

Acoustic phonetics

phonemes - a set of 42 distinctive sounds that characterize spoken English

vowels

diphthongs ~~consonants~~

semivowels

consonants

each phoneme is either

continuant - fixed vocal tract configuration

Vowels

fricatives

nasals

noncontinuant - time-varying vocal tract

diphthongs

semivowels

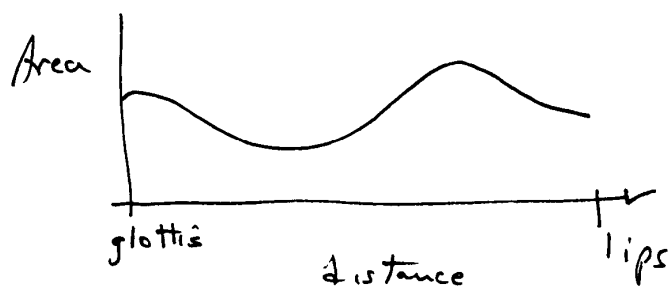
stops

affricates

Vowels

excite vocal tract with quasiperiodic pulses of air caused by vibration of vocal chords

area function: determines formants



Area function determined primarily by tongue

examples

father  
/a/

open in front  
constricted in back  
tongue back

eve  
/i/

constricted in front  
open in back  
tongue forward & up

Formant frequencies

examples:

beet

/i/

low first formant  
high second formant

time waveform shows slow  
oscillation with superimposed  
fast oscillation

spectrogram shows formant  
locations

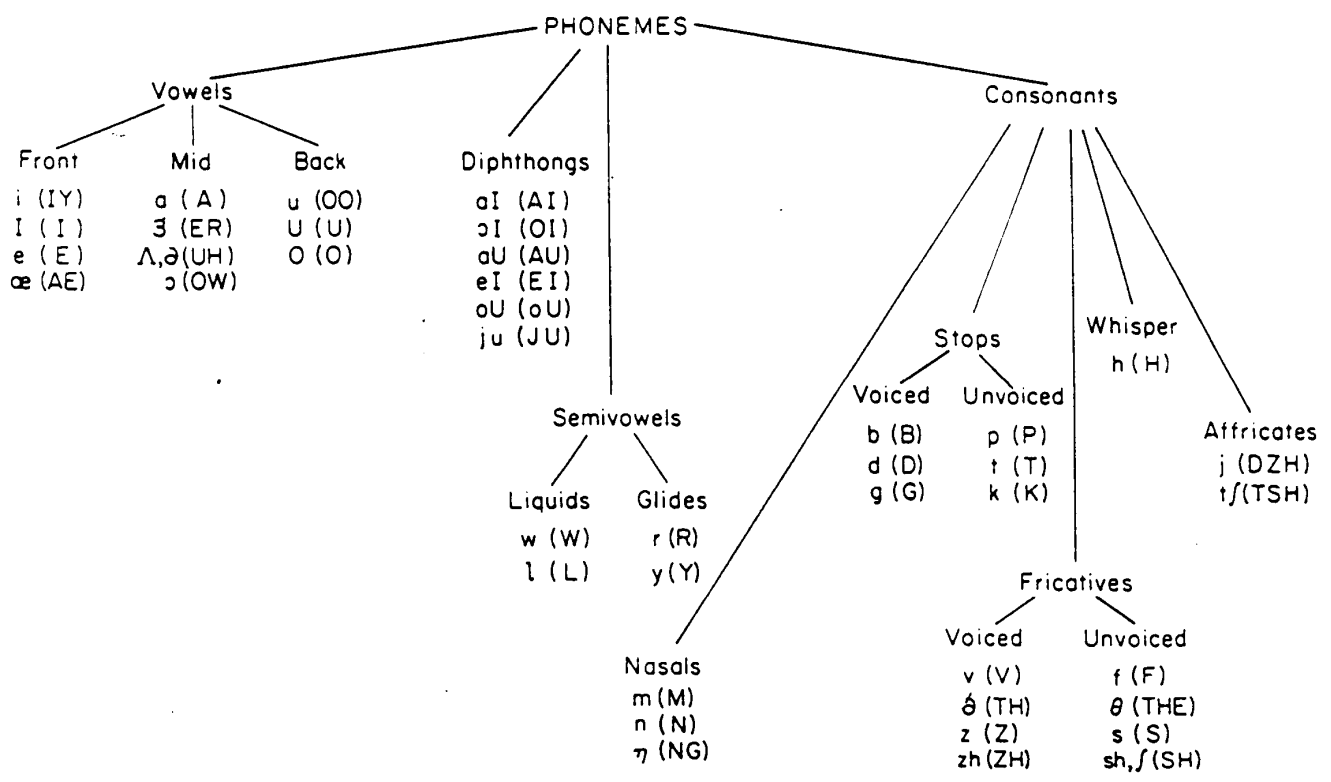
loom

/u/

low first & second formants  
~~the~~  
smooth waveform

spectrogram shows only low  
frequencies

Table 3.1 Phonemes in American English.



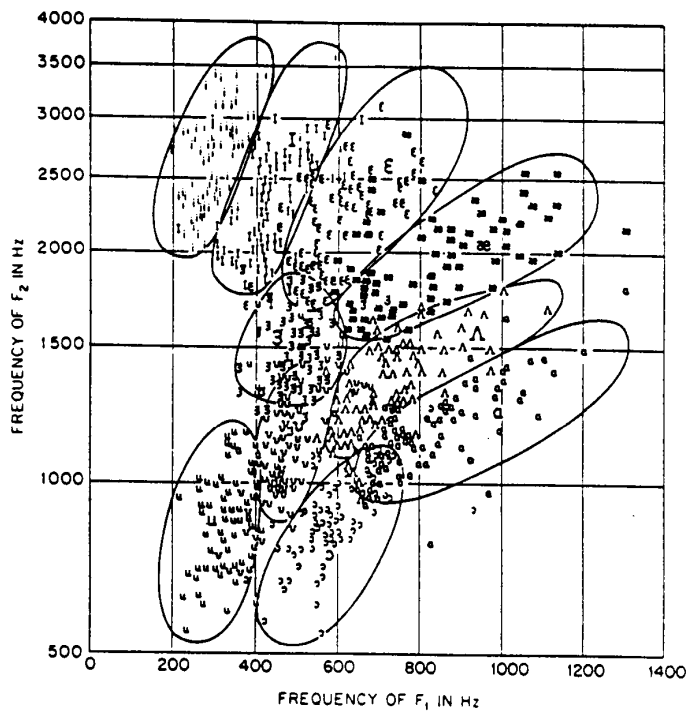


Fig. 3.4 Plot of second formant frequency versus first formant frequency for vowels by a wide range of speakers. (After Peterson and Barney [11].)

**Table 3.2** Average Formant Frequencies for the Vowels. (After Peterson and Barney [11].)

FORMANT FREQUENCIES FOR THE VOWELS					
Typewritten Symbol for Vowel	IPA Symbol	Typical Word	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>
IY	i	(beet)	270	2290	3010
I	ɪ	(bit)	390	1990	2550
E	ɛ	(bet)	530	1840	2480
AE	æ	(bat)	660	1720	2410
UH	ʌ	(but)	520	1190	2390
A	ɑ	(hot)	730	1090	2440
OW	ɔ	(bought)	570	840	2410
U	u	(foot)	440	1020	2240
OO	u	(boot)	300	870	2240
ER	ɜ	(bird)	490	1350	1690

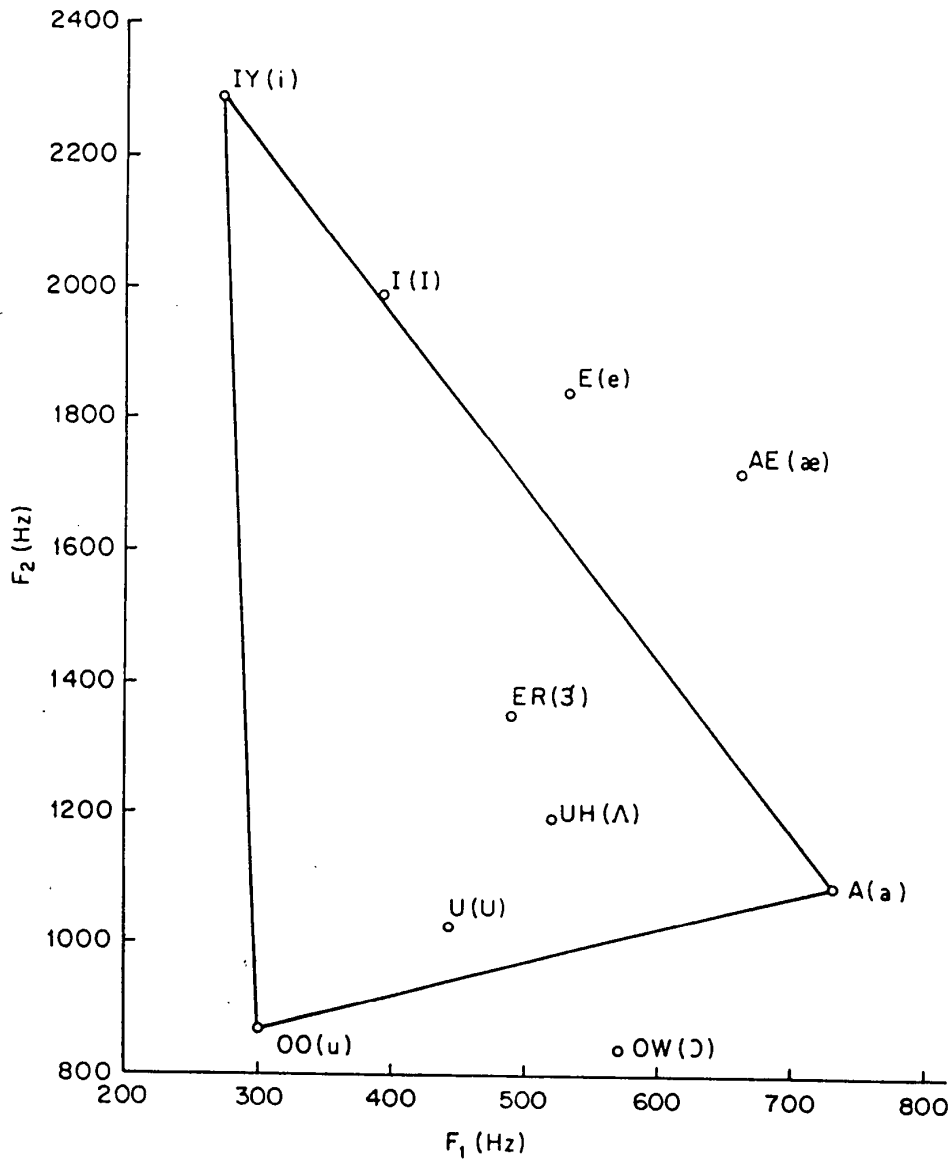


Fig. 3.5 The vowel triangle.

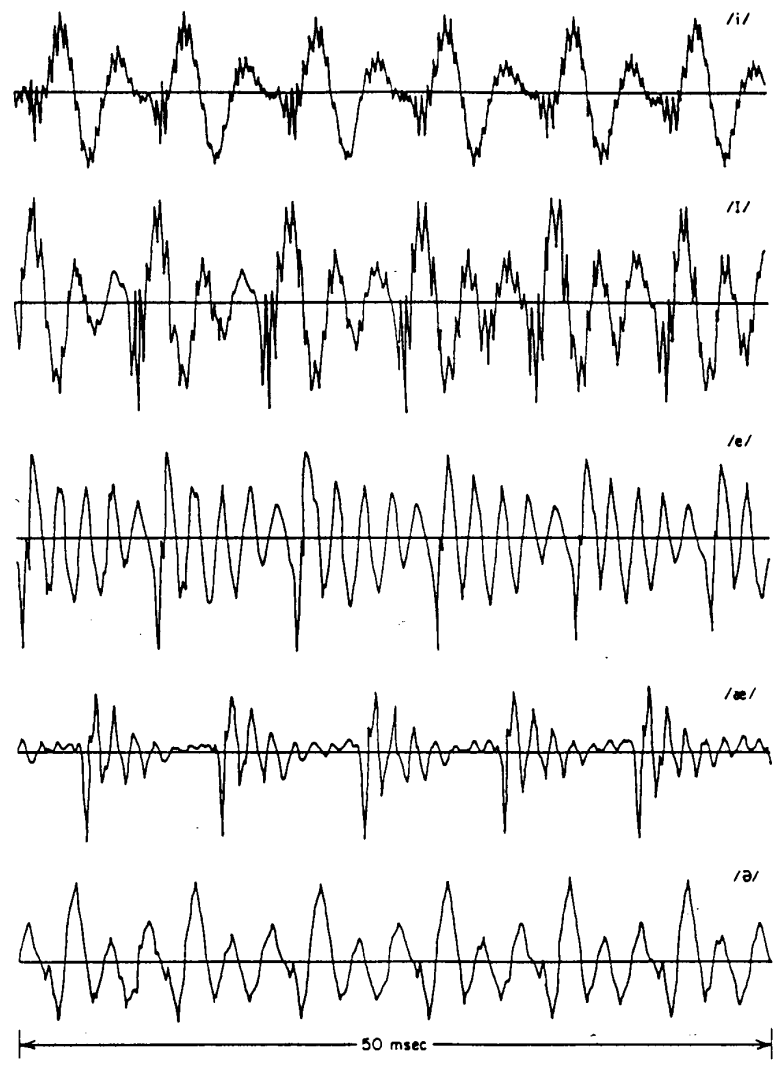


Fig. 3.6 The acoustic waveforms for several American English vowels and corresponding spectrograms.



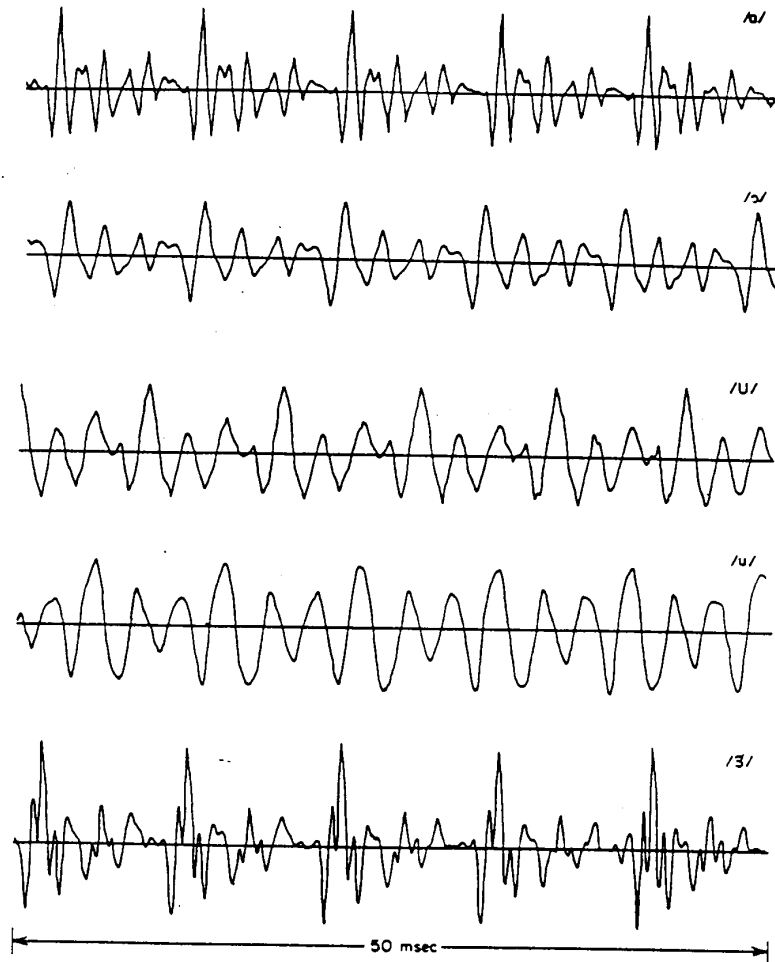


Fig. 3.6 (Continued)

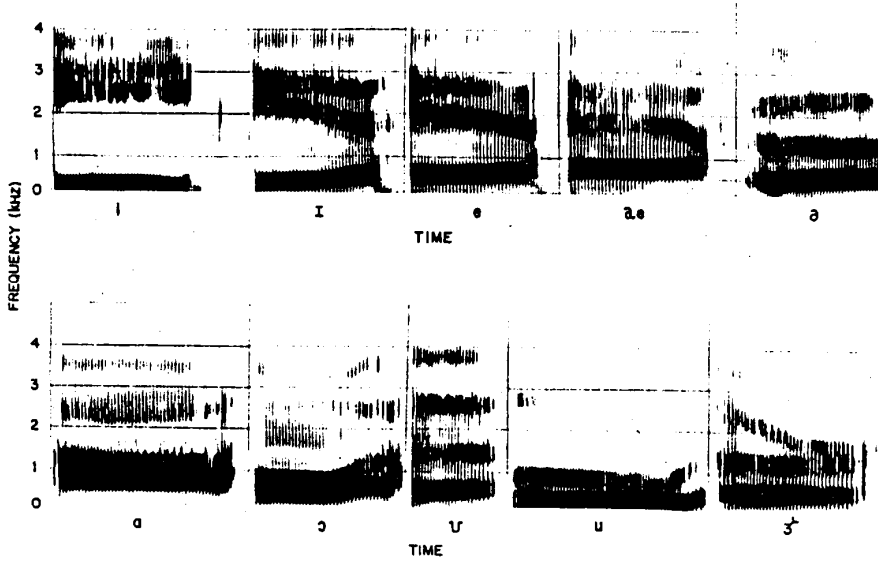


Fig. 3.6 (Continued)