

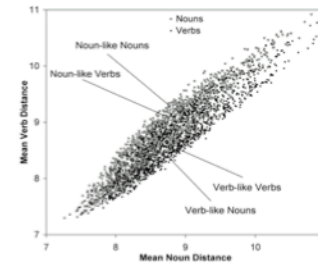
Phonological Typicality and Part of Speech Predictability Affect Speech Duration

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Introduction

- **Phonological Typicality** is a measure of the degree to which the phonological properties of one word are typical of other words in the same grammatical category
- Farmer et al. (2006) calculated phonological typicality of nouns and verbs with a phonemic feature-based representation of a word then calculating the Euclidean distance between it and all other words in and out of its grammatical class, e.g. *marble* is a 'noun-y' noun and *insect* is a 'verb-y' noun
- Comprehenders are sensitive to the phonological typicality of a word during reading: comprehenders read expected nouns faster if they are more typical given the sentence structure (Farmer et al. 2006)
- It is unknown whether speakers are sensitive to the PT of an upcoming word, nor if any speech rate effects are modulated by the part-of-speech (POS) predictability of that word
- Changes in speech duration due to upcoming words may shed light on theories of production



Reproduced from Farmer, Christiansen, Monaghan (2006)

Our Questions

1. Does the phonological typicality of an upcoming word effect speech rate (duration) of current word?
2. Are these effects modulated by the predictability of the grammatical class of the upcoming word?

Conclusion

General Discussion

- Phonological typicality and POS probability interacted for nouns in line with other phonological typicality effects (Farmer et al 2011); We find less predictable nouns show a negative relationship between phonological typicality and duration
 - Planning difficulty with upcoming word is reduced in less probable continuations if the upcoming word is more typical
- Function words showed an interactive effect while content words showed little effect of phonological typicality; may suggest a different role in planning for function compared to content words
- Phonological typicality of verbs was only significant for one data bin and showed no interaction in any bin → different relationship between phonological typicality and probability as compared to nouns?
- Theoretical implications:
 - The reduced speech time for upcoming typical but less probable nouns suggests grammatical information aides during phonological encoding (cf., "cascading activation" Dell et al. 1997)
 - Typicality and POS probability are cues comprehenders are sensitive to. Future work on how typicality and probability of the *current word* effects speech rate may shed light on the Audience Design hypothesis. Specifically, increases (or decreases) in duration by a speaker on the current word may aid (or hinder) their listener

A Corpus Study of Conversational Speech

Strategic Lengthening

Availability of upcoming material based on its predictability given preceding context ...



... affects the speech rate on preceding words

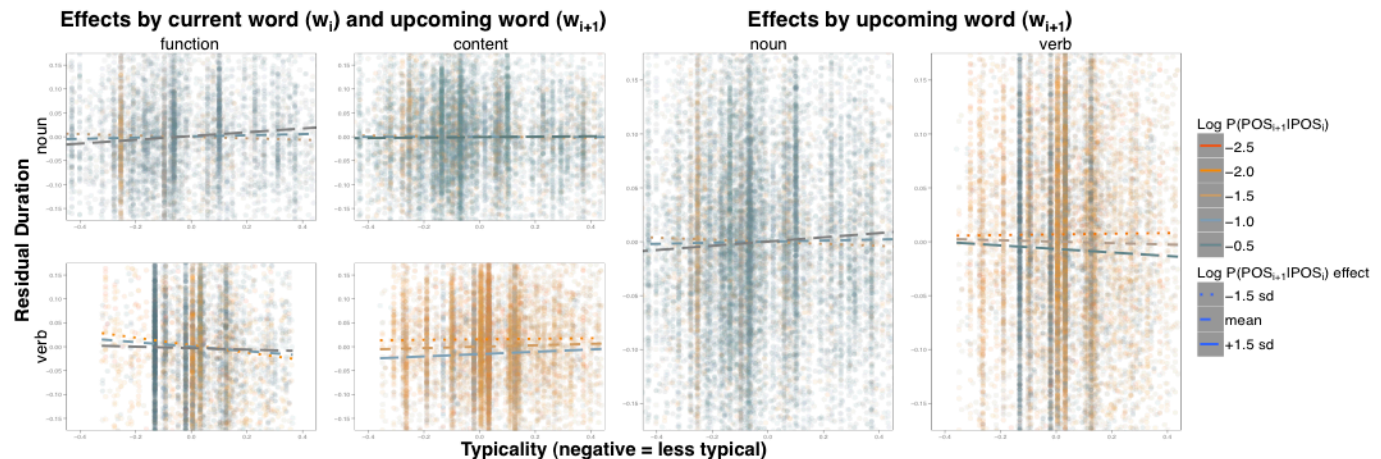
We analyze duration of current word (w_i) as an estimate of the (inverse) speech rate as a function of phonological typicality of upcoming word (w_{i+1})

Results

- 1) **By current word (w_i) x upcoming word (w_{i+1})**
 - *Function words followed by noun*: as $P(\text{POS}_{i+1} | \text{POS}_i)$ probability of upcoming word decreased, greater phonological typicality of upcoming word → shorter duration of current word
 - *Function words followed by verb*: greater phonological typicality of upcoming word → shorter duration of current word
 - *Content words followed by verb*: more probable upcoming verbs → shorter duration of current word
- 2) **By current word (w_i)**
 - *Function word*: as probability of upcoming word decreased, greater phonological typicality → shorter duration of current word
 - *Content word*: more probable upcoming word → shorter duration of current word
- 3) **By upcoming word (w_{i+1})**
 - *Nouns*: as probability of upcoming word decreased, greater phonological typicality → shorter duration
 - *Verbs*: more probable upcoming verbs → shorter duration

Data & Analysis

- Bigrams extracted from the Switchboard Corpus
 - Current word was content or function word, upcoming word was noun or verb
 - Exclusion: $\text{abs}(z\text{-score})$ of any predictor or outcome > 2.5
 - Control effects on current word durations were regressed out (Mean duration of current word, speech rate, current word bigram probability, upcoming word unigram and bigram probability)
- Linear model predicting current word's residual log duration due to upcoming word's phonological typicality * $P(\text{POS}_{i+1} | \text{POS}_i)$
- Three analyses: 1) by current word type x upcoming word type; 2) by current word type; 3) by upcoming word type



References

- Dell, G. S., Schwartz, M. F., Martin, N., Saffran, E. M., & Gagnon, D. A. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological review*, 104, 801-838.
- Farmer, T. A., Christiansen, M. H., & Monaghan, P. (2006). Phonological typicality influences on-line sentence comprehension. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 12203-12208.
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Table 1: Current x upcoming word models

	function noun	content noun	function verb	content verb
(Intercept)	-0.001 (0.001)	-0.000 (0.001)	0.000 (0.002)	-0.000 (0.001)
Next word PT	0.011 (0.007)	-0.000 (0.005)	-0.025* (0.012)	0.004 (0.007)
Next word POS P	-0.000 (0.003)	-0.001 (0.002)	-0.001 (0.002)	-0.026*** (0.003)
Interaction	0.047** (0.017)	0.007 (0.011)	0.021 (0.017)	0.016 (0.022)
R-squared	0.002	0.000	0.001	0.006
Deviance	71.670	90.962	103.116	132.806
BIC	-9688.556	-18020.906	-8471.629	-15218.231
N	6075	9806	6512	10172

Table 2: Current, upcoming word models

	function	content	noun	verb
(Intercept)	0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)
Next word PT	-0.001 (0.006)	0.000 (0.004)	0.004 (0.004)	-0.010 (0.006)
Next word POS P	-0.003 (0.002)	-0.007*** (0.001)	-0.001 (0.002)	-0.007*** (0.002)
Interaction	0.029* (0.011)	-0.001 (0.008)	0.020* (0.009)	-0.015 (0.011)
R-squared	0.001	0.001	0.000	0.001
Deviance	176.126	227.009	163.648	237.446
BIC	-17969.135	-32704.796	-27541.433	-23549.074
N	12587	19978	15881	16684