Advanced Phonological Theory B – Lecture 9: Dispersion and Quanta

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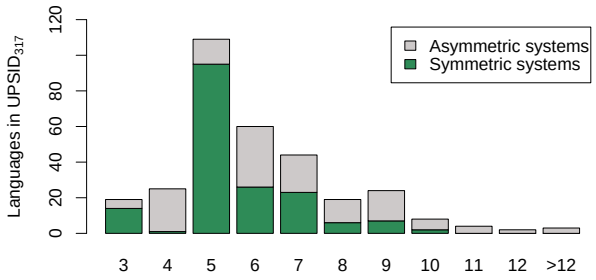
March 16, 2005

What we need to acount for

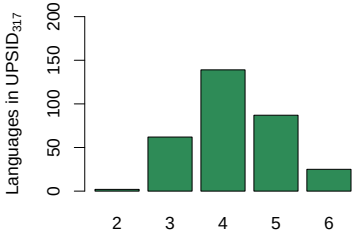
- Two separate issues:
  1. Preferred (gross) phonetic categories in (contrastive?) sound inventories
  2. Preferred inventory sizes

What we need to acount for



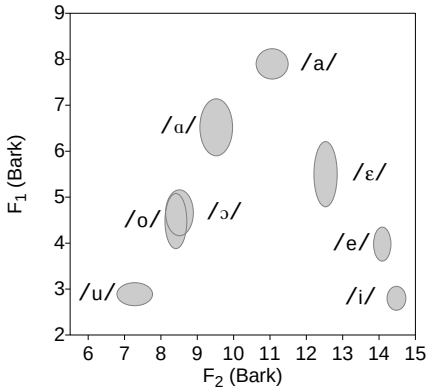
Primary vowel qualities (Schwartz et al. 1997)

What we need to acount for



Places of articulation in stop inventory

What we need to acount for



Some theories

- Adaptive dispersion: e.g., Liljencrants & Lindblom (1972); Lindblom (1986); Flemming (1995); Schwartz et al. (1997b); de Boer (2001)
- Quantal Theory: Stevens (1972, 1989)
- Enhancement: e.g., Stevens & Keyser (1989)
- 'Economy'/symmetry: e.g., Ohala (1980); Lindblom & Maddieson (1988); Clements (2003); cf. Boersma (1998)

Adaptive dispersion

- Key hypothesis: (contrastive) sounds are placed in phonetic space such that the perceptual distances among them are maximised (or otherwise optimised)
- Underlying idea: speakers and listeners benefit if messages are readily recoverable from the speech signal (cf. Lindblom 1990)

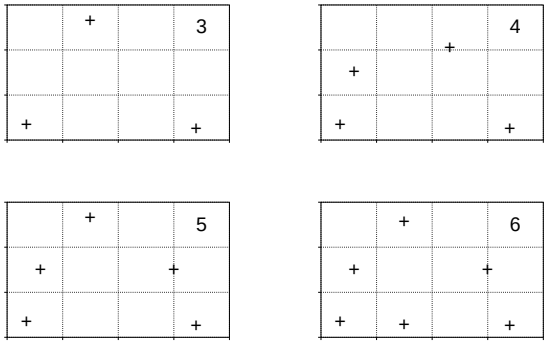
Adaptive dispersion

- The models of Liljencrants & Lindblom (1972) and Lindblom (1986) attempt to predict crosslinguistically preferred vowel categories as follows:
  1. Define a perceptual distance metric: Euclidan distance in F_1 - F_2 space in Liljencrants & Lindblom 1972
  2. Phonetic categories are defined as points rather than regions in phonetic space (though see Crothers 1978)
  3. For every number n of contrastive sounds, find the configuration(s) with maximal/optimal distances in perceptual space

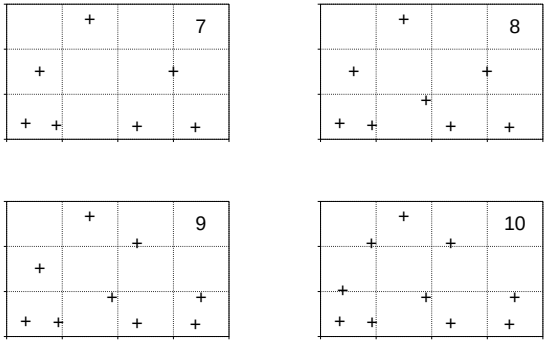
Adaptive dispersion

- Some results of the 'F model' of Lindblom (1986):
  - General preference for three 'corner' peripheral vowels ≈ [i], [a], [u], regardless of inventory size
  - Preference for a single front peripheral mid vowel ≈ [e]/[ɛ], and a single back peripheral mid vowel [o]/[ɔ] over mid central and high non-peripheral vowels
  - Preference for high non-peripheral vowels ≈ [y], [ɨ], [ɯ] over mid central vowels
  - High non-peripheral vowels and a (high)-mid central vowel are introduced before additional mid perphiperal vowels

Adaptive dispersion



Adaptive dispersion



Adaptive dispersion: issues and limitations

- If perceptual contrast is maximised, why don't we observe a preference for, say [i], [a̰], [uˤ]? (Ohala, 1980)
  - We (still) might, if descriptions and databases move beyond lexically contrastive sounds
  - Optimisation does not necessarily involve maximisation
  - Symmetry/economy as a competing constraint: languages maximise use of phonetic dimensions

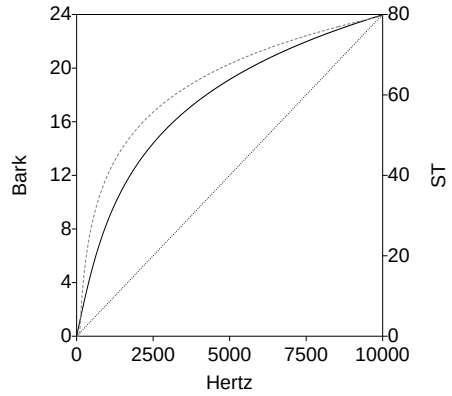
Adaptive dispersion: issues and limitations

- Adaptive dispersion does not generate predictions about preferred inventory sizes
  - Although size preferences may represent optimisations of dispersion against other factors
- Not straightforward to generalise to consonant inventories
  - Although concepts such as contrast maximisation have been used in the analysis of (consonant) phonotactics (Flemming, 1995; Silverman, 1997)

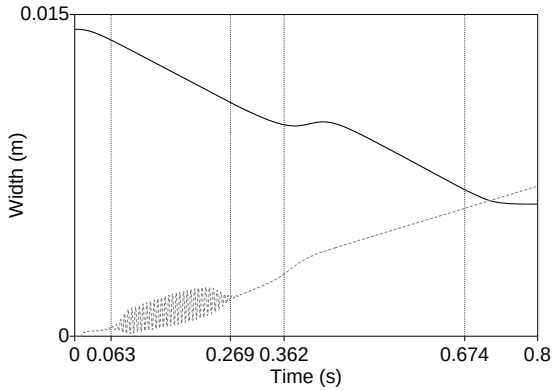
Speech quanta

- Key hypothesis of the Quantal Theory (Stevens, 1972, 1989): crosslinguistically preferred phonetic categories represent relatively stable areas in the articulation-to-acoustics (and acoustics-to-perception) mapping(s)
- Underlying idea: placing phonetic categories in relatively stable areas benefits both speakers and listeners because it increases the probability that acoustic targets are met
- The Quantal Theory relies on models of the articulation-acoustics-perception mapping to identify regions of stability

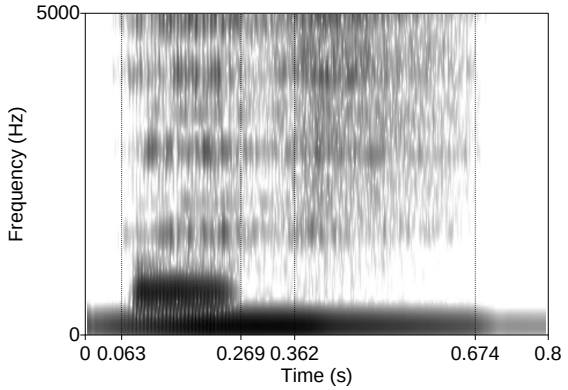
Background: non-linear mappings



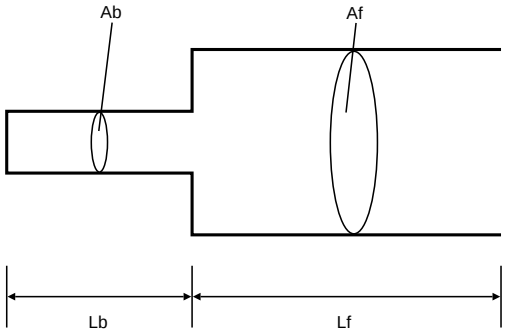
Speech quanta: voicing and frication



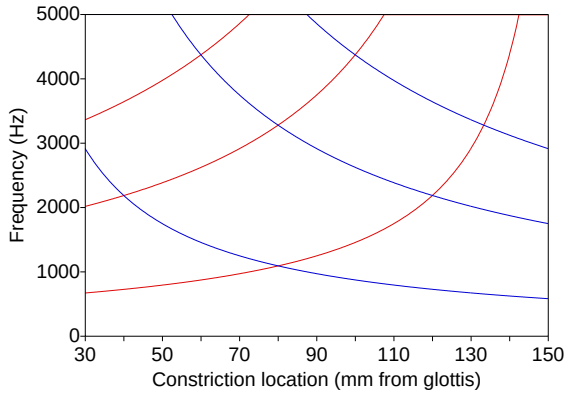
Speech quanta: voicing and frication



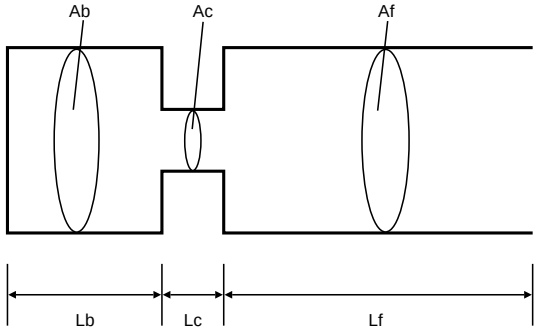
Speech quanta: predicting [a]



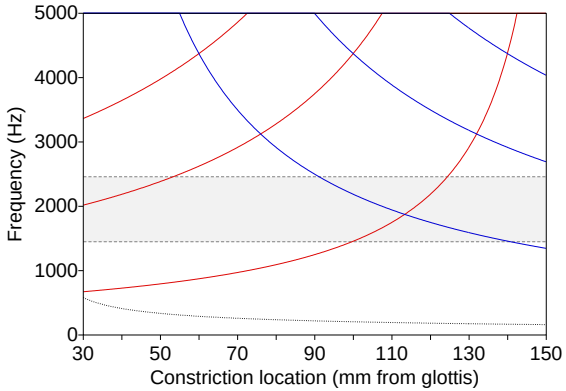
Speech quanta: predicting [a]



Speech quanta: predicting [i]



Speech quanta: predicting [i]



Speech quanta

- Quantal theory goes some way in understanding consonant inventories as well as vowel inventories
- Example: coronal vs. non-coronal distinctions in obstruent inventories grounded in maximal amplitude of front cavity spectral prominence for constrictions made a few centimeters from the opening of the mouth
- These distinctions may be further enhanced by the 'wall turbulence' generated at the lower incisors (sibilancy)

Concluding remarks

- Vowel inventories much better understood than consonant inventories (see also Boersma 1998: chapter 16)
- Dispersion, quanta, economy not necessarily mutually exclusive
- Question: how do speakers manage to disperse/find stable areas in the articulation-acoustics mapping?

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