1pSC32

Do language-specific differences in primary acoustic cues affect relative weighting of secondary cues to phonological contrasts?

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INTRODUCTION

CUE WEIGHTING

- Cross-language differences in cue weighting are often attributed to differences in phonological inventories
  - Listeners give greater weight to those acoustic cues that best differentiate native phonological categories
- Sub-phonological properties of a given contrast may also affect weighting of acoustic cues
  - Cross-language differences in the treatment of primary cues may require different weighting of secondary cues

VOICING

- Spanish and English both contrast voiced and voiceless stops (phonologically)
  - Spanish: Pre-voiced/short-lag
  - English: Short-lag/long-lag
- Both use Voice Onset Time (VOT) as the primary cue, and fundamental frequency at the onset of voicing (Onset f_0) as a secondary cue
- The Spanish VOT boundary (~ 0 ms) is perceptually less robust than the English (~ 20 ms) boundary
  - May promote reliance on secondary cues in Spanish

RESEARCH QUESTION

Do Spanish and English differ in terms of their relative weighting of VOT and Onset f0?

METHOD

PARTICIPANTS

- 15 Native Spanish speakers (10 women, 5 men)
  - All fluent in English
- 17 Native English speakers (9 women, 8 men)

TASK

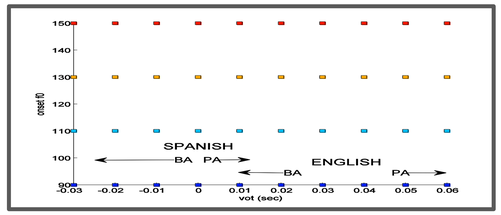
- Two-alternative, forced-choice identification (“pa” or “ba”)
  - Counterbalanced button order
- 11 blocks of 40 tokens, randomized within blocks
  - 10 levels of VOT
  - 4 levels of Onset f_0
- Dropped first block (familiarization)

ANALYSES

- Groupwise logit model to assess perceptual space for each language
- Non-parametric analysis of variance (Kruskal-Wallis) calculated on coefficients from individual logit models fit to each subject separately
  - Violation of homogeneity of variance precludes ANOVA

STIMULI

DISTRIBUTION

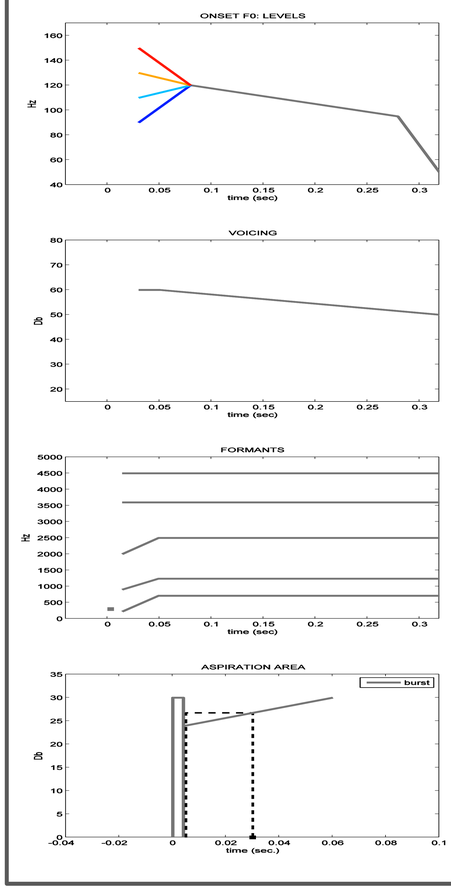


- VOT: 10 steps, 10 ms/step, from -30 to 60 ms
- ONSET F_0: 4 steps, 20 Hz/step, from 90 to 150 Hz

SYNTHESIS

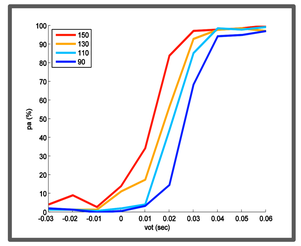
- Generated with Praat (5.2) Klatt synthesizer
- Aspiration linearly interpolated in positive VOT range (covaries with VOT)

PARAMETER TEMPLATES FOR 30 MS VOT

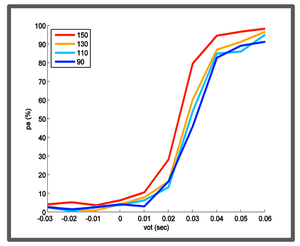


RESULTS

SPANISH



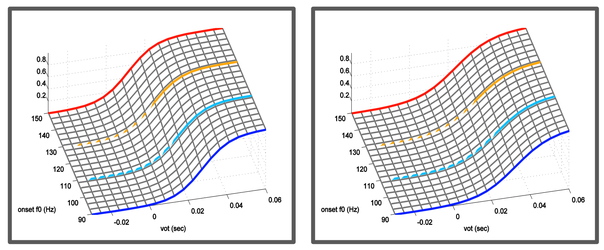
ENGLISH



Identification Curves (% “pa”) for each level of Onset f_0

LOGIT MODEL

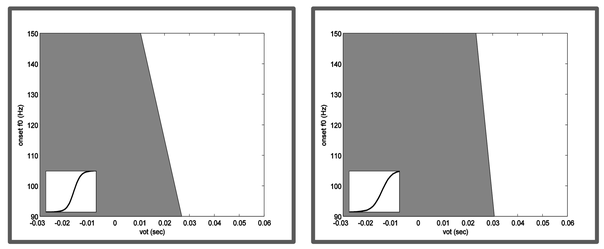
$$z = \alpha + \beta_1 (VOT) + \beta_2 (Onset\ f_0)$$



Standardized Logit Coefficients

α = - 0.602	α = - 1.394
β_1 = 4.132	β_1 = 3.136
β_2 = 0.861	β_2 = 0.352

LOGIT CLASSIFIER



Multivariate binary logit classifier applied to obtain median level boundary (50% of “pa” responses) for each group’s perceptual space

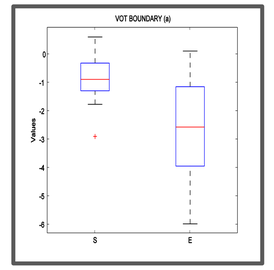
- “ba” area in gray
- “pa” area in white

Compared to English listeners, Spanish listeners show greater influence of Onset f_0 on voicing decisions at intermediate values of Voice Onset Time.

RESULTS [continued]

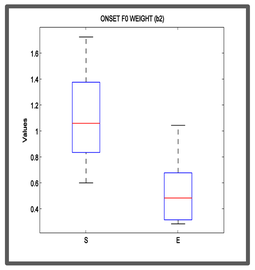
KRUSKAL-WALLIS

α INTERCEPT



Chi-sq(1,30) = 6.84
p = 0.004

2nd β COEFFICIENT



Chi-sq(1,30) = 14.35
p = 0.0002

Pairwise comparison of logit coefficients showed a significant difference between English (right bars) and Spanish listeners (left bars) in terms of VOT boundary location (α) and Onset f_0 weight (β_2)

SUMMARY

- Spanish and English listeners exhibit different boundary locations along the VOT continuum.
- At VOT values close to category boundaries, Spanish listeners show a greater influence of Onset f_0 on category boundary location than do English listeners.

DISCUSSION

POSSIBLE EXPLANATIONS

- Spanish VOT boundary (0 ms) is less auditorily robust than the English boundary (20 ms) (Holt, et al. 2004). Therefore, Spanish listeners may depend more heavily on secondary cues to maintain this contrast.
- Spanish listeners were performing in a second-language (English) context, which may place greater demand on cognitive resources. Greater capacity demand has been shown to increase reliance on secondary cues (Gordon et al. 1993).

REFERENCES

Gordon, P.C., Eberhardt, J.L. & Rueckl, J.G. (1993). Attentional modulation of the phonetic significance of acoustic cues. *Cognitive Psychology*, *25*, 1-42.

Holt, L.L., Lotto, A.J. & Diehl, R.L. (2004). Auditory discontinuities interact with categorization: Implications for speech perception. *Journal of the Acoustical Society of America*, *116(3)*, 1763-1773.

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