INTRODUCTION TO SPEECH SCIENCE

Laboratory 1 - Speech Signal Exploration

WORKSHEET

You will use the WASP computer program to record your voice and display it on the screen.
To record, click the button with the red circle to access the record dialogue. It is important to set the recording level correctly. You can test the levels without actually recording – click "test levels" and speak into the microphone from a distance of 6" to 12" – the blue bar should reach near to but not all the way to the right of the peak level bar. If the levels seem wrong, ask for help. When ready, click "record", speak, and then click "stop" when you have finished speaking.

On the display, the upper trace is called a 'Waveform', and the lower picture is called a 'Spectrogram'.

The horizontal axis of both displays shows time. In the *waveform* trace, the vertical axis shows the change over time of the air pressure as measured by the microphone.

In the *spectrogram* picture, the vertical axis represents frequency: each position on the vertical axis represents one of the many possible sound frequencies that might be present in the sound. The spectrogram is in effect an analysis of the sound, broken down into its components. The spectrogram uses a grey level to show the amount of energy that is present at each frequency and at each point of time. Black represents high energy, and white represents very low levels of energy.

You can use the left and right buttons on the mouse to position cursors on the display. Click on the 'play' button (green arrow) to play the region between the cursors. You can also click on the 🡻 'zoom' button to expand the display, or on the 🡹 button to go back.

Explorations

1 Record someone whistling a short tune made up of three or four notes. Hold the microphone so that it faces at right angles to the mouth. Look at the shape of the waveform and the pattern on the spectrographic display. Use the cursors to select and zoom into a low-pitched note and a high-pitched note. With the waveform zoomed to show about 20 ms across the display, study the waveform and look for a repeating pattern of pressure change. Use the cursors to mark the peaks of one complete cycle to measure the duration or "period" of the cycle. At the bottom right of the WASP display you can read off the duration of the section you have selected.

Note the period of a low-pitched note and compare it with the period of a high-pitched note:

low pitch: _____ high pitch: _____

Using the formula: frequency = 1/period, WASP also calculates and displays the repetition frequency (number of periods per second) for each of these notes: Record these values too.

low pitch: _____ high pitch: _____

Now look at the spectrogram display zoomed out to show several of your whistled notes
How does the prominent pattern in the spectrogram relate to the repetition frequencies of the notes you measured?

_____

_____

_____

_____

2. a). Record the word "see". Zoom in to 0.1 seconds worth of the waveform in the fricative and then the same amount of the vowel. What differences do you observe between the fricative part and the vowel part in the *waveform* ?

_____

_____

What differences do you observe between the fricative part and the vowel part in the *spectrogram*?

_____

_____

You will see horizontal bands in the spectrogram display of the vowel that are called '*formants'*.
You may be able to see vertical lines in the spectrogram of the vowel that are called '*striations*'.

b). Measure the period and repetition frequency of one cycle of the vowel.

_____

c) Record 'ee' spoken on a relatively low pitch and 'ee' spoken on a relatively high pitch. Zoom in to 0.1s of each waveform. How has the difference in pitch affected the repetition period and repetition frequency? _____

_____.

4 a) Record the word “seashore”. Compare the waveform shape in the “ee” vowel region with the waveform shape in the “aw” vowel region. Is the difference between “ee” and “aw” simply one of repetition frequency?

_____

b) What differences between “ee” and “aw” can you see in the spectrogram?

_____

_____.

c). What differences between “s” and “sh” can you see in the spectrogram?

_____

_____.

5. (If you have time) Record yourself speaking your name, zoom in so that it fills the screen, then print it out. Try to identify the regions of the signal corresponding to the different phonetic components of its pronunciation. Use the program to help you replay the signal in parts. Attach your annotated picture to this worksheet.

NOTE: The WASP software, which runs on any multimedia PC, is freely available from the following website. http://www.phon.ucl.ac.uk/resource/sfs/wasp.htm
For other demonstrations and links to information about acoustics and speech perception, go to : http://www.speechandhearing.net