Prepared by Noa Attali
5.25.2018

Slicing Guide

Task

Using PRAAT, create textgrid files to annotate audio files (each about 1 second long).

See page 1 for introduction and technical skills.

See pages 3 and 4 for the essentials of what to create.

Depending on the type of file, we're annotating for:
1. Vowel
2. Voice Onset Time
3. Aspiration
4. Voicing bar
5. Duration of Closure

See pages 5 to 8 on vowels.

See page 9 on VOT, aspiration, and vbar.

See page 10 on duration of closure.

Depending on the type of file, we're manually recording certain measurements like pitch and second formants. See pages 10 and 11 for those measurements.

See page 11 for more resources.

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How to start

Open PRAAT

Ctrl+O to open the .wav files we're analyzing. Each will open as "#. Sound [file name]". Highlight one.

You want to create a textgrid file to pair with that sound file. The textgrid file will annotate the sound file with all the information we want. On the right, click on "Annotate" and then on "To Textgrid" which will open a window. For files we're analyzing as onset, write for "All tier names" "vot asp vowel vbar" just like that with a space between each word, and for "Which of these are point tiers?" keep it blank. All of our tiers are intervals rather than points. For files we're analyzing as coda, write for "All tier names" "vowel vbar dur". All the textgrids will appear as "#. Textgrid [same file name]". **Please refer to Appendix A in Terry Au's (ms) paper to see which files are in which category.**

Holding down Ctrl, highlight both the sound file and its textgrid file. For example, highlight both 1. Sound renamed6701 and 2. Textgrid renamed6701. The menu on the right will change to allow you to click on "View & Edit", opening up a window where the sound file (made up of waveform and spectrogram) is shown on top and the textgrid is on the bottom (as a series of intervals). For example, if you're analyzing a coda file, you'll see a space to mark the interval of the vowel, below that one for the interval of the vbar, and then one for the interval of the duration, with each tier labeled on the right.

If you take a moment to consider it, you'll notice that all those numbers crowded around the waveform, spectrogram, and interval tiers are mostly telling you about durations and frequencies. If you highlight a section of the spectrogram with your mouse, you'll see it's automatically annotated with its duration both above and below. If you click on the spectrogram, you'll see your mouse as the middle cross of two perpendicular red dotted lines; the horizontal line leads to a red number on the left which indicates the frequency (in Hz) of that point in the spectrogram.

Three drop-down labels – Pitch, Intensity, Formant - in the upper menu allow you to show or hide those three important measures on the spectrogram. They're represented with a blue line, a yellow line, and red dots, respectively.

So, depending on the type of file, we are going to mark the beginning and end of the:
1. Vowel (labelled as vowel)
2. Voice Onset Time (vot)
3. Aspiration (asp)
4. Voicing bar (vbar)
5. Duration of Closure (dur)

To set boundaries that mark these intervals, click on where you want to set the boundary, press Ctrl+0 (zero) to adjust the boundary to the point where the waveform crosses the zero line, then click on the little circle above the line you created in order to set down the boundary. Between two boundaries, type in the label itself (vowel, null vbar, dur, etc.) If you can't find it (usually aspiration or vbar), set up where the markers *should* be (i.e., by phoneme boundary, as you'll see below) and type in "null asp" or "null vbar".

See that **Ctrl+I zooms in; Ctrl+O zooms out**. Always zoom in to examine the waveform itself before you set a boundary.

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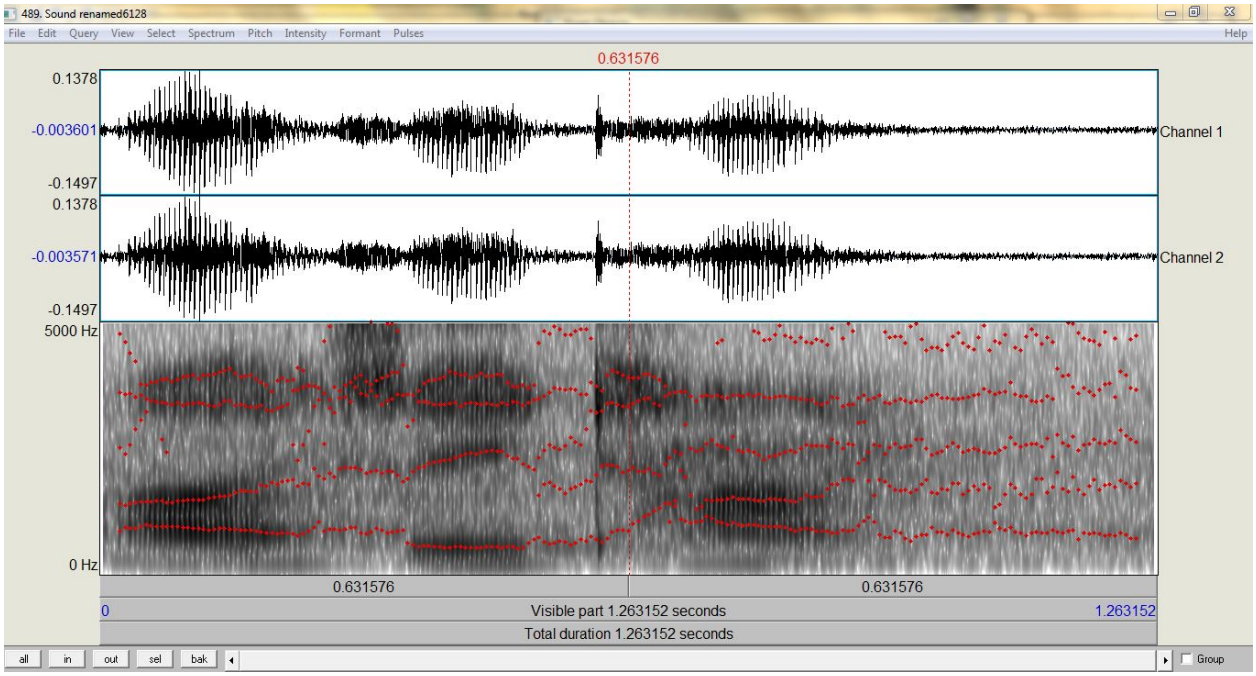
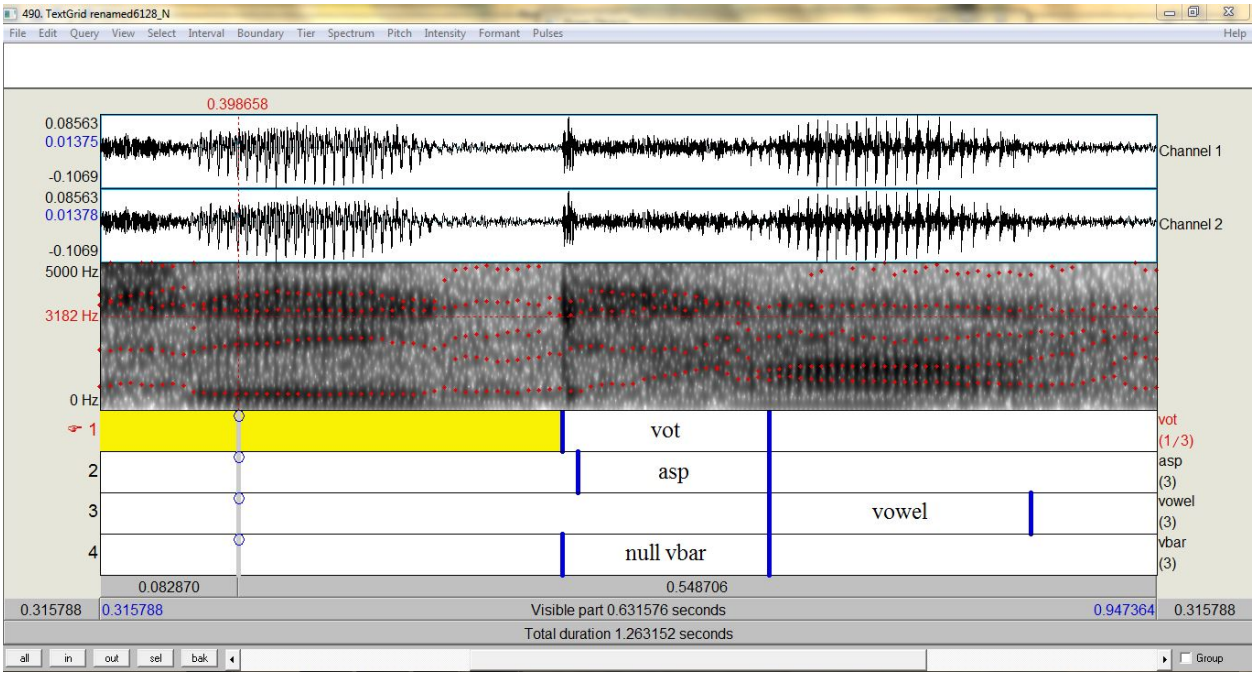
How to set up the textgrids:

Fig. 1. Onset example

Sound file



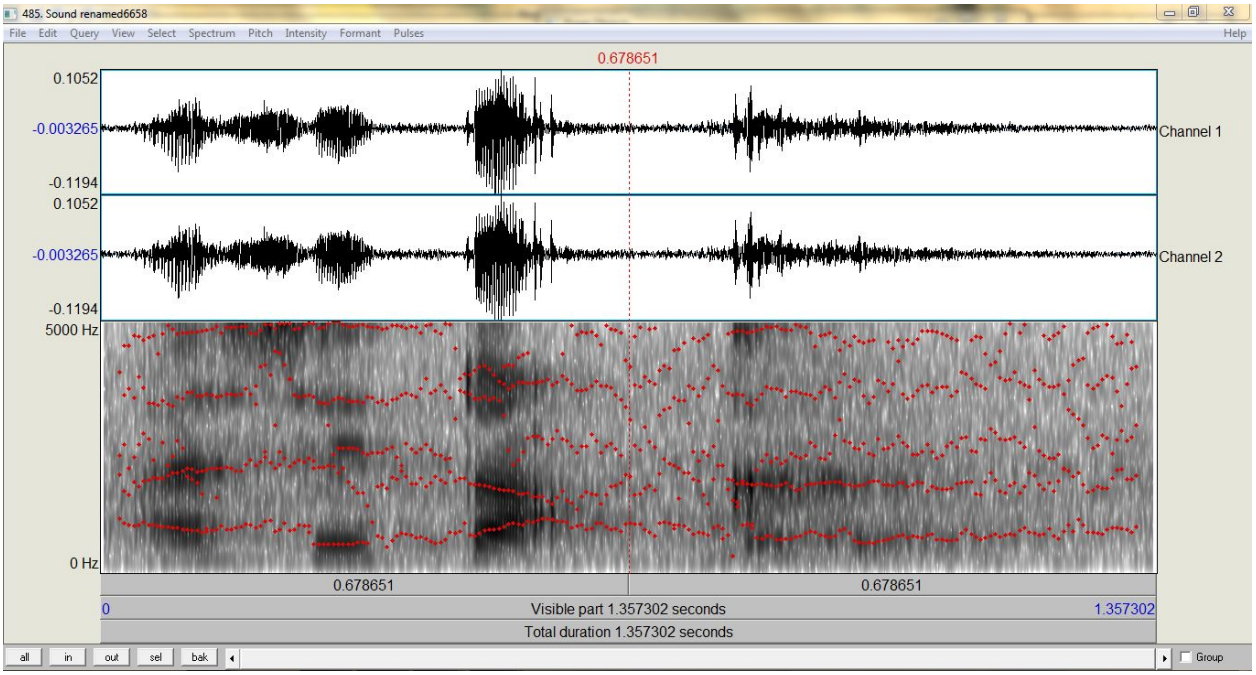
Sound and textgrid file



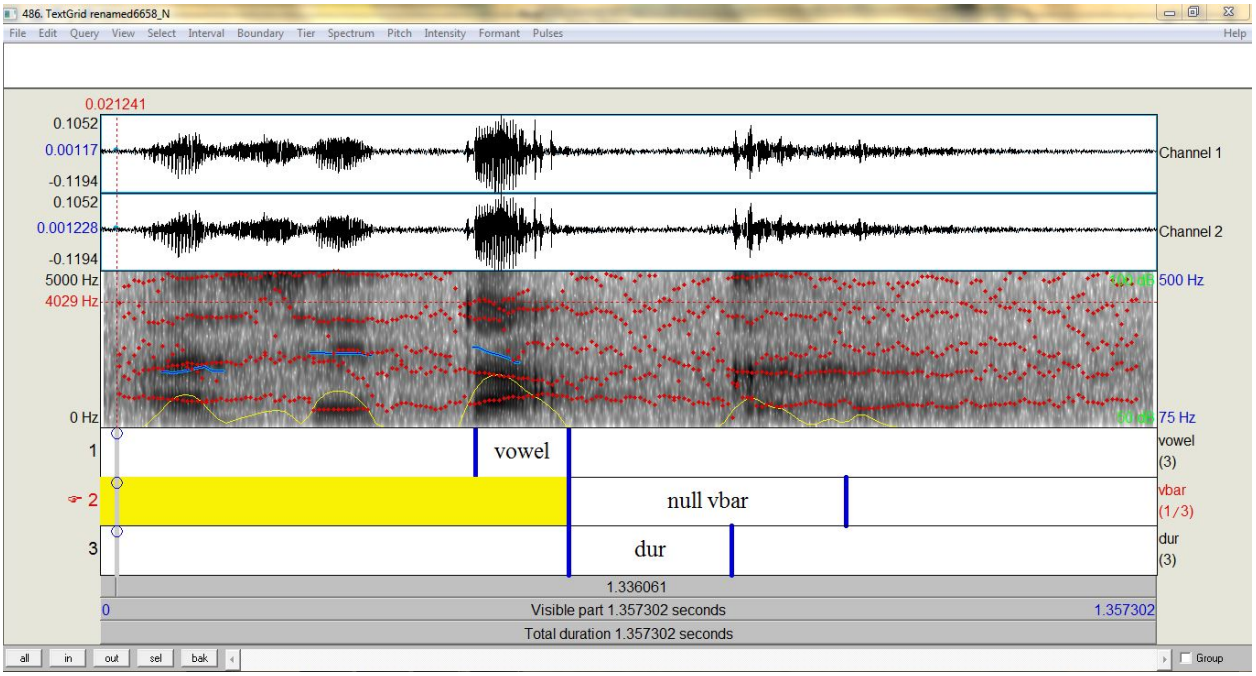
Notice that the ends of vot, asp, and vbar always align with the start of the vowel, and the null vbar is bounded by the phoneme.

Fig. 2. Coda example

Sound file



Sound and textgrid file



Notice that the end of the vowel aligns with the starts of the vbar and dur.

In other words, all of your boundaries to the left of the vowel should align (onset words picture in Fig 2.) and all of your boundaries to the right of the vowel should align (coda words pictured in Fig. 1).

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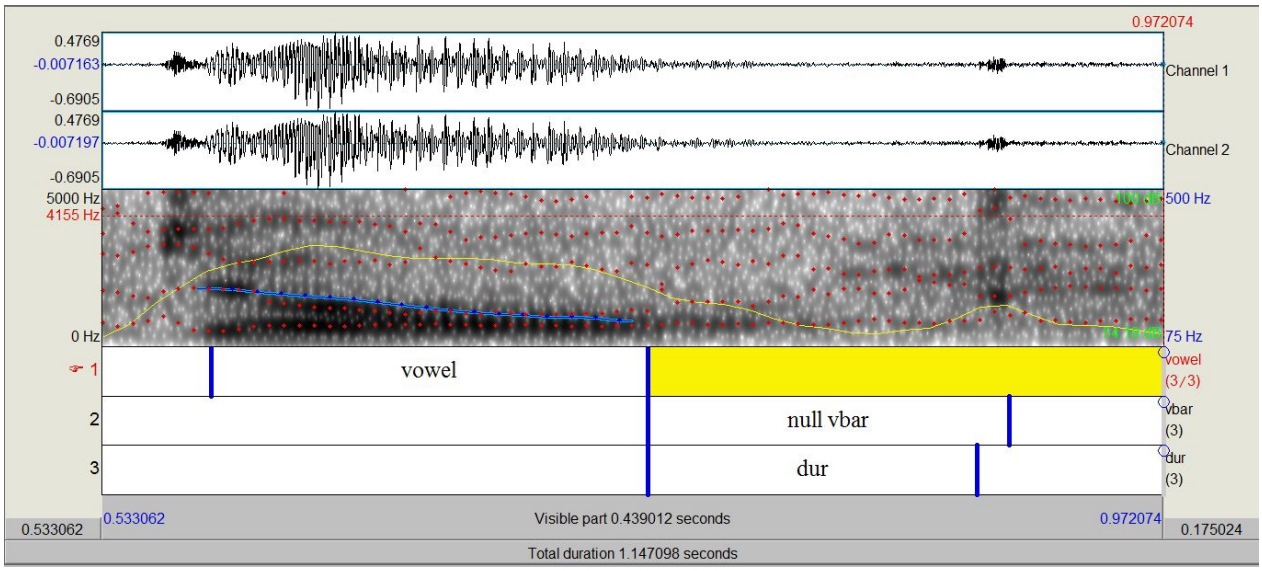
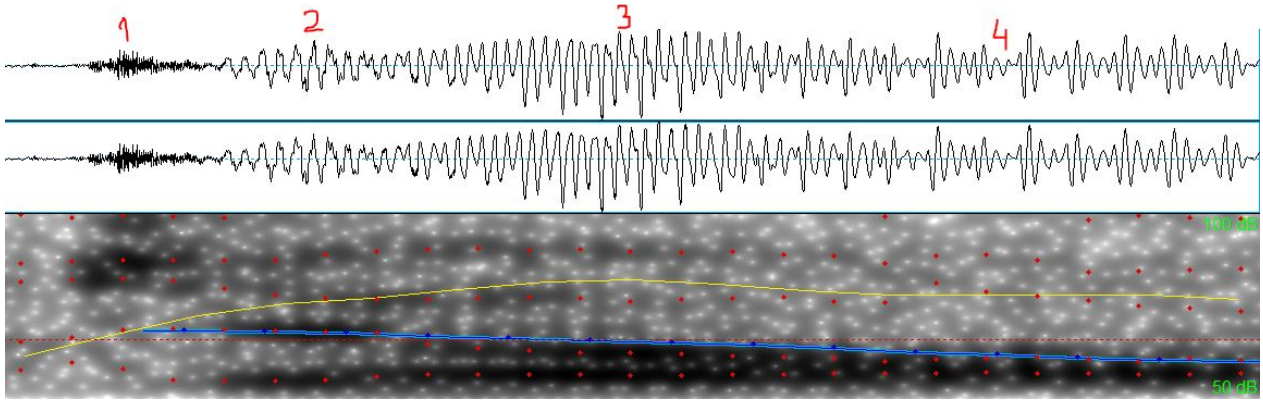
1. Vowels – Duration, pitch, formants, creaks

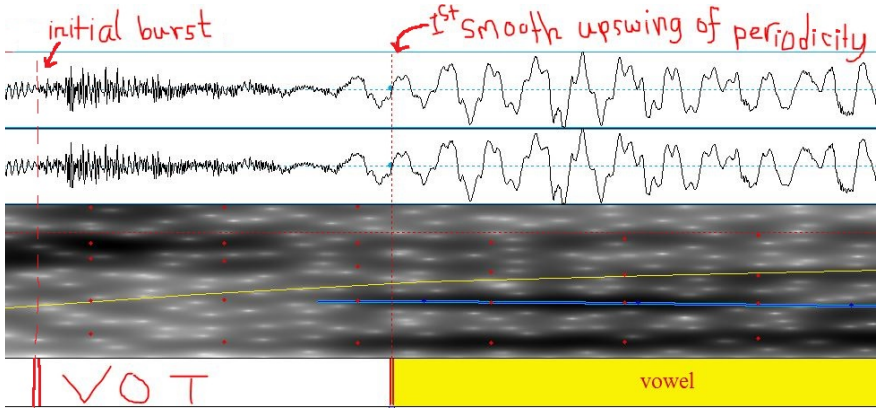
To mark the vowel interval, start with onset of periodicity (when the waveform gets repetitive). This is referred to as the wav method of measuring the vowel.
Here is an example of marking the /o/ in /dog/.



You might find yourself in a dilemma when multiple waveforms all look like candidates for onset.



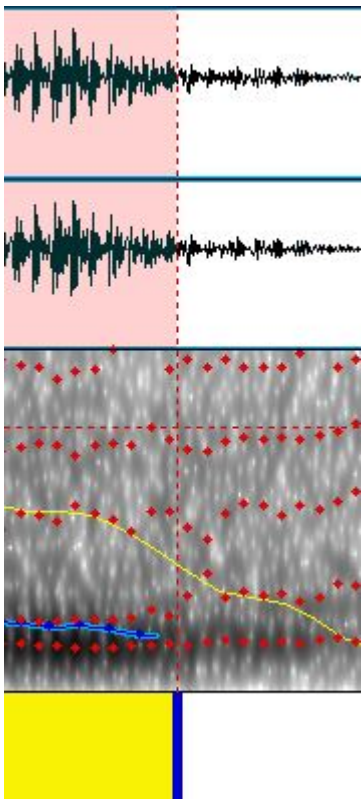
If you listen to 1, it sounds like /t/, whereas 2 sounds like /di/, 3 sounds like /do/, and only 4 finally sounds like /o/. But choose between 1 and 2, when the waveform is "nondeformed' or no longer shaky. 1 is the initial consonant burst; because of coarticulation of consonant and vowel, 2 and 3 sound like they still have consonant in them, but they already have vowel too.



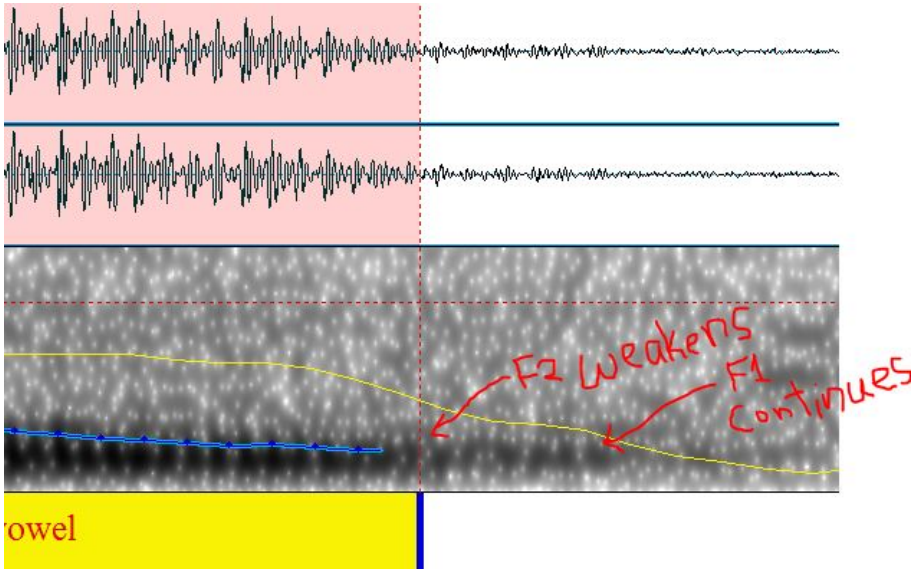
There will be no clean break between the consonant and the vowel.

**Notice that the vowel has other characteristics. Whereas the initial /d/ burst is characterized by a dark band of energy near its top, the vowel always has a dark band of energy at the bottom – its first formant, represented by the first line of red dots. Each subsequently higher line of dots represents the second and third formants and so on. The yellow line, representing intensity, also tends to have this shape where it rises between the VOT and the vowel and then curves downward at the end of the vowel.

End the vowel where the second formant weakens (this is called the F2 method).



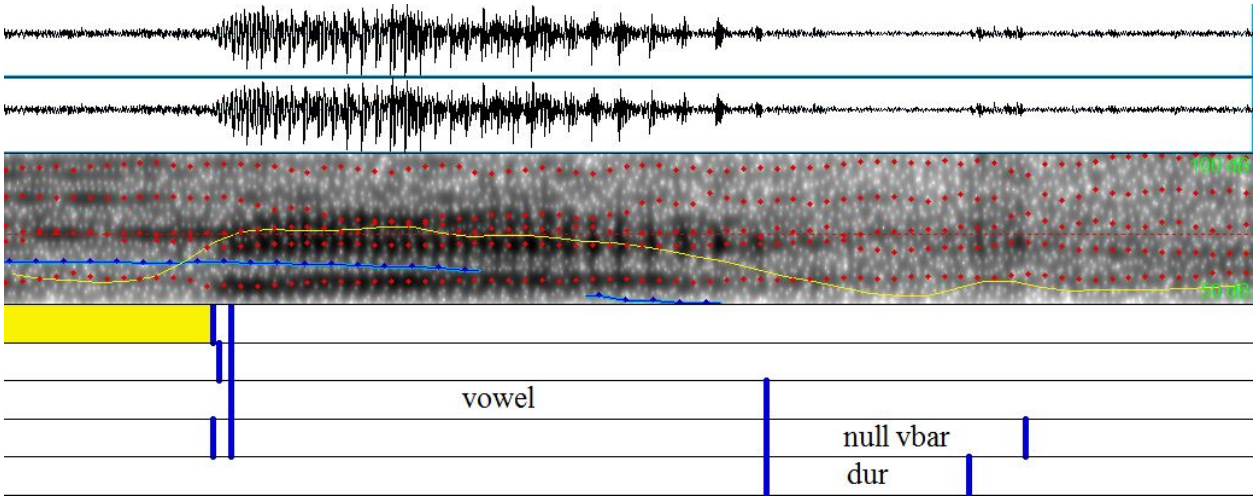
In the left screenshot, the formants are marked with red dots. Having PRAAT show formants allows you to see that the lower band of energy in the spectrogram is comprised of both formants 1 and 2, which isn't always the case – sometimes the lower band is just F1, and F2 is closer to F3. Not showing the red dots allows you to see more clearly where the band of energy gets paler.



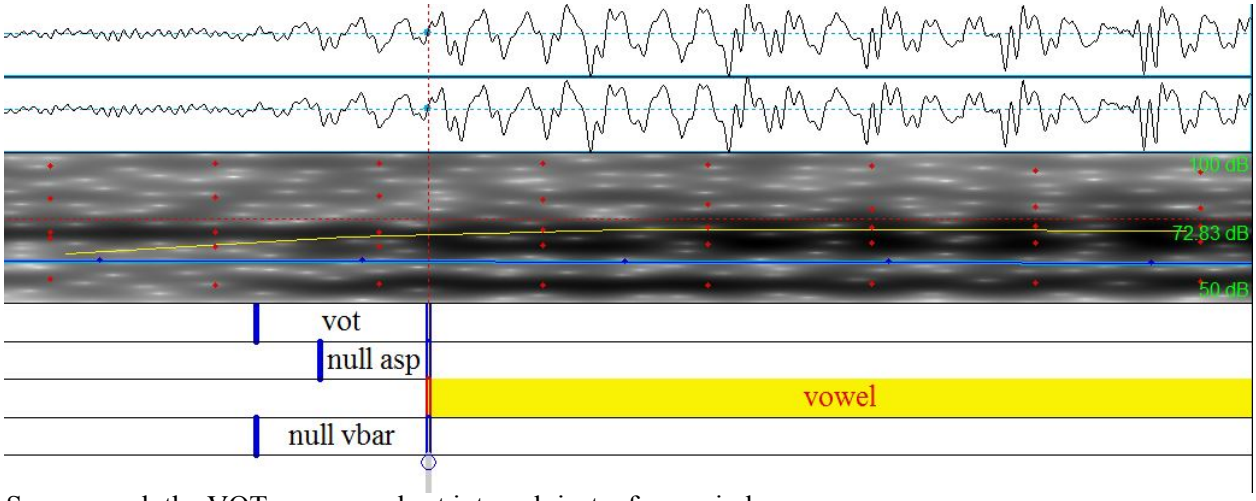
The vowel is done! **Now, take and record two measures from the interval**. With your cursor at the end of the vowel, Ctrl+F2 to get a window that tells you the F2 at that point. Copy and paste that value into the spreadsheet. If the pitch looks relatively level, put your cursor in the middle of the interval and Ctrl+F5. Copy and paste the pitch reading into the spreadsheet. However, if it looks like the pitch changes over time, record the change as = F2 at the end – F2 in the beginning.
We are also interested in the duration itself of the vowel, but we don't have to record that manually. When you mark the vowel boundaries, a program can automatically record that information for you.

**The pitch is never exactly level and tends to slightly decrease. I would record it as level if the change is less than about 50 Hz; I would call it changing if the change is more extreme, in which case it is often a change of 80 or 100 Hz. Also, PRAAT sometimes doesn't tell you the pitch, in which case record "undefined", or else it gives you the pitch for just half of the vowel, in which case I do record the pitch anyway. Whenever possible, try to record it.

Let's consider another example. Here is "back", which is the only file we slice as both onset and coda (you give it all five intervals "vot asp vowel vbar dur").

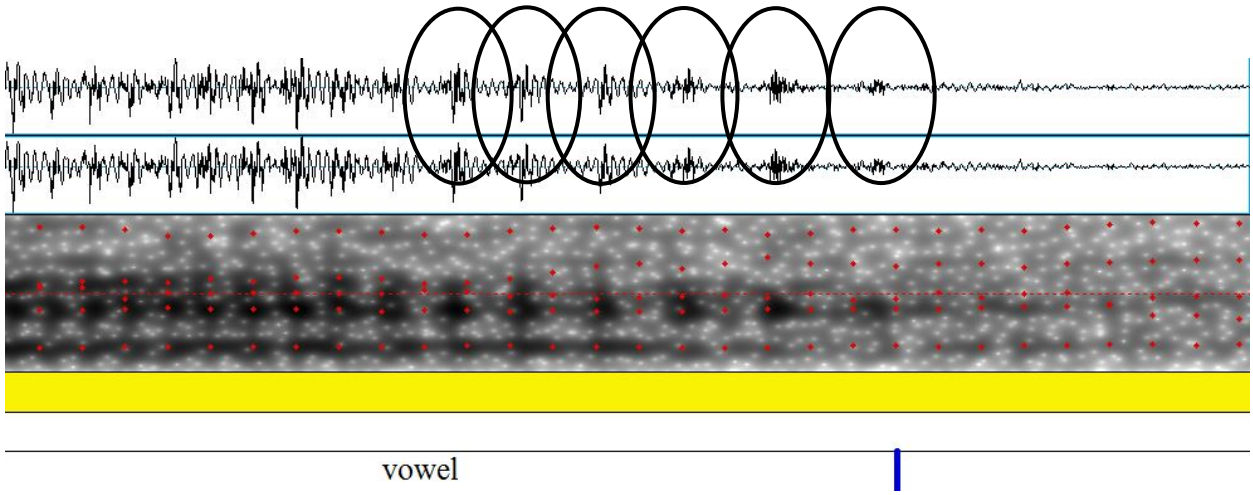


The vowel starts, it seems, almost right with the consonant.



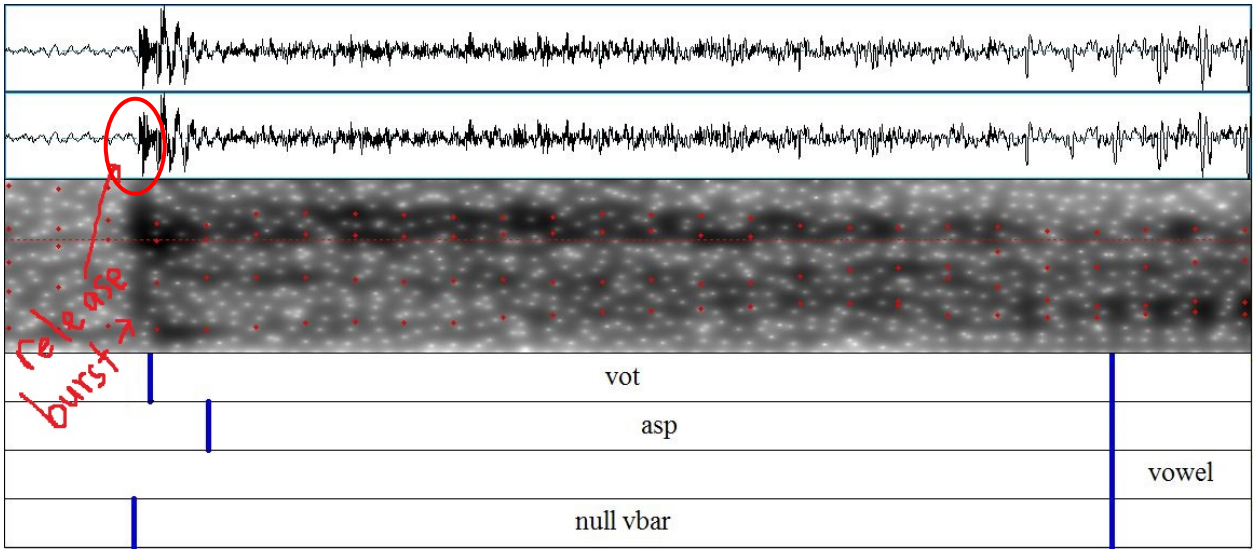
So you mark the VOT as a very short interval, just a few periods.
The end of the vowel is continued on the next page.

What about the end? In this case it seems the F2 is flickering in a particular pattern (outlined with black circles): the vowel is “creaky”. End it *after* the creaks end because we are including the creaks in the vowel length.



2. Voice onset time (vot)

As we saw above, VOT is the time between the release burst of the consonant and the onset of periodicity for the vowel. You can expect that it will be longer for /p/ than for /b/, /t/ than for /d/ - of course! The greater the VOT, the more likely you are to make the categorical distinction that you hear the unvoiced rather than the voiced plosive. It is also within VOT that you'll find aspiration if there is aspiration.



3. Aspiration (asp)

Aspiration looks like it has no waveform in particular and sounds like a continuous "hhhh" sound. Please see the above example for an illustration. To measure mean aspiration intensity when there's aspiration, click on the entire interval and Ctrl+F8. Make sure that the intensity line is showing.

4. Voicing bar (vbar)

This looks like a grey band of energy hugging the lowest part of the spectrogram, within the vot and the dur. We haven't found it in any of slices so far, but here's what it looks like in a spectrogram of the words "a bab, a dad, a gag".

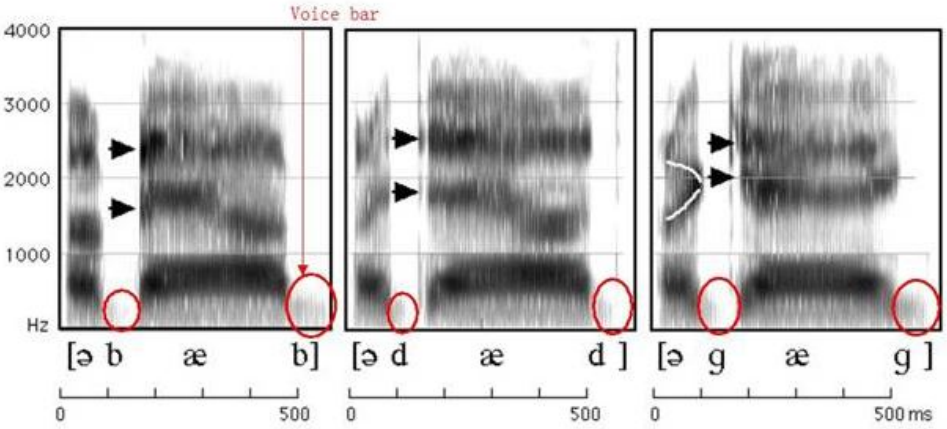
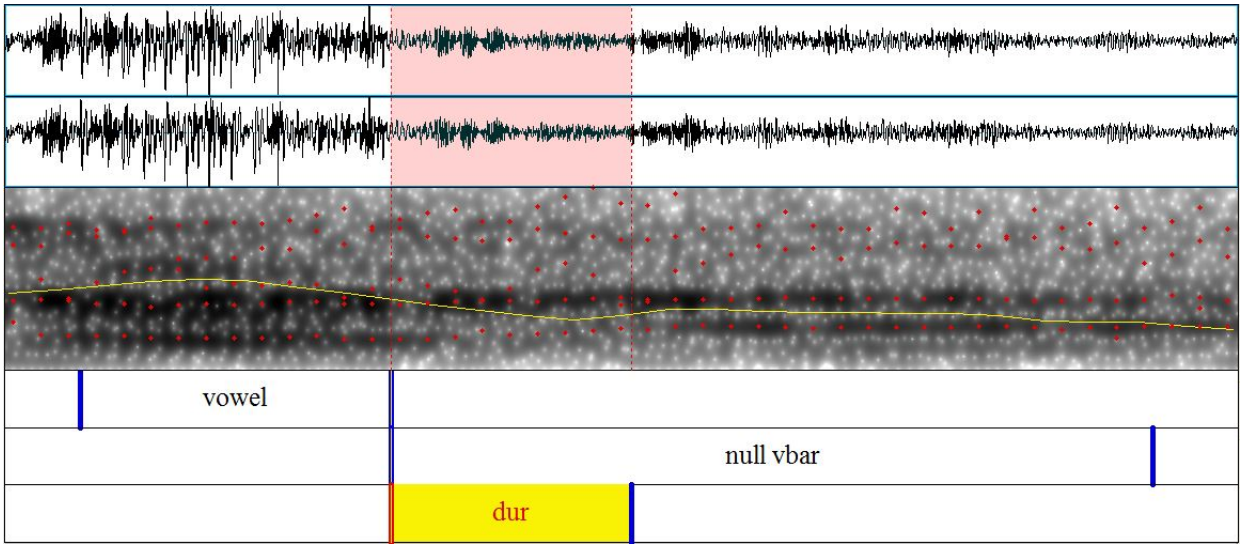


Image retrieved from http://ec-concord.ied.edu.hk/phonetics_and_phonology/wordpress/learning_website/chapter_3_consonants_new.htm

5. Duration of closure (dur)

This is the time between the end of the vowel and the release burst of the coda consonant – please see any of the examples above. There can be two complications with this measurement. First, by this point there may a lot of background noise interfering. Second, very often –when the coda should be /p/ or /b/ – there is no final release burst. In such a case, mark the end of the dur at the point before which it sounds like the rest of the file is just noise. One of the clues you can use to find that point is where the intensity, having dropped after the vowel, rises slightly again.

Here is an example for "cup". Most of the energy you see following the vowel is someone screaming their head off in the background, and not our participant's voice. The boundary is just my best guess – I moved it as close to the left as possible to the point where**, if I listened, it sounded as if I was just about to cut the whole word "cup" off**. If we decide to not include some data in our analysis, files like this would be booted off.



That's it for the textgrids!
Make sure to save them (Ctrl+S). Name them renamedXXXX_yourfirstinitial.TextGrid. E.g., renamed6678_N.TextGrid.

The important thing is that we're consistent with ourselves and each other. Try to always make your decisions in the same way for all boundaries.

Finally, as you slice, record certain measurements on the spreadsheet – file name, type (onset, coda, or both if it's "back"), the age group the data was taken from, what word you think it sounds like, whether there's aspiration and the aspiration intensity, whether there's creak in the vowels or multiple bursts in the consonants, if there's a level pitch contour and therefore the pitch or the change in pitch (F0), the F2 at the end, whether there's a release burst for the consonant, and any other notes you need to make on the file. See the next page for how it looks.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**file**	**type**	**age group**	**guessed word**	**mean asp int (db)**	**aspiration**	**creaky vowel**	**multi-burst consonant**	**level pitch contour**	**F0 (Hz)**	**F2 (Hz)**	**release burst**	**notes**
2													

	A	B	C	D	E	F	G	H	I	J	K	L	M
271	renamed6538.wav	coda	11-12	feud					y	124.4760924	2018.425932	y	
272	renamed6539.wav	onset	11-12	get		n			y	126.5116164	1838.053438		
273	renamed6546.wav	onset	11-12	pay		n			y	126.5490793	1669.124679		
274	renamed6547.wav	coda	11-12	pick					y	123.6547995	1817.089246	y	
275	renamed6548.wav	coda	11-12	pick					y	126.2266866	1980.049372	y	
276	renamed6549.wav	coda	11-12	tab					y	124.3892602	1690.134829		
277	renamed6550.wav	coda	11-12	tap					y	125.2708746	1552.556449		
278	renamed6551.wav	onset	11-12	time	54.52124817	y			y	122.6820221	1374.557305		
279	renamed6552.wav	onset/coda	11-12	back		n	y	y	y	175.0612185	1970.433767	y	
280	renamed6554.wav	coda	11-12	bad					y	193.8661711	2016.107505	y	
281	renamed6555.wav	coda	11-12	bag					y	191.6239201	1968.026624	y	
282	renamed6557.wav	coda	11-12	bat					y	198.0276143	1888.339428	y	
283	renamed6558.wav	onset	11-12	beet		n			y	197.8867937	1555.011177		
284	renamed6565.wav	coda	11-12	cab					y	193.3059039	1502.971146		coda dropped?
285	renamed6566.wav	coda	11-12	cap					y	180.5559668	1738.715199	y	
286	renamed6567.wav	coda	11-12	cat					y	186.1813521	2147.463074	y	

Additional resources

General PRAAT
http://www.haskins.yale.edu/staff/gafos_downloads/AcouToyPraat(1).pdf

General Measurements (including good figures for VOT):
https://www.uvic.ca/humanities/linguistics/assets/docs/LabManual_2015.pdf

Voicing Bar, VOT:
http://ec-concord.ied.edu.hk/phonetics_and_phonology/wordpress/learning_website/chapter_3_consonants_new.htm

Closure duration:
https://linguistics.stackexchange.com/questions/14791/how-to-measure-phonetic-voicing-during-a-stop-closure

Closure duration/ VOT:
http://linguistics.berkeley.edu/phonlab/documents/2007/Yao.pdf

Vowel duration, release burst, aspiration, VOT:
https://home.cc.umanitoba.ca/~krussll/phonetics/acoustic/spectrogram-sounds.html

Other info:
https://www.frontiersin.org/articles/10.3389/fpsyg.2016.00624/full

Also, YouTube.