

Frequency effects and sound changes

Two predictions (Bybee 2001)

- High-frequency words are more conducive to production with an innovative variant (especially reduced), where the innovation is heard as the original sound.
 - More frequent words may show an innovative sound change before less frequent words, especially perceptually.
- But an exemplar model assumes proportional weighting according to how frequently the exemplars are accessed and how many have accumulated,
 - Less frequent words should be able to change more quickly with less exposure to innovative variant.
 - More frequent words may resist change (entrenchment).
 - Less frequent words more susceptible to influence of sound change, specifically in production.

Replicating sound change in a laboratory setting

- Part of a larger series of experiments simulating sound change
- Perceptual learning by exposure to new pronunciation variants (Norris, McQueen & Cutler 2003)
- Shadowing task reinforces learning and enables change in production (Goldinger 1998)

Methods

Procedure

- Part 1: production and vocab familiarity rating
- Part 2: perceptual learning
 - listen to variant (4x)
 - repeat word aloud (4x)
 - read definition (1x) and word in sentence (1x)
- Part 3: lexical decision (RT and ACC) *
- Part 4: post-test production
- Part 5: identification

Overall Lexical Decision Results

Response Time (by subjects)

- Main effect of variant ($F(1,43)=6.18, p<.001$)
 - chw-** faster than **tsw-** for all groups
- Condition*variant interaction ($F(2,86)=5.62, p<.001$)
 - (chw-) group showed effects of training
 - (tsw-) performed similarly to control group

Acceptance of variant in words (by subjects)

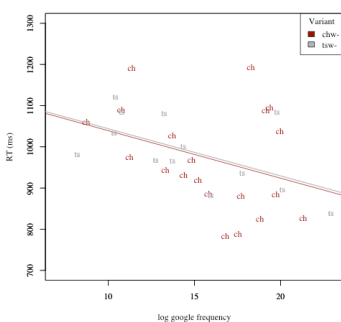
- Main effect of variant ($F(1,43)=7.45, p<.01$)
 - chw-** more accepted than **tsw-** for all groups
- No effect of training condition

Effects of Frequency on Lexical Decision

Response Time (by items)

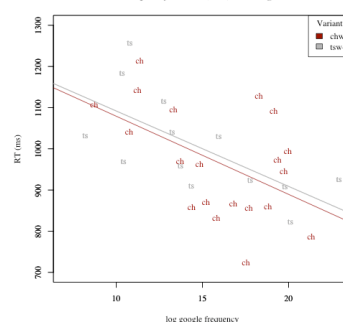
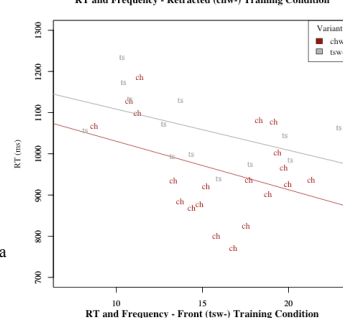
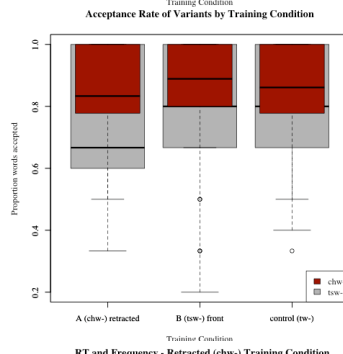
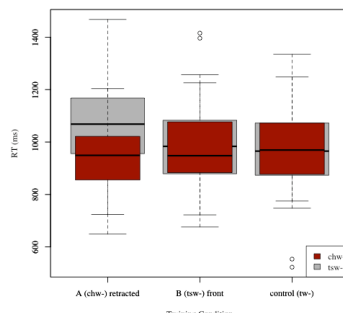
- Main effect of frequency ($F(1,29)=10.59, p<.005$)
 - RTs were faster for more frequent items
- Condition*variant interaction ($F(2,58)=3.58, p<.05$)
 - (chw-) group showed effects of training
 - (tsw-) performed similarly to control group
- Slope and intercept same for both variants within control condition and within front (tsw-) group but intercept is 60 ms different for retracted (chw-) group
 - RT to both variants is correlated with frequency (all groups $p<.05$)
 - Control group $R^2 = 0.14^*$ ($ts=0.27^*, ch=0.5$)
 - Front group $R^2 = 0.30^*$ ($ts=0.39^*, ch=0.21^*$)
 - Retracted group $R^2 = 0.16^*$ ($ts=0.19', ch=0.8$)
 - tsw-** variant shows greatest effect because it is a less familiar variant.

RT and Frequency - Control (tw-) Training Condition



Training Conditions

- retracted variant (chw-) condition (15 Ss)
- front variant (tsw-) condition (15 Ss)
- control (tw-) condition (16 Ss)

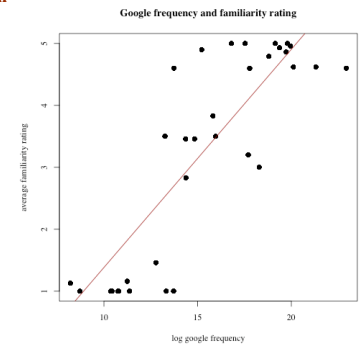


Effects of Familiarity on Lexical Decision

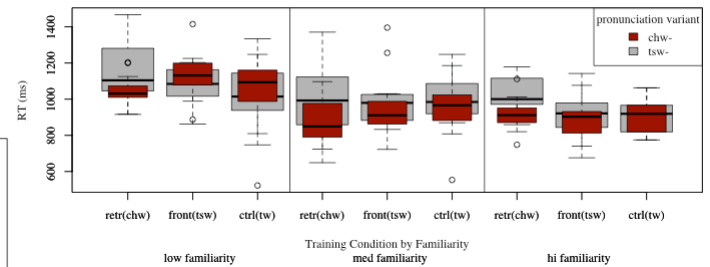
*Google frequency may not reflect subjects' experience, but self-reported familiarity should give greater accuracy

Familiarity Ratings

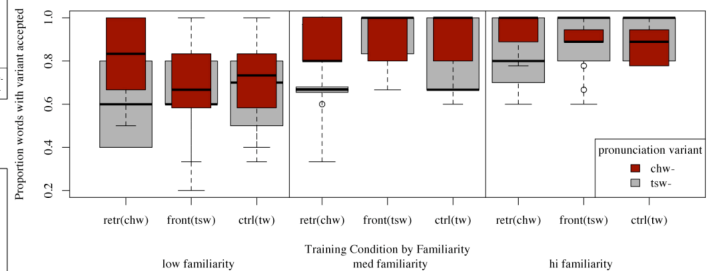
- Plotting google frequency against average subject familiarity reveals 3 groups of items
 - lo = familiarity rating of 1-1.46
 - med = familiarity rating of 2.83 - 3.83
 - hi = familiarity rating of 4.6 - 5
- $R^2 (.70)$ is strong, so familiarity may be used to reflect subjects' exposure/frequency



Response Time to Variants by Familiarity and Condition



Acceptance Rate of Variants by Familiarity and Condition



Familiarity Effects (by subject)

Response time

- Main effect of familiarity ($F(2,86)=47.02, p<.001$)
 - lo > med, hi
- Condition*familiarity ($F(4,86)=2.94, p<.05$)
 - control condition is less influenced by familiarity than other training groups
- Variant*familiarity ($F(2,86)=4.8, p<.01$)
 - chw-** is always responded to faster except in low familiarity words

Acceptance rate

- Main effect of familiarity ($F(2,86)=38.58, p<.001$)
 - hi, med > lo
- Condition*familiarity ($F(4,86)=2.92, p<.05$)
 - tsw-** always has a lower acceptance rate except in high-frequency words

Discussion

- Across training conditions, retracted variant (**chw-**) is more acceptable as a variant of /tw/
 - ch-** is more available as a **t-** variant in **t+**-approximant combinations (*truck, congratulations*)
- Retracted training condition shows more influence of training, greater difference between variants
 - more "natural", thus more effective learning under these conditions
 - subjects found one (or more) talker(s) using **tsw-** variant disagreeable
 - unknown whether because of **tsw-** variant or particular pronunciation
- Familiarity/frequency impacts acceptance of variant, especially for less familiar front (**tsw-**) variant
 - familiar words are easier to accept with variant, but unfamiliar words suffer from odd variant
 - frequency of variant + accept of word = ideal conditions for sound change
- Ongoing work on changes in production following training
 - Different subjects have different interactions of training, frequency, and recency

References

- Bybee, Joan, & Paul Hopper. 2001. *Frequency and the emergence of linguistic structure*. Amsterdam: John Benjamins.
- Goldinger, Steven. 1998. Echoes of echoes? An episodic theory of lexical access. *Psychological Review* 105: 251-279.
- Norris, Dennis, James McQueen & Anne Cutler. 2003. Perceptual learning in speech. *Cognitive Psychology* 47(2): 204-238.
- Pierrehumbert, Janet. 2001. Exemplar Dynamics: Word frequency, lenition and contrast. In Bybee & Hopper 2001.