LING330: Lab 2 VOT and Vowel Duration

Due: Nov 8, 23:59 pm

[you can work in groups of up to 3 people, include all names on your report]

MAX 5 pages plus appendix

Instructions for the Lab Report

In this lab assignment, you will investigate the effect of the voicing of a plosive on the duration of preceding segments. Recall that by "voicing of a consonant" we are referring to whether it is phonologically voiced like /b,d,g,z,ʒ/ or voiceless like /p,t,k,s,ʃ/. For example, can we predict something about the durational properties of segments if we know whether a sound is /b/ (phonologically voiced) or /p/ (phonologically voiceless)?

To this end and to test one additional question, you will measure the VOT (voice onset time) of the initial plosive and the duration of the vowel in a set of C_1VC_2 words. You will then organize and present those measurements and report the conclusions to be drawn from them. You must address the following questions:

1. Does the voicing of a following plosive affect the duration of a vowel? E.g. is the duration of /i/ in "bead" affected by /d/ being phonologically voiced (compared to if that were a /t/)?
2. Does the voicing of a preceding plosive affect the duration of a vowel? E.g. is the duration of /i/ in "bead" affected by /b/ being phonologi- cally voiced (compared to if that were a /p/)?
3. Does the voicing of C_2 affect the VOT of C_1? E.g. is the VOT of /b/ in "bead" affected by /d/ being phonologically voiced (compared to if that were a /t/)?
4. Does the voicing of C_1 affect the VOT of C_1 (i.e. itself)? E.g. is the VOT of /b/ in "bead" affected by that /b/ being phonologically voiced (compared to if that were a /p/)?
5. Does the place of articulation of a stop (C_1) affect the VOT of that stop? E.g. does /p/ have a different VOT than /k/ even though both are voiceless? Does /b/ have a different VOT than /g/ even though both are voiced? Hint: consider the air pressure pattern you need to maintain voicing, which we mentioned in class in the phonation and airstream mechanism lectures.

Develop a hypothesis about each of these questions. For example, for the 4th question, we believe that the answer will be a resounding "yes": voiceless plosives will have a longer VOT than voiced ones. Before making any measurements, you can (and should!) try listening to some of the speech files to make your predictions just from listening. You

could alternatively pronounce words and form a hypothesis based on your own pronunciations.

Note: Your predictions might be wrong even if you base them on perfectly good reasoning. That's ok – be honest about it! You're dealing with very little data, so that isn't surprising.

Data

The data consists of 32 CVC words uttered by a female speaker.

pat	pad	bat	bad
pot	pod	bought	bod
cot	cod	got	god
putt	pud	but	bud
talk	tog	dock	dog
puck	pug	buck	bug
tuck	tug	duck	dug
pick	pig	Bic	big

Table 1: CVC words uttered by a female speaker

There are 4 sound files. Each file contains the words in one of the columns in Table 1, as read by the speaker. Files are posted on the class website along with these assignment instructions. Test words are in the carrier sentence "The word is". There is only one token of each word.

For each word, you will have to measure the duration of the vowel and the voice onset time of the **initial consonant**. You do not need to measure anything in the final consonant!

Measuring VOT

The voice onset time of a plosive is defined as the duration between the release of a plosive and the beginning of vocal cord vibration. Standardly, VOT can be positive, negative, or 0.

1. If the onset of voicing follows the release, measure the interval in milliseconds between the release of the plosive until the onset of voicing. This is positive VOT (VOT > 0ms).
2. If the onset of voicing coincides with the release, this is 0 VOT. (VOT = 0ms).
3. If the onset of vocal fold vibration precedes the plosive release, then measure the voicing duration from the onset of voicing (or the onset of closure if there is voicing throughout), again in milliseconds. This is negative VOT (VOT < 0ms).

Figure 1 illustrates the release of the plosive as well as the onset of vocal cord vibration using the oscillogram (waveform). Boxes (c) and (d) are from English speakers.

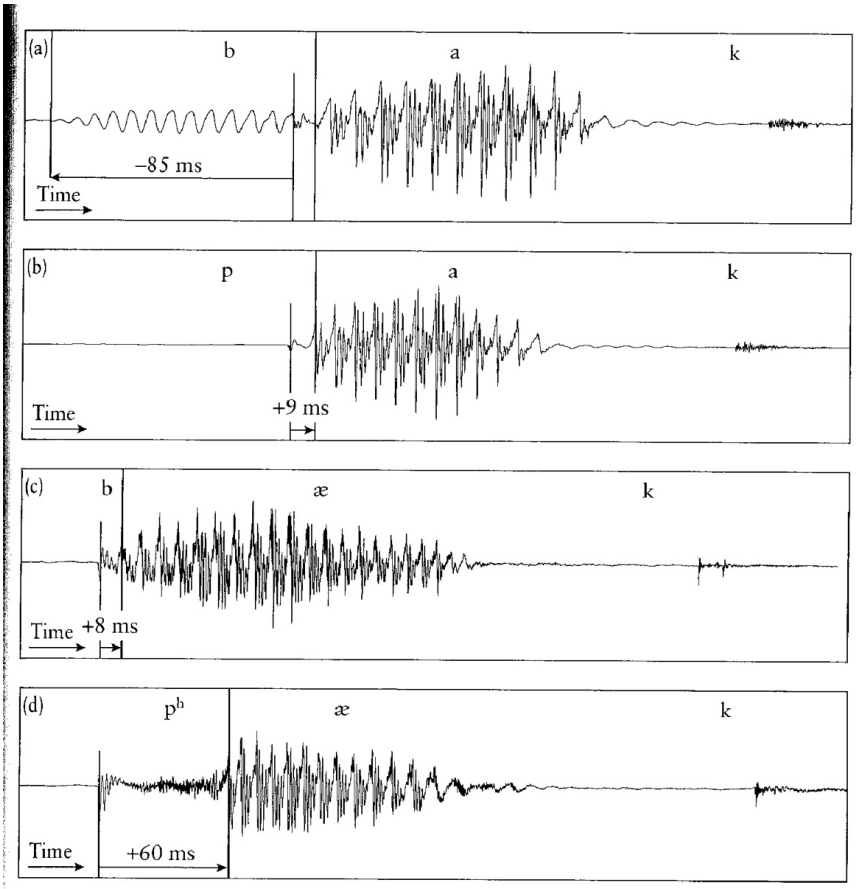

Figure 6.2 Oscillograms and VOT measurements for phonologically voiced and voiceless plosives in syllable-initial position for a male speaker of (a, b) Dutch and (c, d) English. In (a), three vertical markers are shown. The leftmost marker indicates the onset of consonantal voicing, the middle marker indicates the release of the constriction, and the rightmost marker shows the onset of vocalic voicing. In (b, c, d), the leftmost vertical marker indicates the release of the constriction while the right marker indicates the onset of vocalic voicing.

Figure 1: Waveforms and VOT measurements for phonologically voiced and voiceless plosives.

Measuring Vowel Duration

It is common to measure vowel duration from the release of the constriction of the preceding consonant to the formation of the constriction of the following consonant. For simplicity, this lab will use the end of VOT as the start of the vowel. You will need to decide a consistent way to determine the end time of the vowel, picking one (or several)

acoustic cues to use as a diagnostic. To get you started on options, consider the following thoughts and decide based on which one or ones you believe will be most consistent and most relevant:

1. A cue in the formant structure visible in the spectrogram
2. The presence of sharp changes in amplitude visible in the waveform
3. A sharp change in amplitude in the spectrogram
4. The time when the voice bar is no longer visible in the spectrogram
5. The time when the waveform no longer shows periodicity
6. The time when striations are no longer visible in the spectrogram
7. When Praat's Pitch tracker ceases to find an F0
8. When Praat's Pulse tracker ceases to infer the presence of vocal fold pulses

You may find a combination of cues works best, or that you make a decision tree for which cues to use. You may alternatively find that a single cue provides the measurement time you want. No matter what you choose, you will have to (a) tell us what you did, and (b) tell us why you made that choice.

Writing your Lab Report

For this lab, you must write the lab as a consistent, flowing text. (In other words, it must be formatted as a lab report, rather than as a series of numbered answers or of point form answers.) As a general tip, make sure you pay attention to how you use slashes and brackets around IPA symbols, and make sure you give units when presenting a value. In a lab report you would normally have different sections such as introduction, methods, results and discussion. For this report your introduction and methods sections will be very short.

Introduction: include a short statement (one or two sentences) of the objective of the lab and the five research questions that you will try to answer. Provide a hypothesis about the outcome of each question (it doesn't have to be right, just reasonable given what you know).

Methods: Provide a short description of your measurement methods. Provide at least one in-text figure (showing a matching waveform, spectrogram and textgrid), explaining in the text how it illustrates your measurement decisions (i.e. how you determined the burst, onset of voicing and the end of the vowel).

Results: To answer the above questions you need to compare the measurements of different groups. For each research question you should:

- make a table showing the means of each group in milliseconds (round to the nearest millisecond) (this will go in the appendix)
- make a bar graphs showing the difference in means between these groups, and

- do an unpaired, two-tailed t-test used to determine whether the differences between the groups was statistically significant. A sample spreadsheet with a demonstration of the t-test function is provided along with these lab instructions. The t-test returns a p-value: the probability of the observing the data if the means of each group from which the data were samples were the same. Use p = 0.05 as your critical value for significance. Any value returned by the t-test function that is < 0.05 is considered statistically significant. A value returned by the t-test function that is > 0.05 is considered statistically not significant.

For question (1) above, you will want to sort the vowel-duration measurements into two groups: vowels followed by voiceless plosives, and vowels followed by voiced plosives. Show the difference in means between these two groups with a bar graph. Use an unpaired, two-tailed t-test to determine whether the differences between these groups are significant.

For question (2) above, you will want to sort the vowel-duration measurements into these two groups: vowels preceded by voiced plosives and vowels preceded by voiceless plosives. Again, show the difference in means between these two groups with a bar graph. Use an unpaired, two-tailed t-test to determine whether the differences between these groups are significant.

For question (3), you will want to sort the C_1 VOT durations into these two groups: those from words ending in voiced plosives and those from words ending in voiceless plosives. Again, show the difference in means between these two groups with a bar graph. Use an unpaired, two-tailed t-test to determine whether the differences between these groups are significant.

For question (4), you will want to sort the C_1 VOT durations into these two groups: those from voiced plosives and those from voiceless plosives. Again, show the difference in means between these two groups with a bar graph. Use an unpaired, two-tailed t-test to determine whether the differences between these groups are significant.

For question (5), you don't need to do a statistical test. Instead, just tell us which means (bilabial, alveolar or velar) are bigger or smaller than the others. Include a table with your means, looking something like in Table 2.

	voicing	
Place	voiceless	voiced
Bilabial		
alveolar		
velar		

Table 2: The average VOT values by stop voicing and place of articulation.

The results sections should show four bar charts (questions 1-4), a table (question 5), and report whether differences are statistically significant or not (questions 1-4). In an appendix, please include the full table of all your measurements as well as means for each group.

Notes on writing up this section:

a) Have a sub-section for each of the lab questions, which should help you organise your thoughts. In each section, tell us (a) which measurements were compared [e.g. ”the vowel durations for words with phonologically voiced final stops were compared to those for words with phonologically voiceless final stops”], (b) what the t- test result was (if applicable) and describe the pattern [e.g. ”vowels were significantly longer before phonologically voiceless stops compared to phonologically voiced ones (p=0.003)”], and (c) show us the bar graph or table as a figure that you describe in the text [e.g. ”we can see this in figure 4...”].

Discussion:

For each question provide a succinct summary of the results [e.g. “We found that VOT was longer for voiceless stops” or “We did not find a relationship between vowel length and…”], whether they fit with your hypotheses. For questions 1-4, when the results are statistically significant (i.e. $p < 0.05$), that indicates there is a relationship that requires explaining. For the statistically significant cases you found, please speculate why you think such a correlation exists. When it is not significant, simply note that it isn’t.

For question 5, simply discuss why you think you find the pattern you do. Does it make sense to have this pattern of values? Why or why not, thinking about articulation, air movement, and other concepts from the class.

When trying to explain your results, maybe part of what you find seems right, and part seems surprising. That’s ok; this is where you explain methodological reasons why maybe the results are misleading, or where you hypothesize about different ways of measuring the data, or give alternative justifications that weren’t part of your original hypotheses.

Additionally, as a concluding point, speculate about how these initial stops would be perceived by a native speaker of French who heard the stops thinking they were hearing French. What do you expect that French speaker would hear and why?

Appendix

Please attach a table of your measurements as an Appendix. All measurements should be included and clearly identifiable.