# Palatalization more likely where **word_2** **is predictable** from word_1

# **Novel** finding: palatalization more likely when a **high vowel follows /j/**

# PPH: Palatalization in American English

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## Introduction

Production Planning Hypothesis (PPH) assumes that the speaker plans articulation in advance using cues from e.g. the preceding and following context, especially in processes which span word boundaries (Wagner 2012; Kilbourn-Ceron, Clayards, and Wagner 2020). The predictors linked to speech planning modulate the size of the planning window and can account for the variability in pronunciation. Variability can be seen in a choice of the pronunciation variants, e.g. between the palatalized variant *did you* [dɪdʒu] and the non-palatalized variant *did you* [dɪdju].

### Objectives

1. Test if rate of palatalization is positively correlated with smoothed *conditional probability* of $word_2$ given $word_1$ (and $word_1$ given $word_2$) (Seyfarth 2014)
2. Extend PPH to a non-reductory process of palatalization: cf. /t, d/ deletion (Tanner, Sonderegger, and Wagner 2017), flapping, glottalling (Kilbourn-Ceron, Clayards, and Wagner 2020) and consonant liaison in French (Kilbourn-Ceron 2017) studied within PPH so far

## Methods

1. Data: the Buckeye corpus (Pitt et al. 2007) of American English
2. Corpus search: /t, d, s, z/ + /j/ bigrams, e.g. *did your*, *was useless* (LaBB-CAT (Fromont and Hay 2012))
3. Analysis: acoustic analysis and manual annotation of tokens as palatalized ($n = 1{,}136$) or not palatalized ($n = 1{,}180$)
4. Modeling: mixed-effects binary logistic regression (*lme4* package (Bates et al. 2015) in (R) (R Core Team 2022))

## Results

Smoothed conditional probability of $word_2$ given $word_1$ is significant (smoothed conditional probability of $word_1$ given $word_2$ *not* significant).

Significant control variables: target segment and vowel height. Not significant: grammar, mean speaking rate, speaking rate deviation, gender, age, and the interaction between gender and age.

Estimates of all predictors together with their $p$-values are presented in Table 1.

Table 1: Model summary: p-values calculated with likelihood ratio tests

| Term | Estimate | p-value |
|---|---|---|
| (Intercept) | –4.03 | 0.01 |
| scp_giv_prev | 6.61 | < 0.001 |
| scp_gov_fol | 8.07 | 0.32 |
| targ_seg [s] | 2.11 | < 0.001 |
| targ_seg [t] | 1.31 | < 0.001 |
| targ_seg [z] | 3.08 | < 0.001 |
| vowel_height [non-high] | –1.44 | < 0.001 |
| gram_w [lex_w] | 0.48 | 0.131 |
| rate_dev | 0.17 | 0.027 |
| mean_rate | 0.55 | 0.132 |
| gender [m] | –0.37 | 0.552 |
| age [y] | –0.81 | 0.271 |
| gender [m] : age [y] | 0.73 | 0.275 |

Figure 1 is a partial-effect plot of smoothed conditional probability of $word_2$ given $word_1$. Figure 2 is a partial-effect plot of the height of the vowel following /j/. Partial effects estimated with the *effects* package (Fox and Hong 2009).
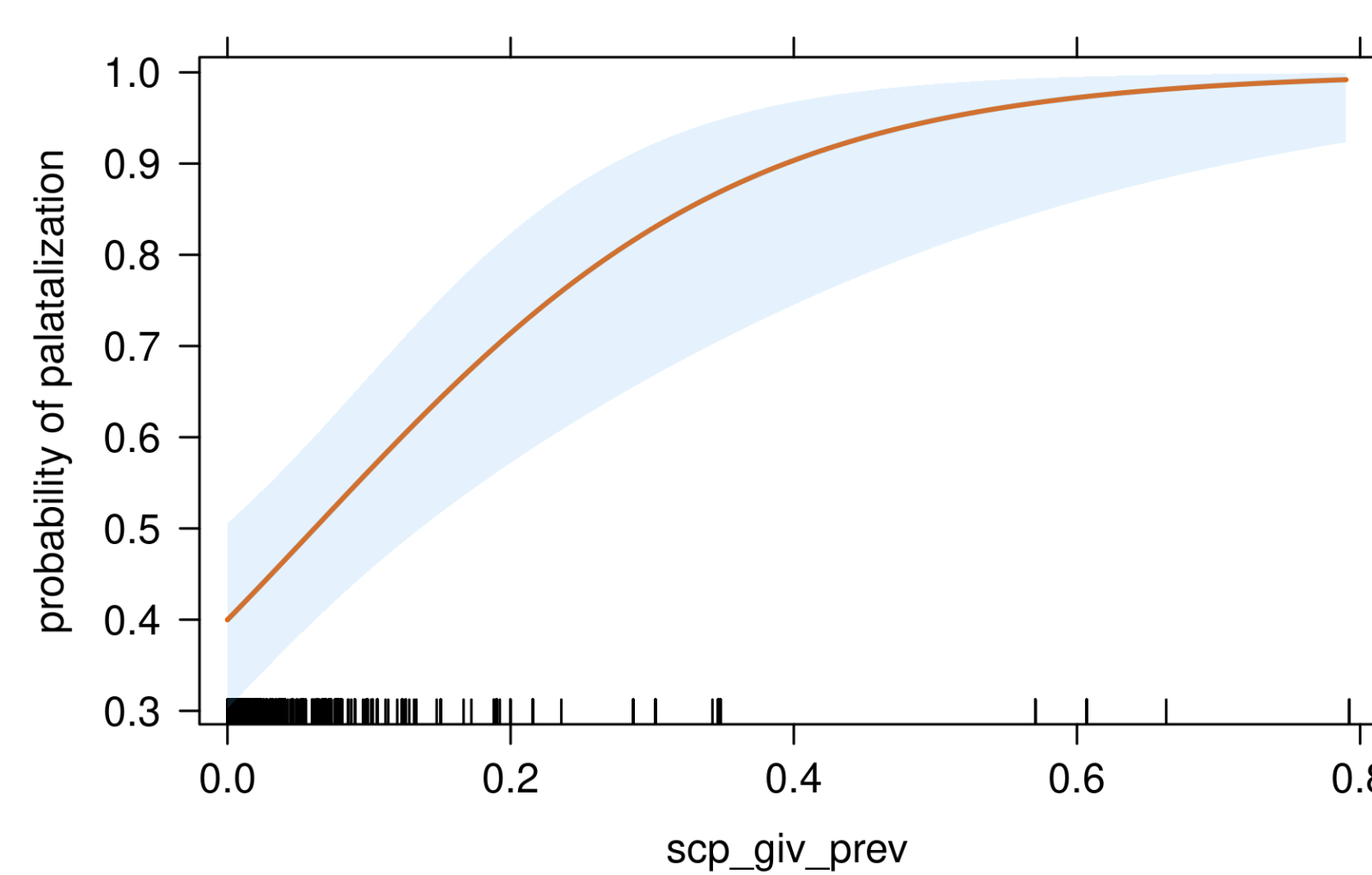


Figure 1: Partial effect plot of smoothed conditional probability of word2 given word1. log-odds converted to probabilities
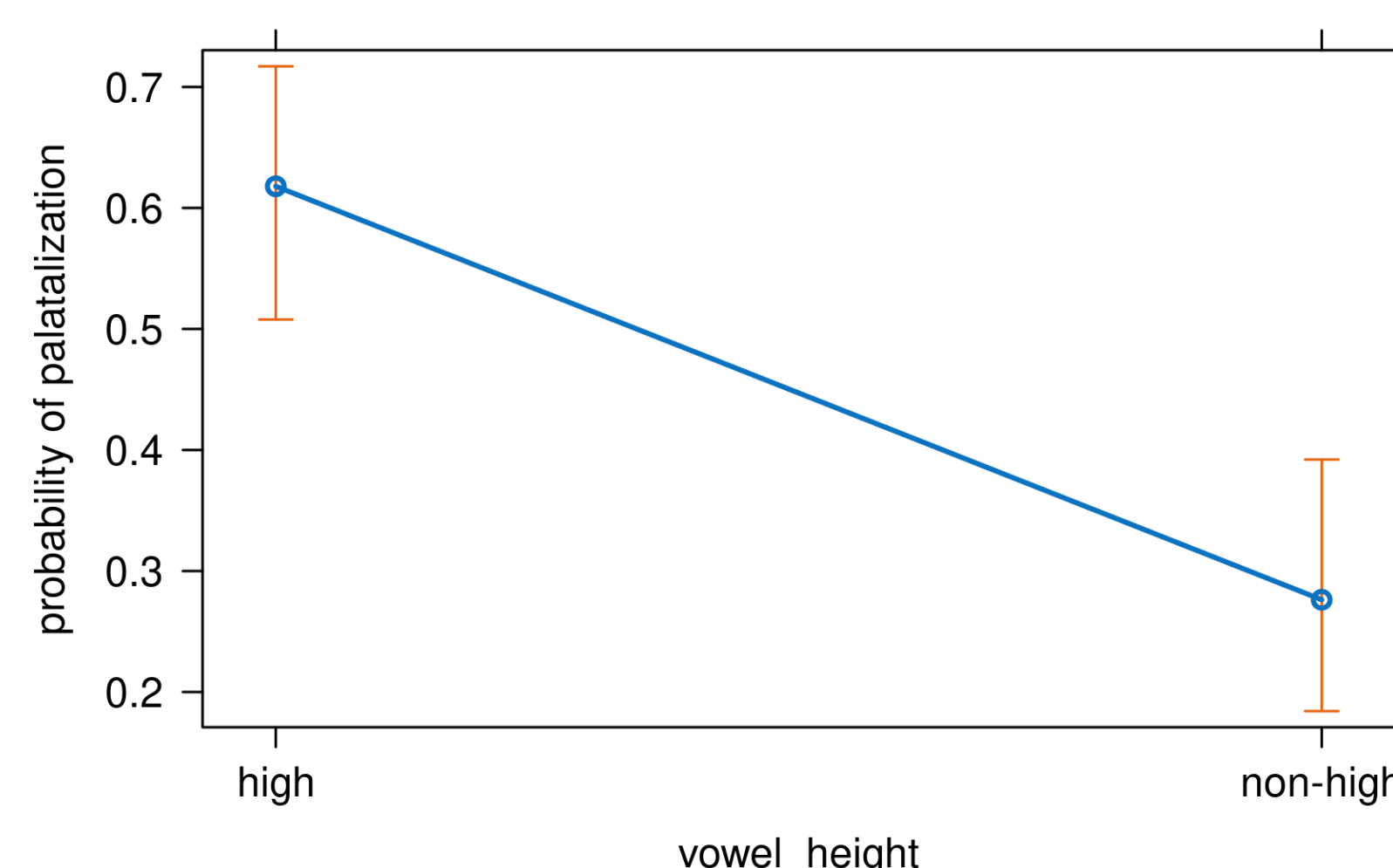


Figure 2: Partial effect plot of vowel height. Log-odds converted to probabilities

Figure 3 shows the 10 least likely and the 10 most likely bigrams to undergo palatalization: log-odds of the the *bigram* random effect were converted to percentages for ease of interpretability.
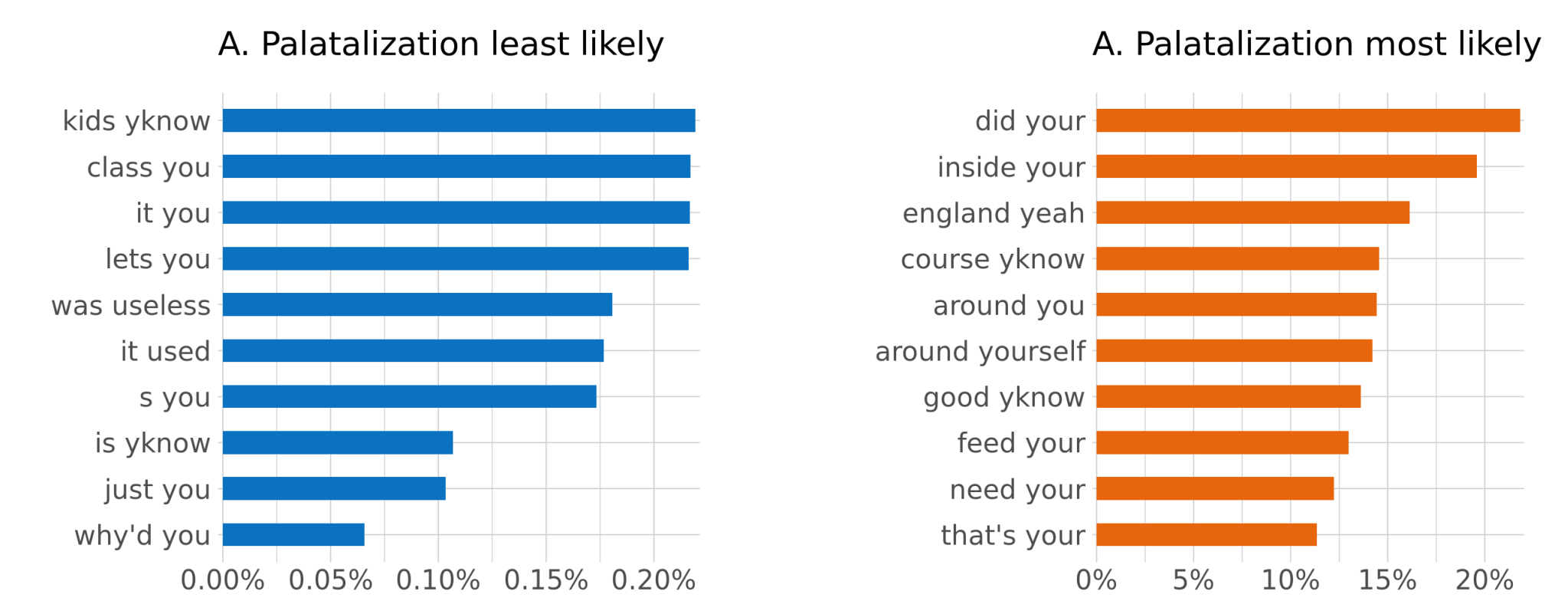


Figure 3: Ten least and ten most likely bigrams to undergo palatalization (random effects)

## Conclusions

1. New evidence for PPH: size of the planning window (with predictability as proxy) plays a role in a non-reductory sandhi process

2. A unexpected finding: height of vowel following /j/ influences whether a variant is palatalized or not, which seems to imply that speakers plan in advance to palatalize given the category of the upcoming vowel following /j/

Our finding that the probability of $word_2$ given $word_1$ is positively correlated with likelihood of palatalization supports PPH. The probability can be seen as a proxy of the planning window: higher probability can be equated with $word_2$ being included in the window, thus making the application of sandhi processes more likely. This is schematically visualized in Figure 4. Additionally, our study adds the height of the vowel following /j/ (Hyman 1975) to a list of factors influencing palatalization in English.
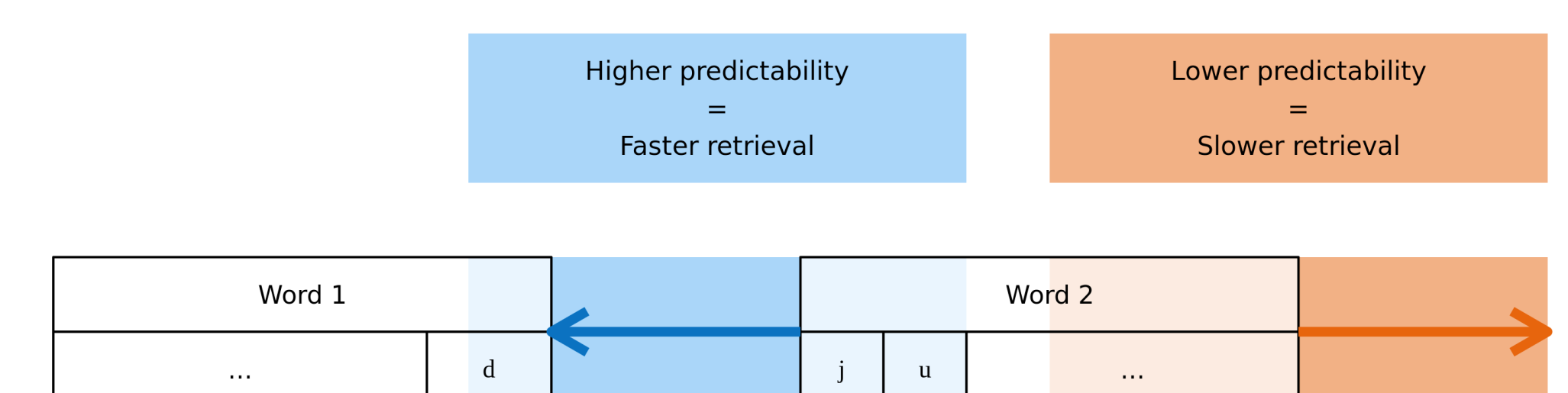


Figure 4: Schema of planning the palatalized around you sequence (adapted from (Kilbourn-Ceron, Clayards, and Wagner 2020)). Higher predictability means the two words are more likely to be planned together thus making palatalization more likely, too

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