

Lab 2+: Measuring the Vocal Tract

As we discussed in class, the air coming out of the lungs is shaped by the configuration of the mouth – this is what makes vowels have different qualities. If, however, the vocal tract is left fairly “neutral,” then there are no obstructions to the airflow and the *actual* shape of the vocal tract is represented by the airflow. We can use this information to calculate the length of the vocal tract.

1. Find a vowel that is relatively “neutral,” like schwa. You can either record your own production or find a sample online, e.g. from the IPA chart at:

<http://phonetics.ucla.edu/course/chapter1/vowels.html>

(Right click on the [ə] to download it.)

2. Check to make sure the vowel is neutral. Open it in Praat and look at the formants (it may help to turn off the pitch tracking and turn on the formant tracking). In a neutral vowel, the formants will be fairly evenly spaced. If your vowel doesn't look like this, try again!

3. The formula for the length of the vocal tract when it is in neutral position is as follows:

$$L = ((2n-1) * c) / (4f_n)$$

◆ L = length of the vocal tract in cm

◆ n = the number of the formant (e.g. n = 1 for the first formant, n = 2 for the second formant, etc.)

◆ c = the speed of sound in cm/s; this depends on the medium you are speaking in (air, helium, water, etc.) and the temperature of the medium. In the “standard” case of warm, relatively moist air, sound travels at 35,000 cm/s. You can see other speeds at:

<http://www.sengpielaudio.com/calculator-speedsound.htm>

◆ f_n = the frequency of the formant in Hz (e.g. the first formant might have a frequency of 500 Hz, the second format 1500 Hz, etc.). You can get the formant frequencies in Praat under “Formant listing.”

4. Calculate the approximate length of the vocal tract that produced your vowel by picking one of the formants, finding its frequency, and plugging it in to the formula above. You can “double check” your calculation by trying it with several different formants or with the same formants at different points in the vowel. How accurate do you think the measurement is?

5. Some cool things to try – get other people's vowels, and compare measurements. How do you think the measurements stack up against people's height / overall size? Try the old “breathing helium from a balloon” trick and record your schwa. Find the speed of sound in helium and recalculate your vocal tract length. Is it the same? Let us know if you find out anything interesting!