

Advanced Phonological Theory B – Lecture 9: Dispersion and Quanta

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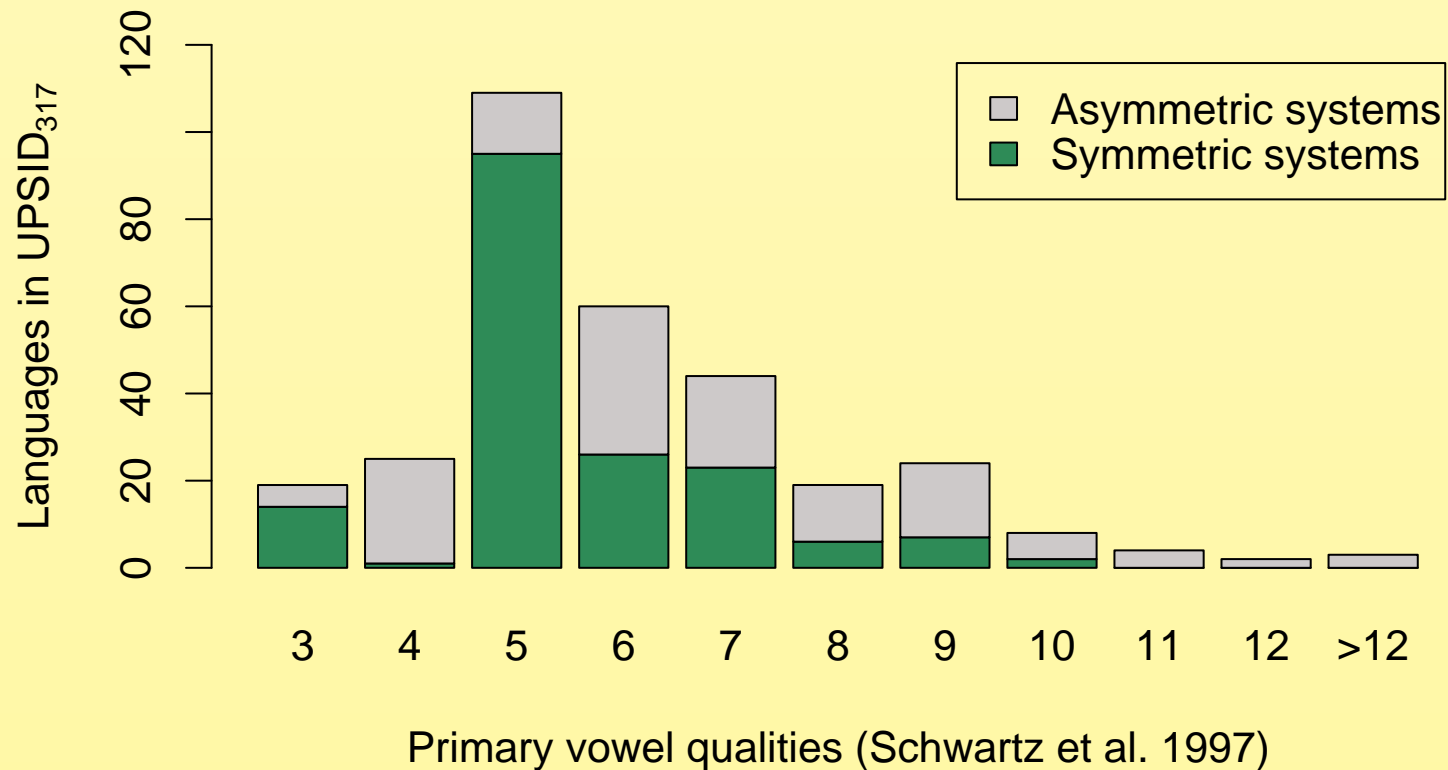
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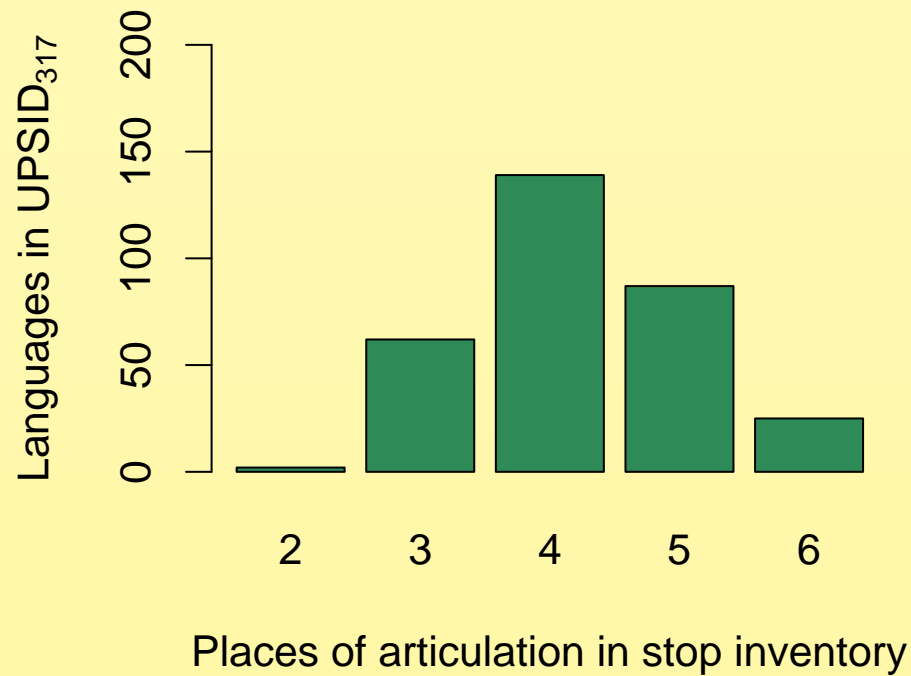
What we need to account for

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

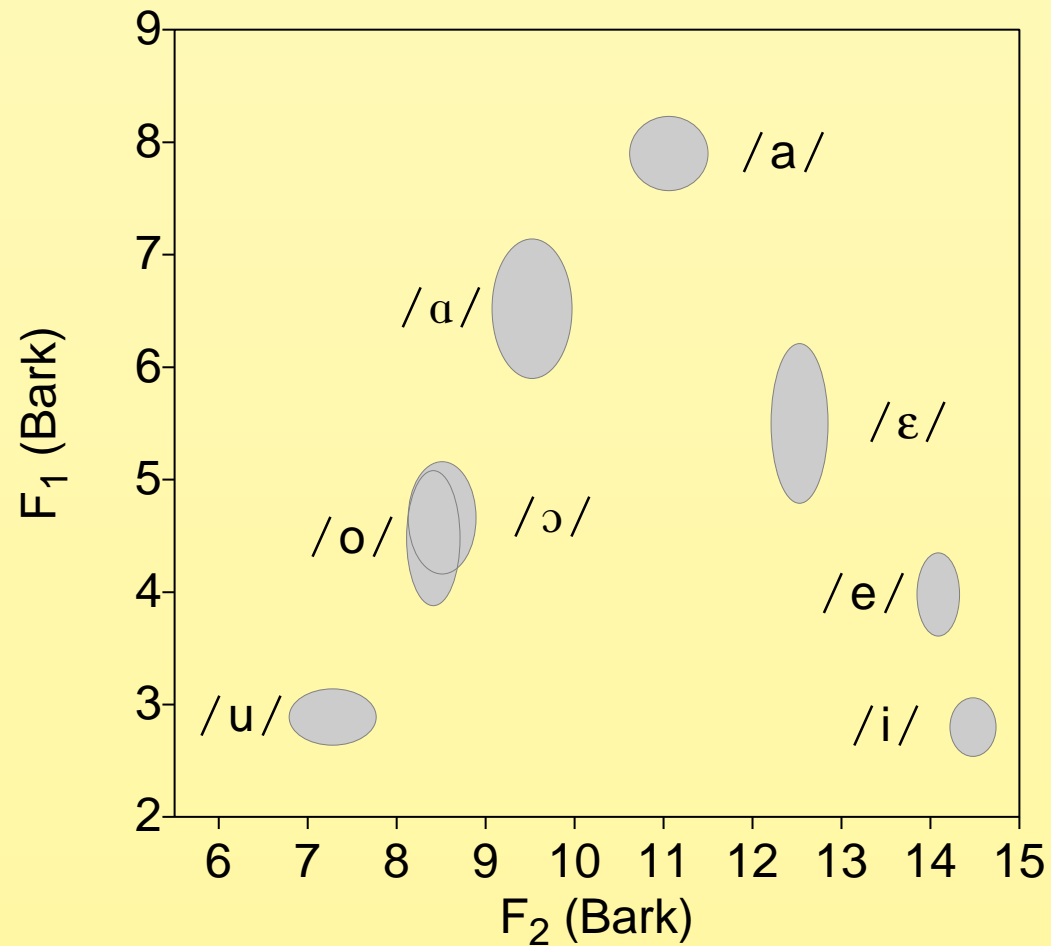
What we need to account for



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What we need to account for



Some theories

- Adaptive dispersion: e.g., Lijencrants & 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](#))

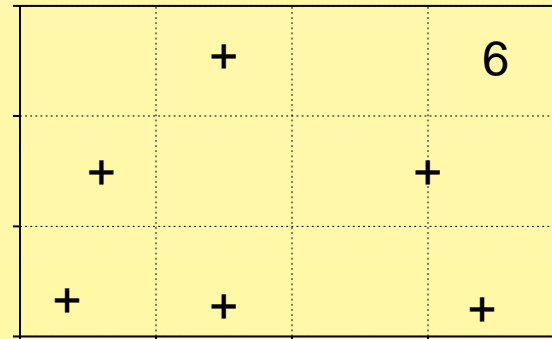
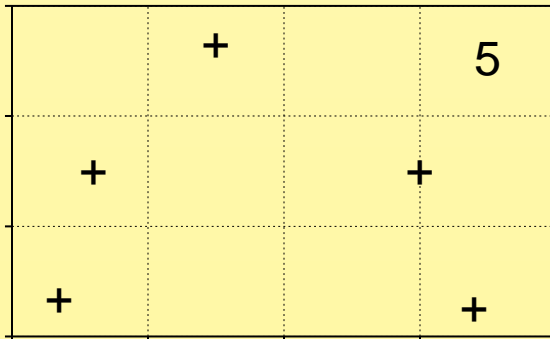
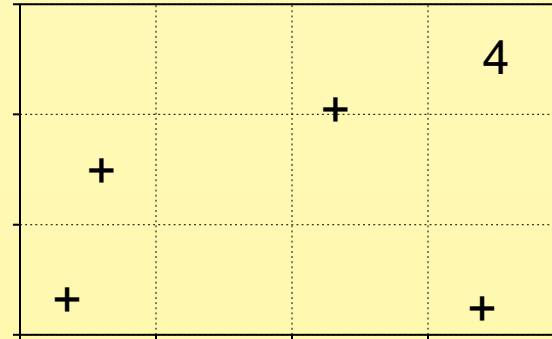
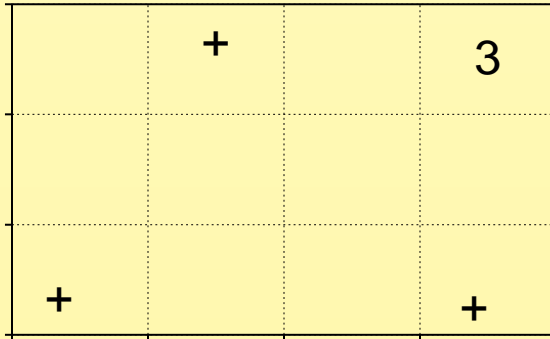
Adaptive dispersion

- 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

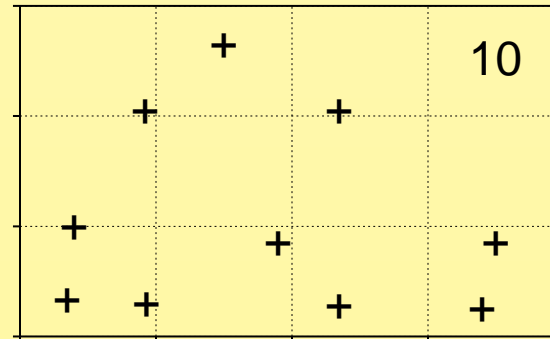
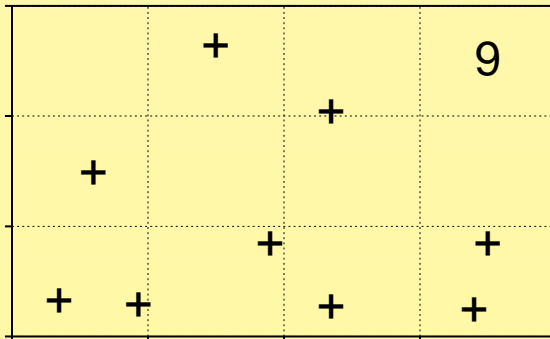
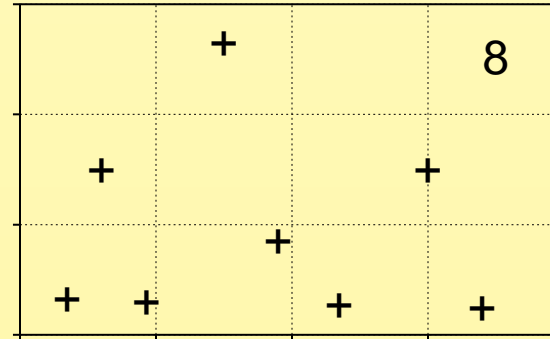
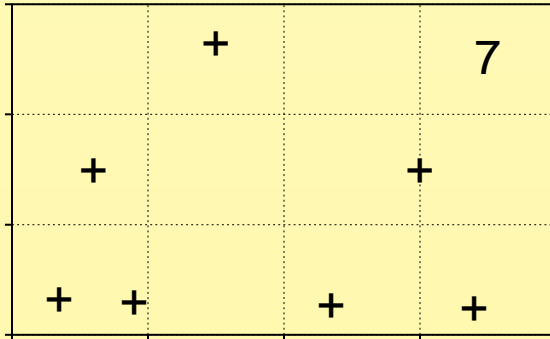
Adaptive dispersion

- Some results of the ‘F model’ of Lindblom (1986):
 - ◆ General preference for three ‘corner’ peripheral vowels \approx [i], [a], [u], regardless of inventory size
 - ◆ Preference for a single front peripheral mid vowel \approx [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 \approx [y], [ɨ], [ɯ] over mid central vowels
 - ◆ High non-peripheral vowels and a (high)-mid central vowel are introduced before additional mid peripheral 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], [ḁ], [u^ɿ]? (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

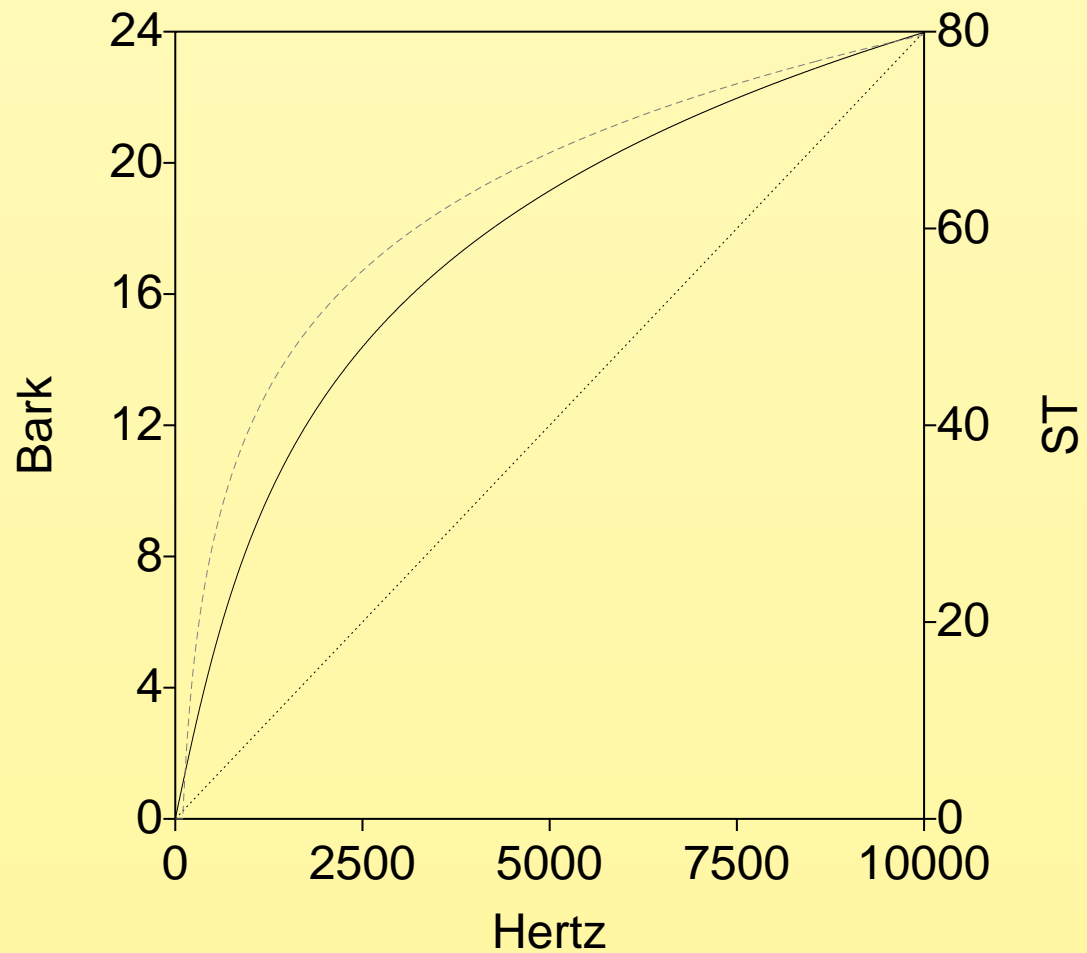
Adaptive dispersion: issues and limitations

- 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)

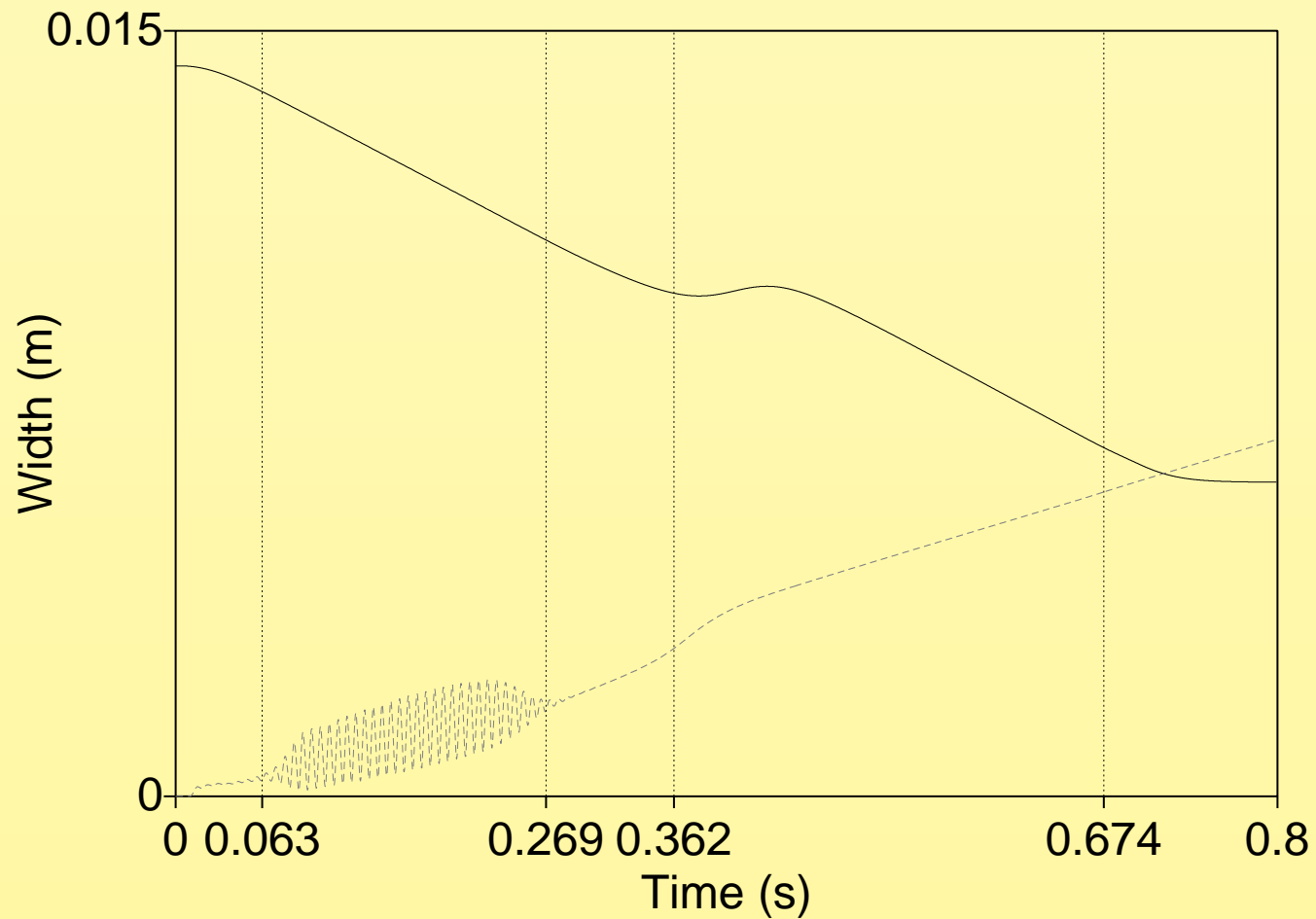
Speech quanta

- 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

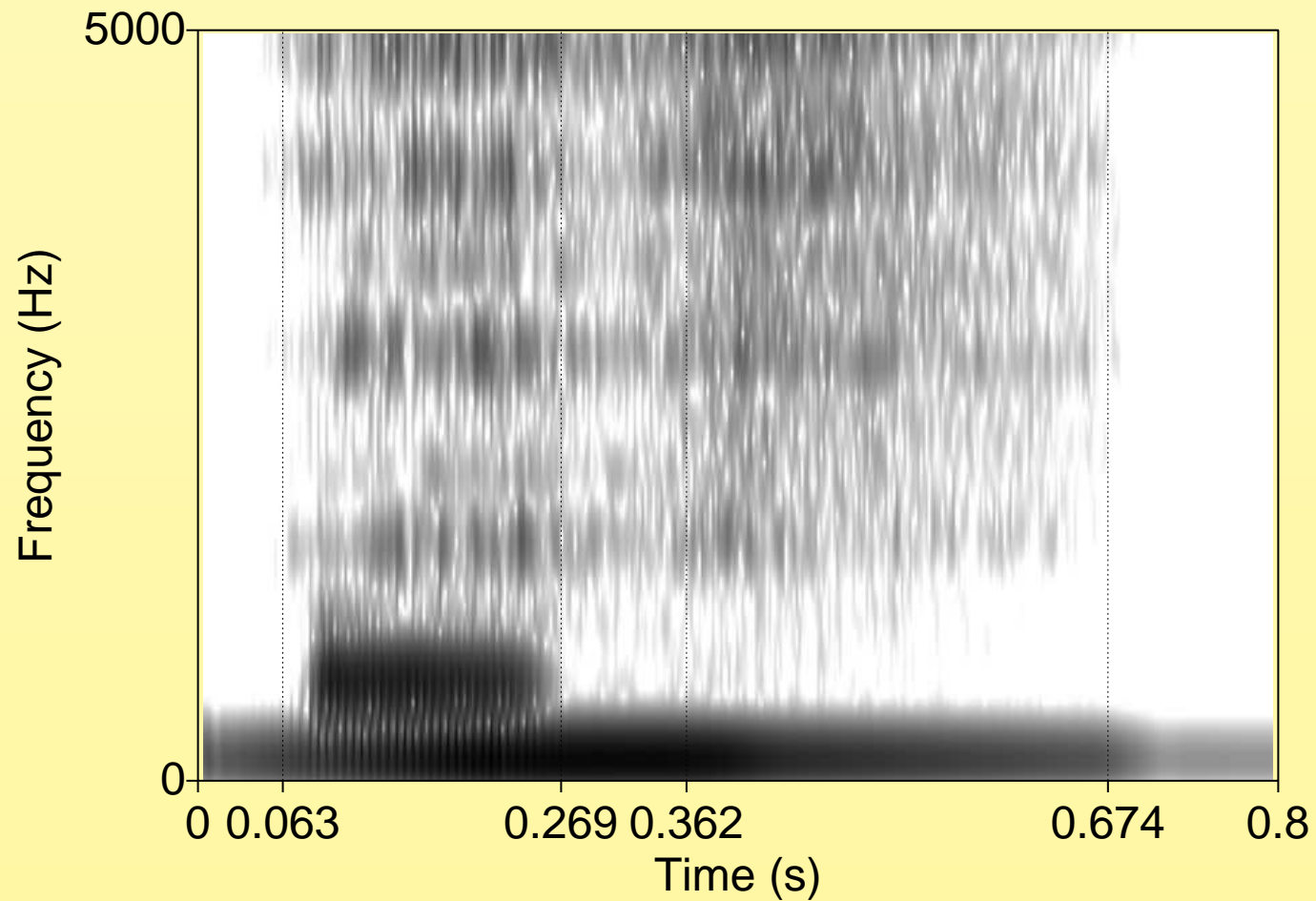
Background: non-linear mappings



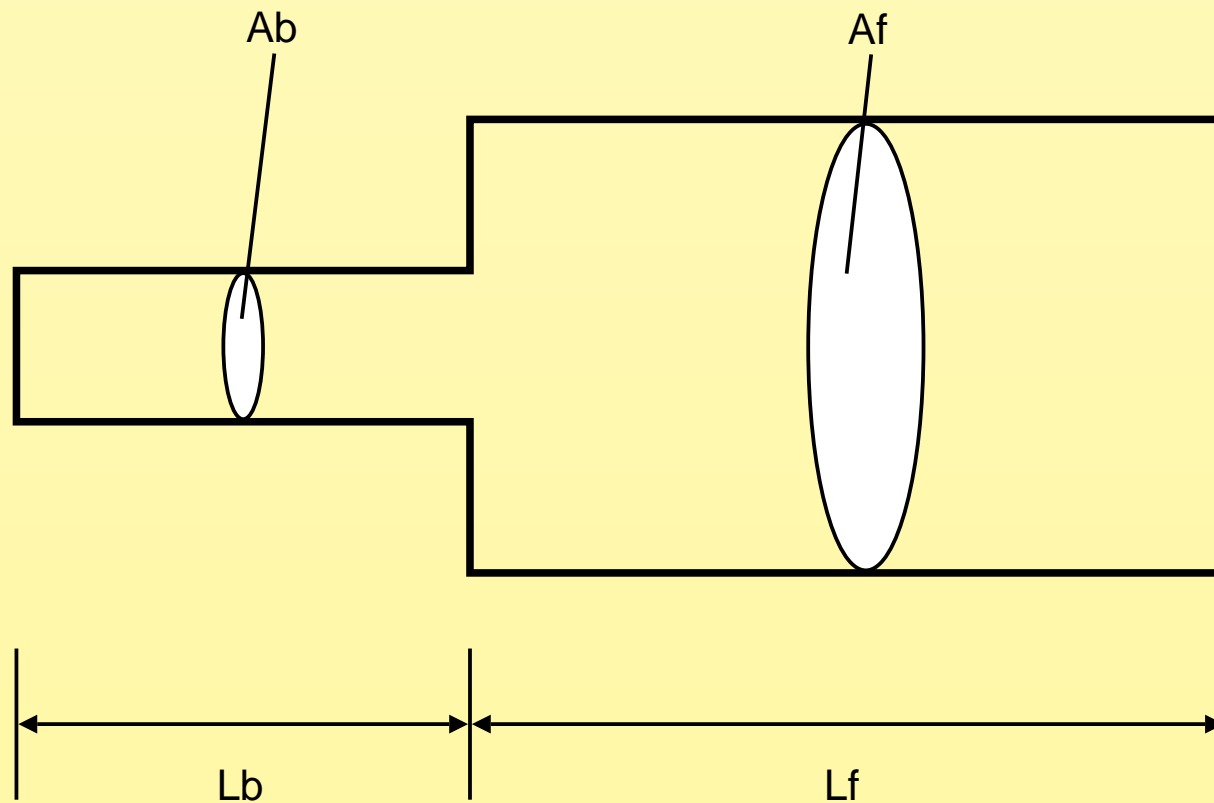
Speech quanta: voicing and frication



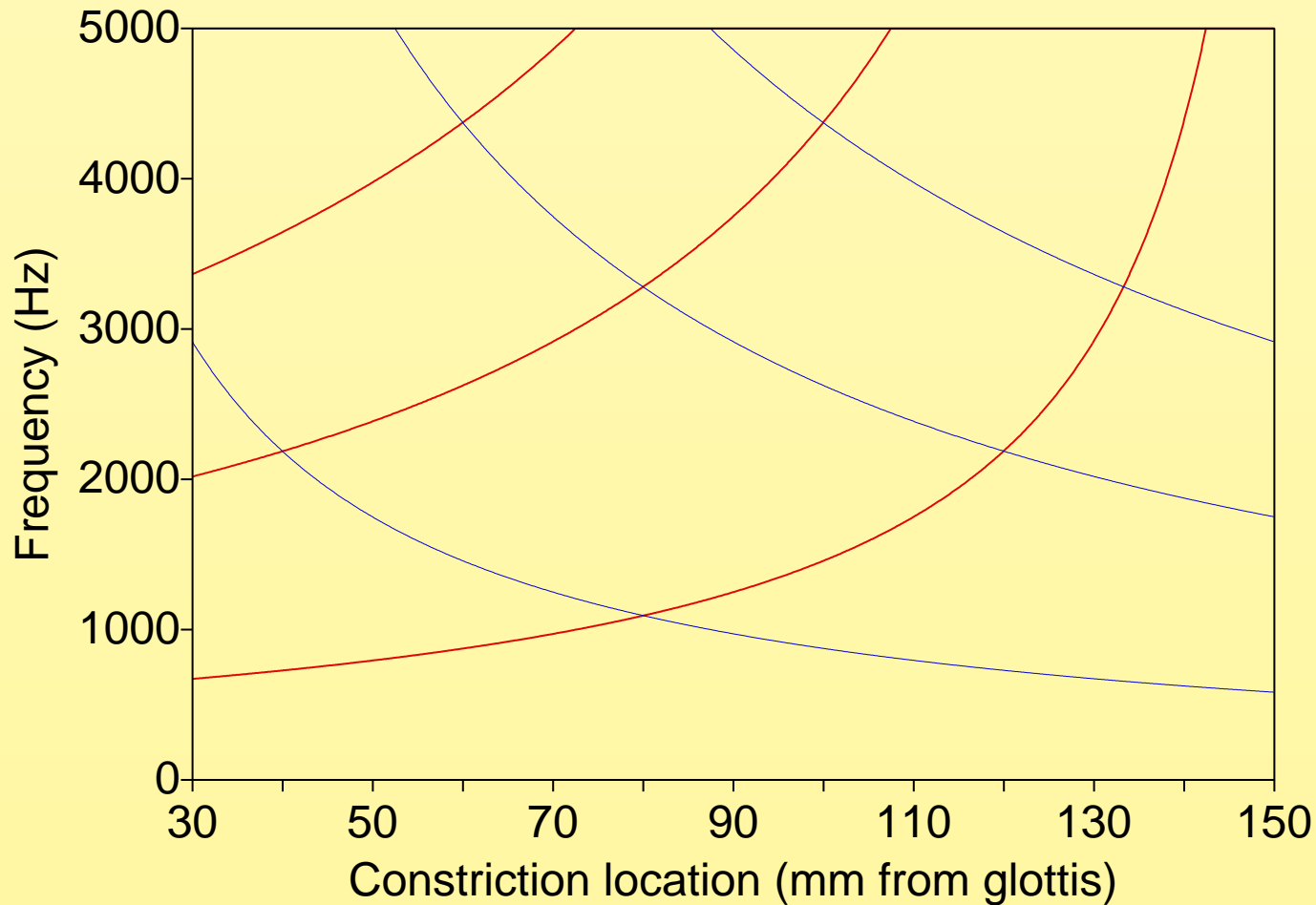
Speech quanta: voicing and frication



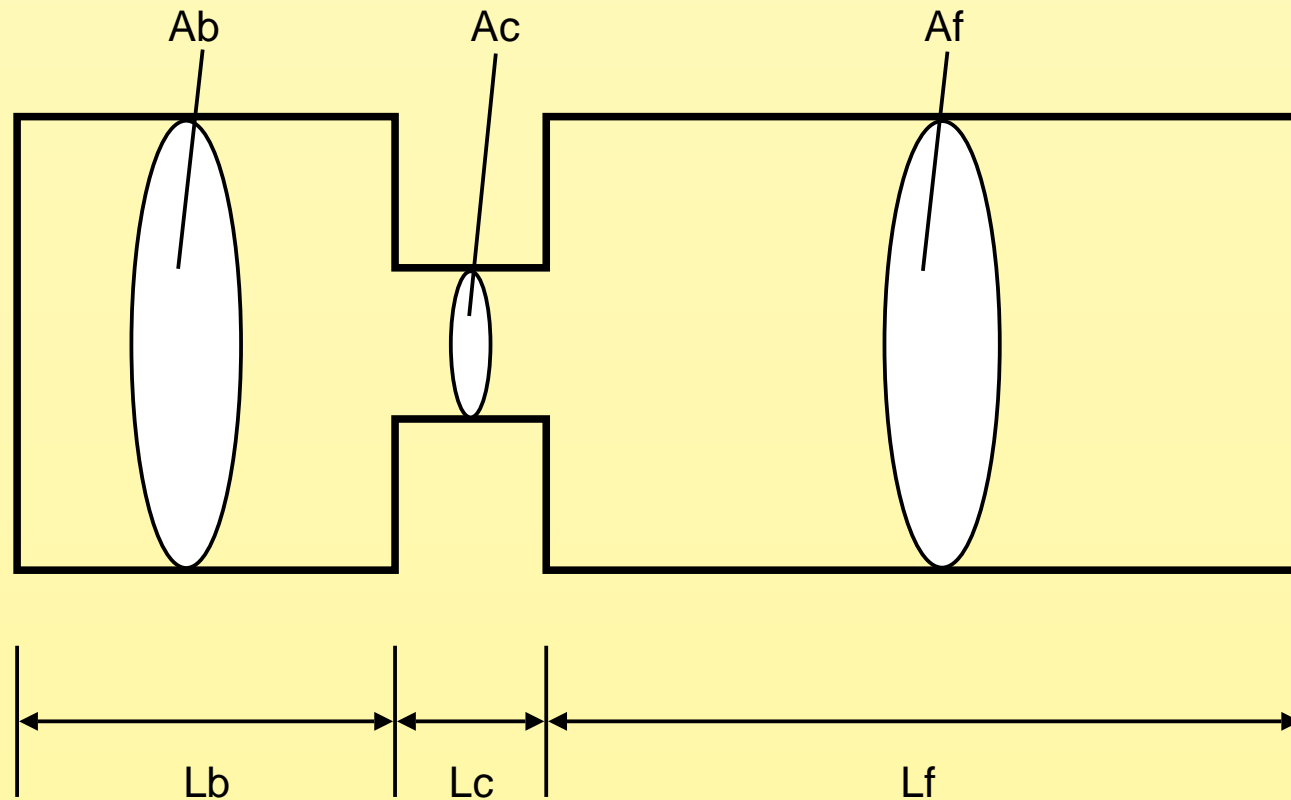
Speech quanta: predicting [a]



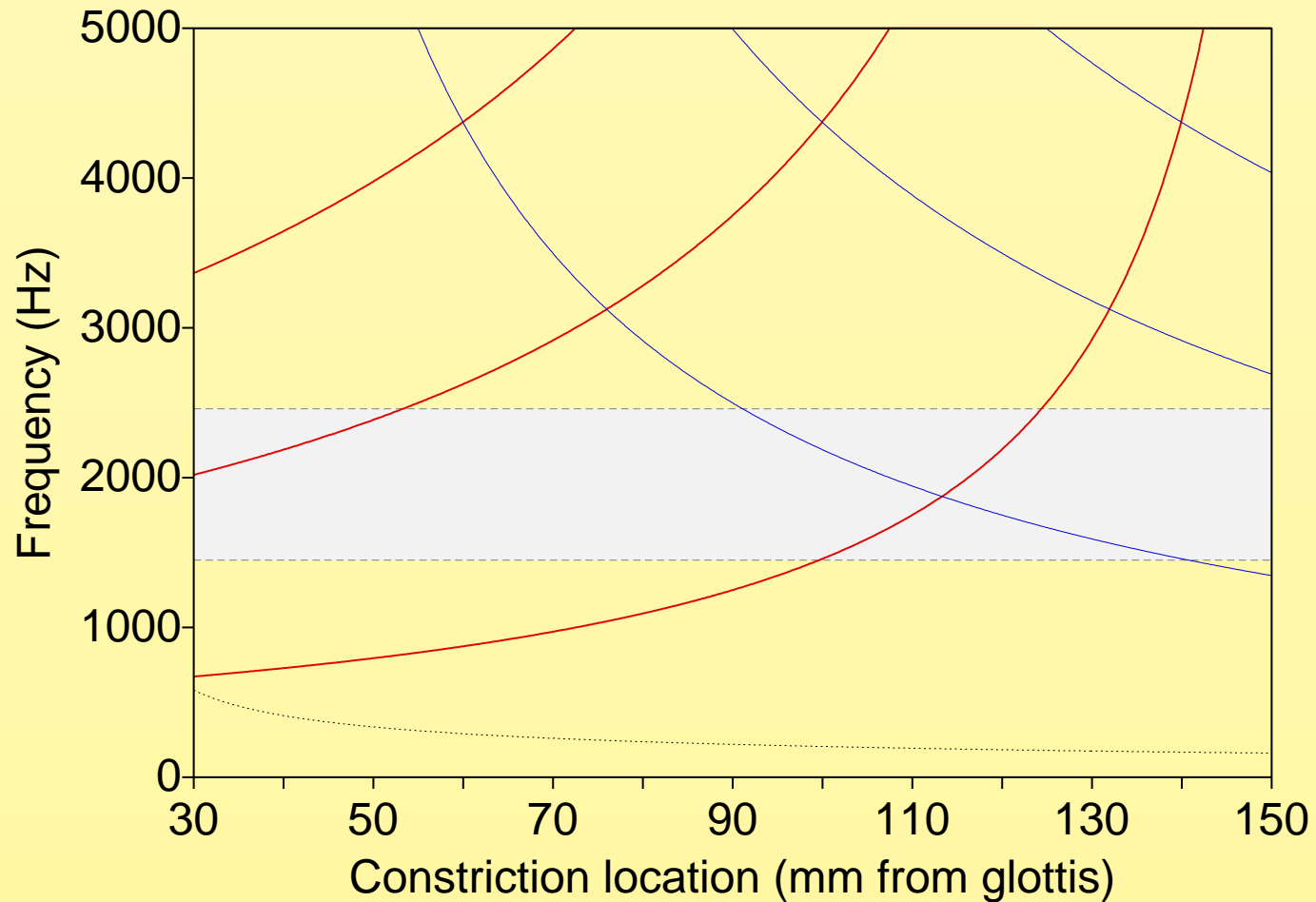
Speech quanta: predicting [a]



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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