

Lab 2: VOT and Vowel Duration

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LING 330 Phonetics

Introduction

In this lab, we will investigate the effect of the voicing of a plosive on the duration of preceding segments. We will try to answer the following questions:

1. Does the voicing of a following plosive affect the duration of a vowel?

Hypothesis: Vowel followed by voiceless plosives will have shorter duration than those followed by voiced ones.

2. Does the voicing of a preceding plosive affect the duration of a vowel?

Hypothesis: The voicing of a preceding plosive does not affect the duration of a vowel

3. Does the voicing of C2 affect the VOT of C1?

Hypothesis: the voicing of C2 does not affect the VOT of C1

4. Does the voicing of C1 affect the VOT of C1(i.e.itself)?

Hypothesis: voiced C1 will have shorter VOT than voiceless ones

5. Does the place of articulation of a stop (C1) affect the VOT of that stop?

Hypothesis: the place of articulation of a stop does not affect the VOT of that stop

Method

1. Open each sound file in praat.

2. Measure the duration of vowel and voice onset time of initial consonant.

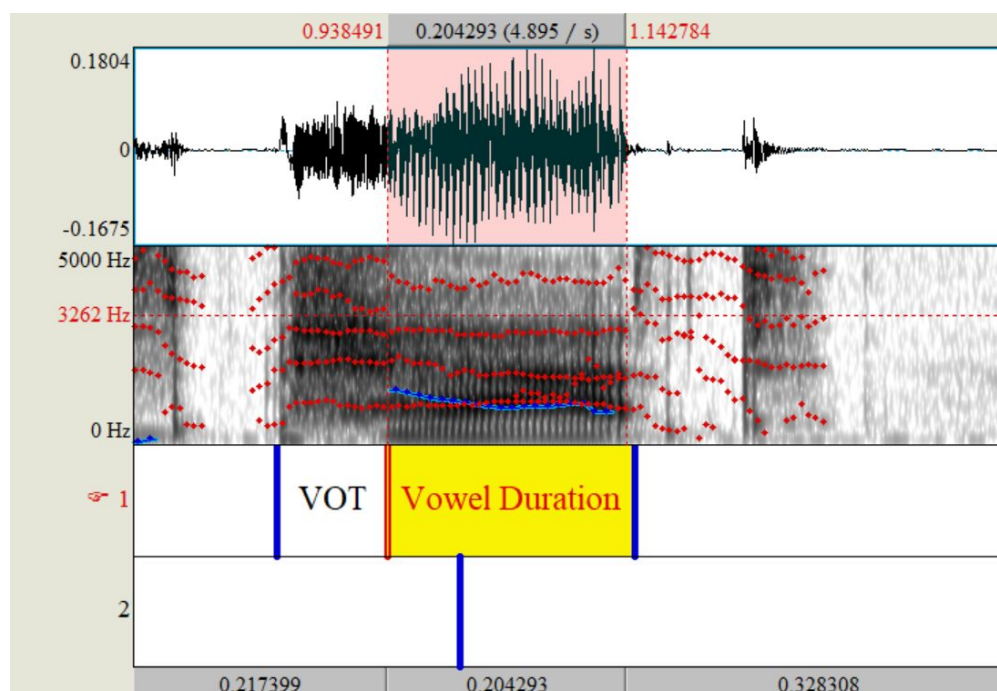
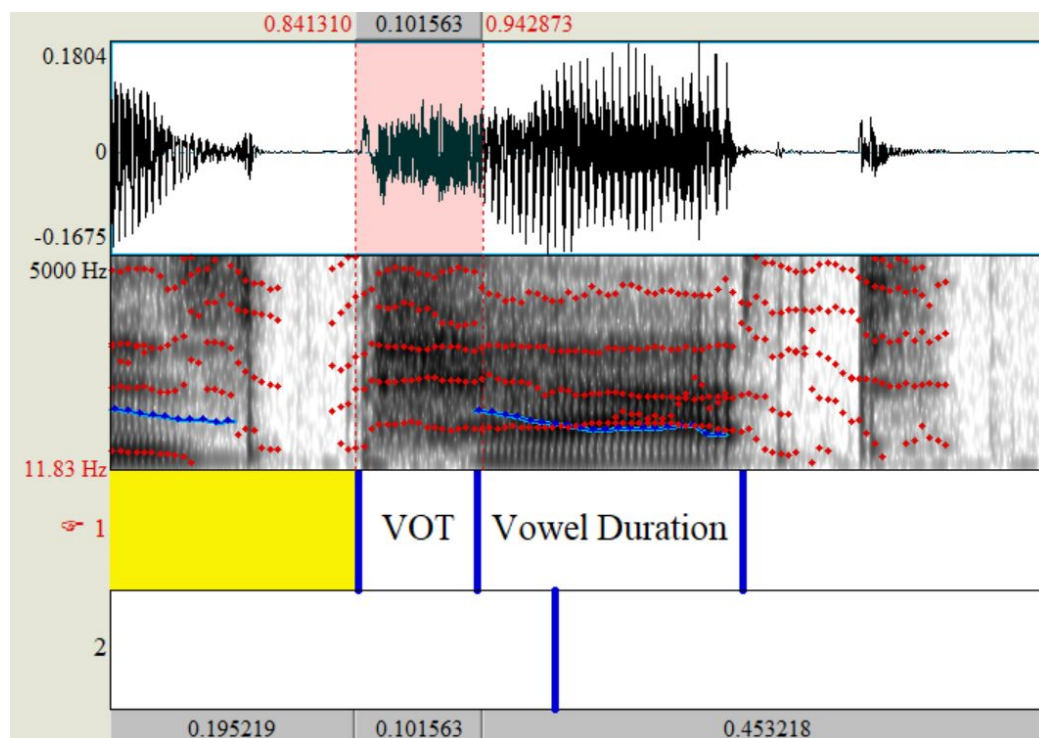
What factors we use to determine the end time of vowel:

1. The presence of sharp changes in amplitude visible in the waveform.
2. A sharp change in amplitude in the spectrogram.

Why we made this choice: To investigate how following plosive affect duration of a vowel, we should determine the end of vowel by "sharp change in amplitude" in waveform and spectrogram.

1. Vowels in the waveform are indicated by relatively dramatic jump of amplitude. If there are no longer such amplitudes present in the waveform, it suggests that the vowel is likely terminated.

2. vowels in the spectrogram are indicated by dark bands with large amplitude. If the amplitude sharply changes, we may expect a shift from vowel to a consonant, and vice versa.



For the word "pat", the figure above showed its waveform and spectrogram.

Burst: after the sentence “the word is” ended, there is a remarkable amplitude change in spectrogram as well as in waveform indicating the burst of the consonant /p/. The start of obvious periodicity in the waveform also suggests the burst.

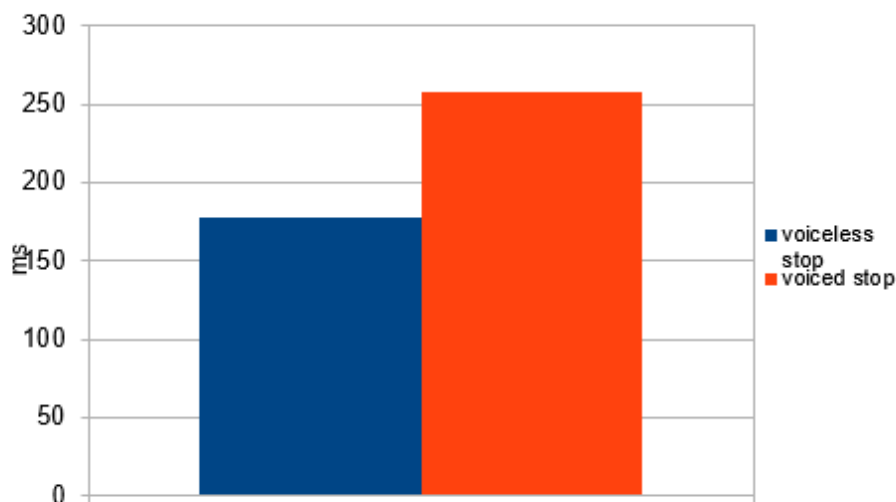
End of vowel: the beginning of sharp changes of amplitude in waveform after the end of the C1 is approximately at 938ms indicating the start of the vowel. The next sharp change which nearly eliminates the amplitude height is approximately at 1142ms. Also, regarding the spectrogram, this interval of time is presented as sharpe change of amplitude of the band patterns compared to the amplitude of the previous consonant. Furthermore, it is clear that in the waveform, periodicity terminates at approximately 1142ms. These factors suggest that the vowel ends at about 1142 ms. Hence the vowel duration in this word is 204ms.

3. Record measurements in data table.
4. Make table and bar graph for each group.
5. Perform unpaired, two-tailed t-test between groups of data.

Results

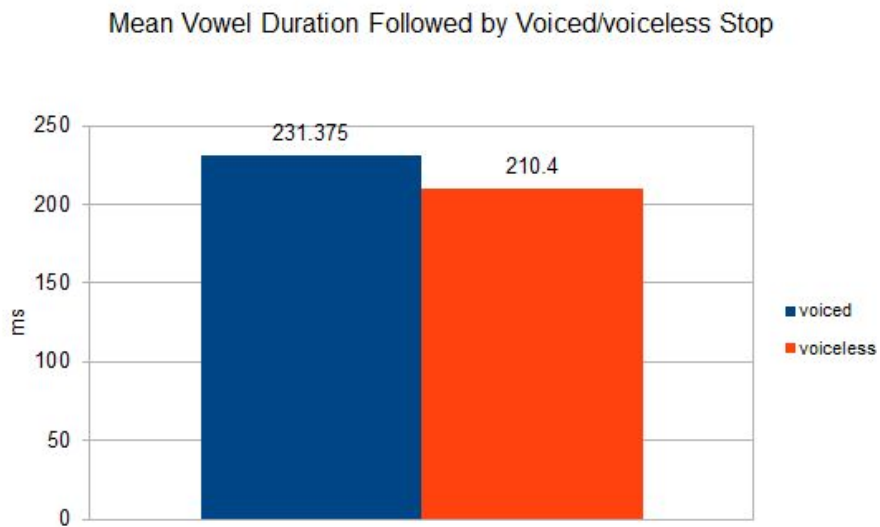
Q1: Does the voicing of a following plosive affect the duration of a vowel?

To answer this question, the vowel durations of words with phonologically voiced final stops were compared to those for words with phonologically voiceless final stops. Vowels were significantly longer before phonologically voiced stops, compared to phonologically voiceless ones ($p < 0.001$).



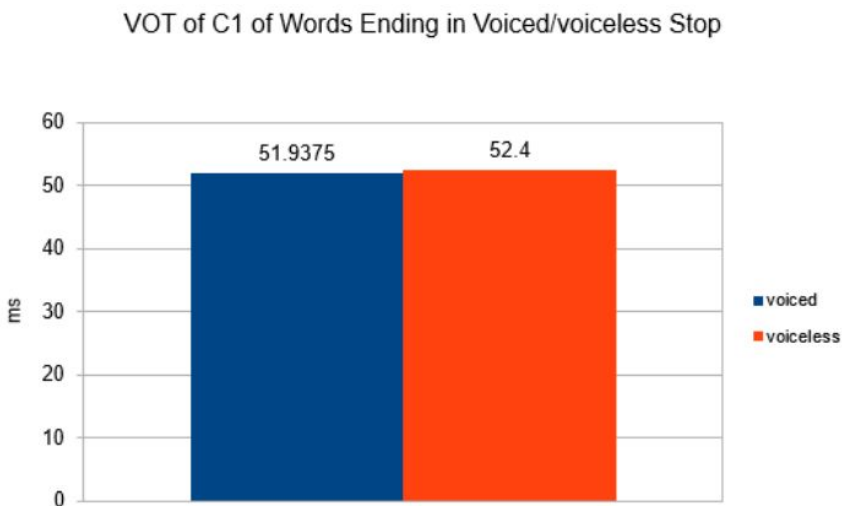
Q2: Does the voicing of a preceding plosive affect the duration of a vowel?

To answer this question, the vowel durations of words with phonologically voiced preceding stops were compared to those for words with phonologically voiceless preceding stops. Vowels were not significantly longer after phonologically voiced stops, compared to phonologically voiceless ones ($p = 0.465$).



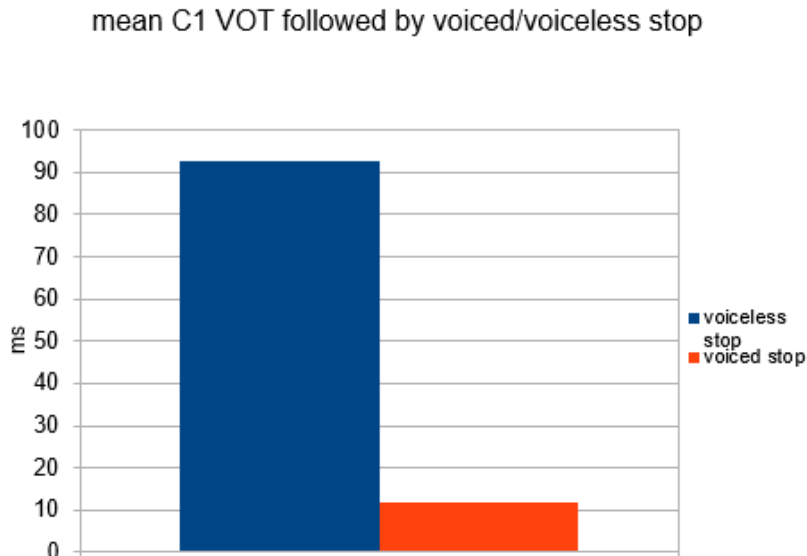
Q3: Does the voicing of C2 affect the VOT of C1?

To answer this question, the voice onset time of C1 in words with phonologically voiceless C2 were compared to those in words with phonologically voiced C2. VOT of C1 were not significantly longer in words with phonologically voiceless C2 ($p = 0.778$).



Q4: Does the voicing of C1 affect the VOT of C1(i.e.itself)?

To answer this question, the voice onset time of phonologically voiced C1 were compared to those of with phonologically voiceless C1. Vowels were significantly longer after phonologically voiced stops, compared to phonologically voiceless ones ($p < 0.001$).



Q5: Does the place of articulation of a stop (C1) affect the VOT of that stop?

To answer this question, we compared the VOT of C1 in different places of articulation. The mean VOT data shows that bilabial C1 tend to have shorter VOT than alveolar and velar C1.

	Voicing Onset Time of C1	
Place of Articulation C1	voiceless C1	voiced C1
Bilabial	84ms	8ms
Alveolar	109ms	16ms
Velar	103ms	21ms

Discussion

Q1: Does the voicing of a following plosive C2 affect the duration of a vowel?

We found that vowel duration was longer following voiced plosive than voiceless plosive. The p -value < 0.001 indicates the difference between these two groups are statistically significant. This finding fit with our hypothesis. We speculate such correlation exists because generally, syllable final voiceless consonants are longer than their corresponding voiced consonants after the same vowel. So to balance the length of the whole word, a given vowel preceding voiceless consonants is shorter than if it is preceding the corresponding voiced one.

Q2: Does the voicing of a preceding plosive C1 affect the duration of a vowel?

We did not find a relationship between vowel length and the voicing of a preceding plosive. The p-value 0.465 indicates the difference between these two groups are statistically insignificant. This finding fit with our hypothesis.

Q3: Does the voicing of C2 affect the VOT of C1?

We did not find a relationship between voice onset time of C1 and the voicing of C2. The p-value 0.778 indicates that the difference between these two groups are statistically insignificant. This finding fit with our hypothesis.

Q4: Does the voicing of C1 affect the VOT of C1(i.e.itself)?

We found that the VOT of voiceless C1 is significantly longer than VOT of voiced C1. The p-value < 0.001 indicates the difference between these two groups are statistically significant. This finding fit with our hypothesis. We speculate such correlation exists because the greater the opening of the vocal folds during a stop, the longer the amount of the following aspiration (i.e. longer VOT).

Q5: Does the place of articulation of a stop (C1) affect the VOT of that stop?

We found that bilabial C1 tend to have shorter VOT than alveolar and velar C1. a relationship between VOT of a stop and the place of articulation of that stop. This finding does not fit with our hypothesis. The finding makes sense because when we produce a bilabial stop, the chambre in oral cavity is larger, and more force from lungs is required to build up same level of air pressure, therefore causing a shorter voice onset time.

Appendix

	Duration of vowel (ms)	Voice Onset Time of C1 (ms)	voicing of C1	voicing of C2	place of articulation of C1
pat	204	94	voiceless	voiceless	bilabial
pot	203	104	voiceless	voiceless	bilabial
cot	202	126	voiceless	voiceless	velar
putt	167	66	voiceless	voiceless	bilabial
talk	230	115	voiceless	voiceless	alveolar
puck	112	72	voiceless	voiceless	bilabial

tuck	109	107	voiceless	voiceless	alveolar
pick	129	65	voiceless	voiceless	bilabial
pad	293	98	voiceless	voiced	bilabial
pod	326	79	voiceless	voiced	bilabial
cod	340	81	voiceless	voiced	velar
pud	188	105	voiceless	voiced	bilabial
tog	284	113	voiceless	voiced	alveolar
pug	215	67	voiceless	voiced	bilabial
tug	196	103	voiceless	voiced	alveolar
pig	169	87	voiceless	voiced	bilabial
bat	268	6	voiced	voiceless	bilabial
bought	237	11	voiced	voiceless	bilabial
got	234	24	voiced	voiceless	velar
but	159	7	voiced	voiceless	bilabial
dock	271	15	voiced	voiceless	alveolar
buck	139	6	voiced	voiceless	bilabial
duck	144	13	voiced	voiceless	alveolar
Bic	99	8	voiced	voiceless	bilabial
bad	342	7	voiced	voiced	bilabial
bod	309	7	voiced	voiced	bilabial
god	311	18	voiced	voiced	velar
bud	225	12	voiced	voiced	bilabial
dog	322	15	voiced	voiced	alveolar
bug	230	11	voiced	voiced	bilabial
dug	223	20	voiced	voiced	alveolar
big	189	8	voiced	voiced	bilabial

Q1:

	mean vowel-duration
vowels followed by voiceless plosives	181ms
vowels followed by voiced plosives	258ms

Q2:

	mean vowel-duration
vowels preceded by voiced plosives	212ms
vowels preceded by voiceless plosives	223

Q3:

	mean C1 VOT
words ending in voiceless plosives	53ms
words ending in voiced plosives	51ms

Q4:

	mean C1 VOT
followed by voiceless plosives	93ms
followed by voiced plosives	12ms

