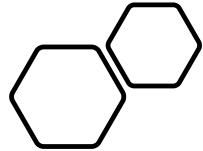


GULP LabLunch
February 3rd, 2022

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Northwestern University

Variable pronunciation and dynamic planning in connected speech

[OSF Repository](https://osf.io/uge8x/) <https://osf.io/uge8x/>



Phonological variation

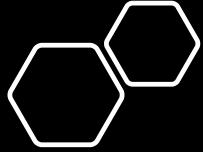
Many possible pronunciations
Same phonological context
Same speaker

Especially segments
at word boundaries

grea[t] artist

grea[?] artist

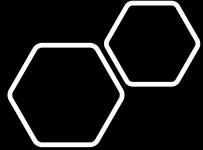
grea[r] artist



Production Planning Hypothesis

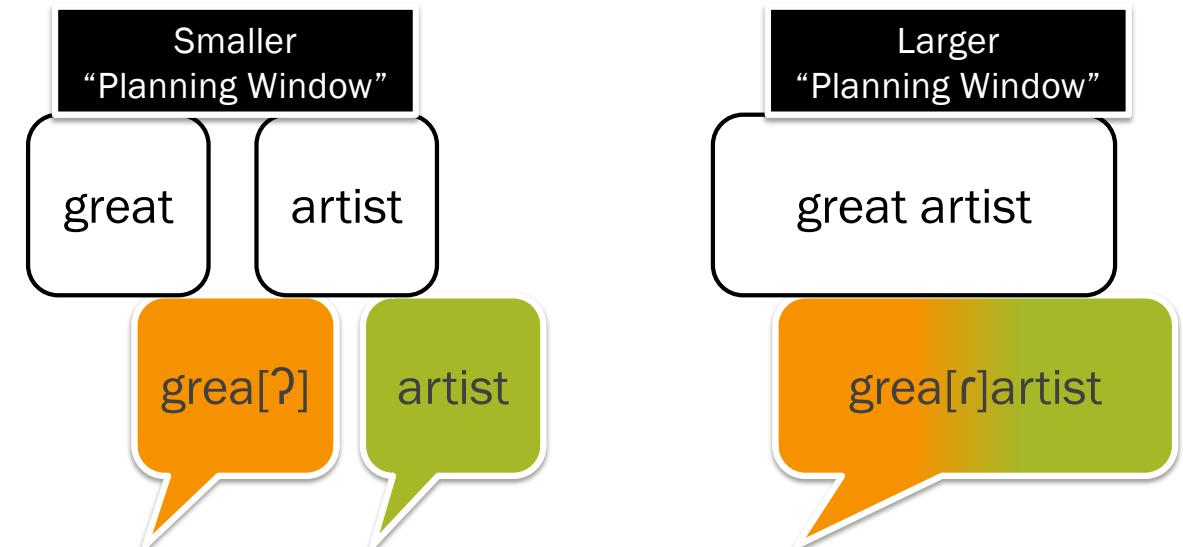
**Phonological variation is partly attributable
to variation in speech planning window**

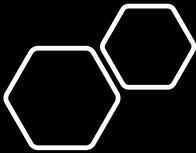
Kilbourn-Ceron (2017), Tamminga (2018), Wagner (2012)



Production Planning Hypothesis

Following words can only influence current word form if planned **within the same window**



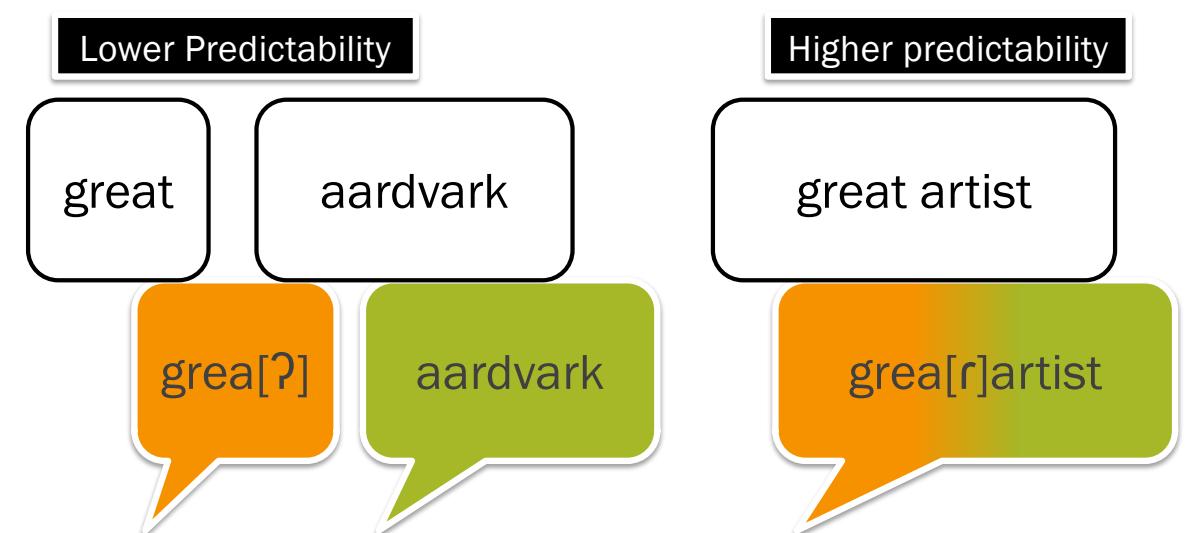


Production Planning Hypothesis

Previous work

Increase in lexical frequency and/or contextual predictability of following word leads to more influence of following word

Kilbourn-Ceron (2017), Kilbourn-Ceron, Clayards & Wagner (2020)



Limitations: spontaneous speech corpus, correlational analysis, high correlations among predictability measures

Connected Speech in the Lab



Change size of “planning window” to change allophone distribution



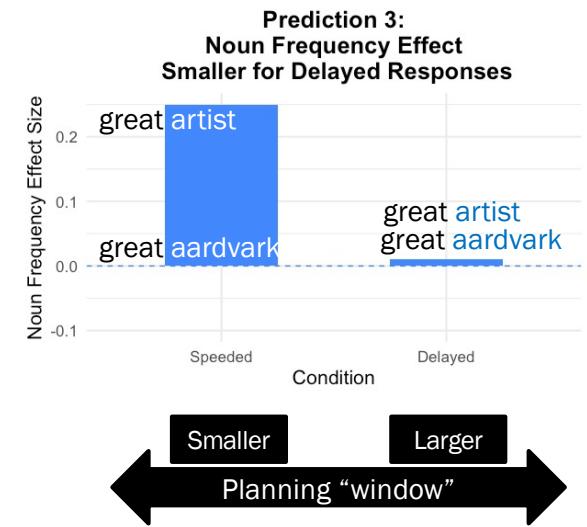
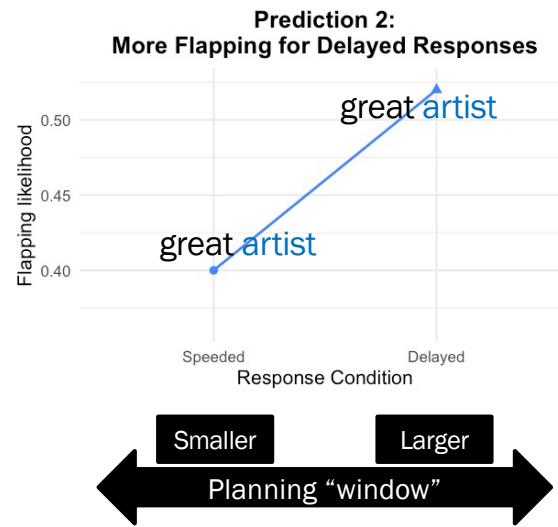
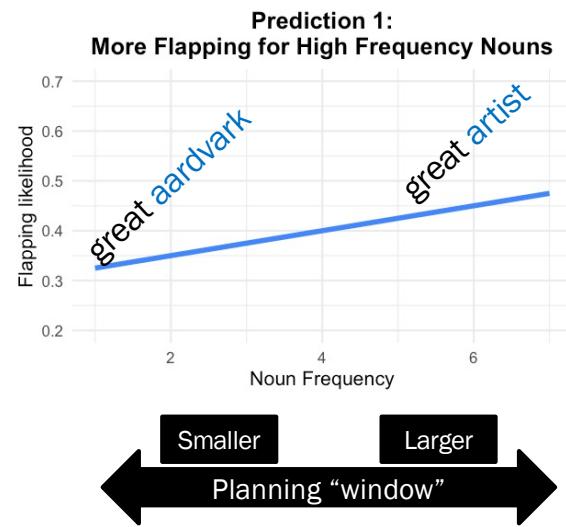
Production of phrases with /t/-final adjectives + vowel-initial nouns (e.g., *great artist*)



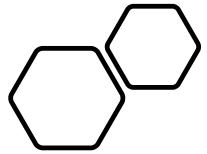
Measured proportion of flap use at word juncture



Manipulate **response timing** (speeded vs delayed) and **word-level planning difficulty** (via lexical frequency)



Predictions



Design



Experiment 1 (Speeded) Reading aloud phrase immediately upon presentation



Experiment 2 (Delayed) Wait 1250-2000 msec after seeing phrase before responding



Manipulated **lexical frequency** as measure of word-level planning difficulty



Sample size (50 participants per experiment*) determined by Monte Carlo power analysis



Pre-registered methods and analysis plan on OSF
<https://osf.io/uge8x/>

Example item

Adjective	Noun	Noun Frequency
complete	exit	High
complete	altar	Medium
complete	antler	Low



40 items, range of adjective & noun frequencies



Controlled for **collocation frequency**
(rare/novel as possible)



Adjective with 1, 2 or 3 syllables;
Noun always **2 syllables**



Filler with **consonant** (e.g., complete madness)
for each item

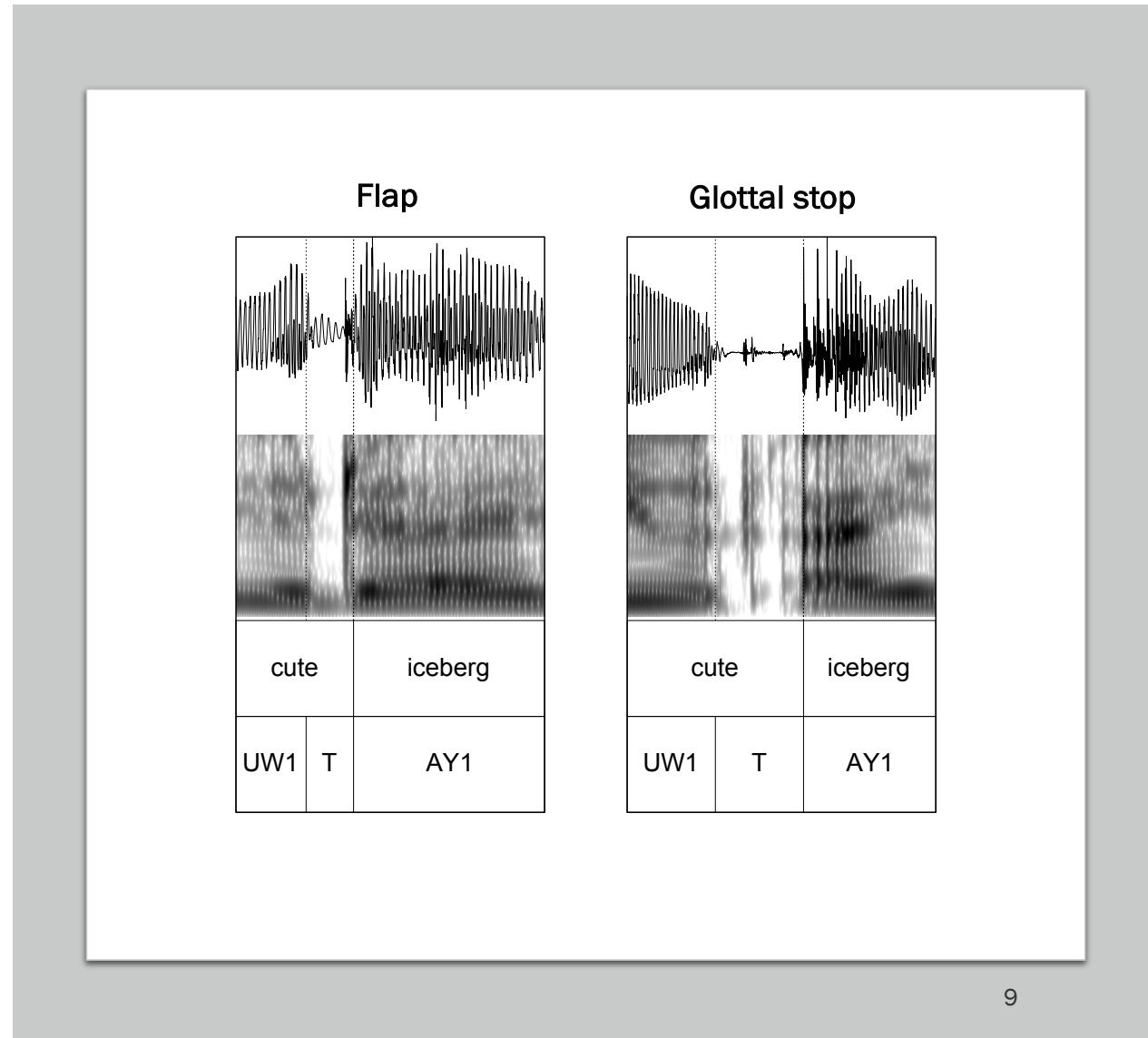


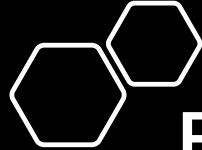
Filler **items** with same structure (3*V, 1*C)

Materials

Acoustic analysis

- Removed any pauses (30 msec min)
- Removed RT outliers +/- 3 SD
- Force-aligned phrases with MFA
- Extracted % voiced frames during force-aligned /t/-interval
- Transform to categorical variable, flap = >90% voicing during /t/
- Validation with manually annotated subset (n=2312), Kappa = 0.72



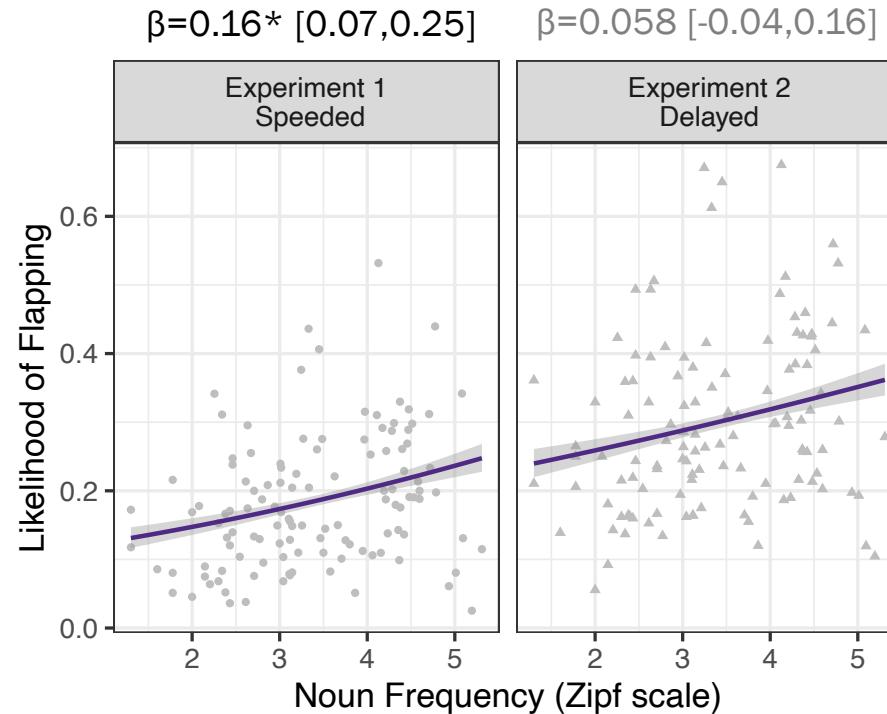


Results

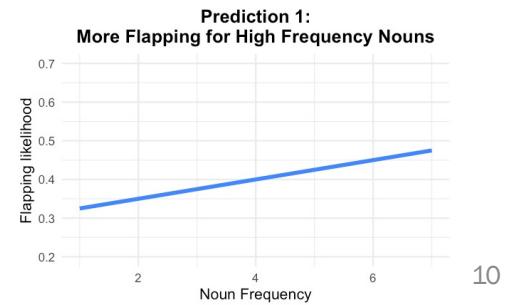
Logistic mixed-effects regression
(Also fit linear models for Reaction Times as sanity checks, same structure)

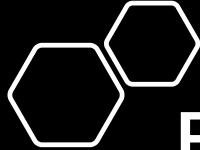
Fixed Effects

- Adjective frequency (continuous)
- Noun frequency (continuous)
- Number of syllables in adjective (1-3)
- Speaking rate (phones/sec, minus /t/ interval)
- Block number (1-8)
- Interactions



Noun Frequency Effect





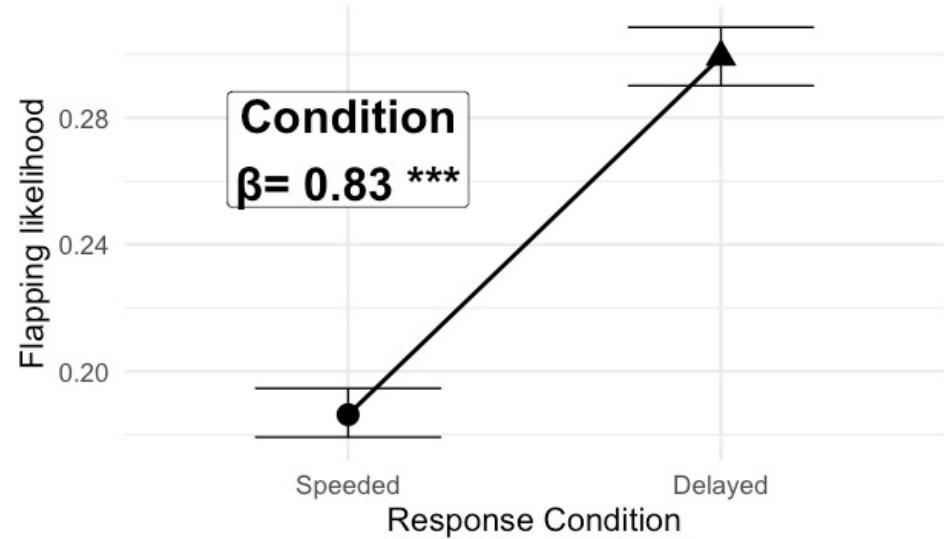
Results

- Significant change in flapping rate between conditions

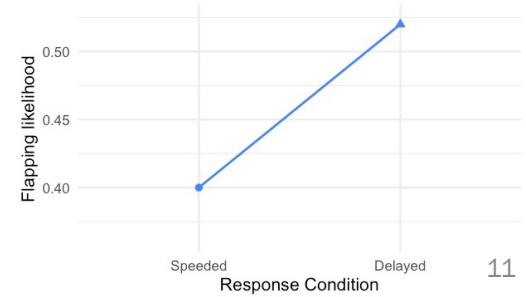
Flapping Rate Change

Pooled Analysis: Speeded vs Delayed

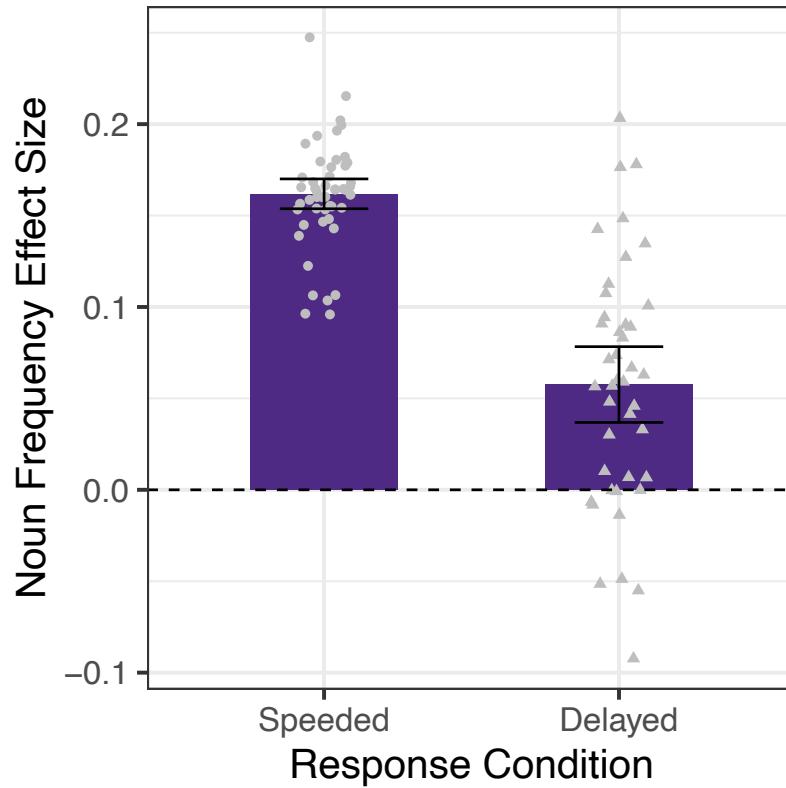
Empirical flapping likelihood difference by condition



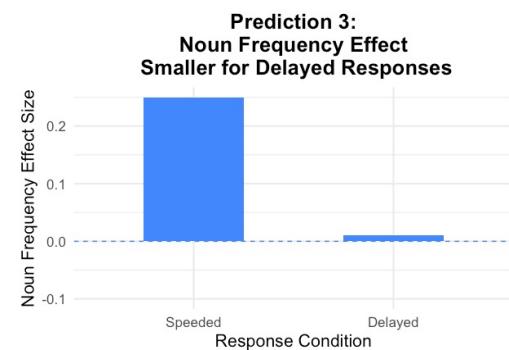
Prediction 2:
More Flapping for Delayed Responses

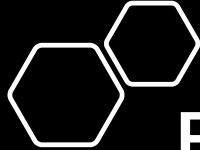


Noun Frequency Effect, by Speaker



Significant interaction between Condition and Noun Frequency in pooled model ($\beta = -0.11$)





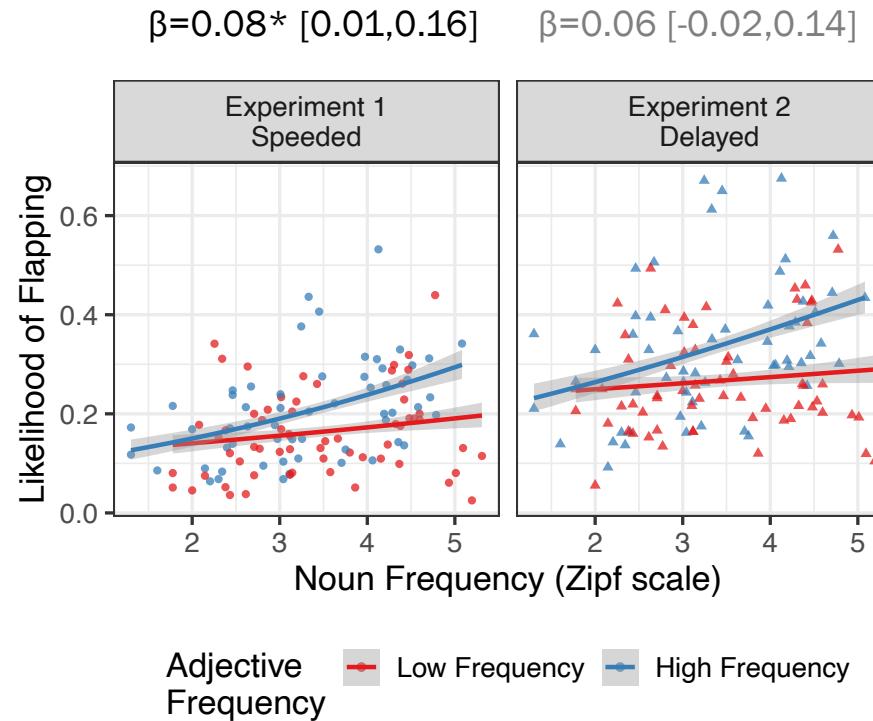
Results

Adjective-related variables

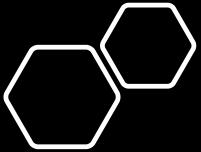
- Adjectives flap more when more frequent
- No effect of Adjective length

Control variables

- Flapping more with faster speaking rate
- Flapping more in later experimental blocks

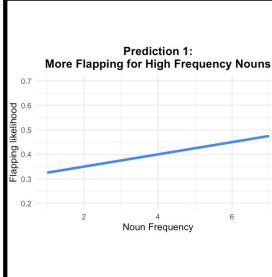


Noun * Adjective Frequency



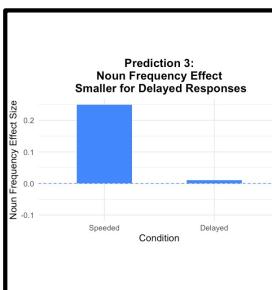
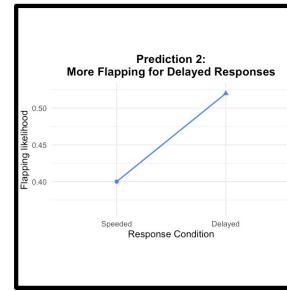
Summary Experiments 1 & 2

Evidence compatible
with PPH predictions



Flapping is more likely when the **following word is frequent** (=larger planning window more likely)

Flapping is more likely when speakers have **more time for planning** before speaking begins (=larger planning window more likely)



Effect of following word frequency is **smaller when speakers have more time for planning** (=larger planning window *already* more likely)

Future work

Experiment 3



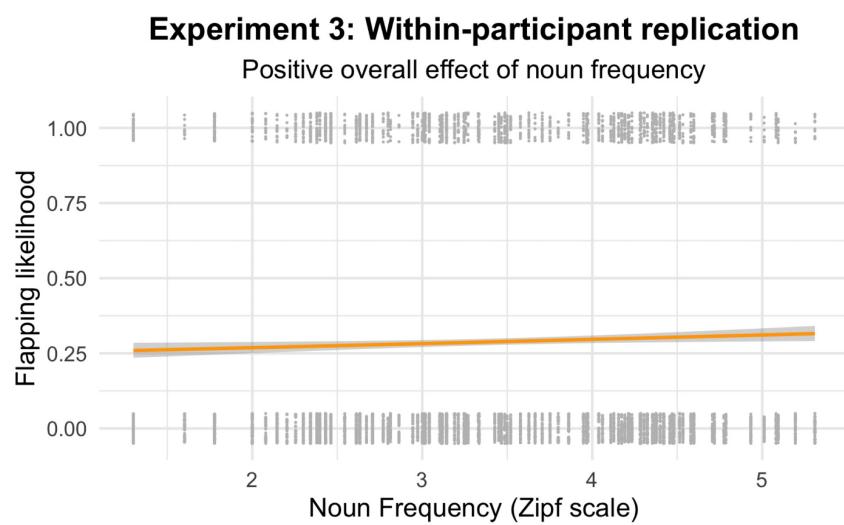
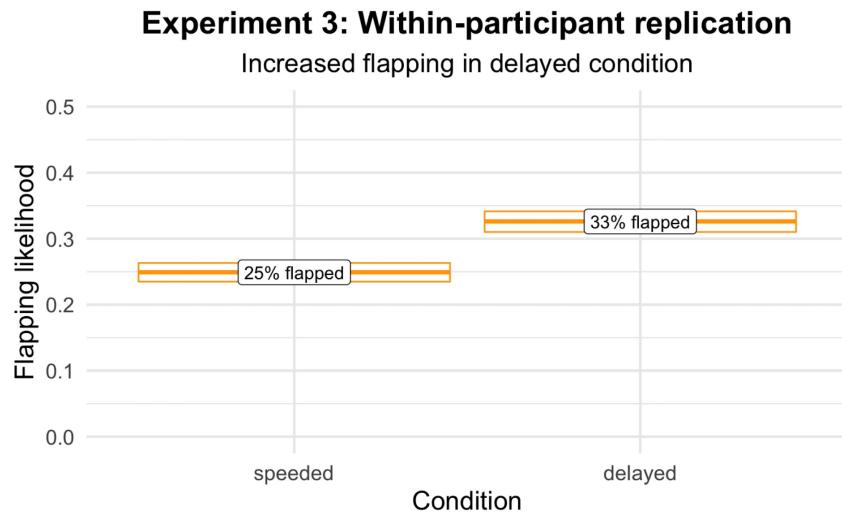
- Replication combining Exp 1 & 2 instructions
- Within-participant manipulation of speeded/delayed responses
- Data collected and partly analyzed

Experiment(s) 4+



- Sentences-sized stimuli
- Partial masking prior to response cue
- Are word-level frequency effects found later in the sentence?

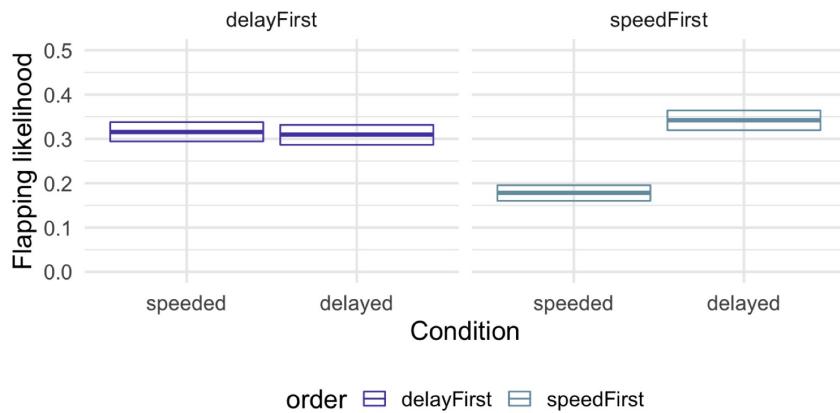
Preview of Experiment 3 results



Experiment 3: Complications

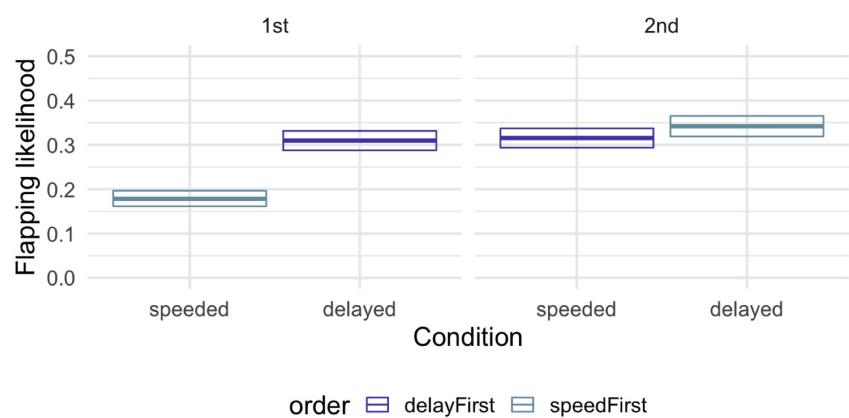
Experiment 3: Within-participant replication

Different depending on presentation order



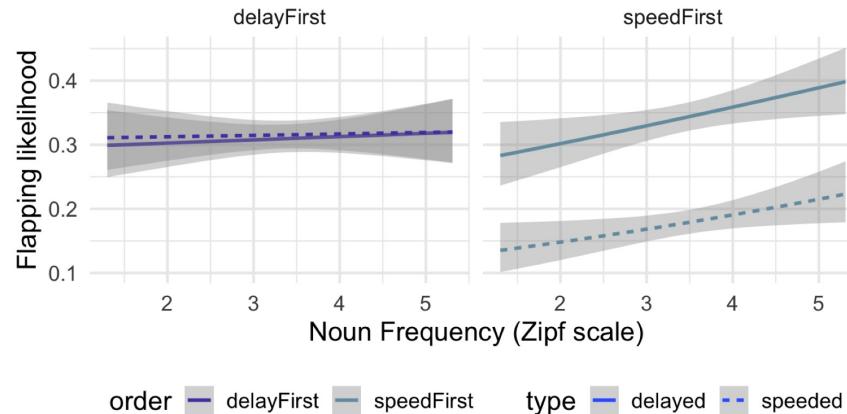
Experiment 3: Within-participant replication

Different depending on presentation order



Experiment 3: Within-participant replication

Difference in Noun Freq effect between conditions, by order



- The order of presentation affects results!
- Delayed first → always plan ahead
- Why is there a Noun Frequency effect in SpeedFirst's delayed block? (Copycat effect?)

Experiment 3 Further Complications

Experiment(s) 4+

Sentence-sized stimuli with target phrases **at the end of the sentence**

Full, partial, or no preview conditions

F *The young rabbit saw the complete exit*

P *The young rabbit saw the*

N

Broader questions

What are the criteria for initiation of speech?

How do speakers maintain fluency throughout an utterance?

When do planned word forms become “frozen”/inaccessible for further modification?

How do delays in earlier stages of planning affect word form encoding?

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