A contrastive acoustic analysis of dental and alveolar stops in Spanish and English

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Introduction

Coronal stops (VOT)

- English and Spanish contrast *fortis* with *lenis* stops
- One acoustic correlate of contrast is VOT

	Lead	Short-lag	Long-lag
Spanish	d	t	
English		d	t

- English uses [spread glottis] while Spanish uses [voice] [1]

Spanish	[voice]	
English		[spread glottis]

Place of articulation

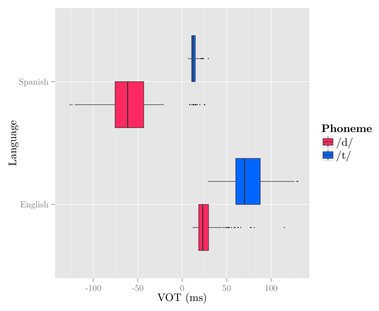
- Spanish /d/ and /t/ are "dental"
- English /d/ and /t/ are "alveolar"

Research questions

- What are the acoustic correlates of place in coronal stops?
- Can we measure the acoustics of the articulatory difference?
- How are short-lag stops manifested acoustically?
  - Question not addressed for Spanish/English
  - Coronal stop acoustics studied for French/English [2]

Goal of present study

Provide acoustic measurements of Spanish/English coronal stops to investigate further questions regarding these stops in different populations (bilinguals)



Method

Materials

- Consonants in utterance-initial position
- **Consonant** (/d t/) × **Language** (English, Spanish) × **Stress** (stressed, unstressed) ['σ.σ] vs. [σ.'σ]:
- 6 (items) × 2 (consonants) × 2 (stress) = 24 words

Speakers (N = 14)

Language	Origin	N
Spanish	Majorca, Spain	7
English	Arizona, US	7

Procedure

- Auditory stimuli: 6 'talkers' (3 Eng., 3 Sp.) each word produced 3 times. 24 words × 3 iterations × 2 languages = 144 stimuli
- Delayed repetition "– is the word" "– es la palabra"

Acoustics

- 144 (observations) × 14 (participants) = 2016 tokens
- Acoustic metrics (VOT, Spectral moments, Mean intensity)

Center of gravity	Standard deviation	Skewness
Kurtosis	Central moment	Mean intensity

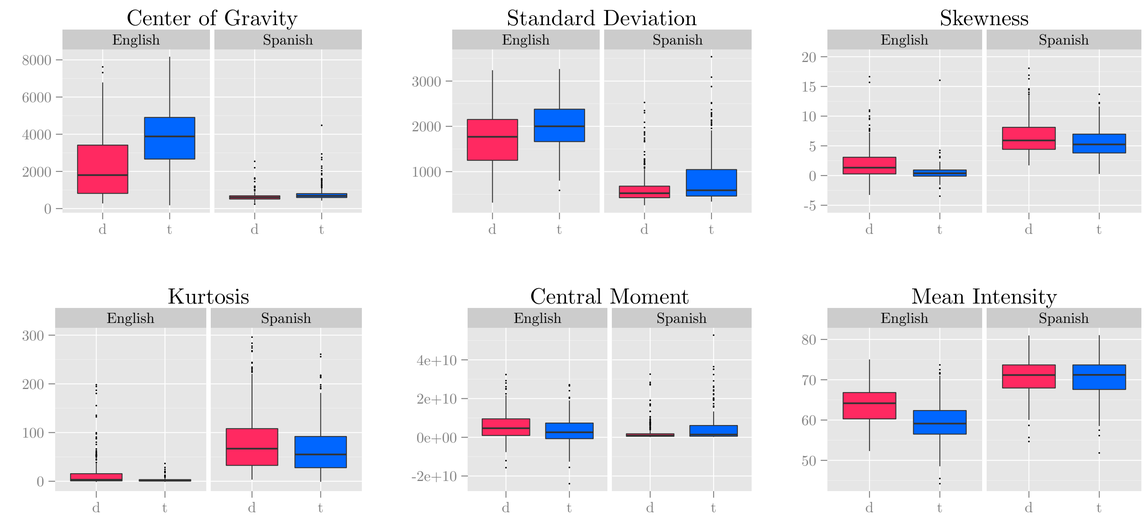
Note: Spectrum of burst (20 ms Gaussian window left-aligned)

Statistics

- Spectral moments individually regressed on VOT
  1. Residuals used as criterion in factorial analysis
  2. Residuals used as predictors in logistic regression

Results

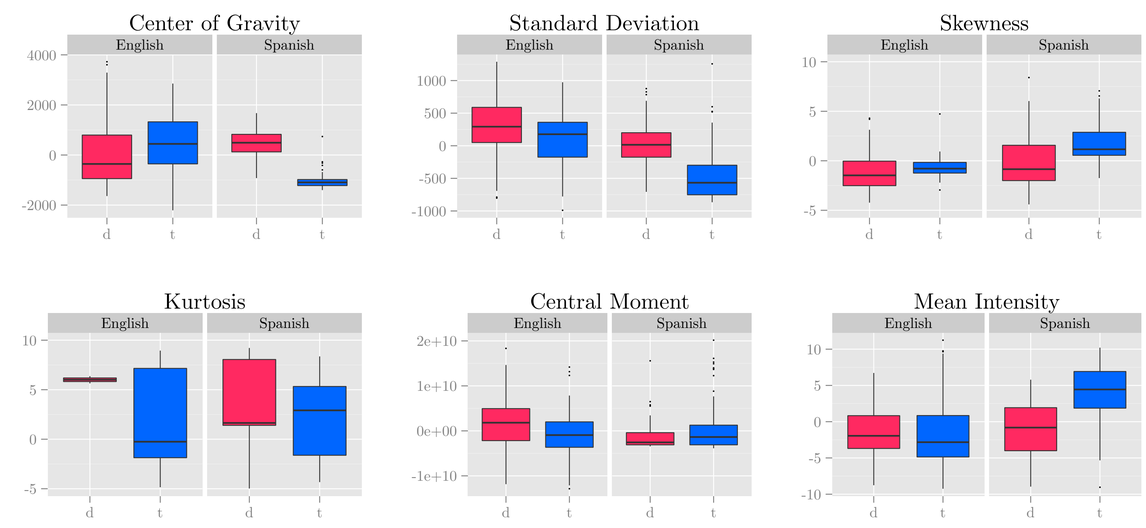
Factorial analysis of spectral moments and mean intensity



ANOVA	COG	SD	Skewness	Kurtosis	CM	Mean Intensity
Language	✓	✓	✓	✓		✓
Voicing	✓	✓	✓	✓		✓
L × V	✓				✓	✓

DV ~ Language (Spanish, English) × Voicing (/d t/)

1. Residuals used as criterion in factorial analysis



ANOVA	COG	SD	Skewness	Kurtosis	CM	Mean Intensity
Language		✓	✓			
Voicing	✓	✓	✓			✓
L × V	✓				✓	✓

resid(DV) ~ Language (Spanish, English) × Voicing (/d t/)

2. Residuals used as predictors in logistic regression

Data subset = short-lag VOT stops (Spanish /t/, English /d/)

	COG	Mean Intensity	SD	Skewness	Central Moment
R^2	.67	.54	.51	.47	.0

Consonant ~ {COG, Mean intensity, SD, Skewness, Central moment}

Conclusion

- Spanish and English coronals differ is spectral envelope of burst
- Effects of spectral envelope above and beyond VOT
- Center of gravity explains 67% of variance in short-lag stops
- Center of gravity is available as correlate for future studies

Selected references

[1] Beckman, J and Helgason, P and McMurray, B and Ringen, C. Rate effects on Swedish VOT: Evidence for phonological overspecification. *Journal of Phonetics*, 39:39–49, 2011.

[2] Megha Sundara. Acoustic-phonetics of coronal stops: A cross-language study of canadian english and canadian french. *The Journal of the Acoustical Society of America*, 118:1026, 2005.