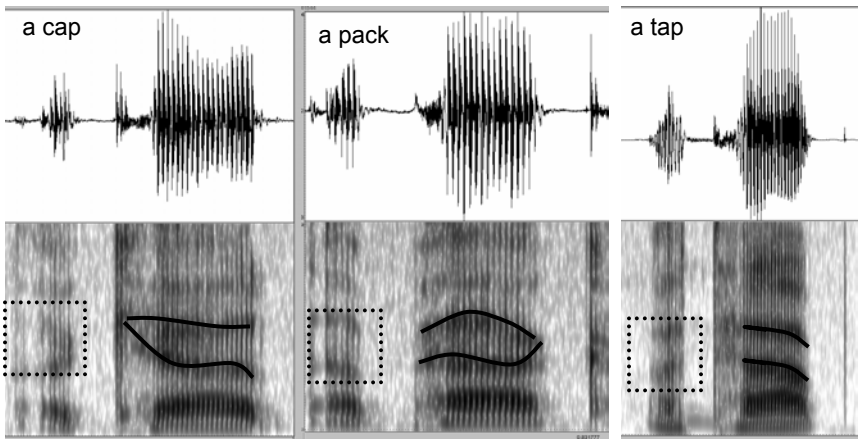
Spectrogram reading

LING110
Fall Quarter 2004

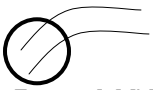
Place of articulation in stops



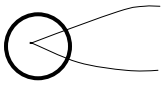
Note the movement of the formants in the vowels; the rectangles show similar formant transitions in the “a” vowel

Cues for stop place of articulation

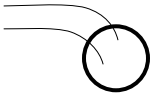
Main cue: shape of F2 and F3 transition (second and third formant respectively) from a stop to a following vowel, or from a vowel to a following stop
Secondary cue for oral stops: aspiration (VOT) is shorter for [p]/[b], than for [t]/[d] than for [k]/[g]



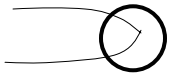
From a [p] [b] or [m] to a vowel



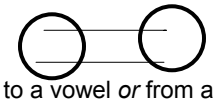
From a [k] [g] or [ŋ] to a vowel



From a vowel to a [p] [b] or [m]

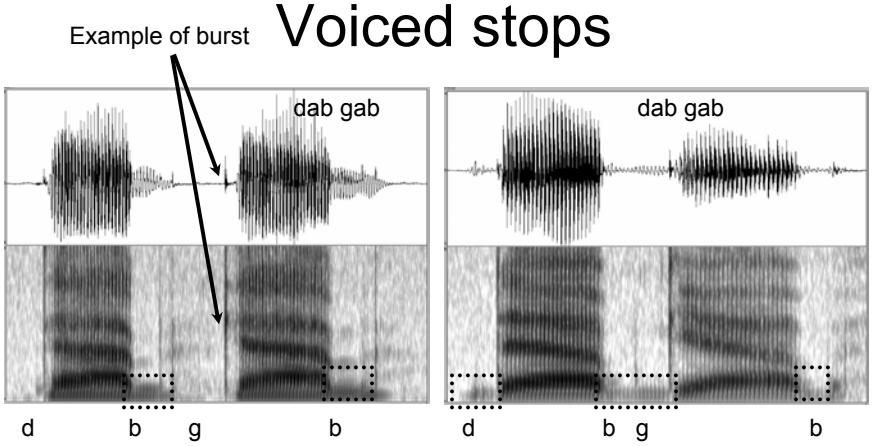


From a vowel to a [k] [g] or [ŋ]



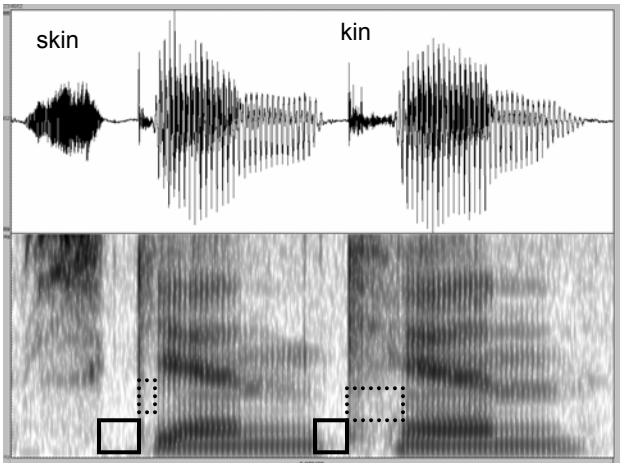
From a [t] [d] or [n] to a vowel *or* from a vowel to a [t] [d] or [n]: the transitions are always flat

Voiced stops



Note the voice bar that appears during the closure for some of these stops (not all of them are voiced); voice bars are marked ⬚
Note also the shorter VOT (relative to that of voiceless stops): the vowels begin shortly after the burst, shown as a vertical striation in the spectrogram and a spike in the waveform
The cues for place of articulation as the same as for [p], [t] and [k]

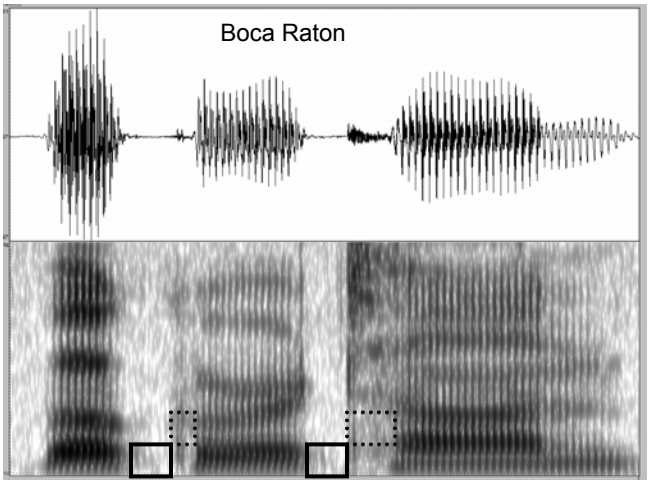
Aspiration i



s k VOT k VOT

The ☐ rectangles show closure for [k] in *skin* and *kin*
The ⬚ rectangles show VOT (aspiration) for the two [k]s
The [k] of *skin* has a short period of aspiration and is considered unaspirated; the [k] of *kin* has longer aspiration and is considered aspirated

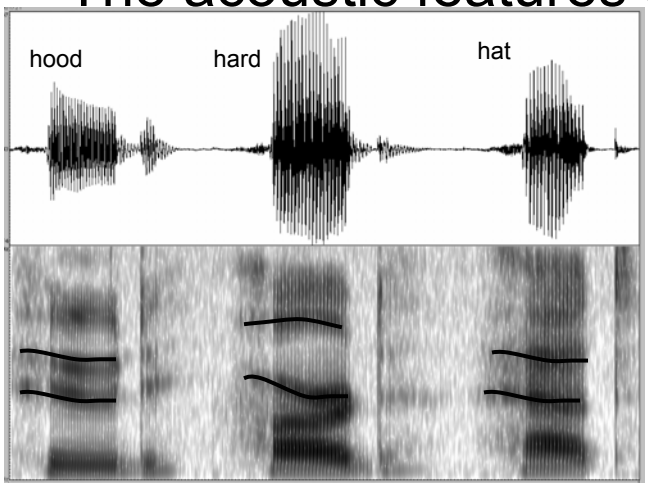
Aspiration ii



k VOT t VOT

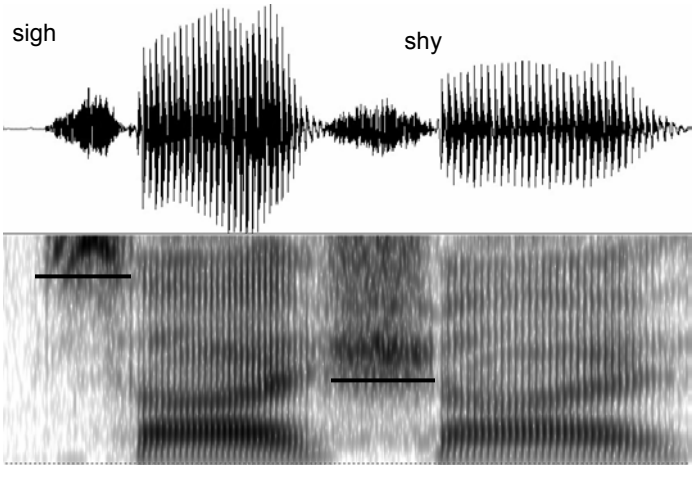
Note how the [k] of *Boca* is unaspirated (since unstressed), while the [t] of *Raton* is aspirated (since stressed)
(The same conventions for marking closure duration and VOT as in slide 5 apply here.)

The acoustic features of [h]



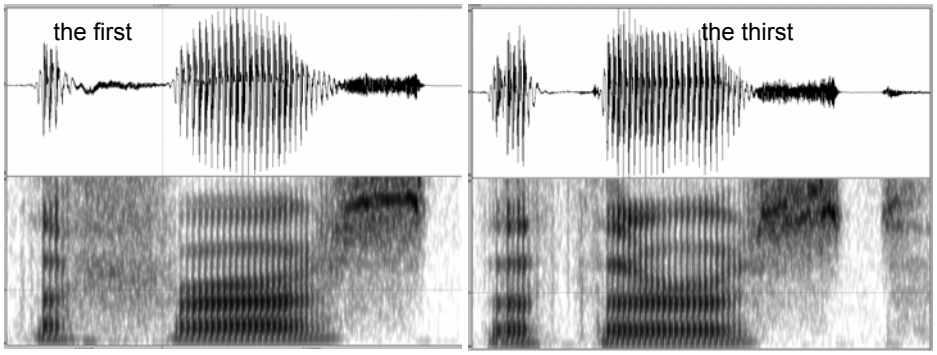
Note how the areas of greater friction change and appear in the same frequency range as the formants of whatever vowel follows [h]

Alveolar vs postalveolar fricative



Cue: higher cut-off point for [s] (around 4 KHz (= 4,000 Hz), than for [ʃ] (around 2 KHz)

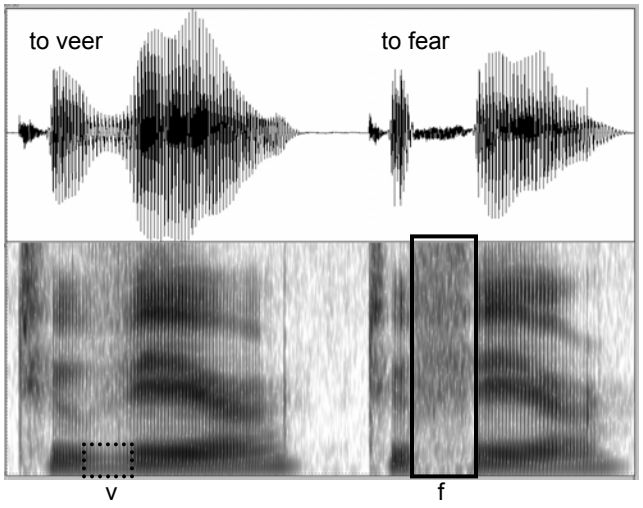
Labiodental vs. dental fricative



f **θ**

Both [f] and [θ] show little energy, but they also show different transitions to the following vowel (downward for [f], even for [θ]).

Voiced vs. voiceless fricatives

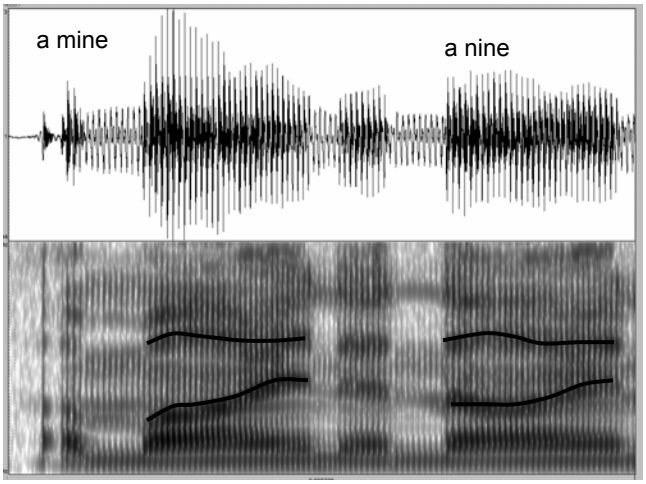


Cue: note the voice bar for [v] and the more prominent friction for [f] Voicing for the [v] is also evident in the waveform

Voice bar

friction

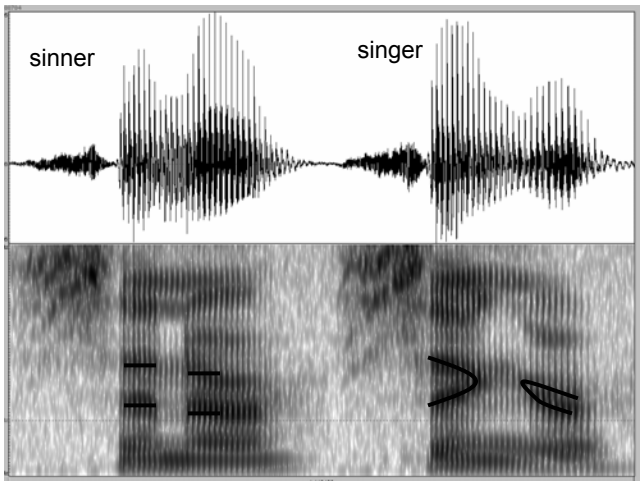
Nasals: labial vs. alveolar



[m] and [n] look very similar; the main difference is in the formant transitions to the following vowel; for the labial, note the downward transition of F2 and F3; for the alveolar, note the even transitions

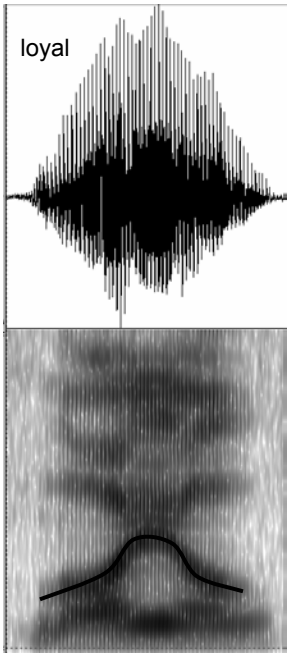
m n

Nasals: alveolar vs. velar



[n] and [ŋ] are similar, but the transitions to and from the nasal differ according to place of articulation. Note also how much less energy the nasals have when compared to the vowels that precede and follow them

n ŋ



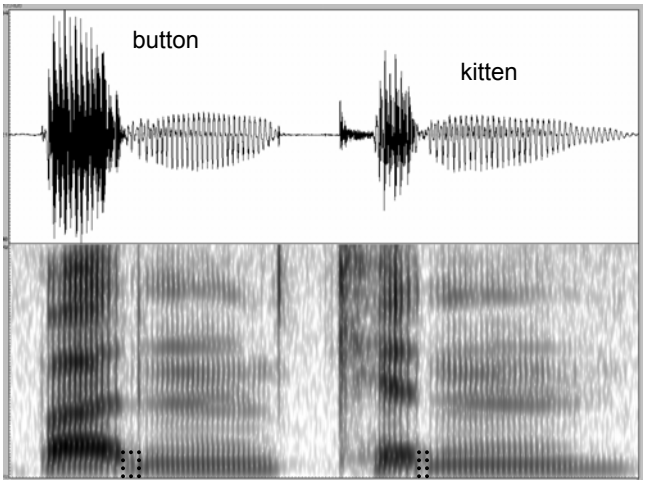
Liquids: [l]

Note how [l] is similar to the vowels, but also shows less energy and a very low F2

Liquids: [r]

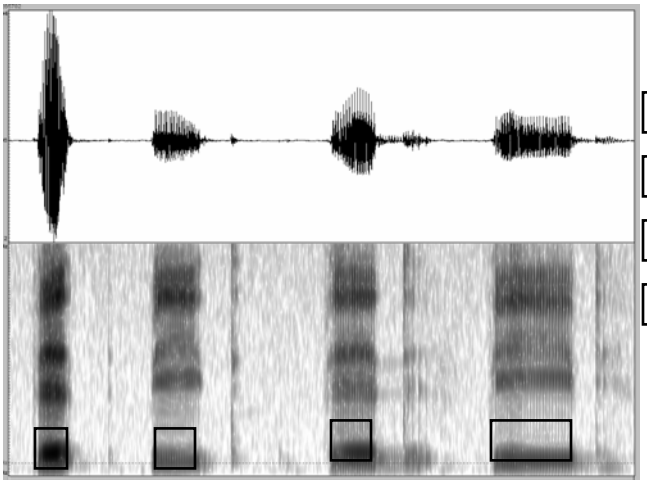
For [r], note the very low F3, in addition to the vowel-like structure (which shows, however, low energy)

Unreleased stops



This speaker has a glottal stop before the [n] in button (i.e. [bʌʔn]); in kitten no stop can be seen between the vowel and the [n] (although there is a very short closure); [t] closures are marked with ⬚

Voicing and preceding vowel length



[ɪ] before voiceless C

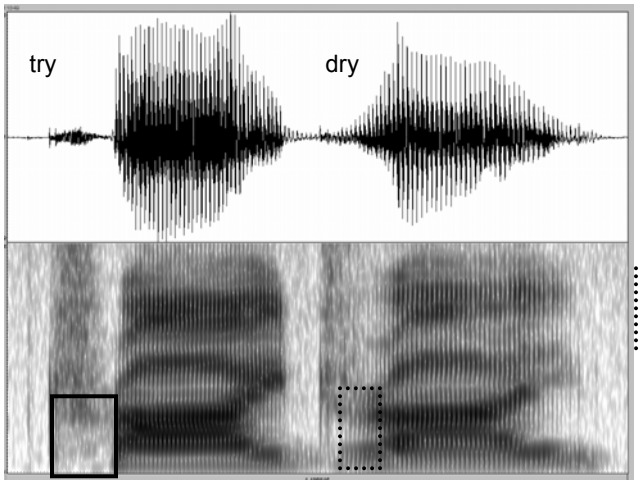
[i] before voiceless C

[ɪ] before voiceless C

[i] before voiced C

b i t b ea t b i d b ea d

Devoicing of approximants



the devoiced [r̥] shows up as friction in the spectrogram

the voiced [r]

r̥ r