Locality and variability in cross-word alternations: a production planning account

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Two puzzles about cross-word alternations

Cross-word alternation: alternating segment and trigger for alternation are in different words. E.g. :

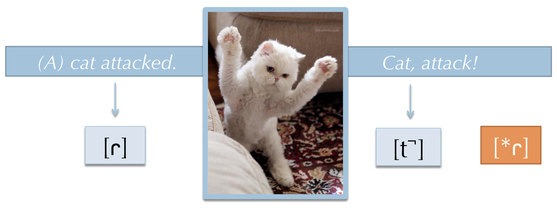
Coronal flapping:
/t,d/ → [ɾ] / V__(#)V

Locality

Words must be in some syntactic configuration

Syntactic locality: Cooper & Paccia Cooper (1980), Kaisse (1986), Pak (2008)

Prosodic domain: Selkirk (1986), Nespor & Vogel (1986)

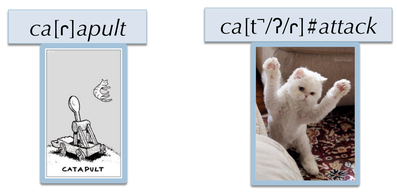


Inherent Variability

Often probabilistic, "optional," less consistent than word-internal

Variable probabilistic rules (Labov 1972, Guy 1991)

Probabilistically ranked constraints (Anttilla 1997 et seq, Boersma 1997 et seq, Kiparsky 1993)



Usually these are assumed to require separate solutions, neither seems to be reducible to the other.

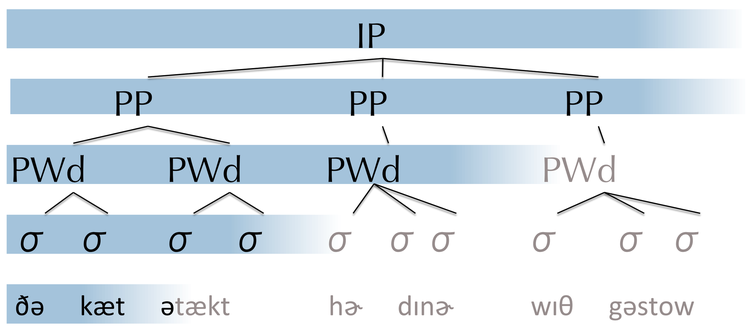
Why do both types of effects correlate? Could they be tied to a common underlying mechanism?

Locality of production planning

Proposal: the locality as well as the probability of cross-word phonological interactions are a direct consequence of the **locality of production planning**

Wagner (2012), Wagner & Clayards (2013), Tanner, Sonderegger & Wagner (2015)

Speech production planning: Hierarchical and incremental



Higher-level information is available **before** detailed segmental and featural information.

Sternberg, Knoll, Monsell & Wright (1988), Dell & O'Seaghdha (1992), Levelt, Roelofs & Meyer (1999), Keating & Shattuck-Hufnagel (2002)

Segmental information is planned in a small window, which may not include the **following word.**

Sternberg et al. (1988), Wheeldon & Lahiri (1997, 2002)

If information about next word/segment is not yet available, the cross-word alternation **cannot apply.**

Whalen (1990)

The **probability** of two words being encoded within the same window can be affected by upstream factors like syntactic/ semantic complexity, lexical frequency or other processing considerations.

Ferreira & Swets (2002), Krivokapic (2007)

→ **Prediction**: the harder it is/longer it takes to plan the upcoming word, the less likely it is that an alternation depending on following word information will apply.

syntactic clause boundary	↑	↓ flapping **less** likely
pre-boundary lengthening	↑	↓ flapping **less** likely
frequent following word	↑	↑ flapping **more** likely

Production experiment

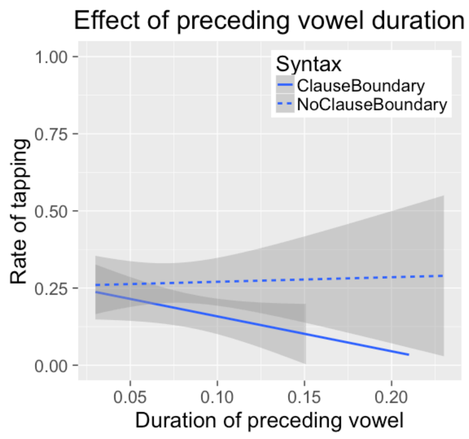


Fig. 1: Empirical plot of the relationship between rate of flapping and duration of the vowel in the nonce verb. Statistical analysis was carried out by fitting a mixed-effects logistic regression fitted the lme4 package for R, with full random effect structure (uncorrelated) by participant and item.

- Target word: nonce verb ending in /t/
- Subjects read sentences with two clauses where target was either followed by direct object (No Clause Boundary) or subject of next clause (Clause Boundary)
  - "While you **blit**, Ernie will be studying"
  - "While you **blit** Ernie, Mike will be studying"
- Duration of vowel → measure of lengthening

Statistical analysis

- *Syntax*: flapping 2.7 times more likely if no clause boundary (β = 0.98, p = 0.032)
- *Vowel duration:* esitmate negative, but effect was not statistically significant (β = −0.919, p = 0.18)

★ Syntax has effect above and beyond lengthening/duration

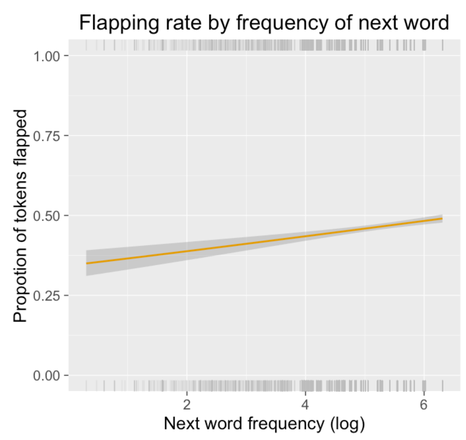
★ Effect of syntax is **gradient**

Corpus study

- Buckeye Corpus of Conversational Speech
- Extracted 11, 738 tokens from 255 speakers, 590 words
- Word frequencies from SUBTLEX-US

Statistical analysis

- Controls: lengthening (normalized word duration), pause, number of syllables, underlying voicing.
- *Following word frequency:* significant positive effect (β = 0.29, p = 0.003)
- *Pause* and *underlying voicing* were only other sig. effects.



★ Higher frequency **following word** increases likelihood of flapping.

Conclusions

Production planning effects provide:

★ An explanatory mechanism for gradient syntactic and lexical frequency effects on phonological patterns

★ New, testable predictions about the relationship between phonological variability and other cognitive factors.

Gestural overlap? The *Syntax* and *Frequency* effects still appear after controlling for duration, so probably not reducible to temporal effects. But production planning locality could be complementary to, e.g. AP account

Whalen (1990), Browman & Goldstein (1992)

Probability driven reduction? Good question – comparing to, e.g. Probabilistic Reduction Hypothesis, predictions are similar when considering joint probabilities. Need to check non-reductive processes: ongoing work!

Jurafsky, Bell & Gregory (2001)

Bybee, J. & Scheibman, J. 1999. The effect of usage on degrees of constituency: The reduction of *don't* in English. *Linguistics, , 37(4)* • Ferreira, F. and Swets, B. 2002. How incremental is language production? *J. Mem. & Lang., 46* • Fukaya, T. and Byrd, D. 2005. An articulatory examination of word-final flapping at phrase edges and interiors. *JIPA 35(1).* • Kaisse, E.M. 1985. *Connected speech: The interaction of syntax and phonology*. • Jescheniak, J. and Levelt, W.J. 1994. Word frequency effects in speech production: Retrieval of syntactic information and of phonological form. *J. Experimental Psychology, 20(4).* • Levelt, W.J., Roelofs, A., and Meyer, A.S. 1999. A theory of lexical access in speech production. *Behavioral and brain sciences, 22(1)* • Nespor, M. and Vogel, I. 1986. *Prosodic phonology* • Pierrehumbert, J.B. 2001. Exemplar dynamics: Word frequency, lenition and contrast. *Frequency and the Emergence of Linguistic Structure, 45(2-4)* • [12] Sternberg, S., Knoll, R., Monsell, S., and Wright, C. 1988. Motor programs and hierarchical organization in the control of rapid speech. *Phonetica* • Ernestus, M., Lahey, M., Verhees, F., & Baayen, R. H. (2006). Lexical frequency and voice assimilation. *J. Acous. Soc. Am.* • Schuppler, B., Dommelen, W.A. van, Koreman, J., and Ernestus, M. How linguistic and probabilistic properties of a word affect the realization of its final /t/: Studies at the phonemic and sub-phonemic level. *Journal of Phonetics, 40(4)* • Whalen, D.H. 1990. Coarticulation is largely planned. *Journal of Phonetics,* 18, 3-35. • Wheeldon, L. and Lahiri, A. 2002. The minimal unit of phonological encoding: Prosodic or lexical word. *Cognition, 85(2)*

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