6.541J Handout

2/24/04

Rounding for vowels

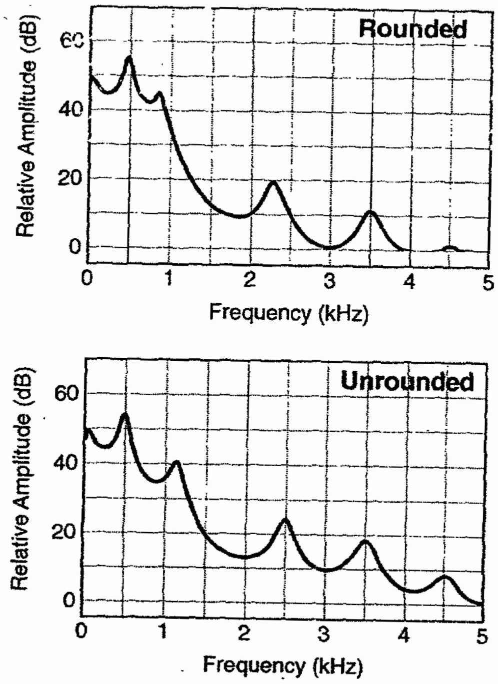

Figure 6.19 Calculated spectrum envelopes for two back vowels, illustrating the contrast between a rounded (top) and an unrounded (bottom) back vowel. The formants $F1$ and $F2$ are closer and higher-frequency peaks are weaker for the rounded vowel.

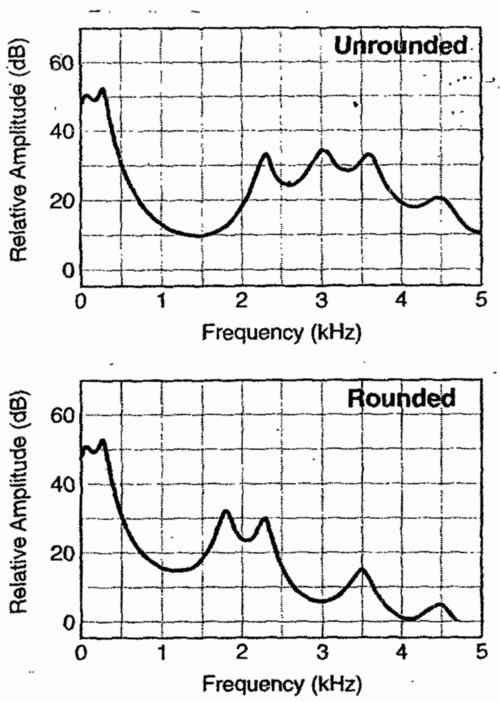

Figure 6.21 Calculated spectrum envelopes for an unrounded high front vowel (top) and a contrasting rounded front vowel (bottom).

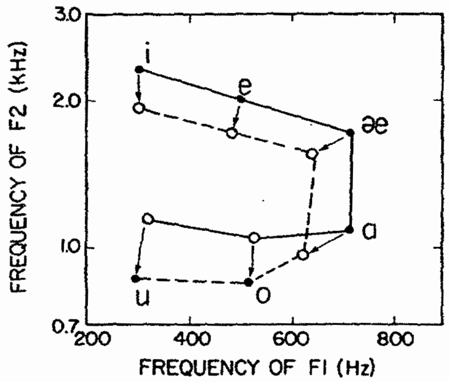

Figure 6.22 Comparison of the values of $F1$ and $F2$ for a set of six unrounded vowels (points joined by solid lines) and six rounded vowels (points joined by dashed lines). The labeled vowels (solid circles) are approximations to the six basic extreme vowels discussed in the text. The arrows indicate how the formants change when rounding occurs. The frequencies are in the range corresponding to adult male speakers.

2 Tense-lax for vowels in English

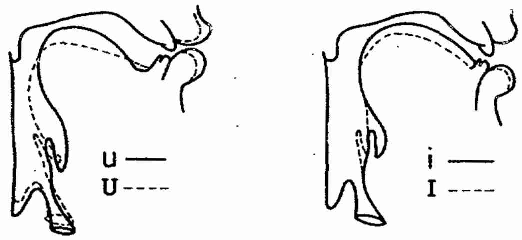

Figure 6.23 Comparing midsagittal vocal tract configurations for tense and lax high vowels for a speaker of American English. (Data from Perkell, 1969.)

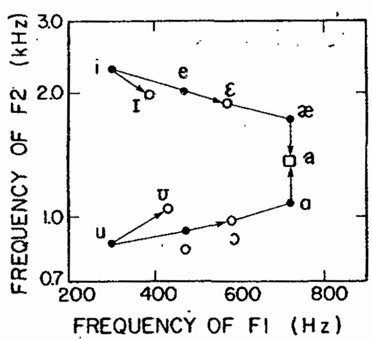

Figure 6.24 Comparison of the values of $F1$ and $F2$ for the basic set of six tense vowels (closed circles) and the four non-low lax vowels /ɪ ɛ ɔ ʊ/ (open circles). Arrows point from tense vowels to corresponding lax vowels. Data are appropriate for adult male speakers. For the high vowels, data are from American English (Peterson and Barney, 1952). For the vowels /e ɛ ɔ o/, data are estimates from measurements of vowels in English, Italian, and Korean, and for any one language the pair /e ɛ/ or /o ɔ/ may shift somewhat relative to the position shown in the figure. The point for the "lax" low vowel /a/ is arbitrarily placed between /ɑ/ and /æ/.

Vowel nasalization

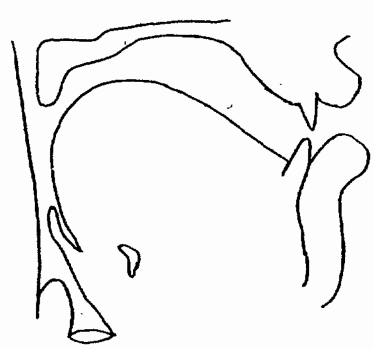

Figure 6.29 Midsagittal section of the vocal tract for the nasal vowel /ɑ̃/ produced by a speaker of French. (From Bothorel et al., 1986.)

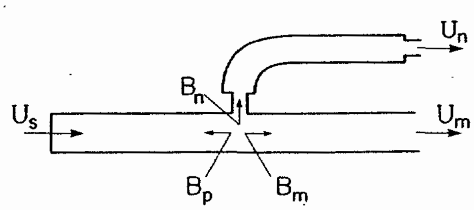

Figure 6.30 Schematization of the shapes of the vocal and nasal tracts for a nasal vowel. The volume velocities U_s, U_n, and U_m at the glottis, nostrils, and mouth are shown, as are the acoustic susceptances at the coupling point looking into the pharynx (B_p), the nasal cavity (B_n), and the mouth cavity (B_m).

Tense-lax examples

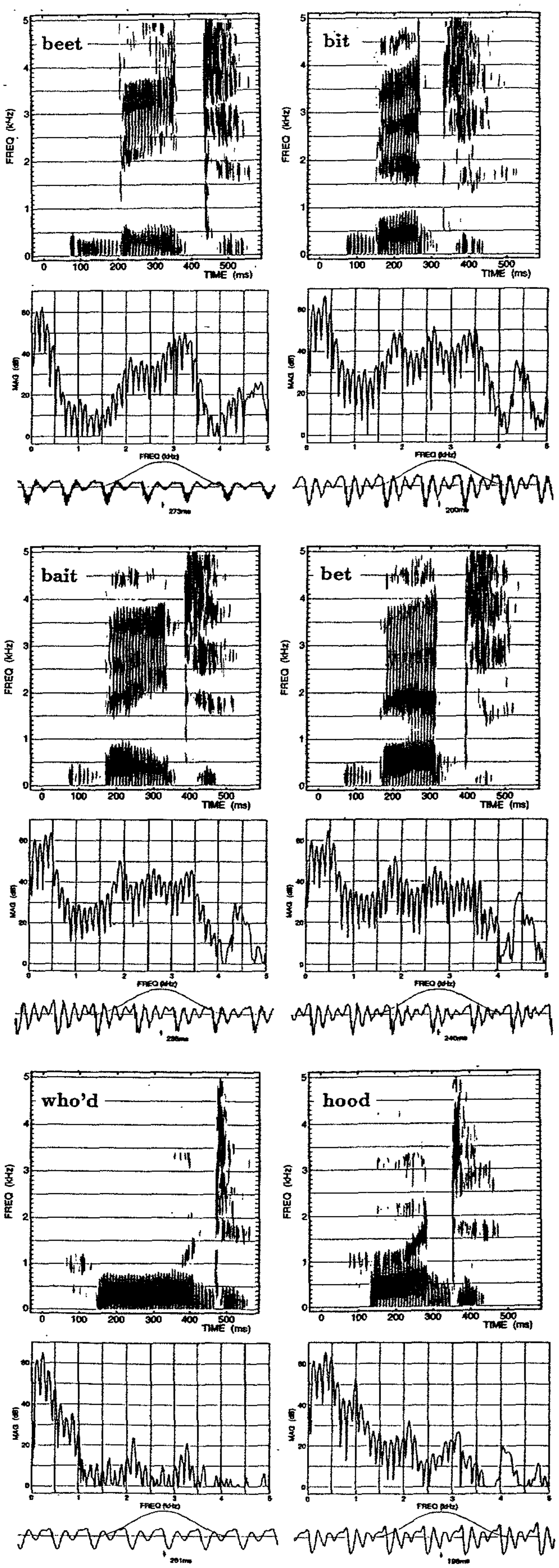

Figure 6.25 Spectrograms and spectra of utterances illustrating the tense-lax pairs of vowels in American English produced by a male speaker. Tense vowels are on the left and lax vowels on the right. The spectrum under each spectrogram is sampled at a point about one-third of the vowel length from the onset. Waveforms are displayed below each spectrum. The spectra show the locations of the formant peaks and the different relative amplitudes of these peaks.

More on nasal vowels

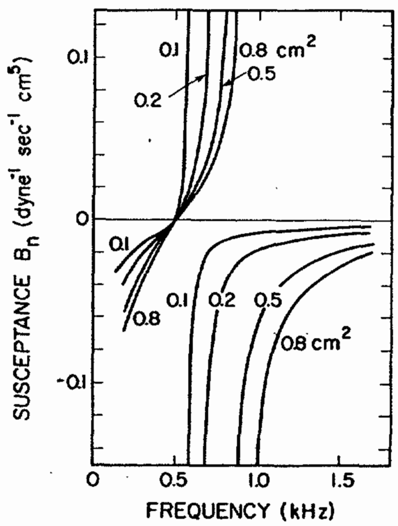

Figure 6.32 Estimates of the acoustic susceptance B_n looking into the nasal cavity for several values of the cross-sectional area of the velopharyngeal opening.

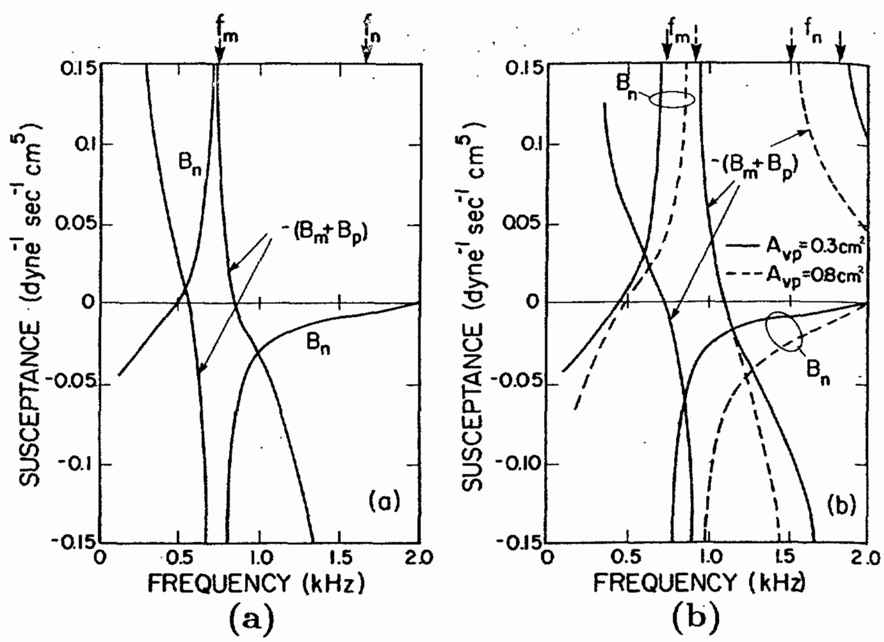

Figure 6.37 Estimated susceptance curves as in figure 6.33, except that the articulatory configurations correspond to the two nasalized back vowels /ɔ̃/ and /ɑ̃/. For the vowel /ɔ̃/ (a), the velopharyngeal area is 0.3 cm^2. For the vowel /ɑ̃/ (b), two sets of curves are shown, one for a velopharyngeal area A_{vp} of 0.3 cm^2 and the other for 0.8 cm^2. Details of calculations for these vowels are given in table 6.3.

Nasal vowels

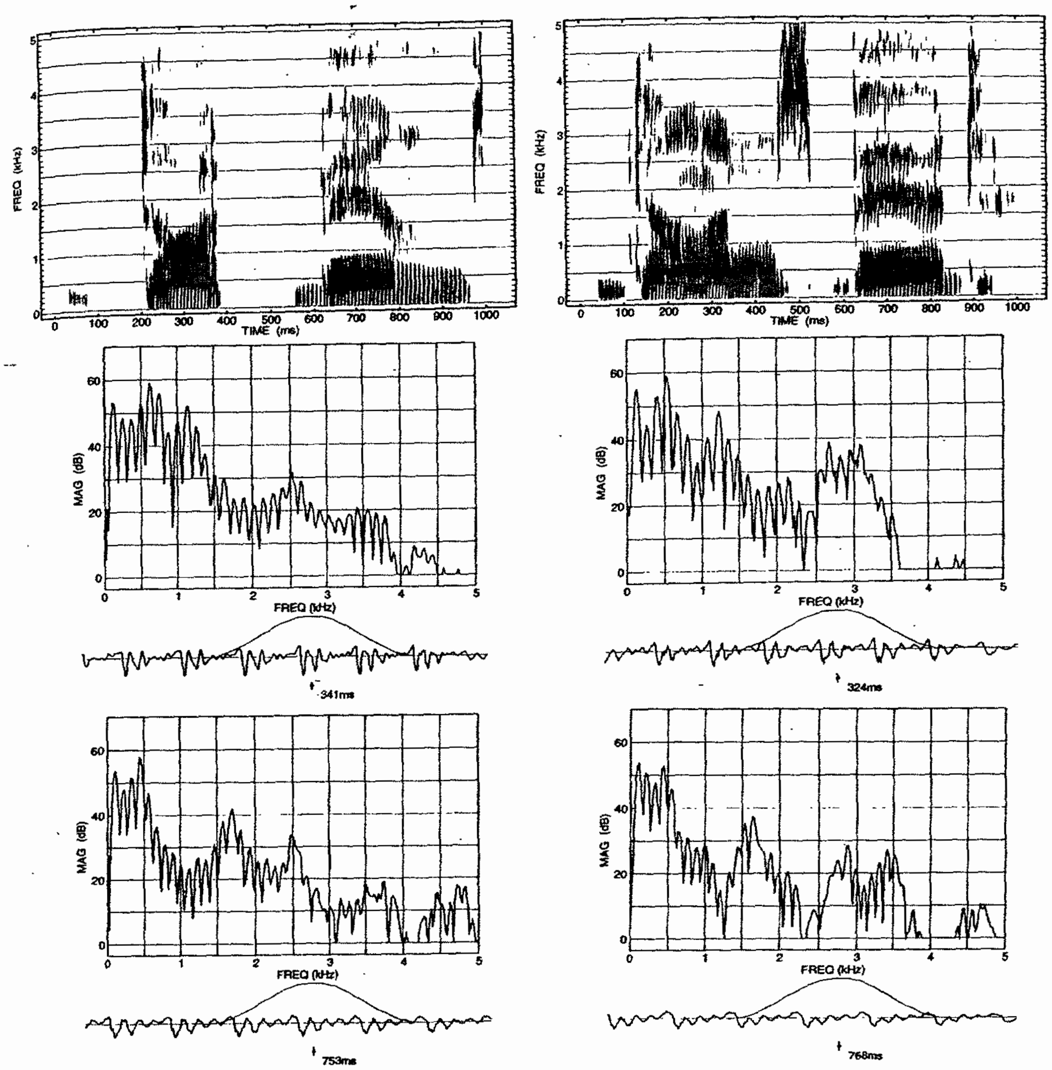

Figure 6.43 Same as figure 6.42, except that the speaker is an adult male.

Figure 6.42 Spectrograms and spectra illustrating nasalized vowels and their non-nasal cognates in English for a female speaker. The spectrograms at the top are the utterances *dot bend* (left) and *don's bed* (right). The spectra immediately below the spectrograms are sampled in the non-nasal /ɑ/ in *dot* at the left and the nasalized /ɑ/ in *don* at the right. The spectra at the bottom are sampled in the non-nasal /ɛ/ in *bed* (left) and the nasalized /ɛ/ in *bend* (right).