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Pitch Differences in Bilingual Speakers

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Pitch Differences in Female Bilingual Spanish/English Speakers

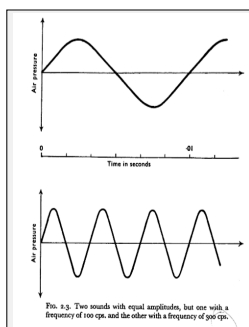
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Introduction

This phonetic study examines differences in fundamental frequency (F0), perceived as pitch, between Spanish and English within Spanish/English bilingual speakers.

- **What is sound?**
Sound is air pressure vibrating off of our eardrums.
- **What is pitch?**
The rate of these vibrations results in the perception of pitch.

Human ears can hear vibrations between 16 Hz and 20,000 Hz. However most frequencies of speech are below 8,000 Hz (Ladefoged 1962).



These two sound waves differ only in pitch. The top sound wave shows one cycle every 1/100 of a second, having a pitch of 100 cycles per second (cps).

The bottom sound wave has 300 cps. The amplitude, or loudness, diagrammed by the maximum and minimum peak pressure, is the same between these two sounds.

Background

Previous studies of the differences in F0 of English/Russian bilinguals and English monolinguals show Russian to be significantly higher. However, when bilinguals spoke in English first, the Russian F0 was lower than usual. This suggests "that for languages with different characteristic mean F0's, one language may influence the mean F0 of the other language." (Attenberg and Ferrand 2006).

Goals

The two central questions guiding the analysis of pitch difference of Spanish and English in the current study are:

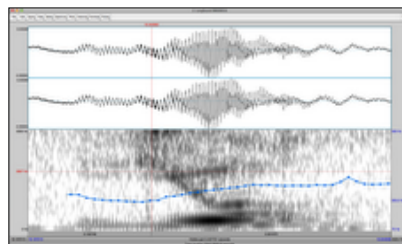
- **Is there a significant difference in the fundamental frequencies of Spanish and English within an individual speaker?**
- **Do the mean frequencies of these two languages change when bilinguals code-switch?**

Methods

Four Spanish/English female bilinguals, whose first language is Spanish, were recorded. Acoustic measurements were taken for three segments of Spanish and three segments of English for each, with each segment averaging three seconds in length

Participants were recorded describing a narrative, beginning in a language of choice and switching between Spanish and English.

Utterances were recorded on an Olympus DM-10 digital recorder and then analyzed with the Praat: doing phonetics by computer software program.



The blue line of the bottom section indicates the fundamental frequency of a sound file in the Praat: doing phonetics by computer software program.

Results

Paired-sample *t*-tests were conducted for the whole group to determine if the mean F0 of each language had a significant difference.

Person A	Spanish	English
1	198.08	187.5
2	194.89	180.17
3	198.5	181.1
	Average Sp	Average Eng
	197.16	182.92
Person B	Spanish	English
1	210.88	177.58
2	192.28	175.98
3		
	Average Sp	Average Eng
	201.58	176.78
Person C	Spanish	English
1	177.93	163.25
2	169.52	166.49
3	175.56	185.45
	Average Sp	Average Eng
	174.33	171.73
Person D	Spanish	English
1	183.79	148.52
2	174.56	163.88
3	170.3	146.4
	Average Sp	Average Eng
	176.21	152.93

The results for each individual participant are shown for English and Spanish.

Results indicate that the difference in fundamental frequency is statistically significant ($p = 0.05$), with Spanish having an overall higher pitch than English.

T-Test		
Person	Average Spanish	Average English
A	197.16	182.92
B	201.58	176.78
C	174.33	171.73
D	176.21	152.93

A *t*-test of participants' averages determined that pitch differences were significant ($p=0.05$)

Conclusion

Evidence from prior studies conducted indicates that some languages may have an effect on the pitch characteristics of other languages when they come into contact in bilingual/multilingual communication.

Future Directions

The data gathered proved to be insufficient to analyze differences in F0's during code-switching. To provide the necessary data, the following guidelines would be in order:

- Record longer segments to ensure sufficient data, not effected by circumstantial fluctuations.
- Record multiple segments for each participant to ensure natural, relaxed speech.
- Record and analyze separate samples of English and Spanish to compare with bilingual/ code-switching samples.
- Select English words or phrases in the environment of Spanish and vice versa to analyze fundamental frequency tendencies in bilingual speech.

References

- Attenberg, Evelyn P. and Carole T. Ferrand. "Fundamental Frequency in Monolingual English, Bilingual English/Russian, and Bilingual English/Cantonese Young Adult Women." *Journal of Voice*. Volume 20, Issue 1, March 2006 (89-96).
- Boersma, Paul and David Weenink. *Praat: doing phonetics by computer* (Version 5.1.05) [Computer program]. Retrieved May 1, 2009, from <http://www.praat.org>
- Ladefoged, Peter. *Elements of Acoustic Phonetics*. University of Chicago Press. 1962.