Abstract

We show that the information value of a phone influences its duration. Informative phones like /g/ are longer than uninformative phones like /d/.

This extends previous work showing that predictability affects word and phone duration. Uninformative phones are short even when they appear in informative (unpredictable) contexts.

Introduction

Uniform Information Density/Smooth Signal Hypothesis

- Contextually predictable words and their subparts (morphemes, syllables, segments) are shorter than unexpected words.
- This may play a role in smoothing information across the signal, mediated by prosody.

(Pitt et al. 2005, 2007)

Segment Simplicity

- Underspecification theories assume that some segments are simpler (specify fewer values) than other phones. (Kiparsky 1993, inter alia)
- Markedness accounts claim there is a hierarchy of simplicity that is inherent to human language. (de Lacy 2002, inter alia)

Present Study

- Are certain phones simpler information theoretically?
- Are simpler (underspecified) phones shorter?
- Does this correlate with underspecification or markedness?

Method

Estimation Method

- We used linear regression to estimate the log phone duration.
- The duration of a phone is estimated to be a product of several factors.
- The linear regression estimates the weight each factor has.

- Phone duration is a function of a categorical factor, and a phone's informativeness.
- Phone duration is raised to the power of real-valued parameters, weighted by some λ.

- We check how significant each coefficient is, and in what direction it influences duration.

- Significance is estimated by comparing the residual sum of squares of two almost-identical models, one containing the variable in question, and one that does not contain it.

A Comparison of Factors (codas)

- Log phone probability, given previous phone was not significant
- Log phone probability, ignoring context
- Phone informativity

A Comparison of Factors (onsets)

- Log phone probability, given one or two previous phones
- Log phone probability, ignoring context
- Phone informativity

Corpora and Data

- Token frequencies estimated from the Switchboard and Buckeye corpora.

- Pronunciations are from the CMU dictionary (CMU 1992).

- Phone durations are from the Buckeye corpus of phonetic transcriptions (PN at 2005, 2007).

- We limited ourselves to word-medial, non-deleted consonants.

- Onsets and codas were estimated separately.

Controls

- The phonological attributes of the phone and adjacent phones
- Syllable stress
- Word and phone frequency
- Local predictability, based on previous one / two phones (bi / tri-phones)
- Rate of speech

Future Directions

- Cohen-Priva (2008) has similar results for medial phone deletions.
- Vowel duration models are trickier:
  - The base measurement, surprisal, has to control for stress.
  - Vowels are greatly affected by local context.

- Informativity shows in duration stability: informative vowels vary less.

- Promising but incomplete results for reduction models.
- How much of historical change is derived by informativity?

- Use informativity to explain why different dialects of English delete and change /t/, /d/, /l/, /r/, /n/ and /ŋ/, which have extremely low informativity.

- In Latin languages, similar processes target /l/.

Conclusion

- Phone informativity has a strong influence on phone duration.
- Consistent with the smooth signal hypothesis.
- Lengthening a more informative phone provides a more even distribution of information.
- Lengthening a phone after an informative phone allows spillover.

- Problem: Why shorten a phone when a highly informative phone follows?

- Partly consistent with markedness or underspecification.
- Coronal are indeed less informative, underspecified and unmarked.
- But not clear why dorsals would be more marked than labials, or the other way around.

- The mental representation of phones includes their informativity.

- A contextually unpredictable phone with low informativity may be shorter than a contextually predictable but highly informative phone.

- This is true even after we control for phone frequency. (Pitt et al. 2004, inter alia)

- This is true even after we control for local predictability factors. (Jaffe and Turk 2004, inter alia)

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