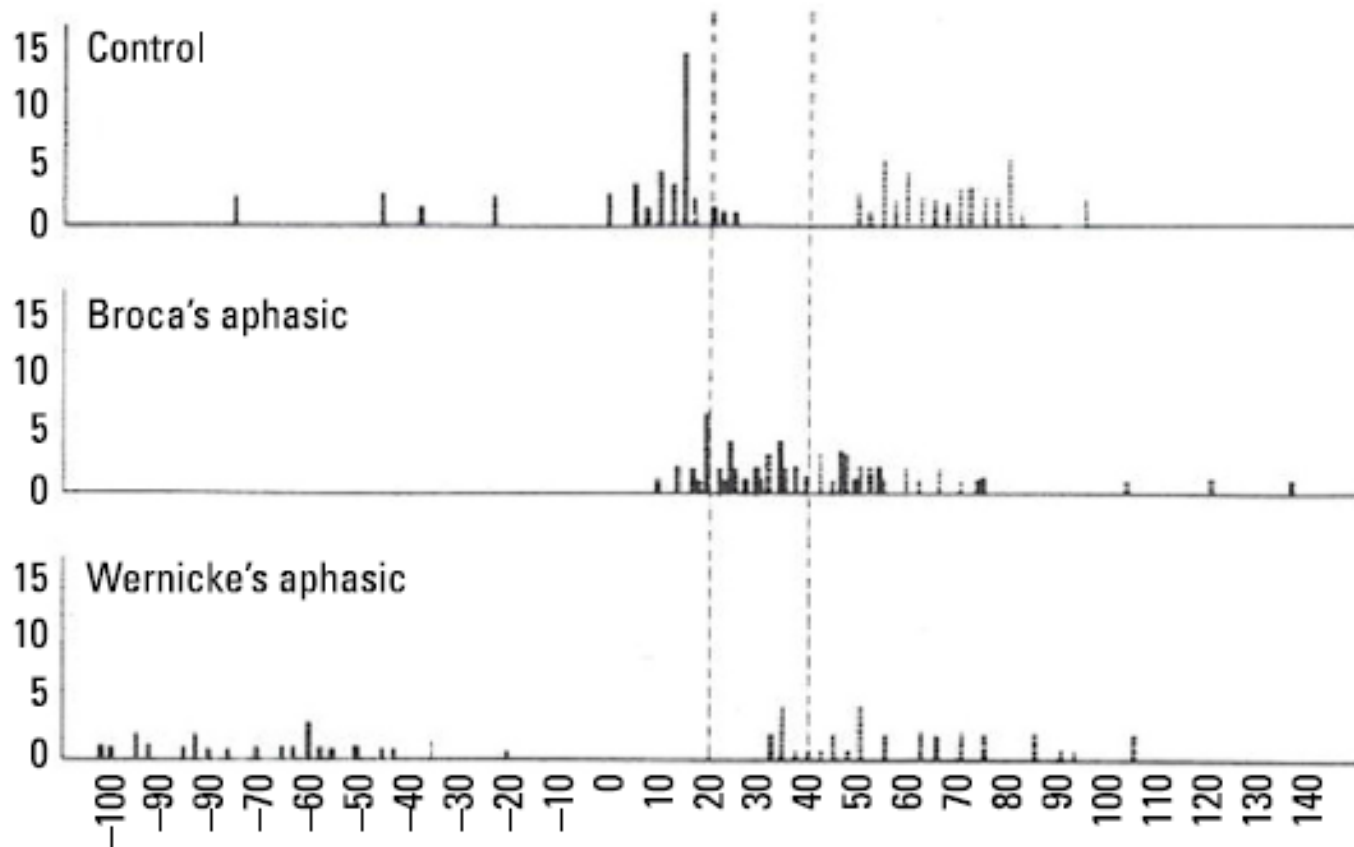


Figure 5-3. VOT productions of a single normal adult speaker of American English for words beginning with /d/ and /t/. (Figure adapted with permission from Blumstein, Cooper, Goodglass, Statlender, & Gottlieb, [1980]. Production Deficits in Aphasia: A Voice Onset-Time Analysis. *Brain and Language*, 9, 153-170. Copyright 1980 by Academic Press.)

VOT production breaks down in aphasic speech ($n=3/\text{group}$)



S.B. Filskov and T.J. Boll (Eds), Handbook of Clinical Neuropsychology, J. Wiley & Sons, 1981. This material is reproduced with permission of John Wiley & Sons, Inc.



Ease of articulation

vs.



Perceptual distinctiveness

- Two properties which constrain language
- Tend to balance each other in an opposing fashion....

Ease of articulation

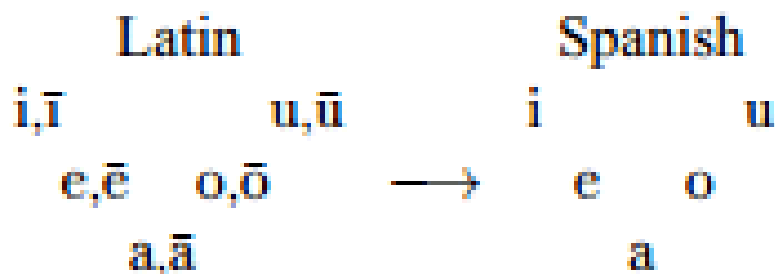
- EXAMPLES
- “*soften*” /t/ -> 0 (ellipsis)
- “*in*” + “*possible*” = “*impossible*” (assimilation)

Q: What is “easier” to produce in speech?

EXAMPLES:

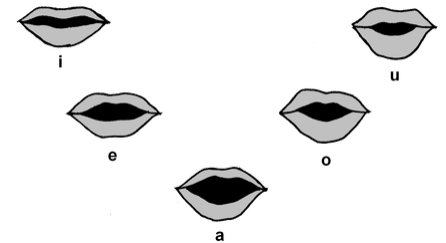
- Vowels easier than consonants
- CV syllables easier than heavy syllables (e.g., CVC) – *see infant babbling*
- Short vowels easier than long – *evidence from language change (diachronic):*

Longer vowels difficult to produce because of extra time and energy to expel air out of the lungs



Perceptual distinctiveness

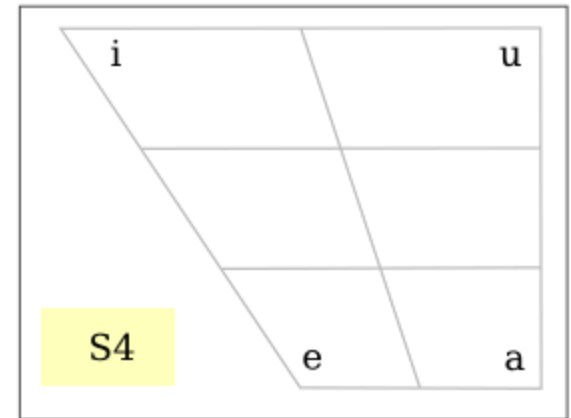
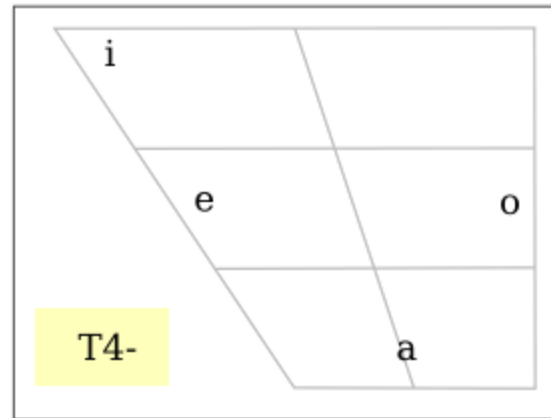
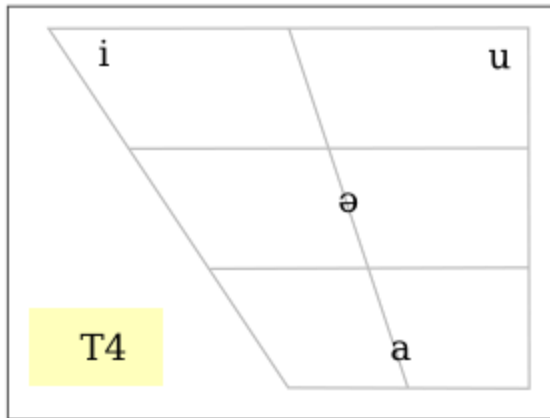
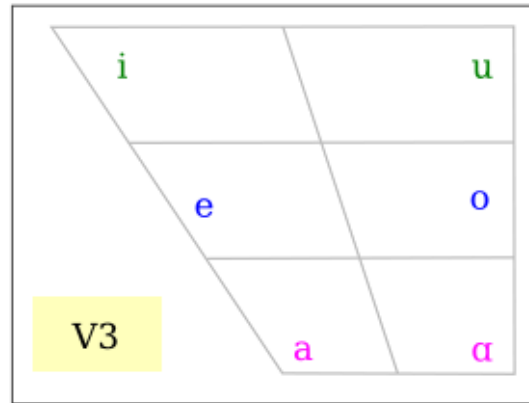
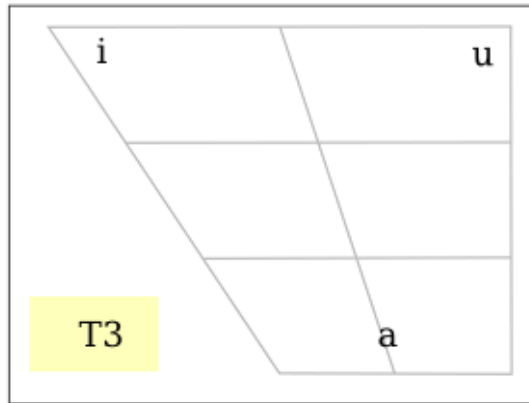
- Vowel systems of world languages appear organized for maximal “listen-ability”
- Languages with small vowel inventories tend to “hug the periphery” and be spread out
- Languages with larger inventories tend to have additional features (e.g. length, nasalization) to ensure perceptual distinctiveness



Examples

- From UPSID (UCLA Phonetic Segmental Inventory Database) > 317 languages
- Range of 3 -15 vowel phonemes in inventory
- Most common: 5 vowel system with /a i u e o/
- Tellingly, no as “ /i ɪ ɛ ε/” or “/u ʊ ɔ o ɑ /” systems found....

Common 3- and 4-vowel patterns



Common 5-vowel patterns

