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Lindsey Rife

*Indiana University - Purdue University Fort Wayne*

Jill Rice

*Indiana University - Purdue University Fort Wayne*

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# A Voice Onset Time Comparison of English and Spanish Stop Consonant Productions: Perception of Foreign Accent



Lindsey Rife (rifelm01@students.ipfw.edu) & Jill Rice  
 Indiana University - Purdue University Fort Wayne  
 Department of Communication Sciences and Disorders

## Abstract

The study seeks to compare and contrast how voiced and voiceless stops differ in voice onset time (VOT) between the phonetic productions of a native English speaker and a native Spanish speaker who learned English as an adult. The hypothesis tested is that there will be differences in VOT between native and non-native speech and that this difference will have a noticeable effect on the identification of these words by English listeners. Minimal pairs of words containing the stops /p, b, t, d, k, g/ were compared. The two speakers were recorded reciting 10 randomized tokens of each of the six words 'peak,' 'beak,' 'tuck,' 'duck,' 'coat' and 'goat.' The experiment data was collected by measuring the speakers' voice onset time using WaveSurfer software. This was done by comparing the measurements made from wide band spectrograms. A significant duration difference in average VOT was found. To test the effects of this difference on perception of these stops, native English-speaking listeners were presented with the recorded words and asked to identify what word they heard, in a two alternative, forced choice task. Results of the listening test showed that the differences in VOT between native and accented speech did affect listener perception of these consonants. For the voiceless stops /p, t, k/ the shorter VOT's produced by the accented speaker (which were similar to the durations of these stops in Spanish) often led English listeners to hear the voiced stops /b, d, g/.

## Introduction

- It is a well-established fact that duration of voice onset time (VOT) of English stop consonants before stressed vowels is the primary cue to the voicing contrast.
- VOT is the measure between the release of the stop closure and the beginning of the following vowel.
- It is well known that other languages do not use VOT to distinguish stops in the same way that English does.
- One of the most challenging aspects of learning a second language is to learn to perceive and produce the subtle phonetic differences such as voice onset time.

| Contrast Words  |                       |                        |
|-----------------|-----------------------|------------------------|
|                 | 'Voiced'<br>Short VOT | 'Unvoiced'<br>Long VOT |
| <b>Bilabial</b> | beak                  | peak                   |
| <b>Alveolar</b> | duck                  | tuck                   |
| <b>Velar</b>    | goat                  | coat                   |

## Hypothesis

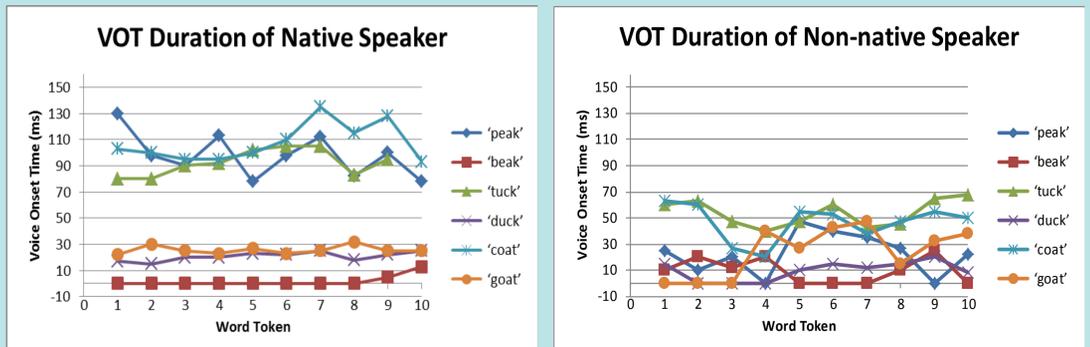
- 1) The native Spanish speaker will have a shorter VOT in voiceless stops than the native English speaker.
- 2) VOT will cause English listeners to misidentify the accented words.

## Methods

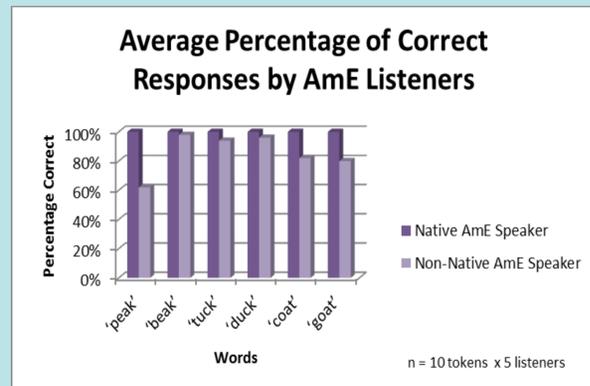
- Six words were chosen specifically for this study, which contained three voiceless stops and three voiced stops, with three different places of articulation. The combinations were comprised of /bilabial stop -voice/ 'pik/, 'bilabial stop +voice/ 'bik/, 'alveolar stop -voice/ 'tʌk/, 'alveolar stop +voice/ 'dʌk/, 'velar stop -voice/ 'kot/, and 'velar stop +voice/ 'got/.
- Ten tokens of each word were created and then the words were randomized and put in a list. Six words with ten tokens each resulted in 60 tokens. The subjects were asked to read the words which were randomly ordered.
- The utterances were acoustically analyzed via WaveSurfer. Voice onset time was read and measured on a wideband spectrogram starting at the release burst of the stop to the point where the voicing of the vowel began. The mean and standard deviation of each speaker's voice onset time for each word was calculated.
- Next, five participants listened to both the native AmE and non-native AmE speaker's recordings through headphones. They were asked to determine whether the speaker stated "peak or beak," "tuck or duck," or "coat or goat" depending on the true utterance.

## Results

- The non-native AmE speaker had shorter average voice onset time overall.
- The non-native AmE speaker's utterances containing the voiced stops, /beak, duck, goat/, were close in average to the native AmE speaker's utterances.
- The native Spanish speaker's utterances containing voiceless stops, /peak, tuck, coat/, had noticeably shorter average voice onset times compared to the native English speaker.
- Differences between voicing and place of articulation affected the non-native AmE speaker's VOT.



- The results for the identification of the bilabial stops were expected.
- The results for the alveolar and velar stops were less clear.
- The study did not test for voicing or look at audible pitch periods.
- Other cues are also important when identifying speech. Determining other cues would be worthwhile for further research.



## Discussion and Conclusion

- While the utterances containing voiceless stops of the Spanish speaker did have a shorter VOT than the English speaker, as expected, they had a variance of VOTs within the specific word category.
- The Spanish speaker was not consistent with the amount of voice onset time she used when producing her words.
- It is believed that even though the speaker has learned the phonetics of the words correctly, she has yet to "master" the English language. Voice onset time is learned through experience.

## References

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