

Waveform Homework

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This homework is intended to provide practice in:

- 1) Identifying manner of articulation from a speech waveform;**
- 2) Examining cues to stop consonant voicing in a speech waveform.**

Part 1

Download the sound files *manner1 - manner6* from the class Blackboard website (under “Material for Assignments”). (You will also need *voicing1 – voicing4* for Part II of the assignment, so you may also want to download those at this time.)

Next, download the appropriate version of Audacity™ (Mac, Windows, etc.) from the following site: <http://audacity.sourceforge.net/>. This link is also on Blackboard. Choose platform (mac, pc, unix) at left. It’s possible that some computer labs might have Audacity already installed; so if you’re on campus, you could check first—if it’s already there, you don’t need to download a copy.

[Mac OSX: You only need the audacity-macosx.dmg (Mac OS X Disk Image, 3.0 MB) file. PC users: Double-click on it to start the installer after downloading it. If you prefer not to use the Installer program, you can also download Audacity as a ZIP file, which you can decompress using WinZip.]

Once downloaded, you can launch Audacity by double-clicking on the icon. After launching Audacity, open (choose ‘Open,’ under the ‘File menu) the 6 sound files (*manner1 - manner6*).

Each of these files is a speech waveform. In order to see them all at once, you will have to re-size the windows of each file and arrange them on your screen. The tracks can be made bigger on the screen by selecting the magnifying tool in the top left corner of each window and clicking on the waveform, or by selecting ‘Zoom In’ under the ‘View’ menu.

These six files are the phrases (*not* in this order): *a chat, a nap, at, a bat, a sat, and a pat*,

Speech waveforms record the sound pressure fluctuations that hit a microphone, much like those that hit your eardrum. A speech waveform includes information as to whether a speech sound is voiced or voiceless. A voiced segment will have a regular (periodic) repeating pattern that looks like close, evenly spaced, spikes that are present for each vibration of the vocal folds.

A speech waveform also includes information about manner of articulation. Vowels are usually the loudest or highest amplitude segments and are voiced. Nasals and approximants are also voiced but are of a lesser amplitude. Nasals also have a simpler repeating pattern than vowels; more like a smoother sawtooth. Fricatives have a turbulent or irregular pattern of vibration. Stops closures are either basically silent for voiceless stops or may have very low amplitude voicing for voiced stops. Voiceless stops will also be aspirated in English. *Think about how aspiration might be indicated in a waveform based on what we've learned in class.*

1a-f• Your first task is to identify *without listening to them* which phrase each speech waveform (manner1 – manner6) is. It may be helpful to phonetically transcribe the phrases first.

- a. manner1 is the phrase _____
- b. manner2 is the phrase _____
- c. manner3 is the phrase _____
- d. manner4 is the phrase _____
- e. manner5 is the phrase _____
- f. manner6 is the phrase _____

After you have done this, listen to each one (by clicking on the 'Play' button) and see if you were right. Correct and understand your mistakes.



The Audacity Toolbar: buttons from right to left: Play, Stop, Record.

Your second task involves segmenting the waveforms to answer the following questions. Please make and record your measurements as accurately as possible. [To measure accurately, you might want to zoom in using 1(Mac) or CTRL1(Win); you can zoom out again if you want using 3(Mac) or CTRL3(Win)].



The Audacity Toolbar: The bottom right tool is the magnification tool, and the top left tool is the selection tool.

For these questions you will have to refer to the times in the window in the bottom left of your screen. To select a portion of the waveform, click on the selection tool. Then, make your selection by holding the mouse down and dragging horizontally in the waveform. The window in the bottom left of your screen will display the start (first number) and end (second number) times of the selection. To determine the duration of your selection, you need to subtract these two numbers. (You may round to the nearest millisecond). [Some

versions of Audacity might do the subtraction for you, given in brackets after the selection.]

Project rate: 22255 Selection: 0.297378 - 0.587816 s

Single-clicking in the waveform displays the timepoint for where the cursor was last clicked.

Project rate: 22255 Cursor: 0.455411 s

2a,b• What are the beginning and end timepoints for the nasal consonant in *a nap*?

3• At what time point do the lips close in *a bat*?

4• At what time point do the lips close in *a pat*?

5• At what time point do the lips open in *a pat*?

6• At what time point does the (second) vowel start in *a pat*?

Part II.

If you haven't already, download the files *voicing1 – voicing4* from the class Blackboard website and open them in Audacity. These files also contain speech waveforms. (As before you can resize the windows to see them all at once and Zoom In (⌘1/CTRL1) if necessary.)

The waveforms are of the words:

pad
pat
bat
spat

Identify which waveform is which word by listening (press Play button). Answer the following questions (To measure accurately, you may want to zoom in using ⌘1/CTRL1; you can zoom out again if you want using ⌘3/CTRL3):

7• Which is longer: the [æ] in *pad* or the [æ] in *pat*?

8• Which is longer: the [d] in *pad* or the [t] in *pat*?

In fact, these durational patterns are typical of English and many other languages, and whether a final stop is perceived as voiced or voiceless can be determined completely by the duration of the preceding vowel.

9• Are the [p]s differentiated from the [b] by *i*) the presence versus absence of voicing during the closure; by *ii*) Voice Onset Time (the time between the release of the closure and the onset of voicing for the following vowel; or *iii*) by both *i* and *ii*?

10a-d• What is the Voice Onset time for the bilabial stop in each of the four words?
(*Hint: Start your cursor at the first spike of the stop release burst and drag it to the first spike of vowel voicing and record the times indicated in the window below the waveform, subtract these times to obtain the duration.*)

11• Select (drag over) the first stop closure and vowel in *spat* (i.e. leaving out the initial fricative). Play the selection by clicking the Play button. What word do you hear? Think about why.