Explaining lexical frequency effects: a critique and an alternative account

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Outline

Introduction

Exposure

Independence

Conclusion
Introduction

- lexical frequency effects (e.g. Schuchardt 1972; Bybee 2001; Pierrehumbert 2001): *lexical frequency (partly) determines the speed at which lexical items undergo sound changes*
- in this talk: only looking at *phonetically gradient* sound change
- rapidly growing literature → many different explanations & findings
Introduction

- different sources for frequency effects:
  - exposure (Pierrehumbert, 2001)
    *high-frequency items ‘erode’ faster*
  - independence (Bybee, 2001)
    *high-frequency items are more independent → more resistant to change*

...
Introduction

- **problem:**
  many different explanations $\rightarrow$ predictions not clear and not sufficiently distinct

- **main goal:**
  clarify the predictions of the exposure-based and independence-based accounts

- **solution:**
  computational and mathematical modelling
Outline

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Exposure
Prediction

- high-frequency forms are exposed to phonetic biases more often → they change faster
- Pierrehumbert (2002): ‘[... H]igh frequency words are affected more because they are produced more often and so more memories of them in their lenited form accrue, once the lenition gets underway.’
Exposure Prediction

- apparent prediction: positive linear frequency effect (e.g. Pierrehumbert 2001)
Exposure
Simulation architecture

- modelling framework: simplified version of Pierrehumbert (2001)
- each word has a separate representation
- looking at how those representations evolve as a function of frequency
- parametric (prototype-based) representations
  → the results hold for the original model as well
Exposure

Simulation architecture

- Category representations
- Sampling
- Biases

Feedback

VOT (ms) density

-100 -50 0 50

0.00 0.02 0.04
Exposure
Simulation architecture

- in exemplar models:
  - memory activation of exemplars decreases with time
  - memory activations summed (MASS) $\propto$ frequency
- current model also includes MASS
- words with higher MASS (i.e. high frequency categories) are more resistant to incoming stimuli
Exposure
Simulation architecture

- a single phonetic dimension
- each word initialised at 0
- 20,000 simulated word categories
- word frequency varies between 1 and 100 per time unit
- constant positive bias
- 500 time units for each word
- looking at means for each word
Exposure
Results

- word frequency vs word means after 500 time units
Exposure

Results

1. frequency has no effect on the expected values of the means
   ▶ the effect of MASS cancels out the effect of exposure

2. the mean values vary more for low frequency words
   ▶ consequence of the algebra of random variables...
   ▶ this is an empirically testable prediction!
Outline

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Independence
Prediction

- instances of the same sound category in different words are not completely independent
- high-frequency forms more independent than low-frequency forms (cf. Bybee (2001))
  → they resist analogical change more
  → they can also stray further from the rest of the category?
Independence

Simulation architecture

- each word represented separately
- category representation, bias and update same as previously
- sampling is different:
  - samples from a weighted mixture distribution
  - frequent words $\rightarrow$ heavier weight
  - target word $\rightarrow$ heavier weight
Independence
Simulation architecture

- same as before, except:
  - only half of the words are affected by the bias
    - otherwise, results would be identical to prev. sim.
    - similar to e.g. /u/-fronting: tube → biased; cool → not biased
  - 100 word categories (frequencies: Zipf distribution)
  - simulation repeated 100 times with same parameters
  - looking at one word from each frequency bin
Independence

Results

- word frequency vs word means
  (pooled results from 200 simulations)
Independence

Results

1. frequency has a positive effect for biased words (tube-type)
2. frequency has a negative effect for non-biased words (cool-type)
3. the mean values vary more for low frequency words in both groups
Outline

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Conclusion

- careful modelling is crucial to unpack the predictions of theories of sound change
- exposure:
  - no effect on expected value of mean
  - the evolution of infrequent words is less predictable
- independence:
  - positive frequency effect in trigger environment
  - negative frequency effect in elsewhere environment
  - the evolution of infrequent words is less predictable


theory of phonological change (Linguistische Forschungen 26), pages 29–72. Athenium, Frankfurt am Main.
Conclusion

Simulation architecture for independence simulations