Phonetic variation in French conversational speech

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What is phonetic variation?

• Naturally-occurring language is inevitably variable
  – E.g.
    • The same word or sound may be pronounced differently by different speakers, or even the same speaker
    • The same meaning may be encoded in different sentence forms
Why studying phonetic variation?

• Variation in language production used to be considered as noise in the signal
  – Needs to be filtered for better signal recognition

• However, the value of phonetic variation has been recognized in the research on
  – Sociolinguistics: group and individual indexing
  – Language production
Phonetic correlates of variation

• Studies of phonetic variation often examine
  – Duration
    • Short vs. long
  – Vowel production
    • Centralized vs. peripheral
  – Segment deletion
    • Deleted vs. non-deleted
Phonetic correlates of variation

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\[ \text{Reduction} \quad \text{Vs.} \quad \text{Hyperarticulation} \]
## Findings of phonetic variation

### Main variation patterns

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High probability (predictability) leads to reduction.
Explaining variation

**Listener-oriented**
- Response to different models of listener’s needs
- Result of ease or difficulty of comprehension (modeled by the speaker)
- Examples
  - Foreigner- and child-directed speech
  - Speech under noise
  - Shortening and reduction in
    - High-frequency or high-predictability forms
    - Repeated items

**Talker-oriented**
- Result of ease or difficulty of production
- Examples
  - Shortening and reduction in
    - High-frequency or high-predictability forms
    - Repeated items

Many properties have the same predictions for comprehension and production...
Questions (I)

• How to tease apart listener-oriented and speaker-oriented forces in shaping phonetic variation?
  – Examine properties that generate different predictions for comprehension and production
    • E.g. phonological neighborhood density (PND)

We will come back to PND later.
Questions (II)

• In the talker-oriented account, why should high probability/predictability lead to reduction?
  – “articulatory routinization” (Bybee, 2001)
    • But homophones (e.g. *time* and *thyme*) are reduced to different degrees (Gahl 2008)
  – “synchronous planning and articulation” (Bell *et al.*, 2011)
    • High-probability words are *easier to retrieve*, and therefore executed faster in order to keep the synchrony
    • But why is synchrony important? Is synchrony only about duration? What about vowel quality? How does synchrony interact with other aspects of the language?
A more general problem

• Current literature on phonetic variation is mostly based on the study of English
• Phonetic variation patterns may be language-specific
  – Due to the interaction of language structure and language processing/production

Cross-linguistic evidence is vital for establishing a general account of phonetic variation.
What we are trying to do

• Exploring phonetic variation in French
  – Compare with English results

• Why French?
  – Similar to English in many aspects
  – But also different in morphological structure, speech rhythm, prosody, etc.
A preliminary study

• The phonological neighborhood density (PND) project
  – PND is a lexical property which refers to the number of phonological neighbors of each word
    • One-phoneme difference rule (Luce & Pisoni 1998, etc)
Effects of neighborhood density

• Phonological neighbors
  – Both compete with and bring more activation to the target word
  – Either impede or facilitate the processing of the target word

• Therefore
  – High PND \(\rightarrow\) hard to perceive but easy to produce
  – How does PND affect phonetic variation?
Predictions

• Talker-oriented
  – High-density words are easy to produce → shortening and reduction

• Listener-oriented
  – High-density words are hard to perceive → lengthening and vowel dispersion

Results based on English found support for shortening and reduction in high-PND words.
Current study

• Conversational French corpus

• Aspects of production
  – Word duration

• Preview of results
  – High-PND words have longer durations than low-PND words
    • opposite of the English results
Corpus

• The CID corpus
  – 16 speakers, one-to-one conversations
  – 8 hours
• Target words
  – Monosyllabic
  – Monomorphemic
  – Content words
• Dataset
  – 5412 tokens of target words
Modeling

- Mixed-effects regression models
  - Outcome variable: (log) word duration
  - Random effects: word and speaker
  - Fixed effects
    - PND
    - Neighbor frequency
    - Other control factors (frequency, predictability, word length, speech rate, speaker sex, etc.)
Results

• Significant positive effect of PND
  $- \beta = 0.034, \ t = 2.12, \ p_{MCMC} = .03$

Neighbor frequency is not significant.
Revisiting predictions

• Talker-oriented
  – High-density words are easy to produce →
    shortening and reduction

• Listener-oriented
  – High-density words are hard to perceive →
    lengthening and vowel dispersion

Results based on English found support for shortening and reduction in high-PND words.

Results based on French found support for longer duration in high-PND words.
Discussion

• How to explain the differences between English and French?
  – French speakers are more accommodating?
  – Maybe the predictions do NOT hold for French?
Revisiting predictions for French

• Talker-oriented
  □ High-density words are easy to produce → shortening and reduction

• Listener-oriented
  ✔ – High-density words are hard to perceive → lengthening and vowel dispersion

Results based on French found support for longer duration in high-PND words.

Dufour & Frauenfelder (2010)
Discussion

• How to explain the differences between English and French?
  – French speakers are more accommodating?
  – Maybe the predictions do **NOT** hold for French?
    • Maybe high-PND $\rightarrow$ difficulty of production?
      – Pattern found in Spanish. Morphological structure?
    • Maybe easy to produce $\rightarrow$ longer duration?
      – Planning-articulation synchrony not as important in French?
Future work

• Examine effects of PND on
  – French lexical retrieval and vowel production
• Systematic examination of the effects of probability (predictability) in French
• Phonetic variation phenomena in other languages

→ Propose a general theory of phonetic variation - its underlying mechanisms and language specificity
End

• This project is supported by the Brain & Language Research Institute (BLRI) in Aix-en-Provence, France.
• We thank the audience at the BLRI and LPL research meetings for comments and suggestions.
**Findings of phonetic variation**

- **Main variation patterns**

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