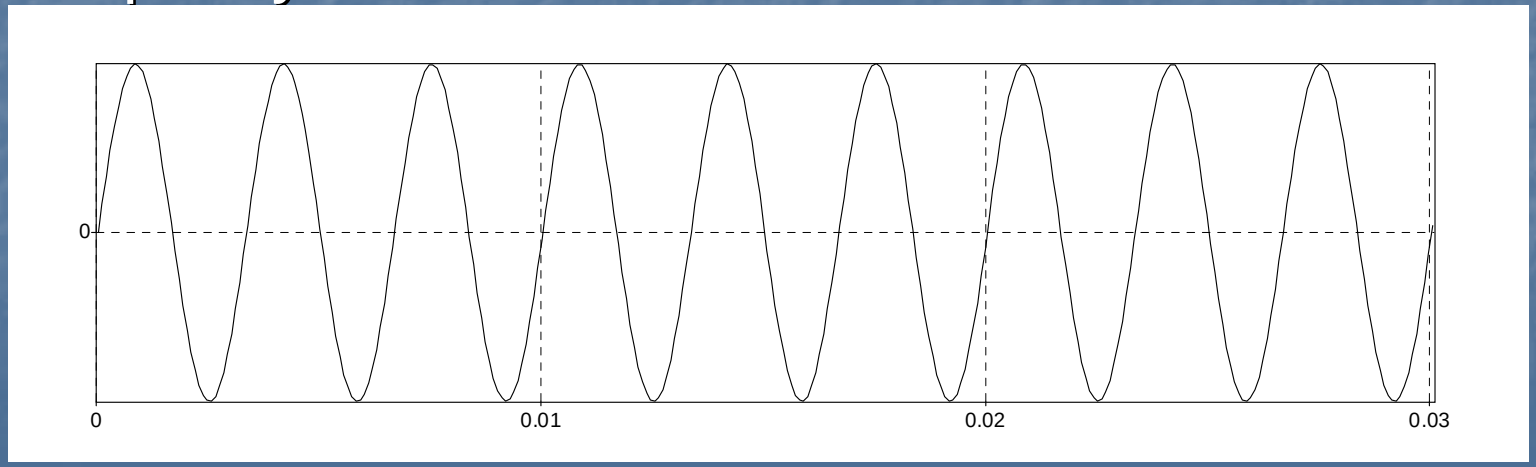
Acoustic Phonetics

Chapter 8

1. Sound waves

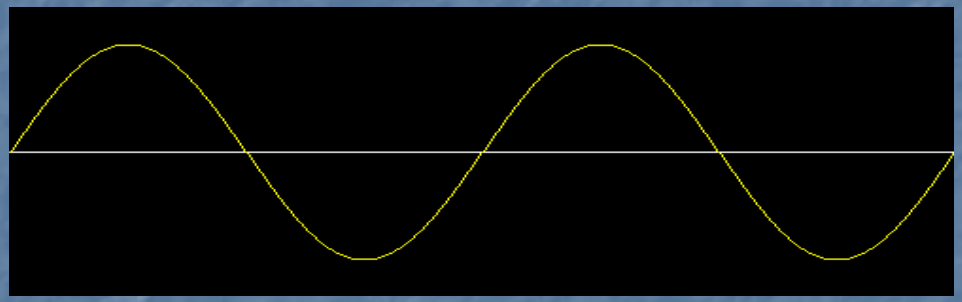
Vocal folds:

Frequency: 300 Hz



1.1 Sound waves: The parts of waves

We will be considering the parts of a wave with the wave represented as a transverse wave as in the following diagram:



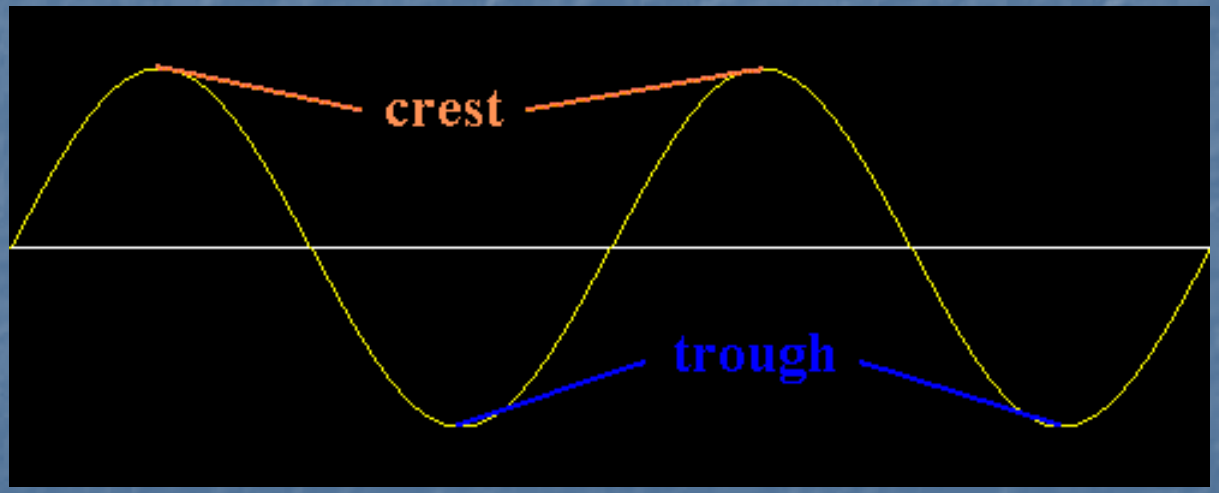
In the above diagram the white line represents the position of the medium when no wave is present. This medium could be imagined as a rope fixed at one end a few feet above the ground and held by you at the other end.

The yellow line represents the position of the medium as a wave travels through it. We simply say that the yellow line is the wave. If we consider the rope mentioned before, this wave could be created by vertically shaking the end of the rope.

Often, when several waves are traveling along a medium as shown above, the continuous group of waves is called a wave train.

1.2 Sound waves: What is crest and trough?

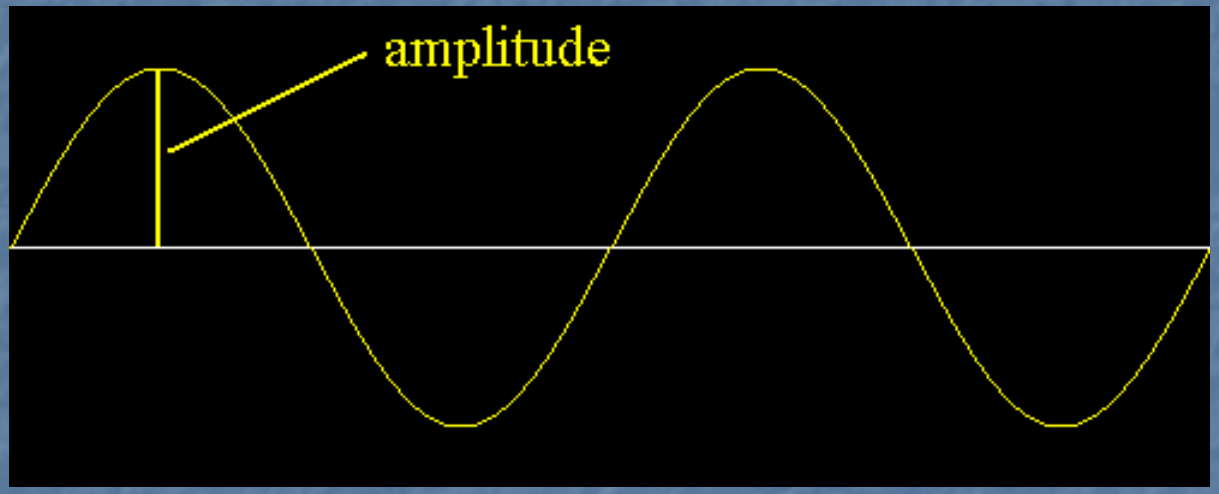
The section of the wave that rises above the undisturbed position is called the **crest**. That section which lies below the undisturbed position is called the **trough**. These sections are labeled in the following diagram:



1.3 Sound waves: What is amplitude?

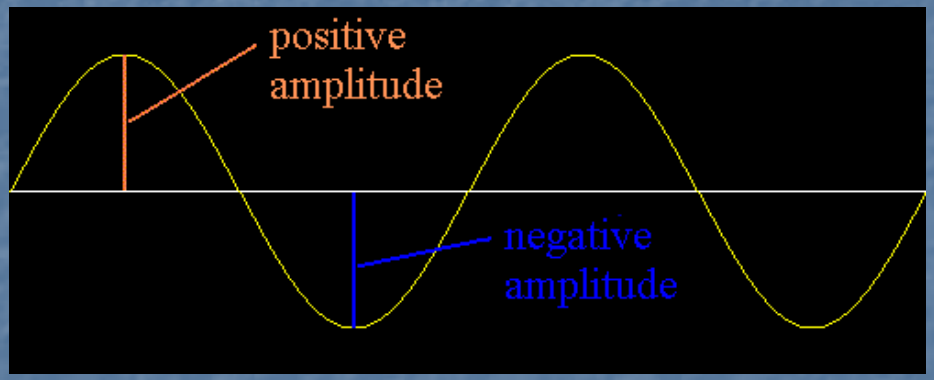
The term **amplitude** can have slightly different meanings depending upon the context of the situation.

Its most general definition is that the amplitude is the maximum positive displacement from the undisturbed position of the medium to the top of a crest. This is shown in the following diagram:

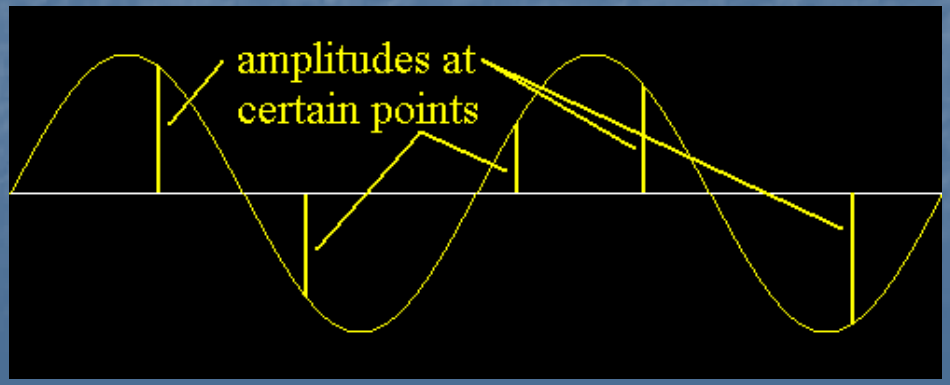


1.4 What is positive & negative amplitude?

The displacements of positive and negative amplitudes are shown in the following diagram:

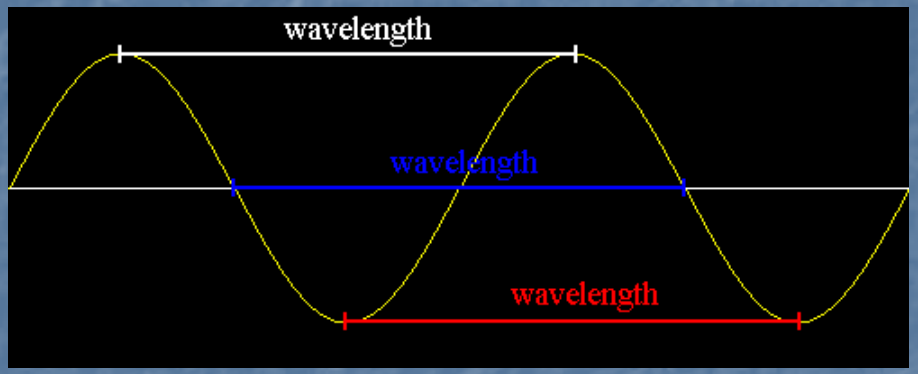


Sometimes it is necessary to discuss an amplitude at a certain point along the wave. Several of these amplitudes are shown in the following diagram:

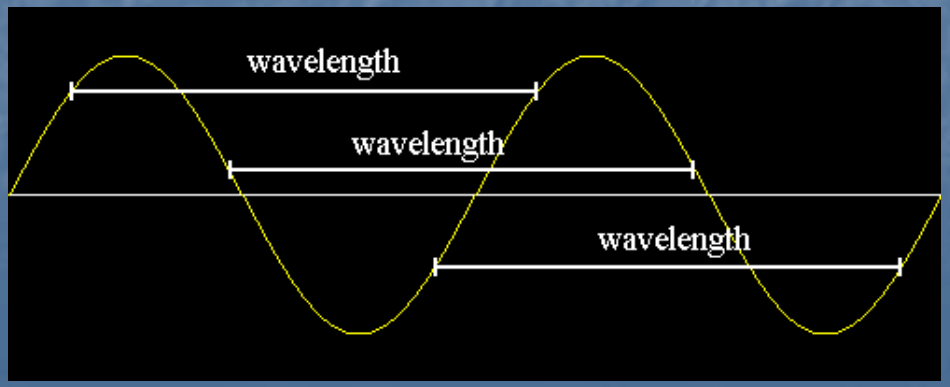


1.5 Sound waves: What is wavelength?

The wavelength of a wave is the distance between any two adjacent corresponding locations on the wave train. This distance is usually measured in one of three ways: crest to next crest, trough to next trough, or from the start of a wave cycle to the next starting point.



Actually, the a wavelength exists between any point on a wave and the corresponding point on the next wave in the wave train. A few of such distances are shown below:



2.1 What is frequency?

1. Frequency refers to how many waves are made per time interval. This is usually described as how many waves are made per second, or as cycles per second.

2. If ten waves are made per second, then the frequency is said to be ten cycles per second, written as 10 cps.

3. Usually, we use the unit Hertz to state frequency. A frequency of 10 cps is noted as a frequency of 10 Hertz. So, one cycle per second is one Hertz, as in:

   1 cps = 1 Hertz or it is abbreviated this way:

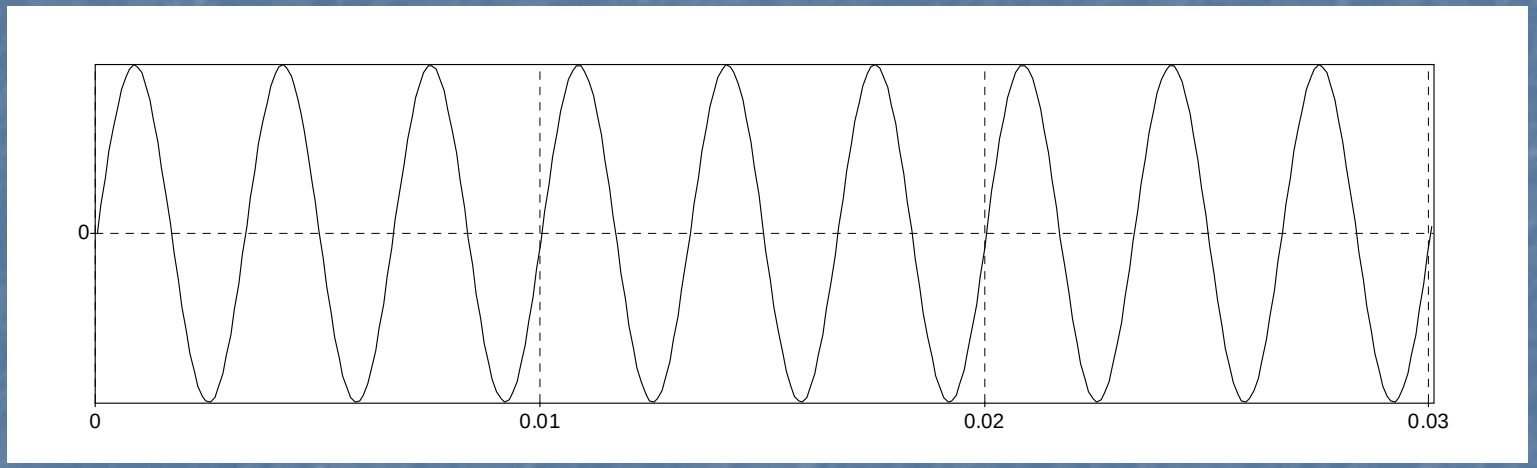
   1 cps = 1 Hz

   120 cps = 120 Hz

   350 cps = 350 Hz

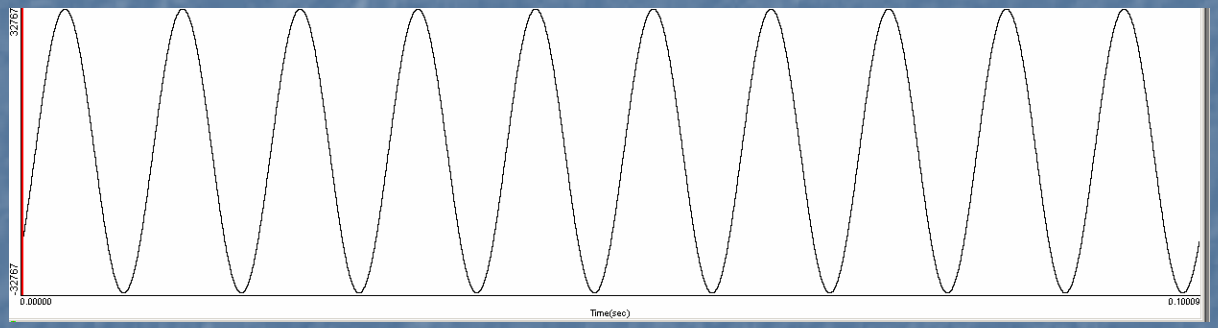
2.2. Sound waves and the frequency

Frequency: The number of complete repetitions (cycles) of variations in air pressure occurring in a second. The unit of frequency measurement is the hertz (Hz).

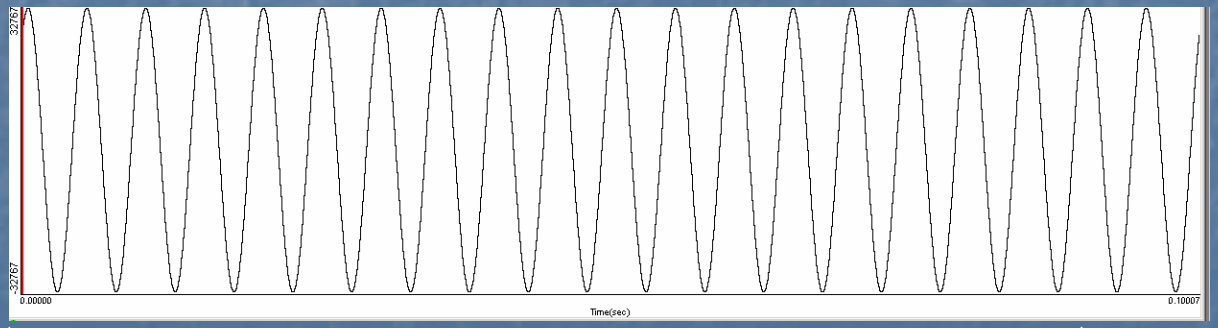


2.3 Sound waves with different frequencies?

100 Hz



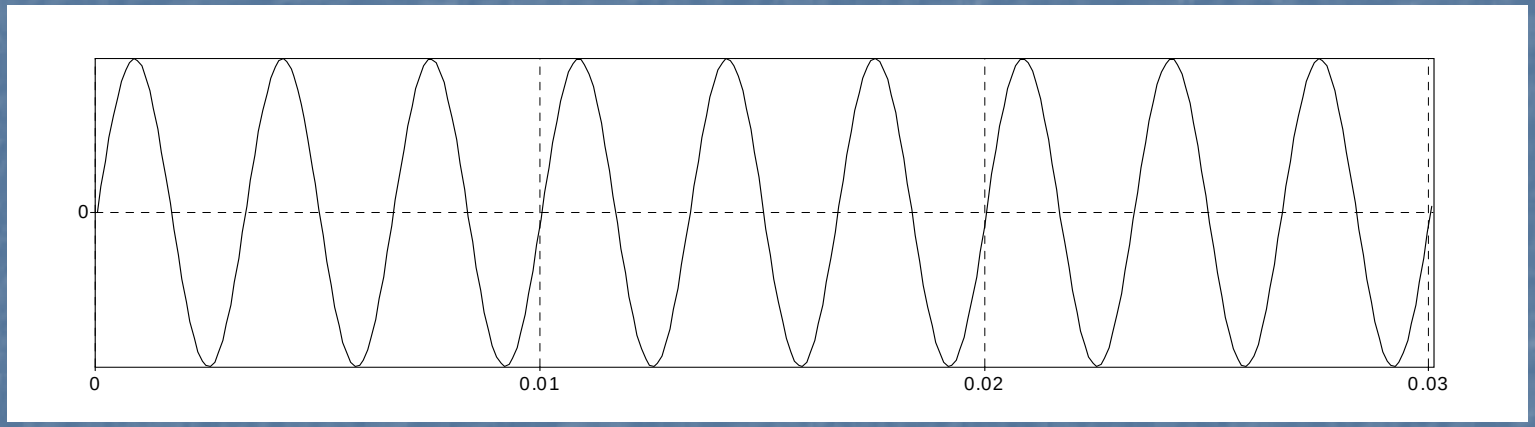
200 Hz



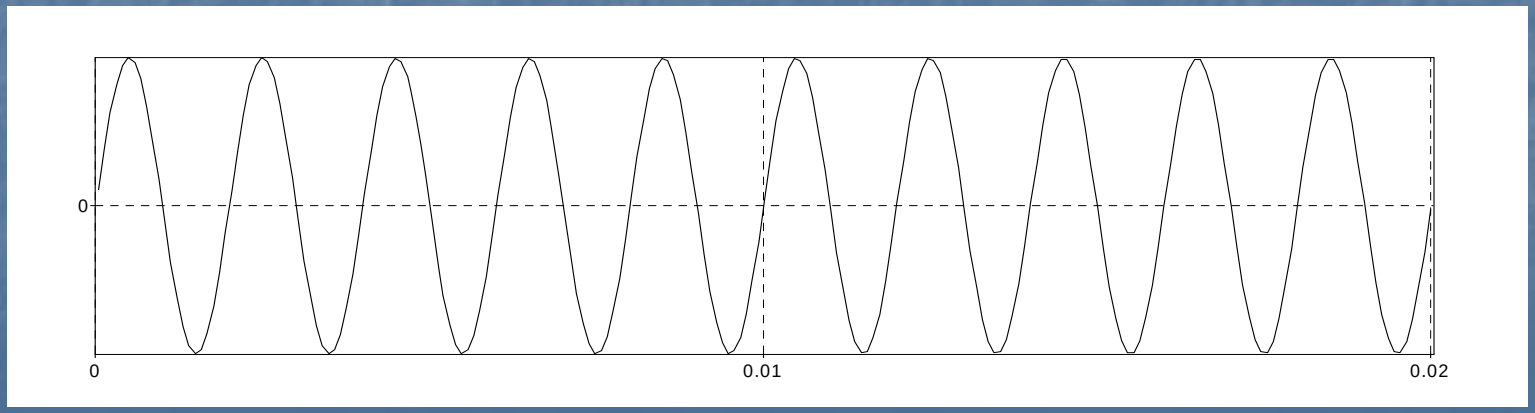
0 0.1 second

2.4. Frequencies and sound waves

Frequency: 300 Hz

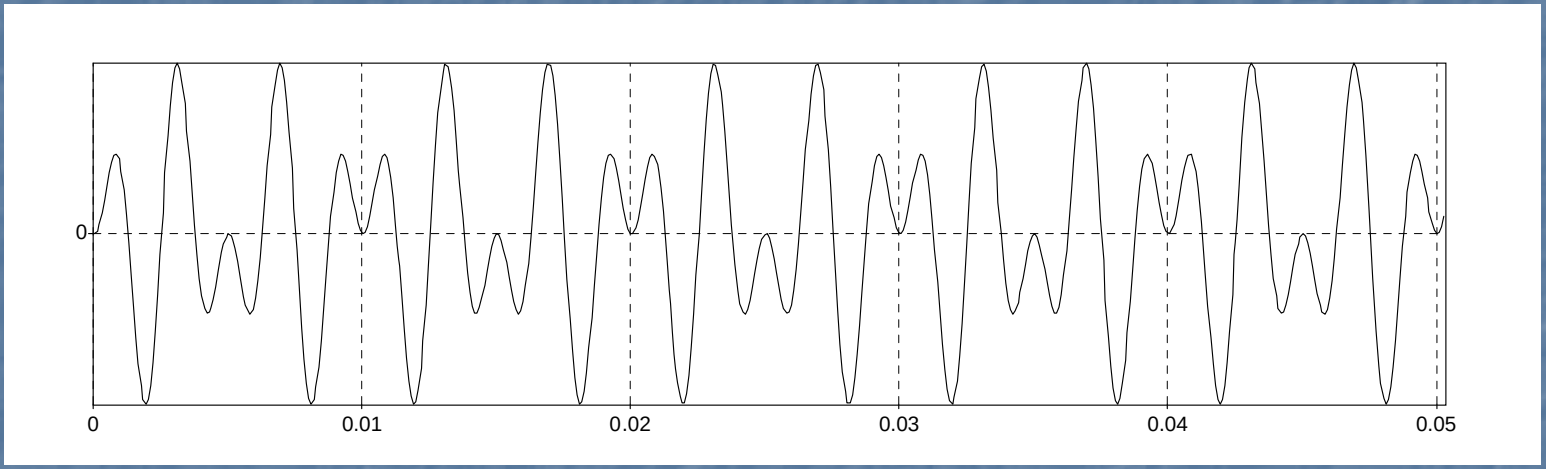


Frequency: 500 Hz



2.5 High & low frequencies and sound waves

Frequency: 350 Hz



Try to listen to the following sounds:

10000, 11000, 12000, 13000, 14000, 15000,

16000, 17000, 18000, 19000, 20000, 100, 20, 10, 8, 6, 5

2.6 More varieties of frequencies

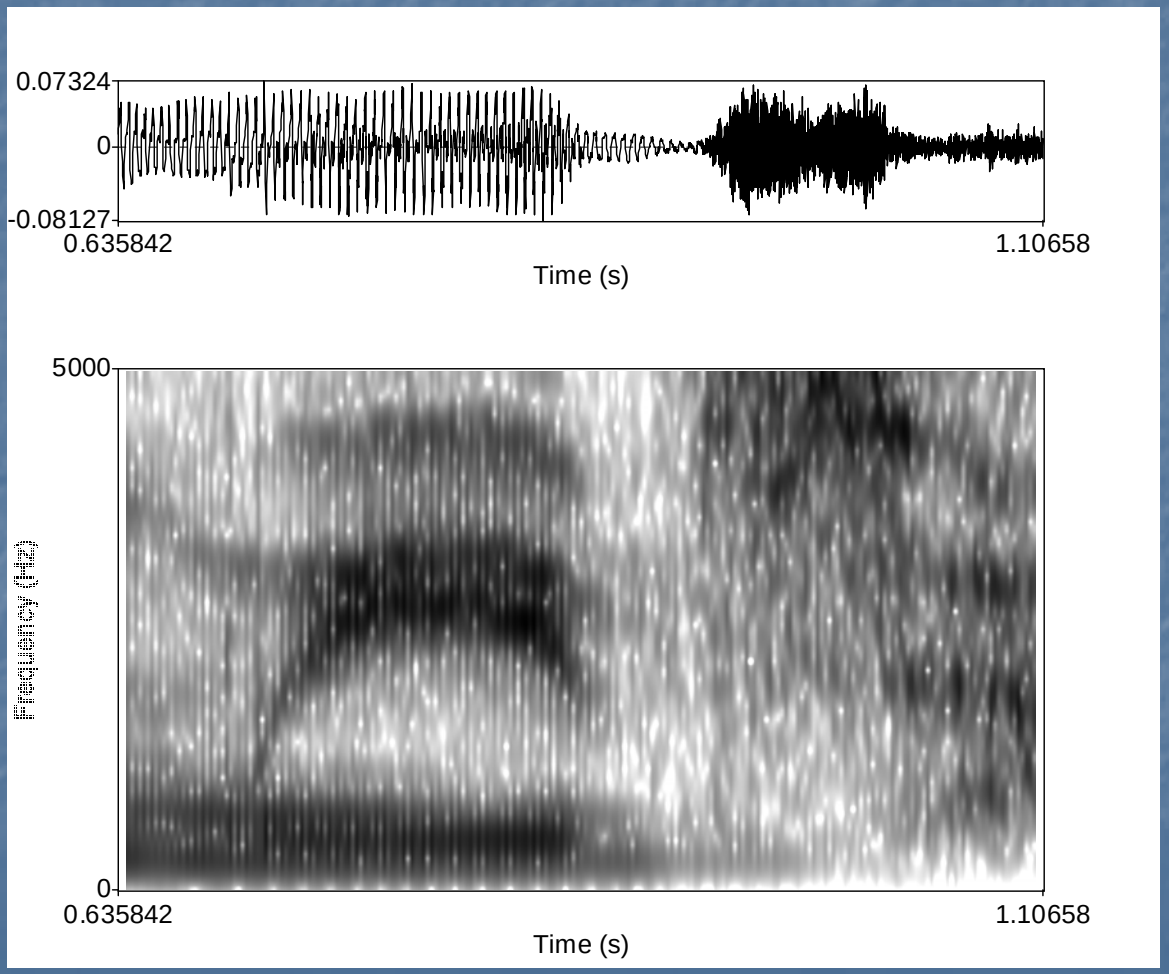
16 Hz
32 Hz
64 Hz
100 Hz
160 Hz
200 Hz
250 Hz
320 Hz
400 Hz
450 Hz
1000 Hz
1600 Hz
2000 Hz

4000 Hz
5000 Hz
8000 Hz
12000 Hz
16000 Hz
20000 Hz

900 Hz + 1100 Hz
300 Hz + 2000 Hz

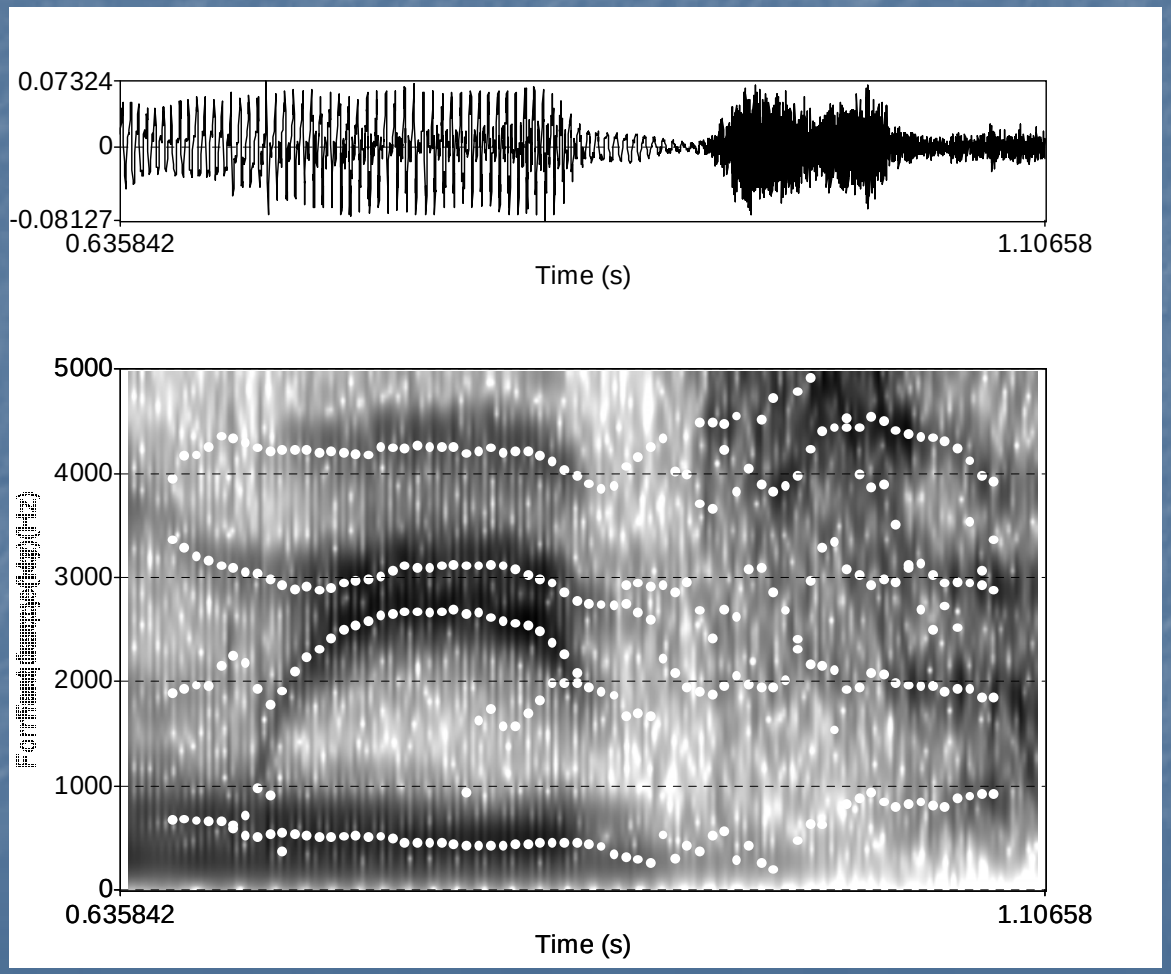
3. Formants

Formants 1-4: leaves (Amanda)



3.1 Formants with lines

Formants 1-4: leaves (Amanda)



3.2 Formants of different vowels

See CBCAP

3.2 The relationship between F1 and F2

Formant 1: reflecting the “high” or “low” of the vowel in the oral tract

Formant 2: reflecting the “backness” of the vowel in the oral tract

Try to use praat to figure out the relationship described above.

See also CBCAP

3.3 The Assignment

Try to examine the articulation positions and sounds.

1. Draw the matrix to represent space of oral tract
   Make sure that the X and Y axes
   (with X axis = 3000 Hz and Y axis = 1500 Hz)

2. Try to produce different vowels by yourself

3. Try to collect the acoustic info of the first and second formants by means of any speech analyzer (e.g., PRAAT)

4. Try to locate each vowel according to the sets of formant values from speech analyzers

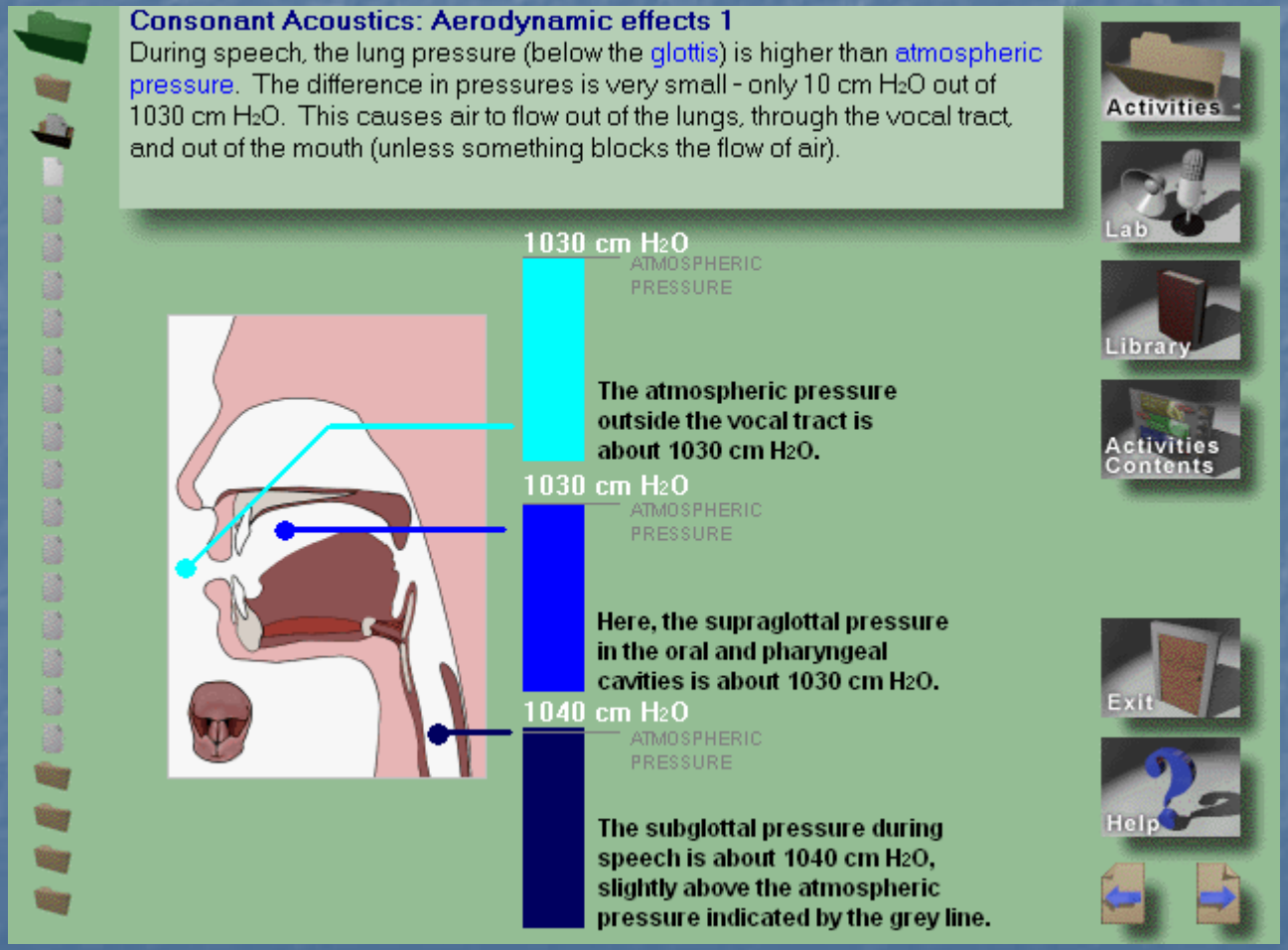
4 Formants of consonants

See CBCAP

1. Aerodynamic effects
2. Degree of constriction
3. Place of articulation
4. Voicing
5. Nasalization

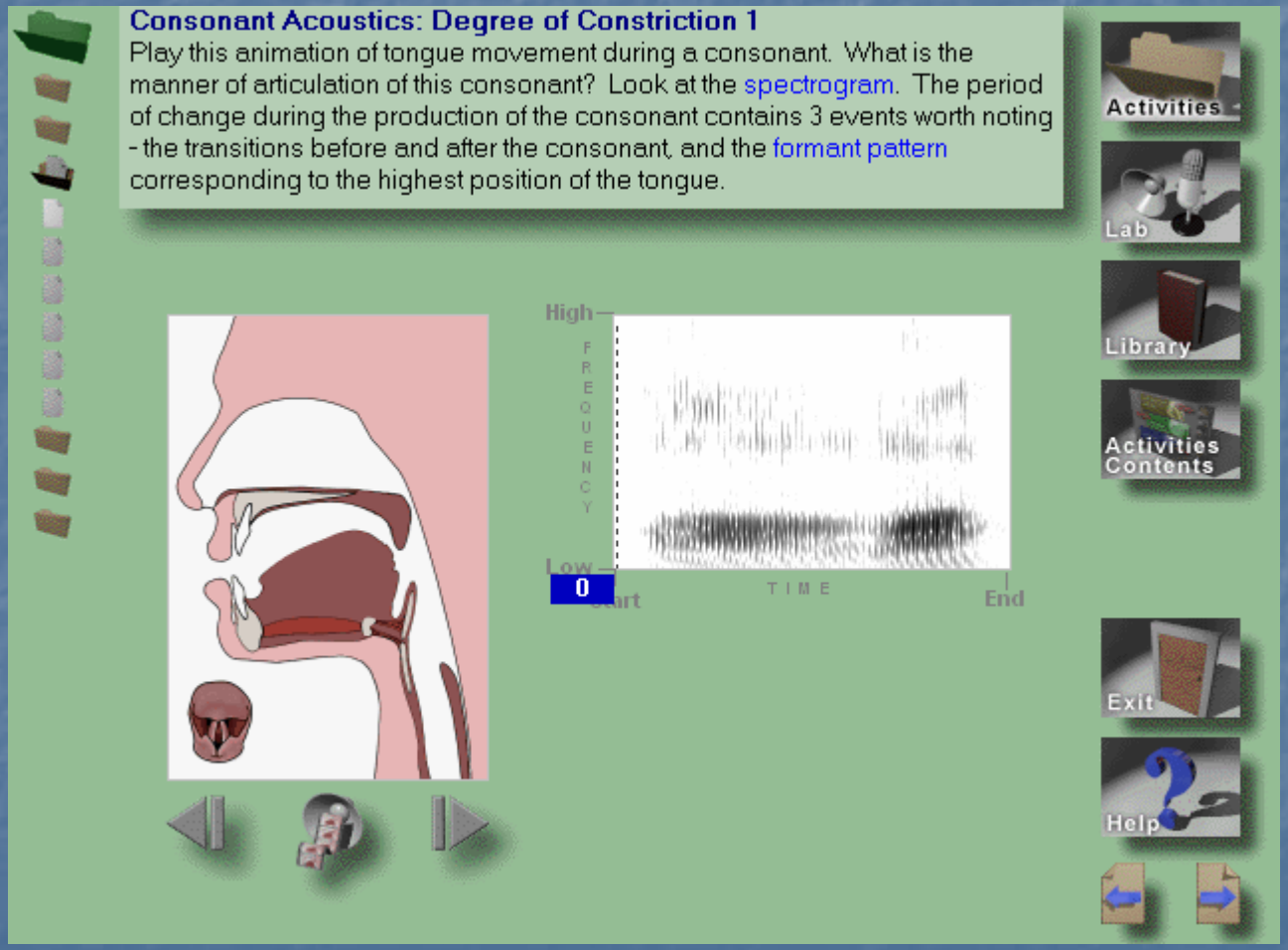
4.1 Aerodynamic effects

See CBCAP



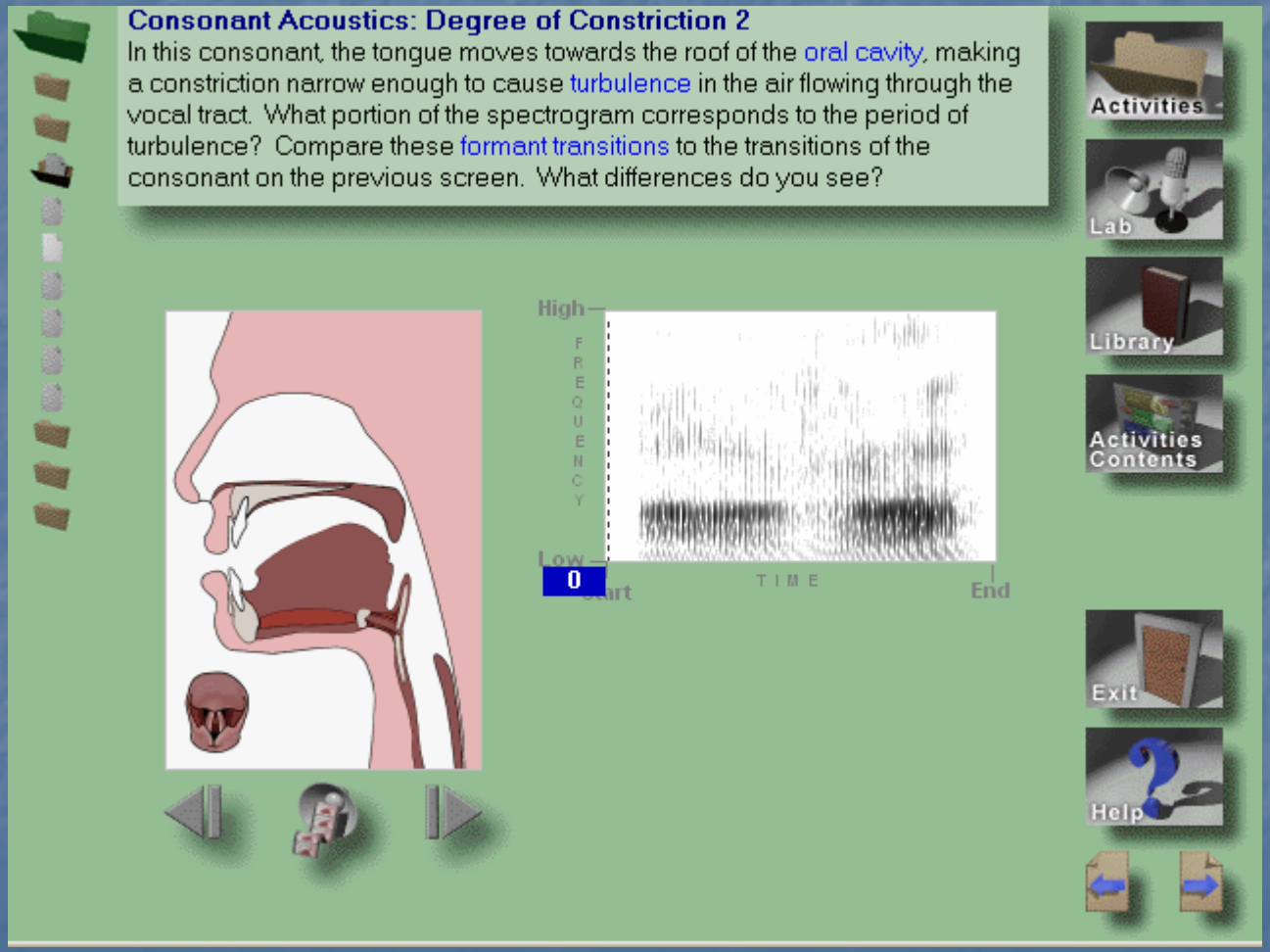
4.2.1 Degree of constriction

See CBCAP



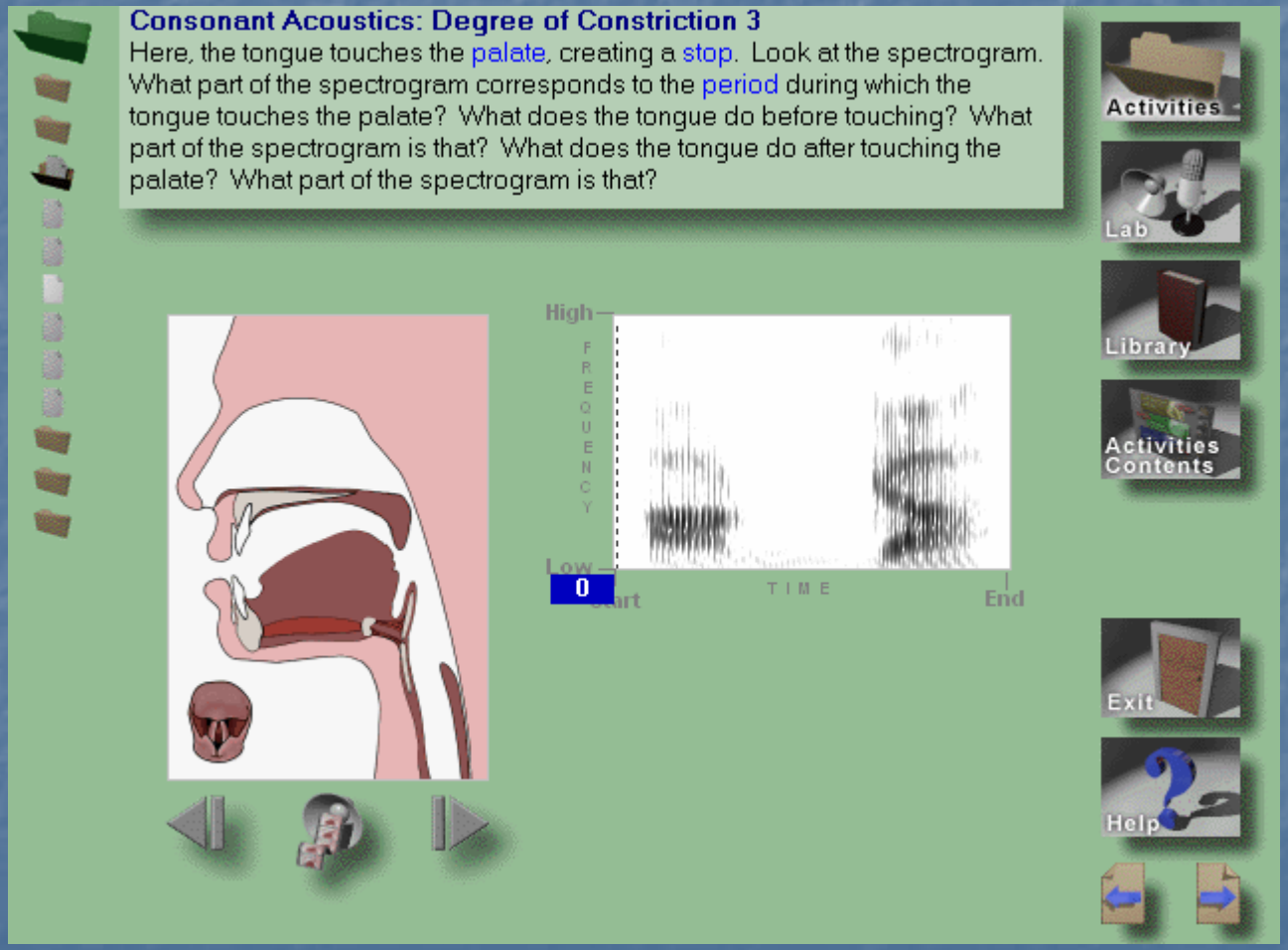
4.2.2 Degree of constriction

See CBCAP



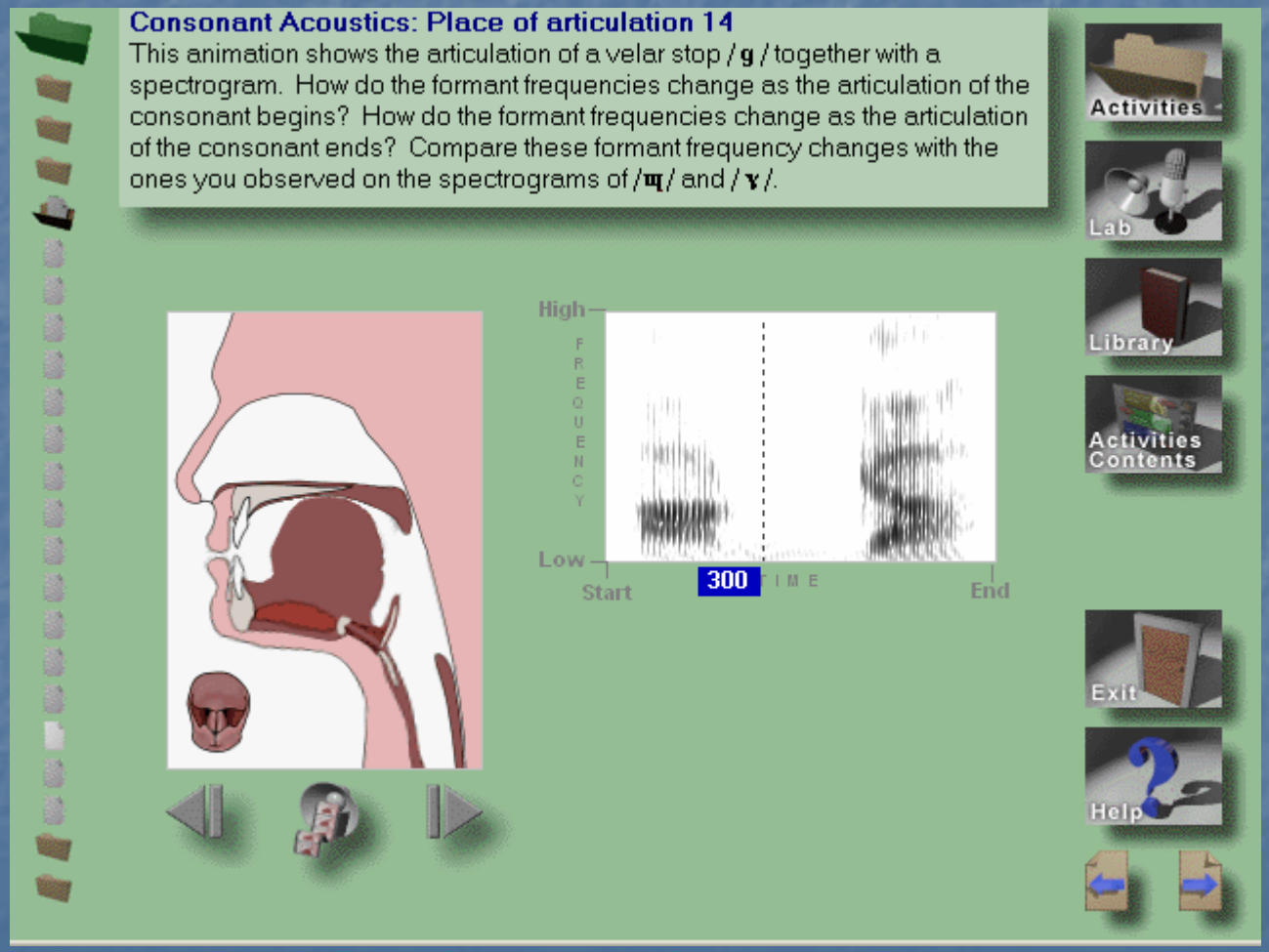
4.2.3 Degree of constriction

See CBCAP



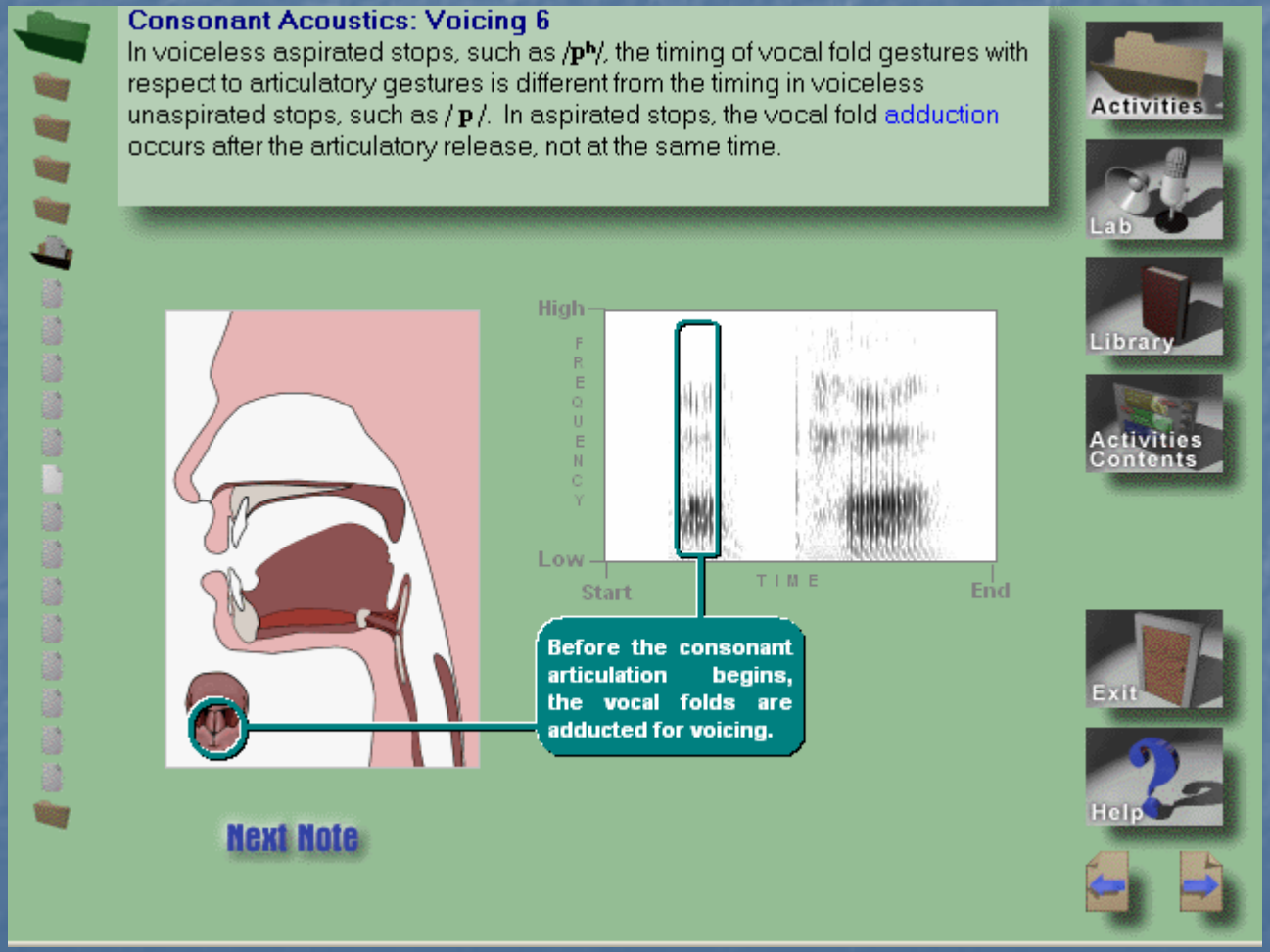
4.3 Place of articulation

See CBCAP



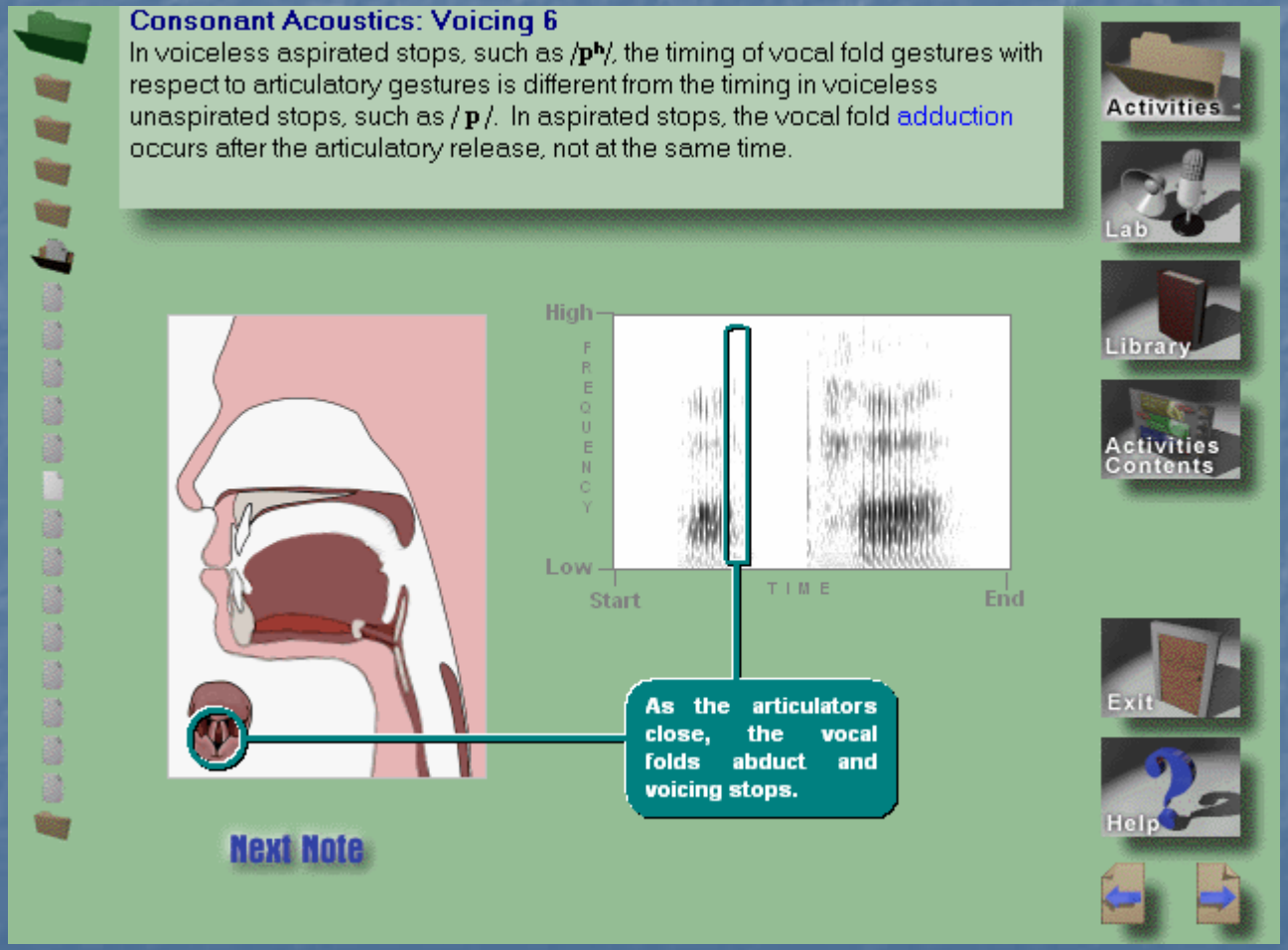
4.4.1 Voicing

See CBCAP



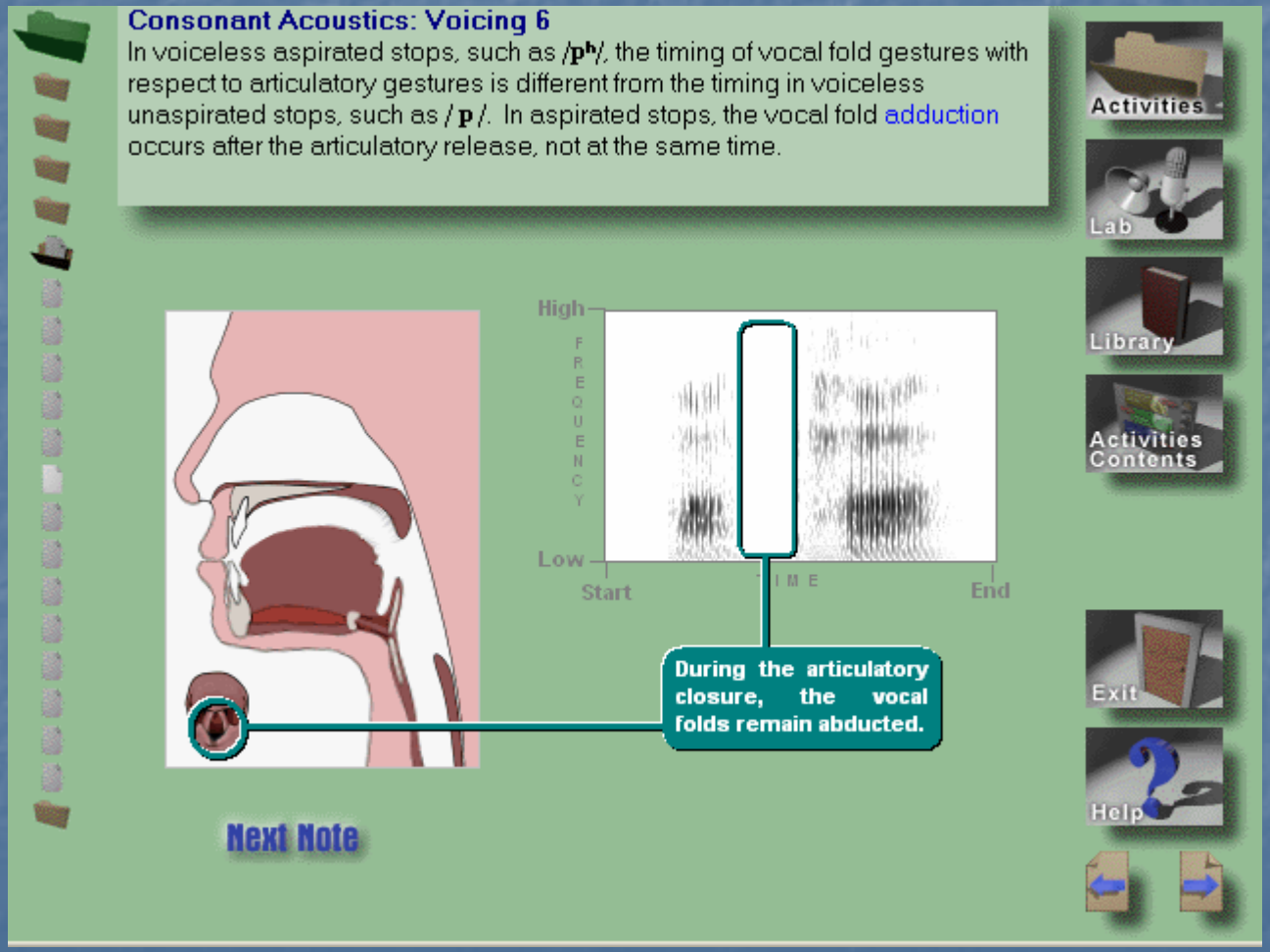
4.4.2 Voicing

See CBCAP



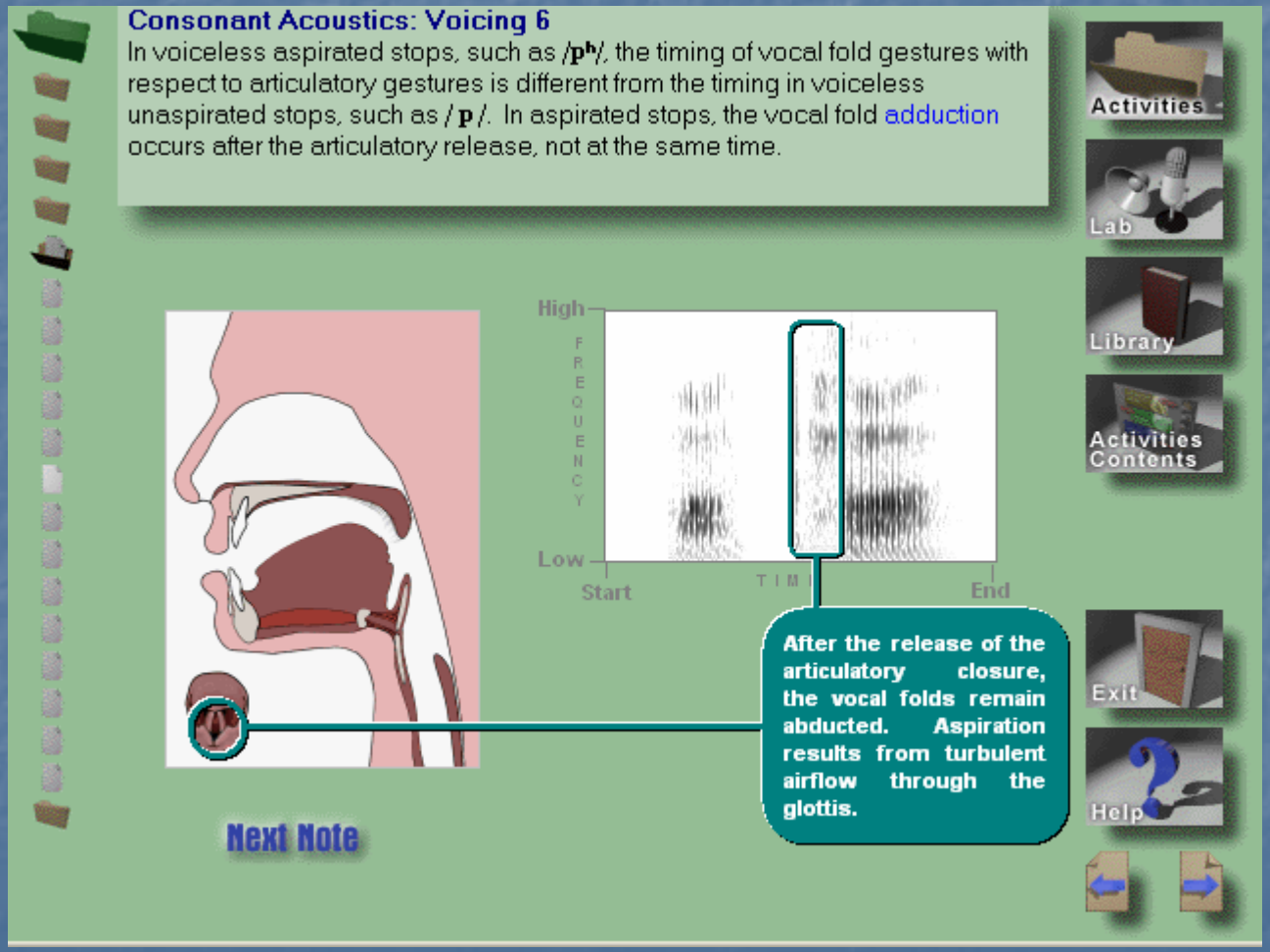
4.4.3 Voicing

See CBCAP



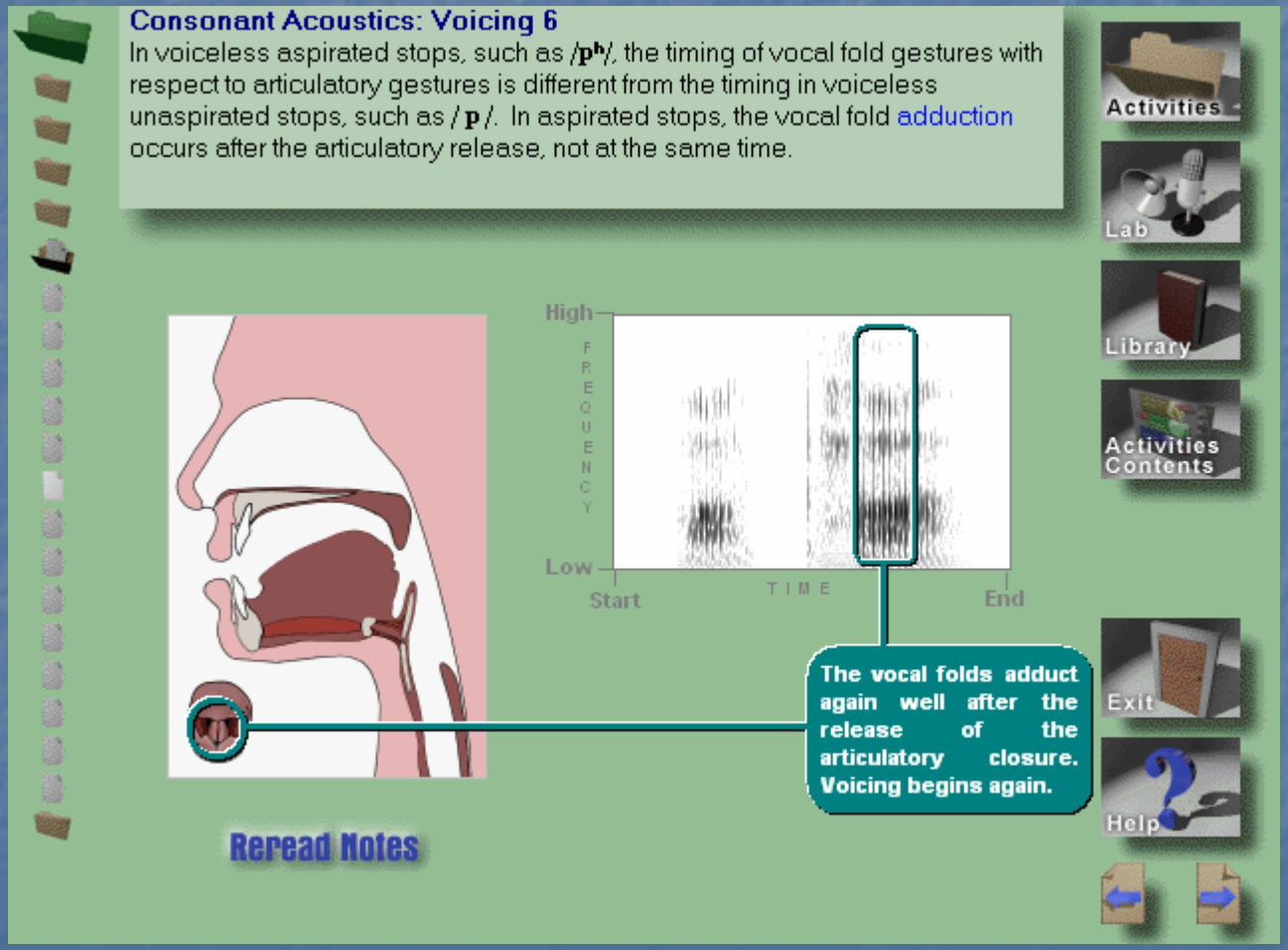
4.4.4 Voicing

See CBCAP



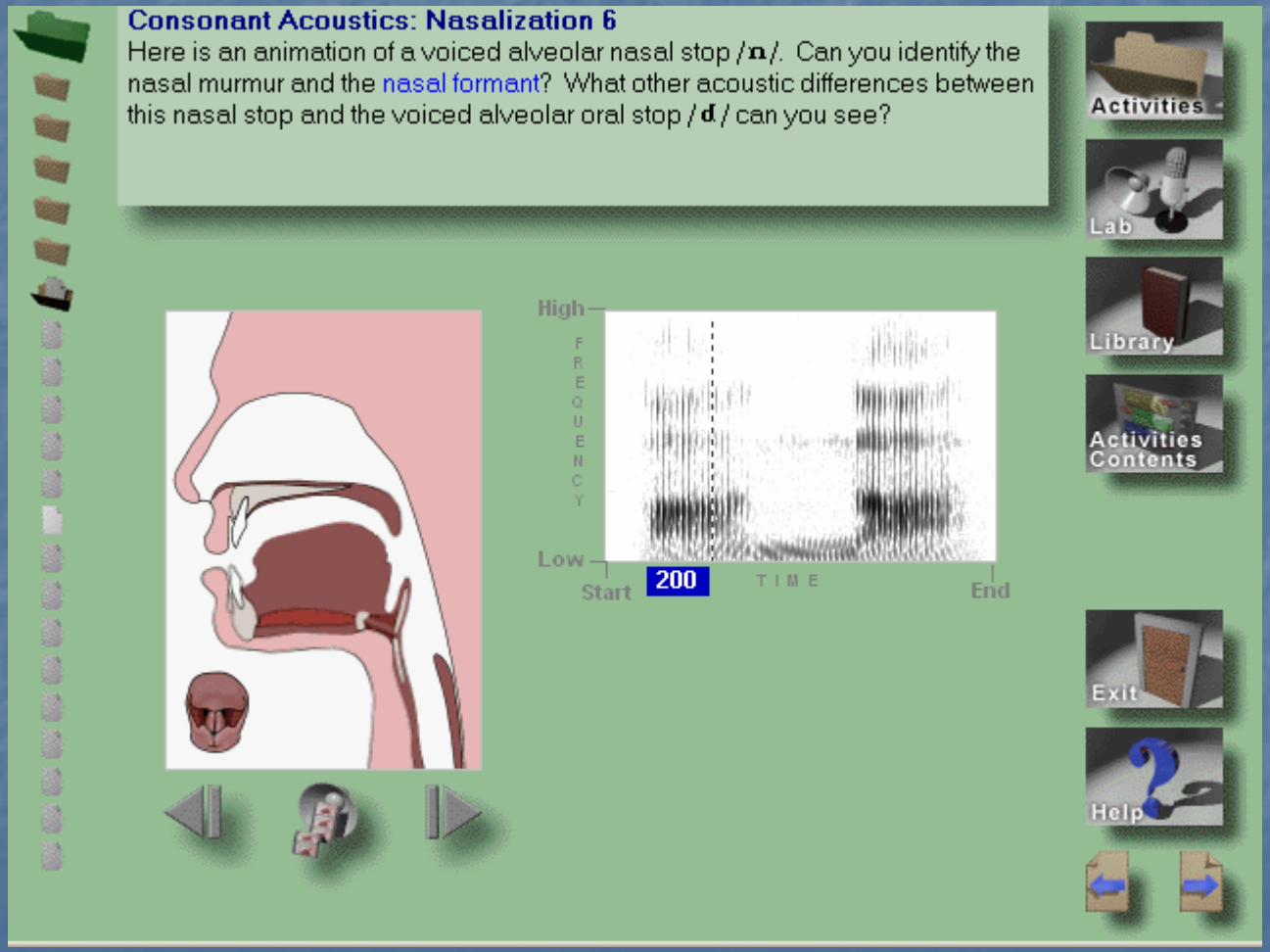
4.4.5 Voicing

See CBCAP



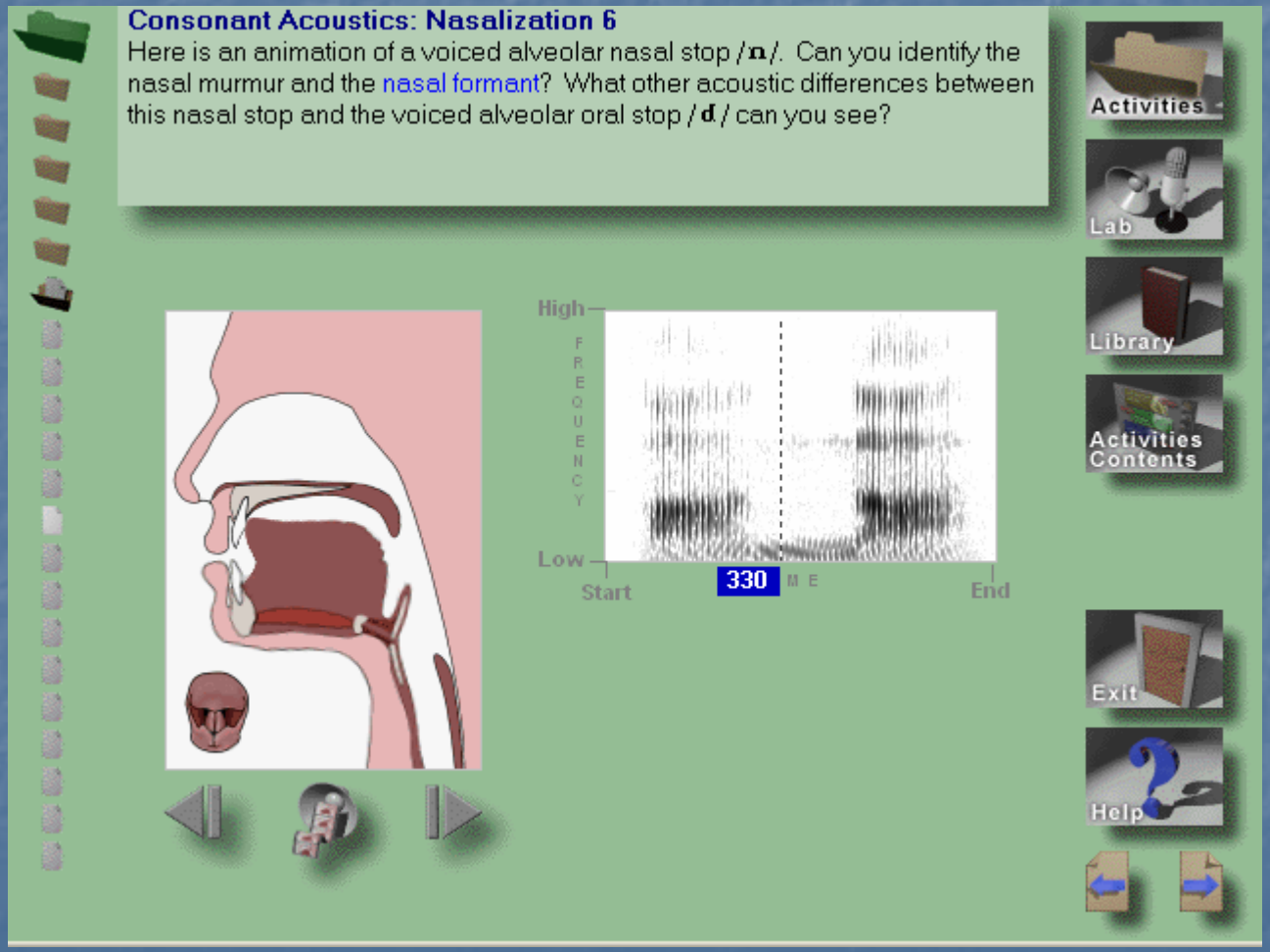
4.5.1 Nasalization

See CBCAP



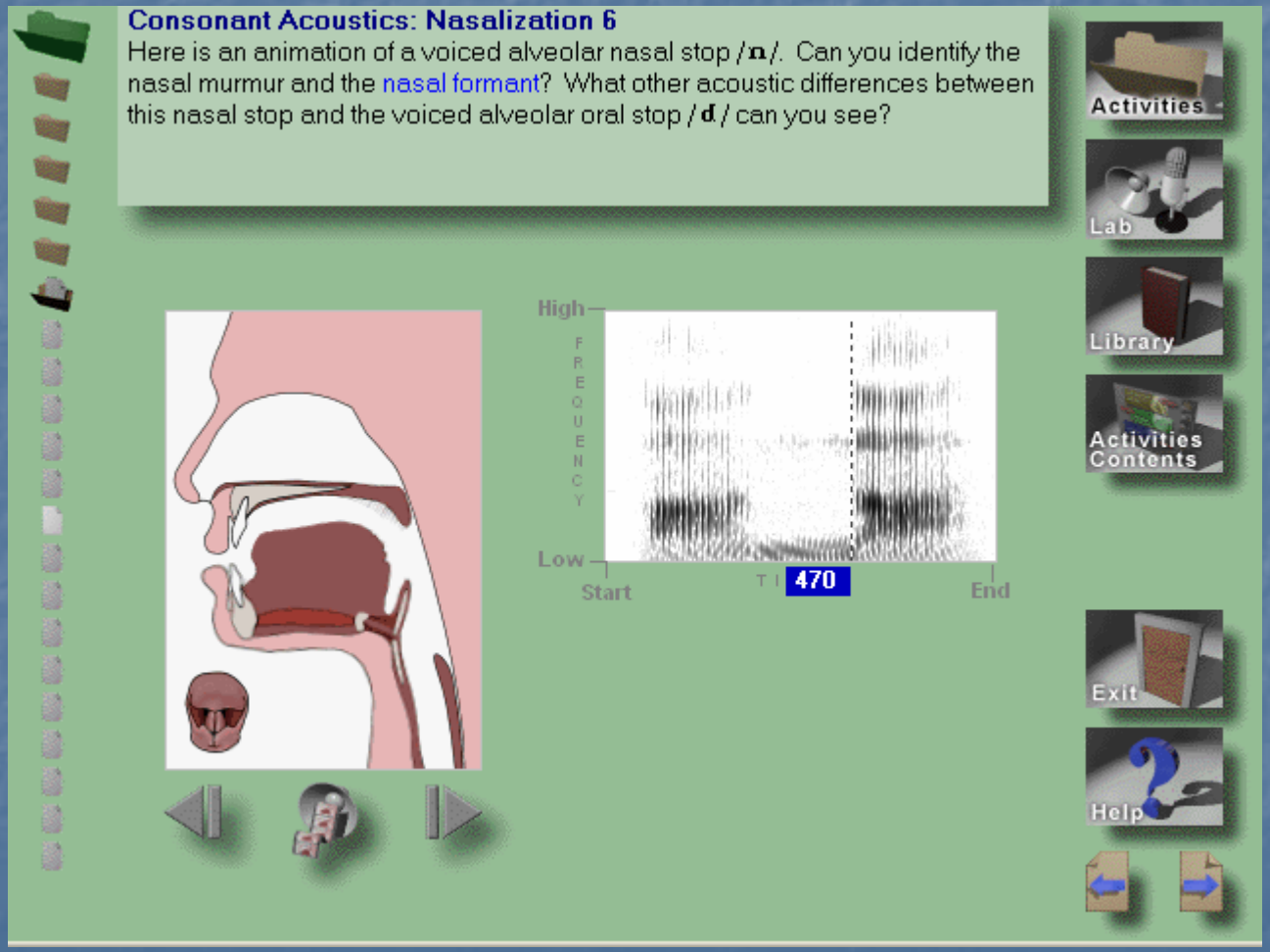
4.5.2 Nasalization

See CBCAP



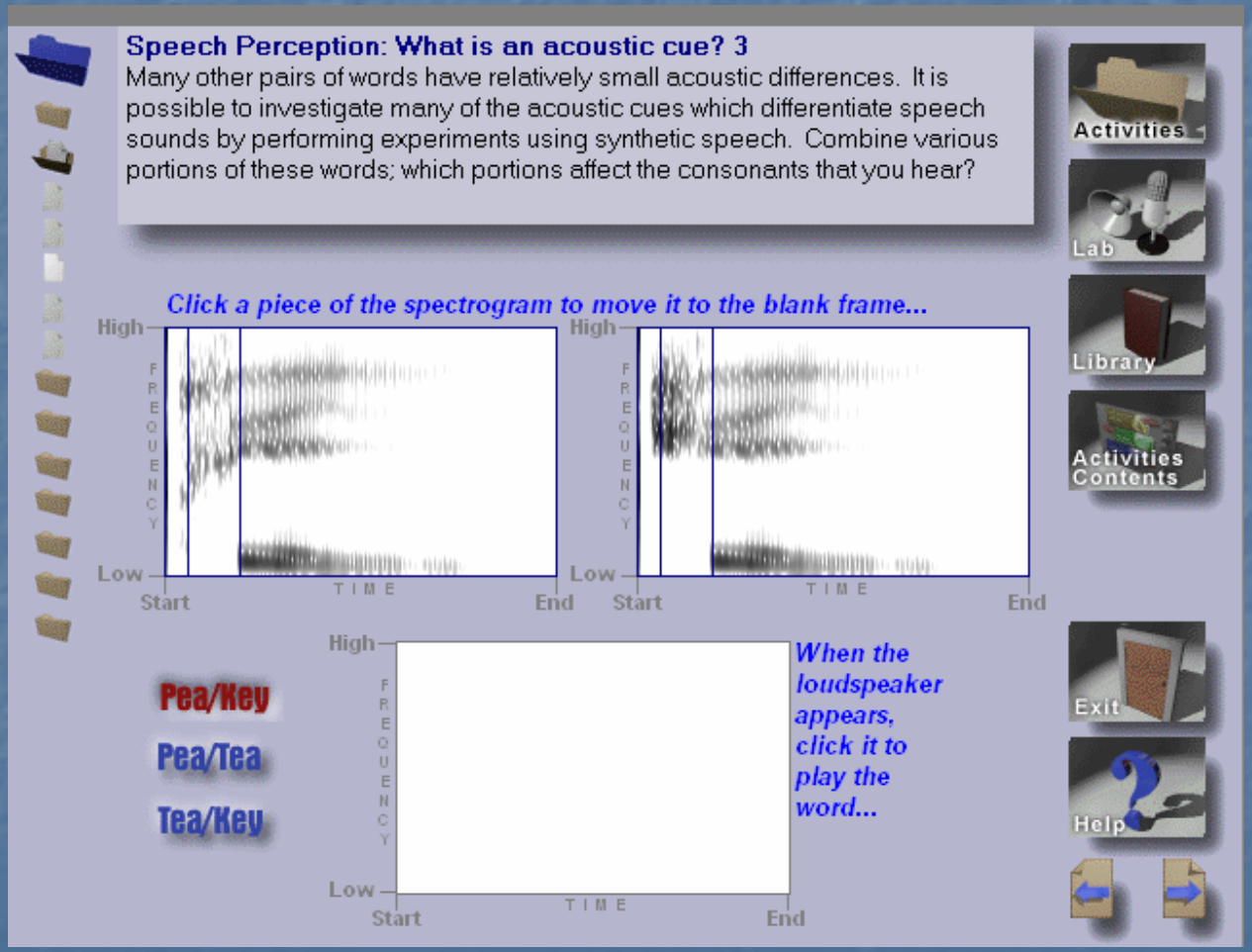
4.5 Nasalization

See CBCAP



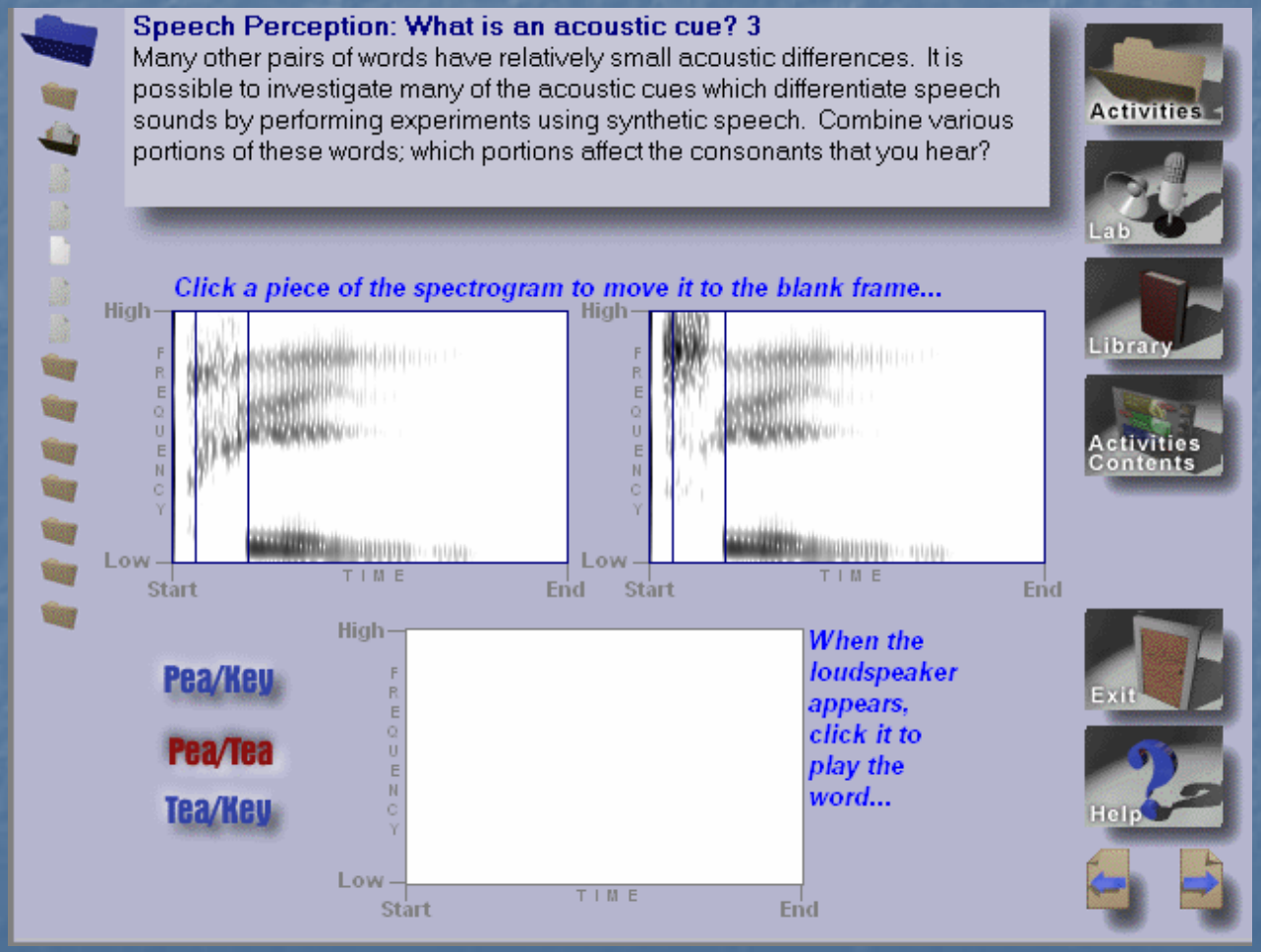
4.6 Summary and conclusion

See CBCAP



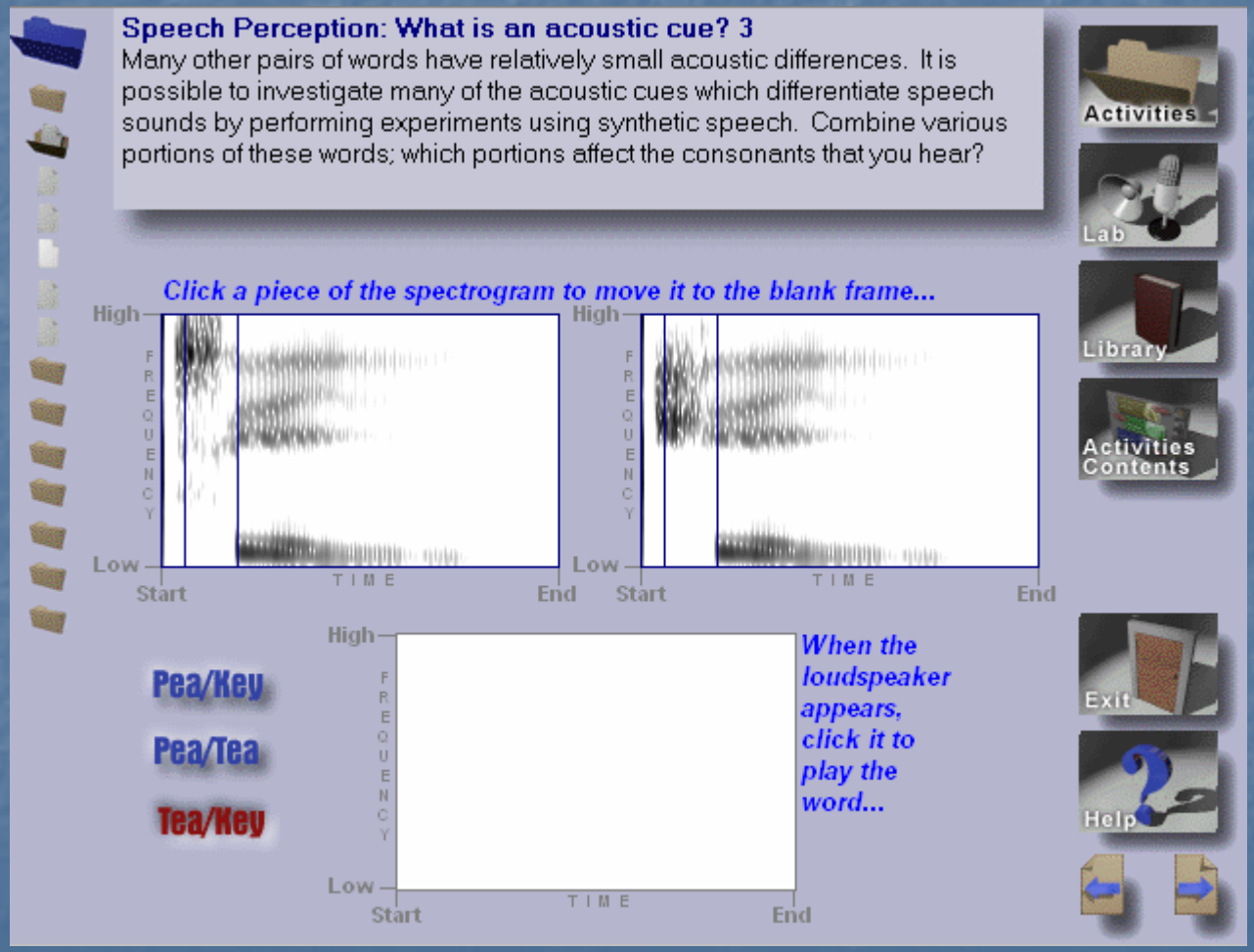
4.7 Summary and conclusion

See CBCAP



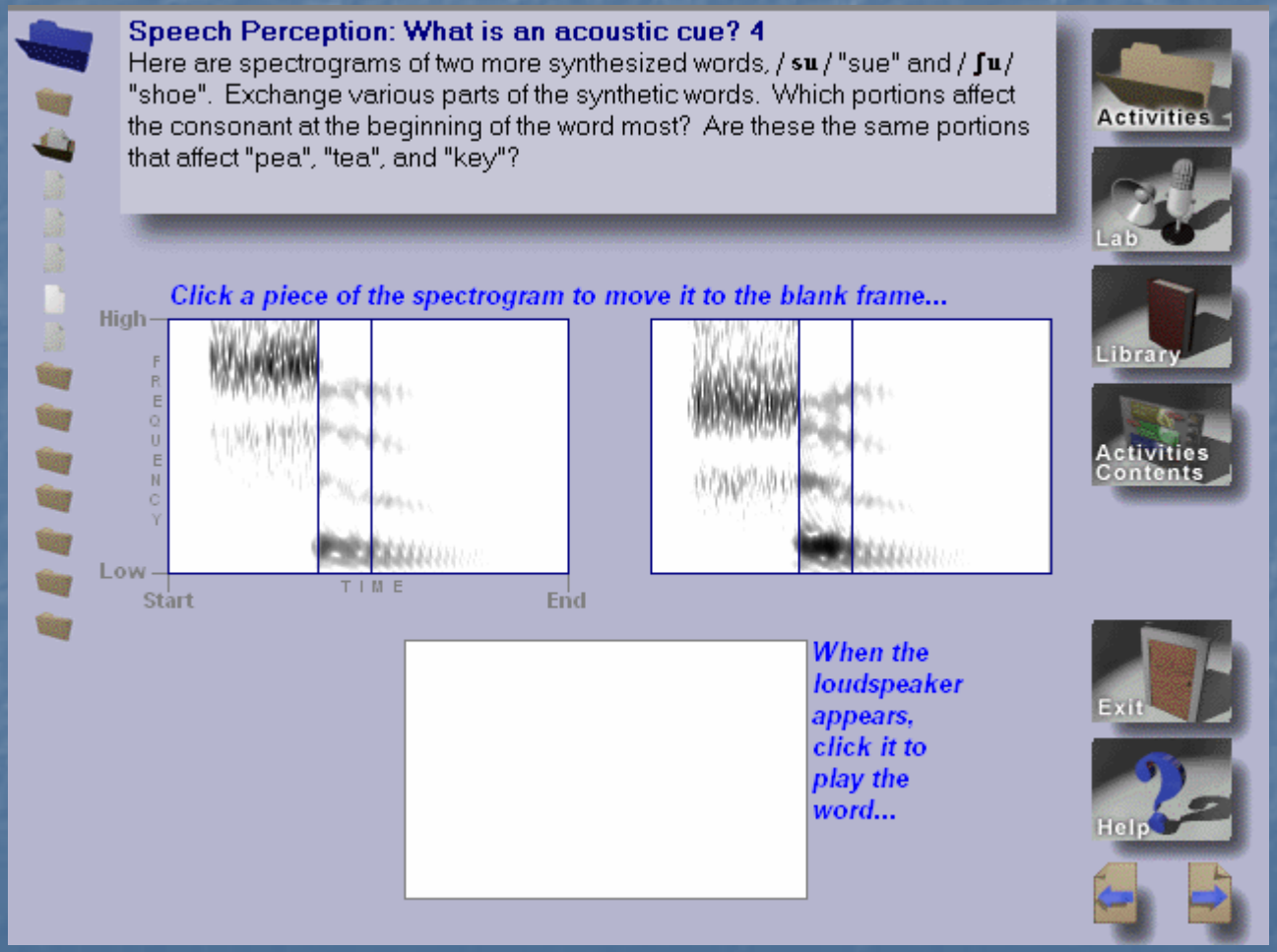
4.8 Summary and conclusion

See CBCAP



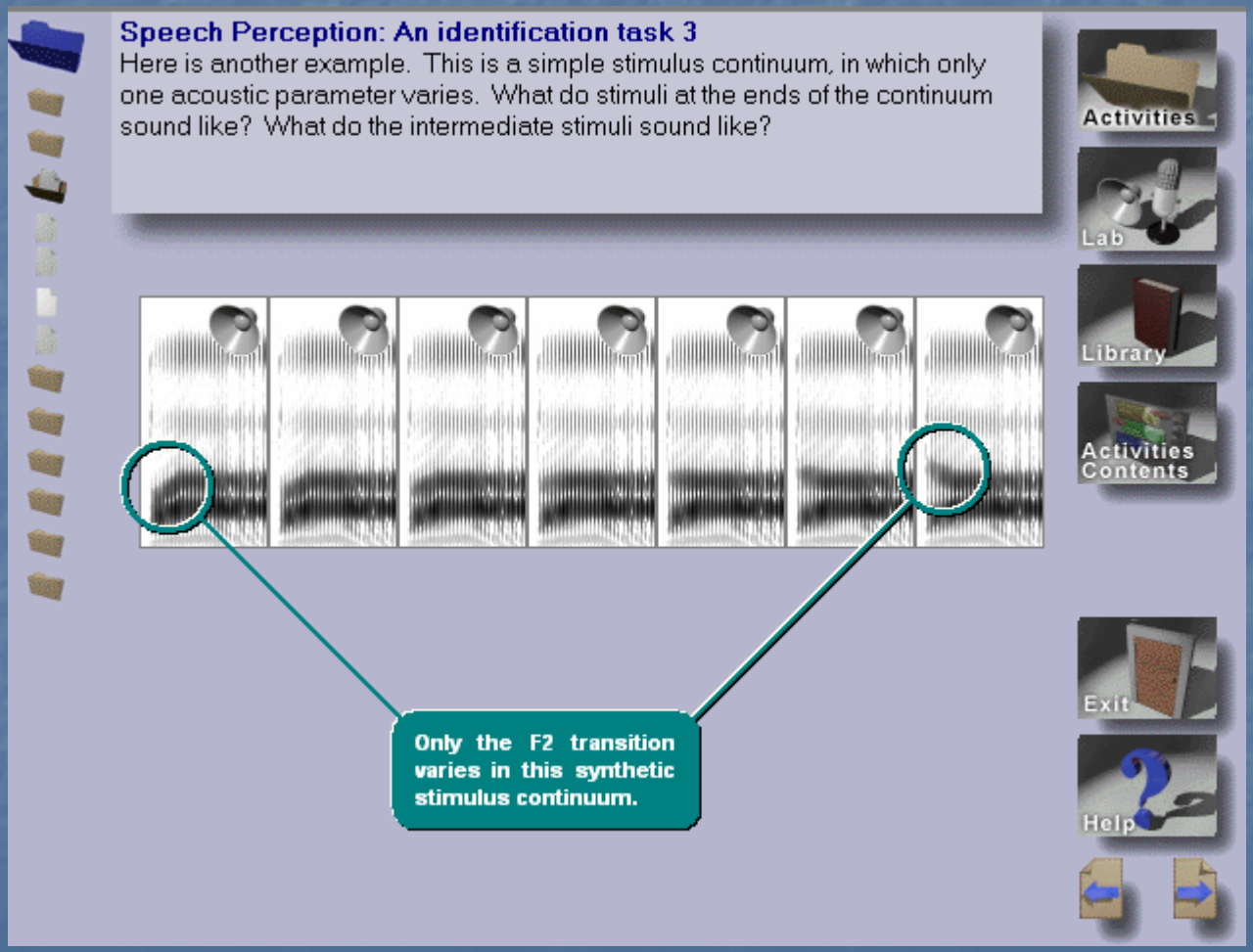
4.9 Summary and conclusion

See CBCAP



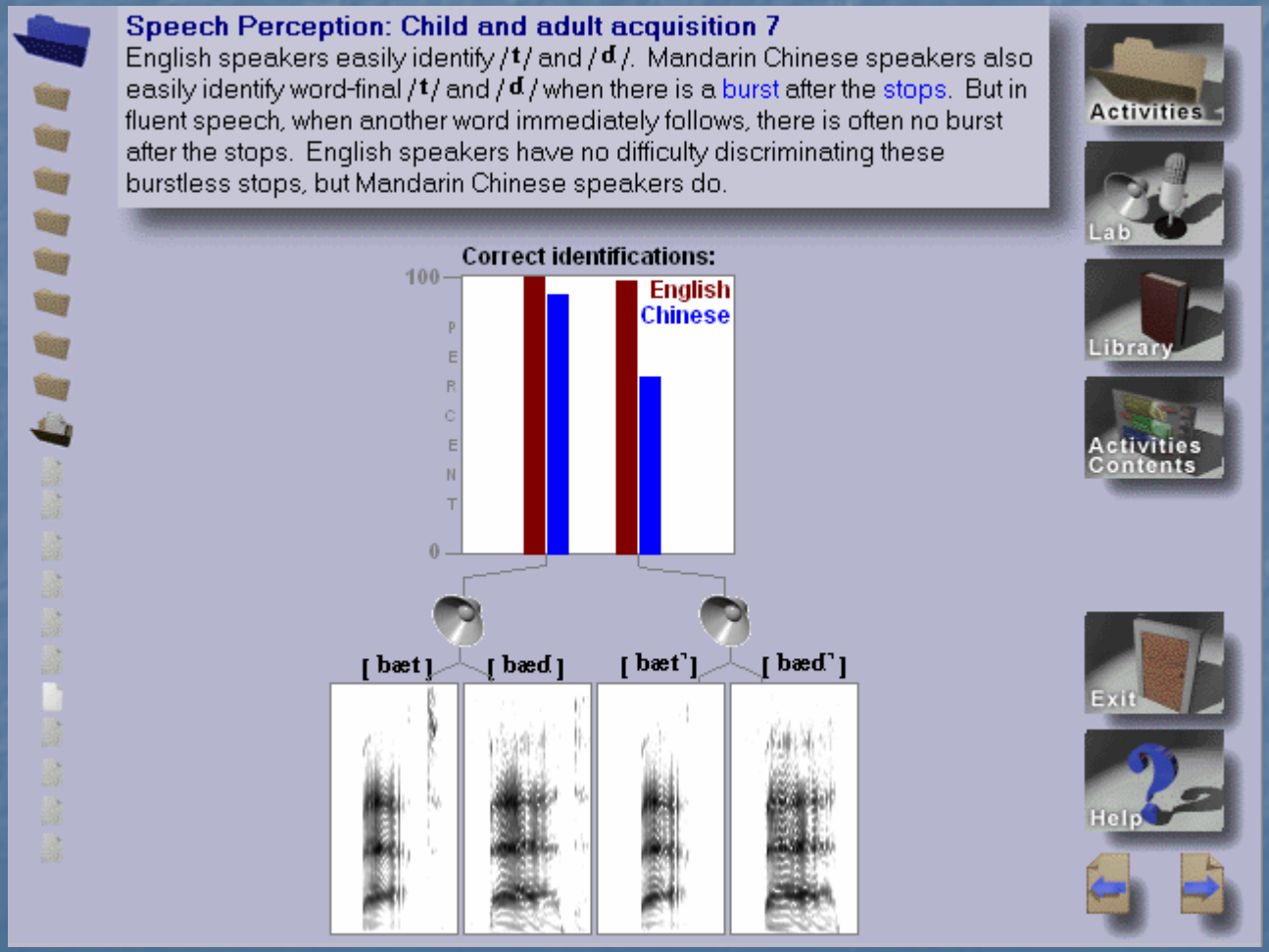
4.10 Summary and conclusion

See CBCAP



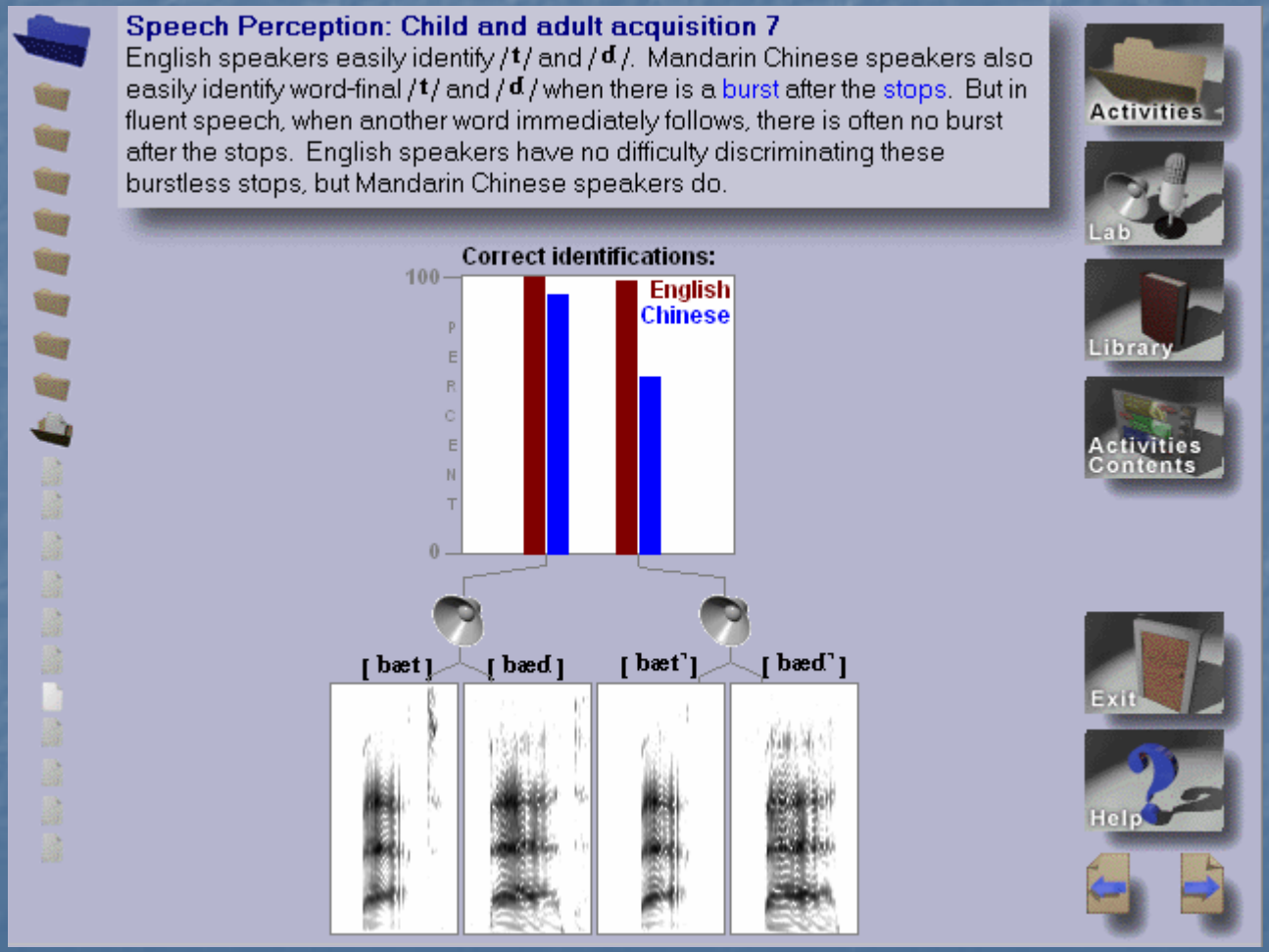
4.11 Summary and conclusion

See CBCAP

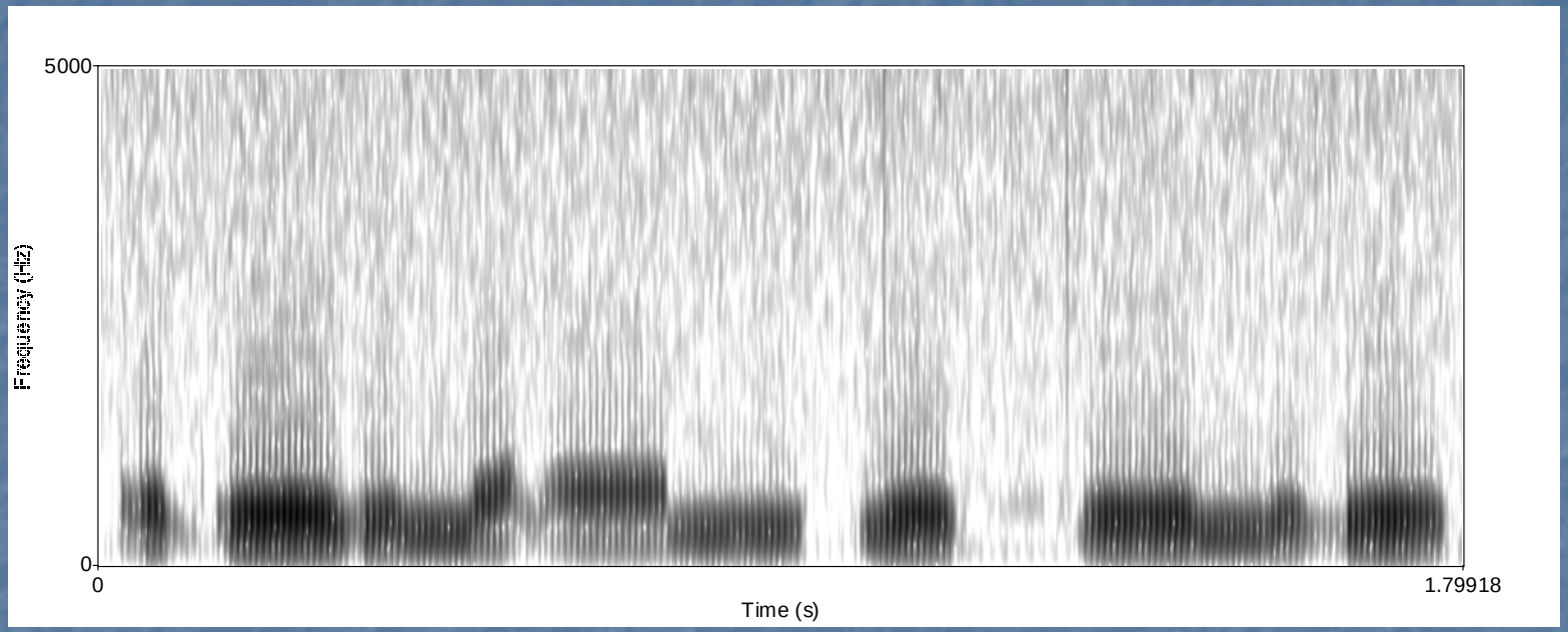


4.11 Summary and conclusion

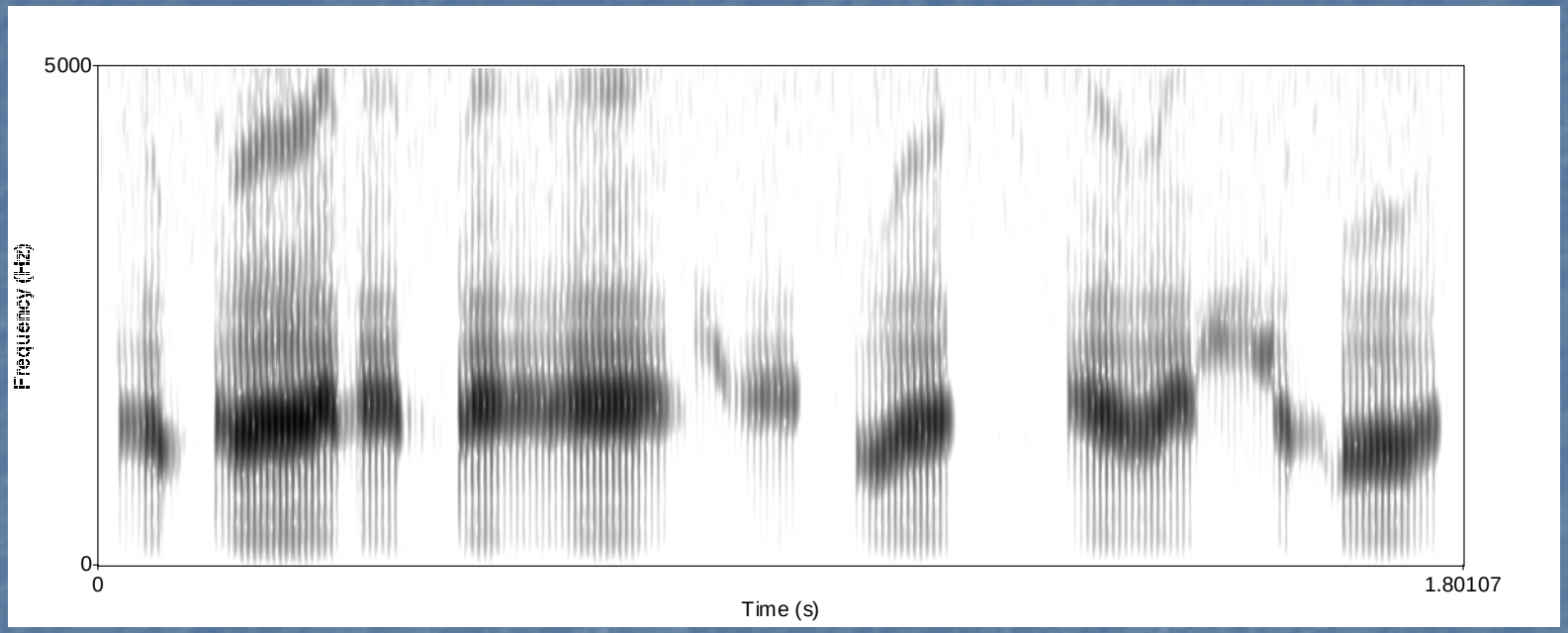
See CBCAP



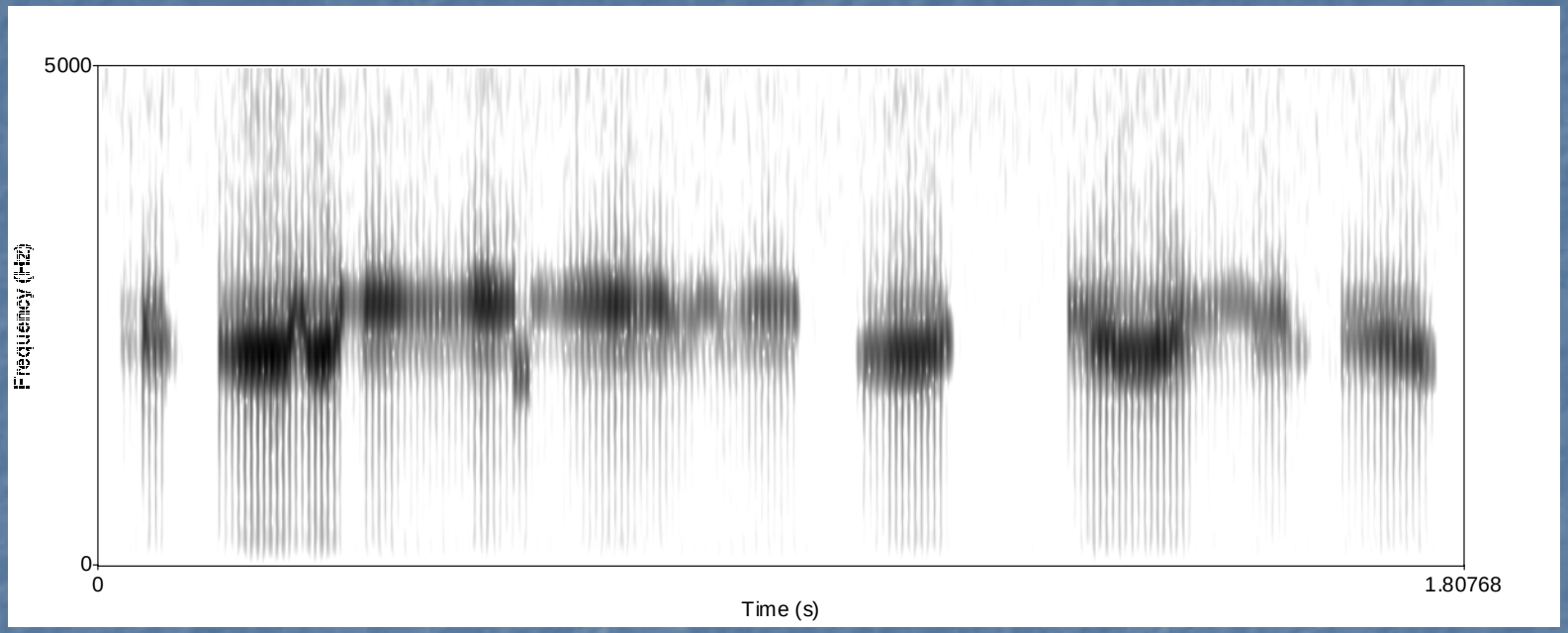
4.12 An expression with only the first formants



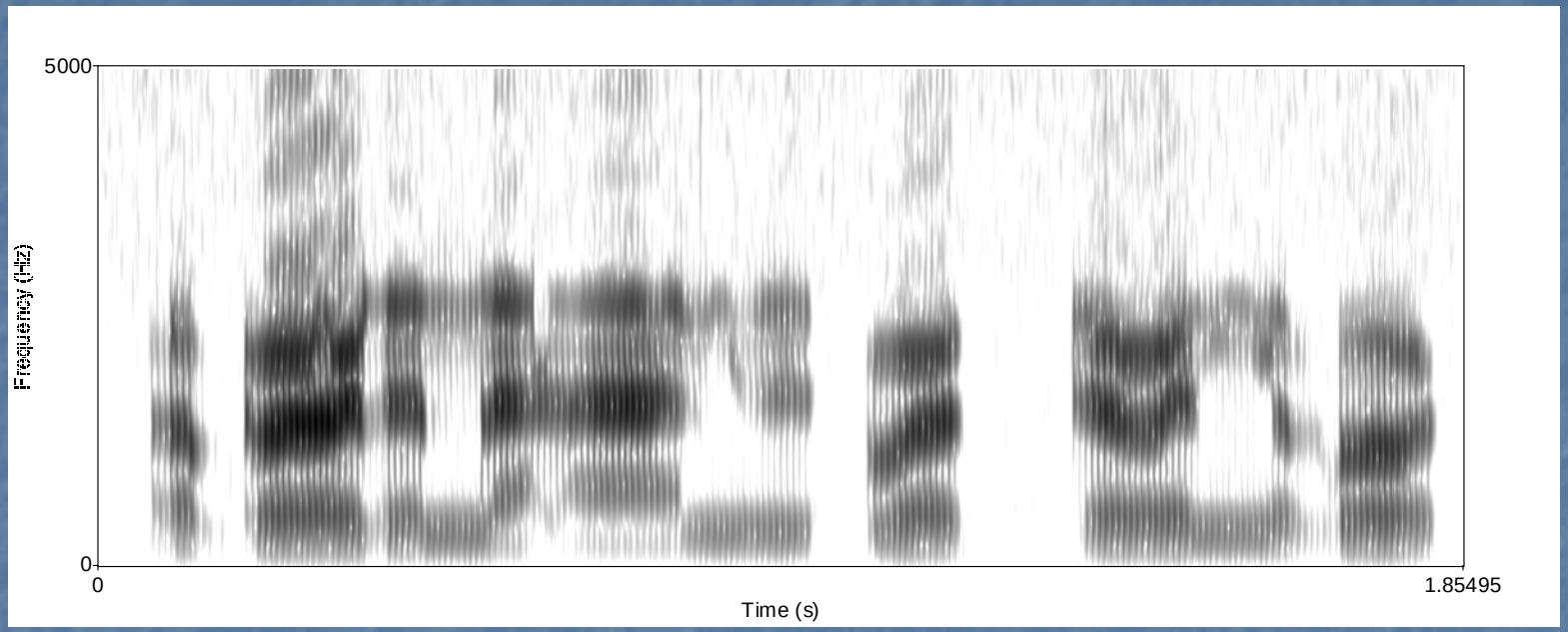
4.13 An expression with only the second formants



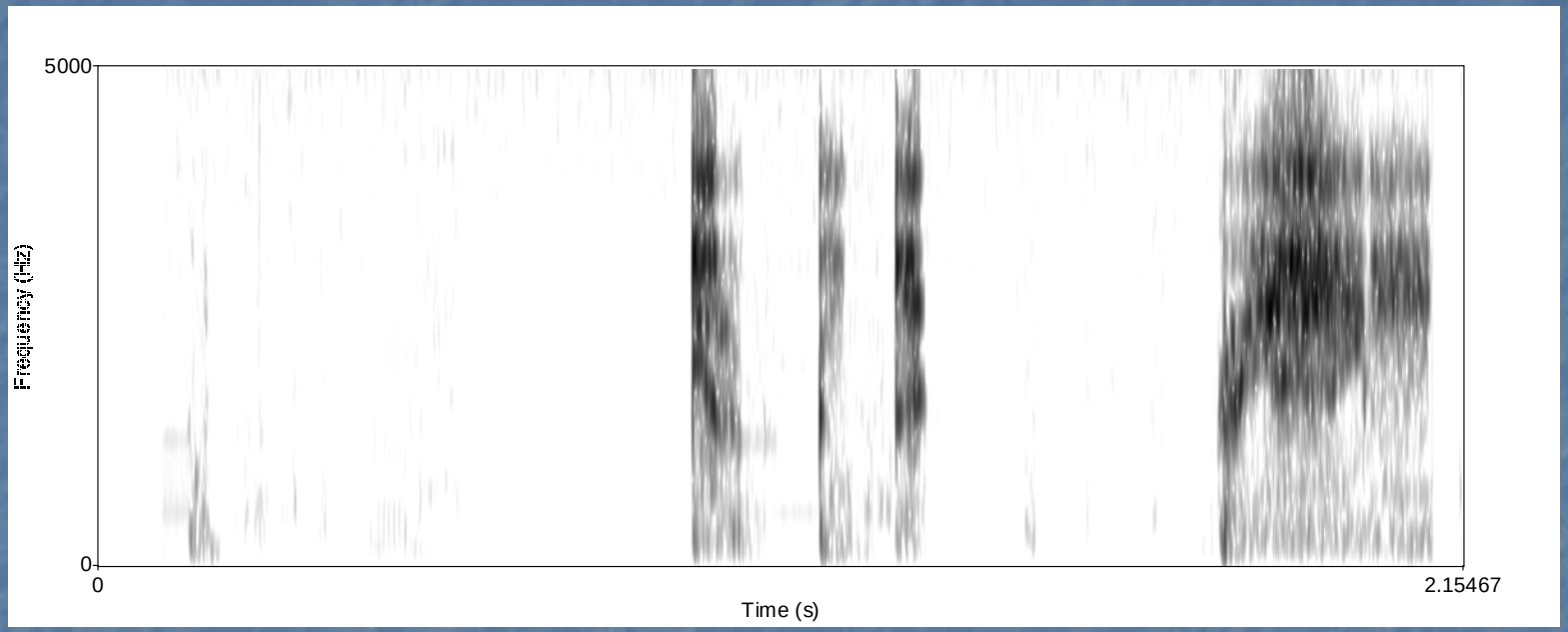
4.14 An expression with only the third formants



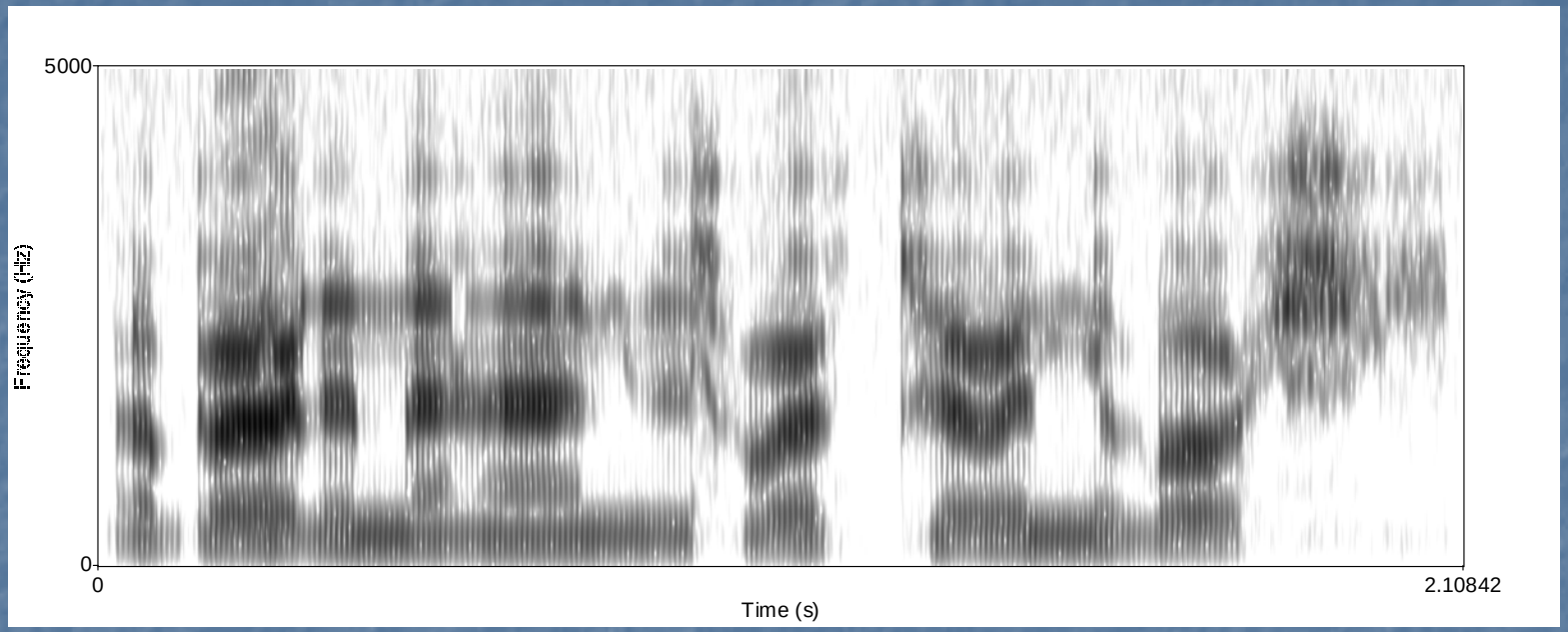
4.15 An expression with only the first three formants



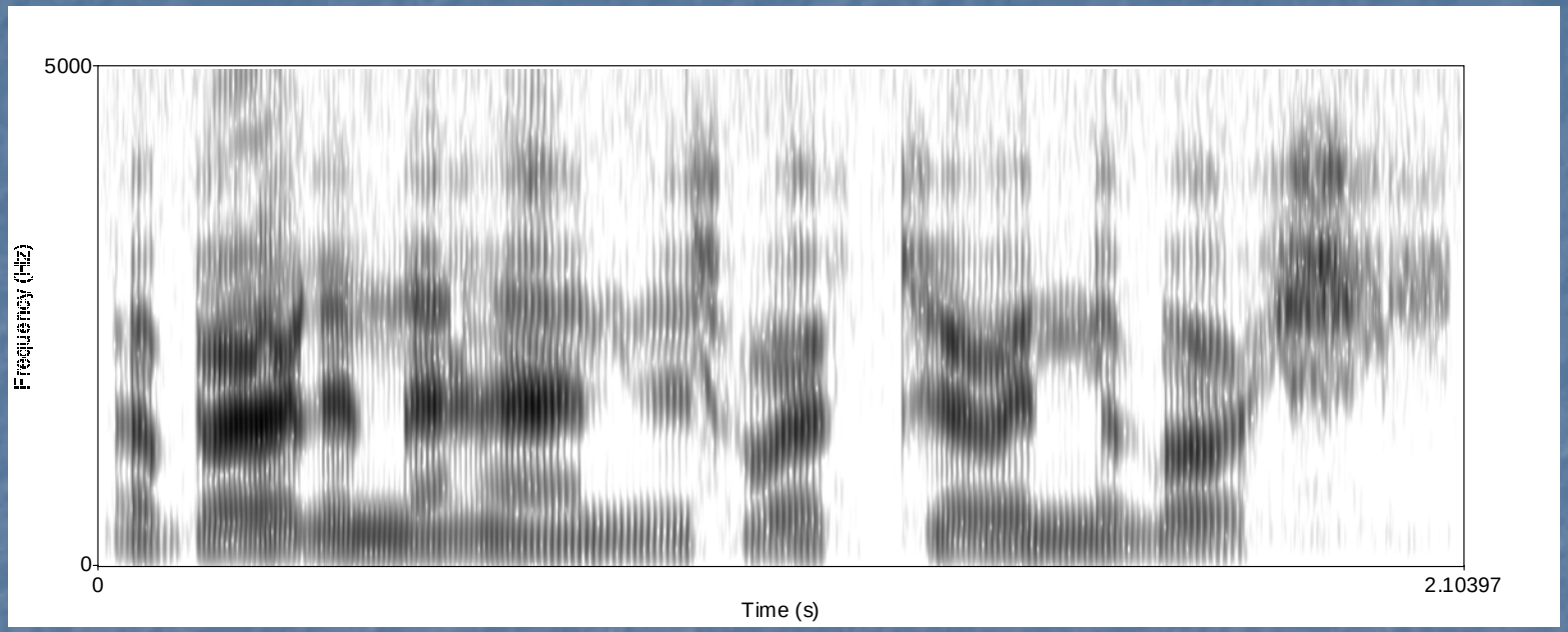
4.16 An expression with only the consonants



4.17 An expression with everything but F0



4.18 An expression with everything



4.19 Try to read the following pairs in PRAAT