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"Spelling matters": The timecourse of sublexical retrieval in written word production

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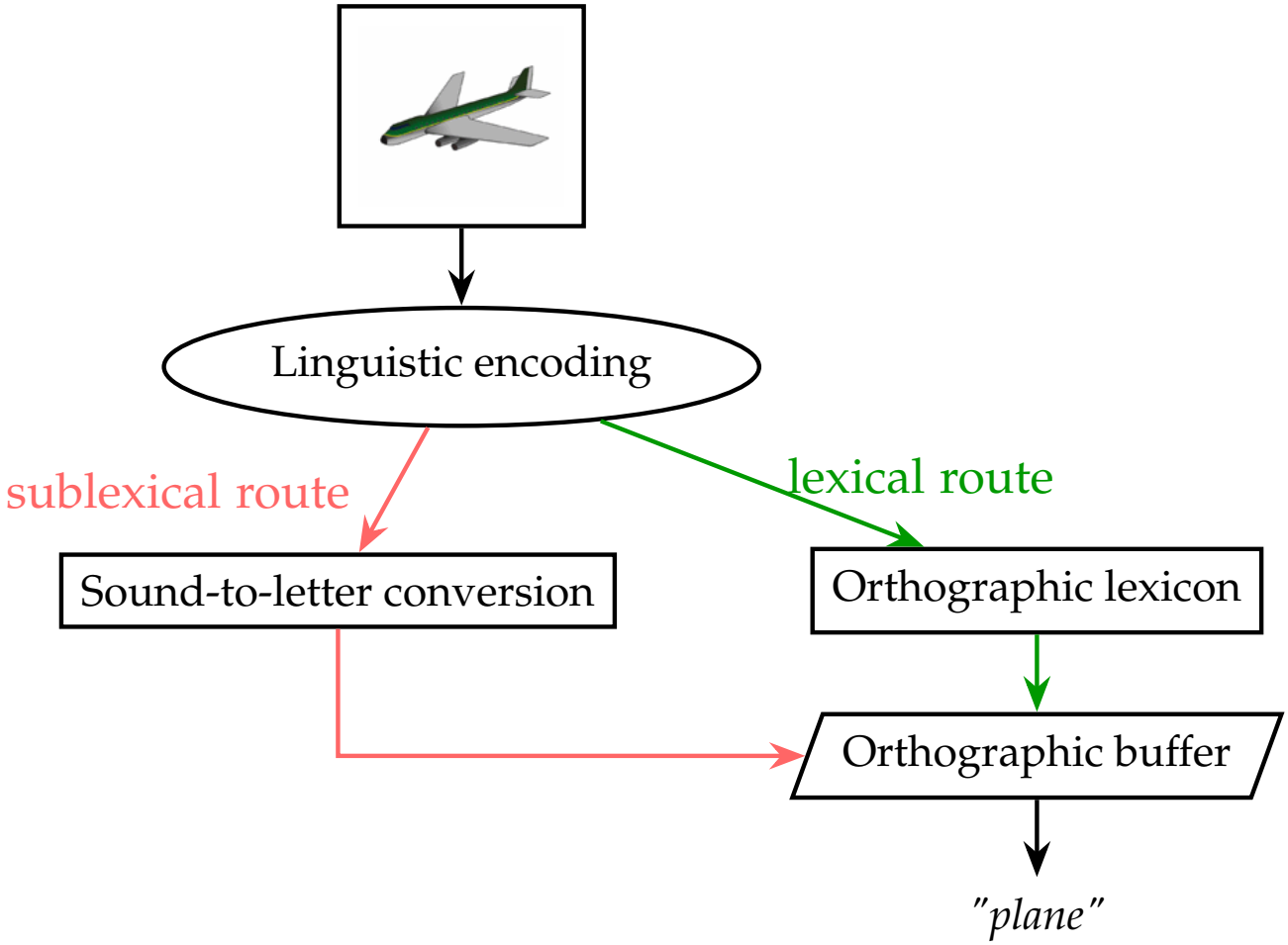
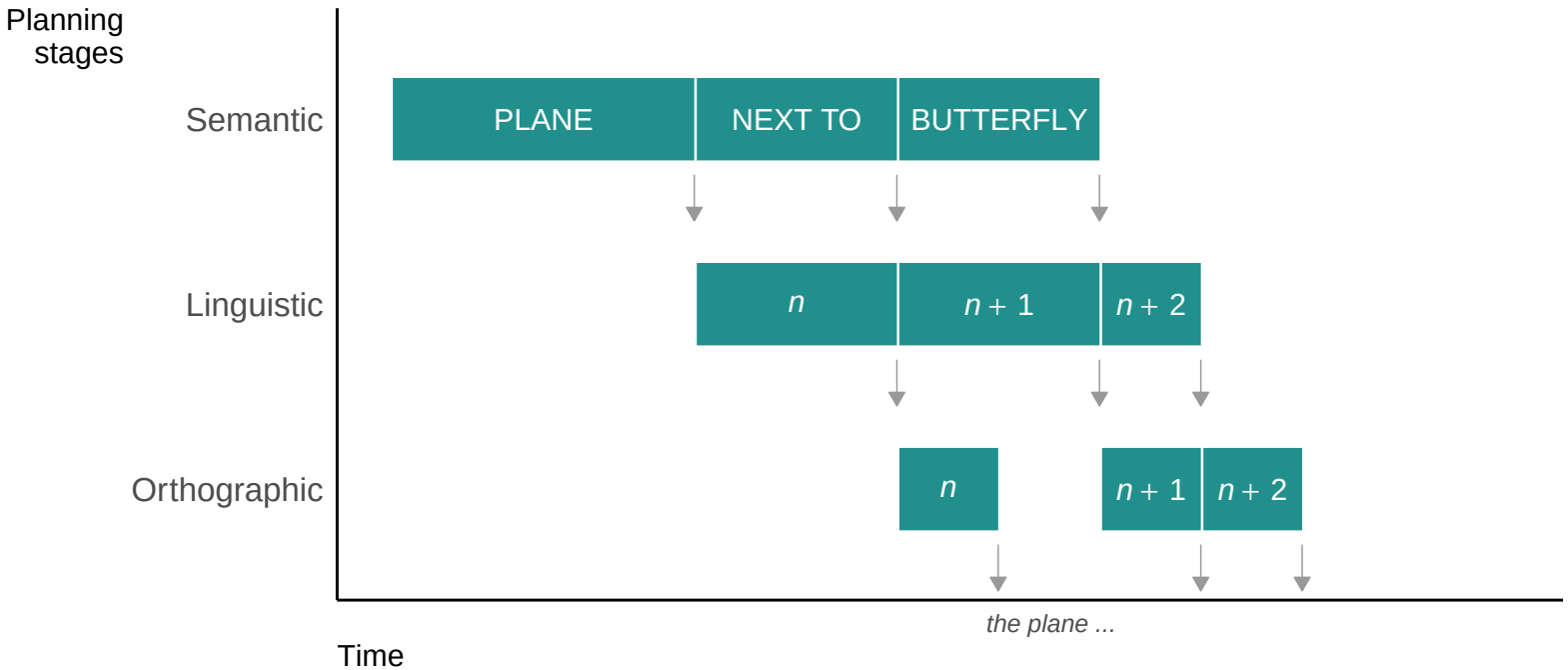
Writing a word involves three general planning stages



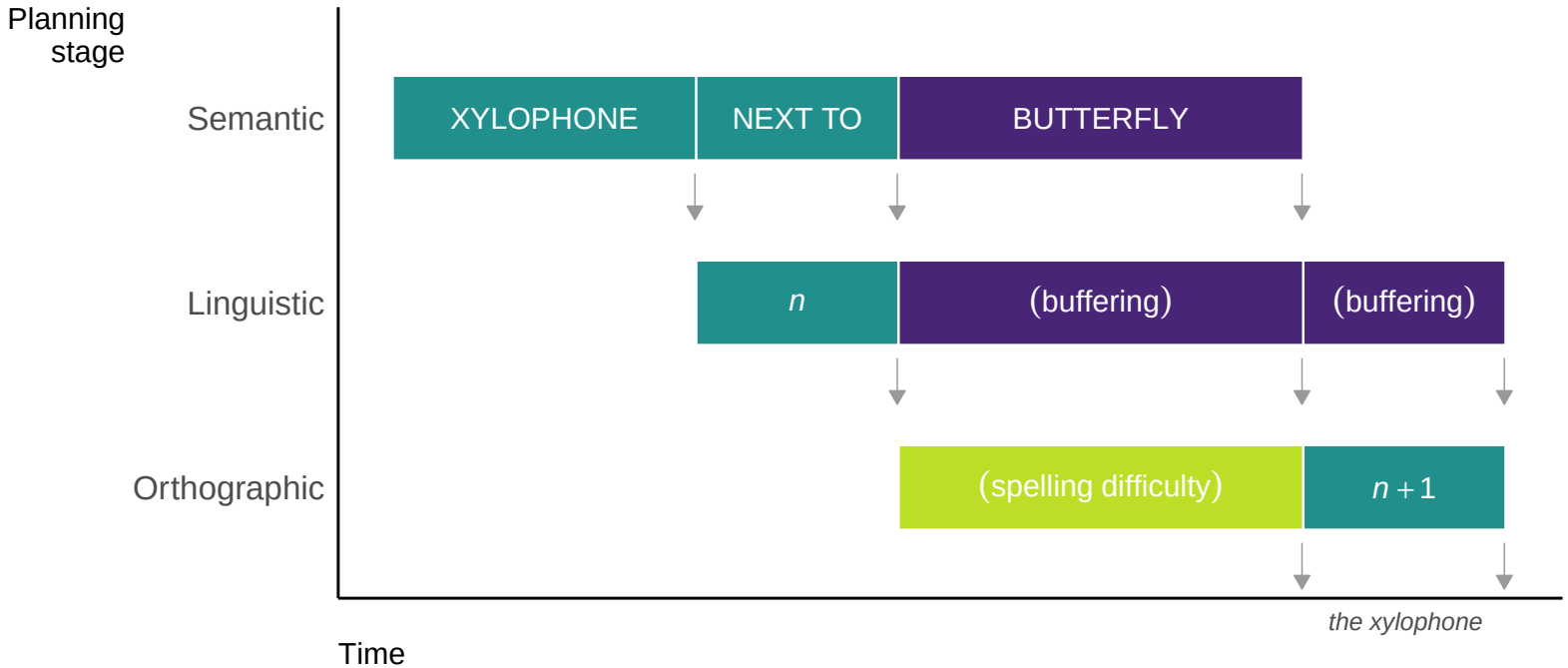
Classic model of word writing (Caramazza, 1991; Kandel, 2023).

Planning happens in parallel to writing



Difficulty at higher levels delays output; see e.g. Olive (2014).

Planning happens in parallel to writing



Difficulty at higher levels delays output; see e.g. Olive (2014).

Spelling difficult has knock-on effects for upstream processes

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- Poor spellers produce weaker texts (Feng et al., 2019; Kent & Wanzek, 2016).
- Spelling difficulty affects writing fluency:
  - Irregular spelling affects keystroke dynamics (Lambert et al., 2011; Maggio et al., 2015; Suárez-Coalla et al., 2020).
  - Weak spellers write more slowly (Torrance et al., 2016) and less between pauses (Alves & Limpo, 2015; Limpo & Alves, 2017).
- Word-level difficulty in written production (familiarity, number of lexical alternatives) impacts syntax planning (Roeser et al., 2019; Torrance & Nottbusch, 2012).

Research question & aims

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To what extent does difficulty with word spelling affect our ability to convey ideas in writing. This research aims to …

- establish time course of orthographic retrieval in single word production.
- evaluate how difficult-to-spell words affects planning and execution of adjacent words?

Picture-word interference task

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Type the name of the depicted item!

Picture-word interference task

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Type the name of the depicted item!

Picture-word interference task

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Spell match

Spell mismatch

Baseline

Target word: “plane”

Writing as mixture process (Roeser et al., 2021)

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Response time is the result of a mixture of two processes:

1. Picture encoding, naming retrieval, orthography, motor codes does not interrupt the information flow.
2. Difficulty at higher levels delay information flow and therefore the writing onset.

Prediction: Either can in principle happen across all conditions but the latter is more likely in the spelling mismatch condition.

Writing as mixture process (Roeser et al., 2021)

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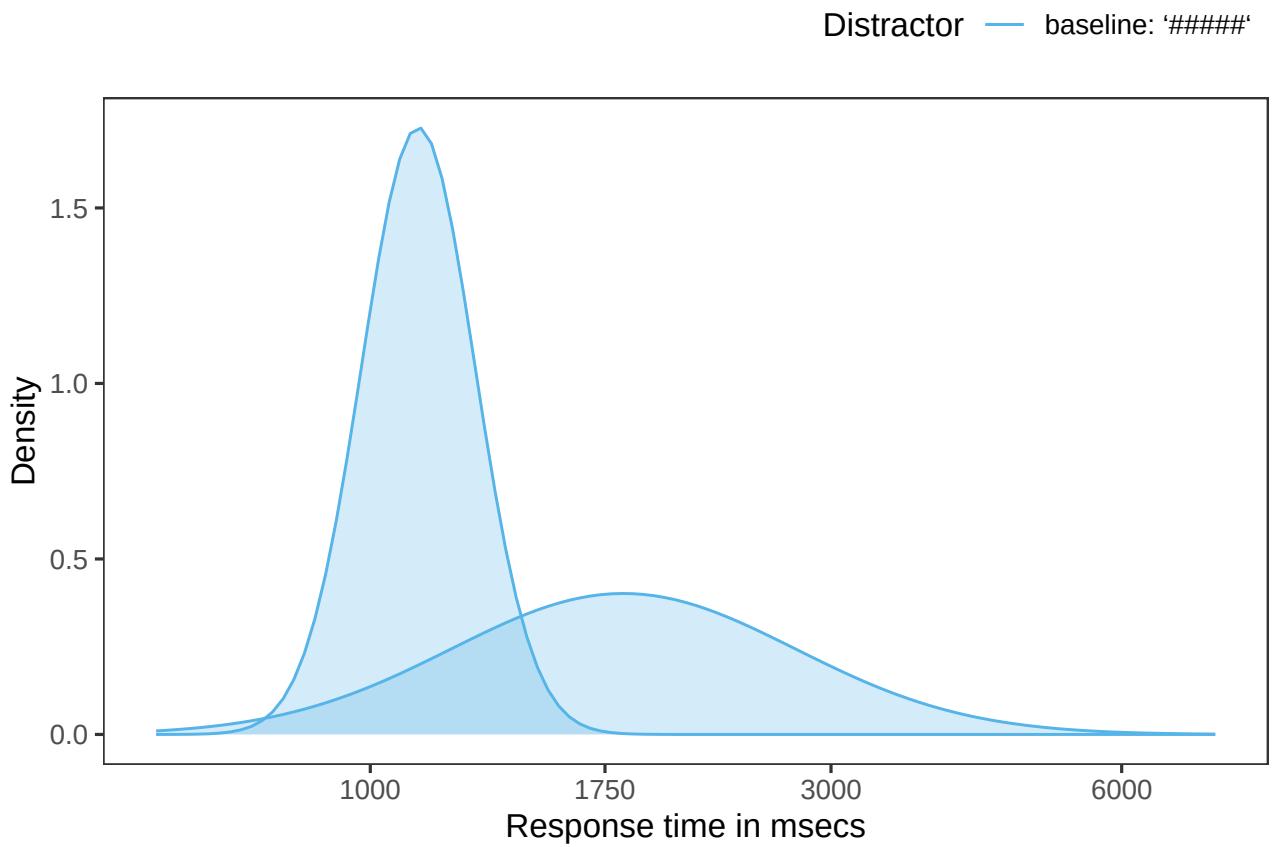
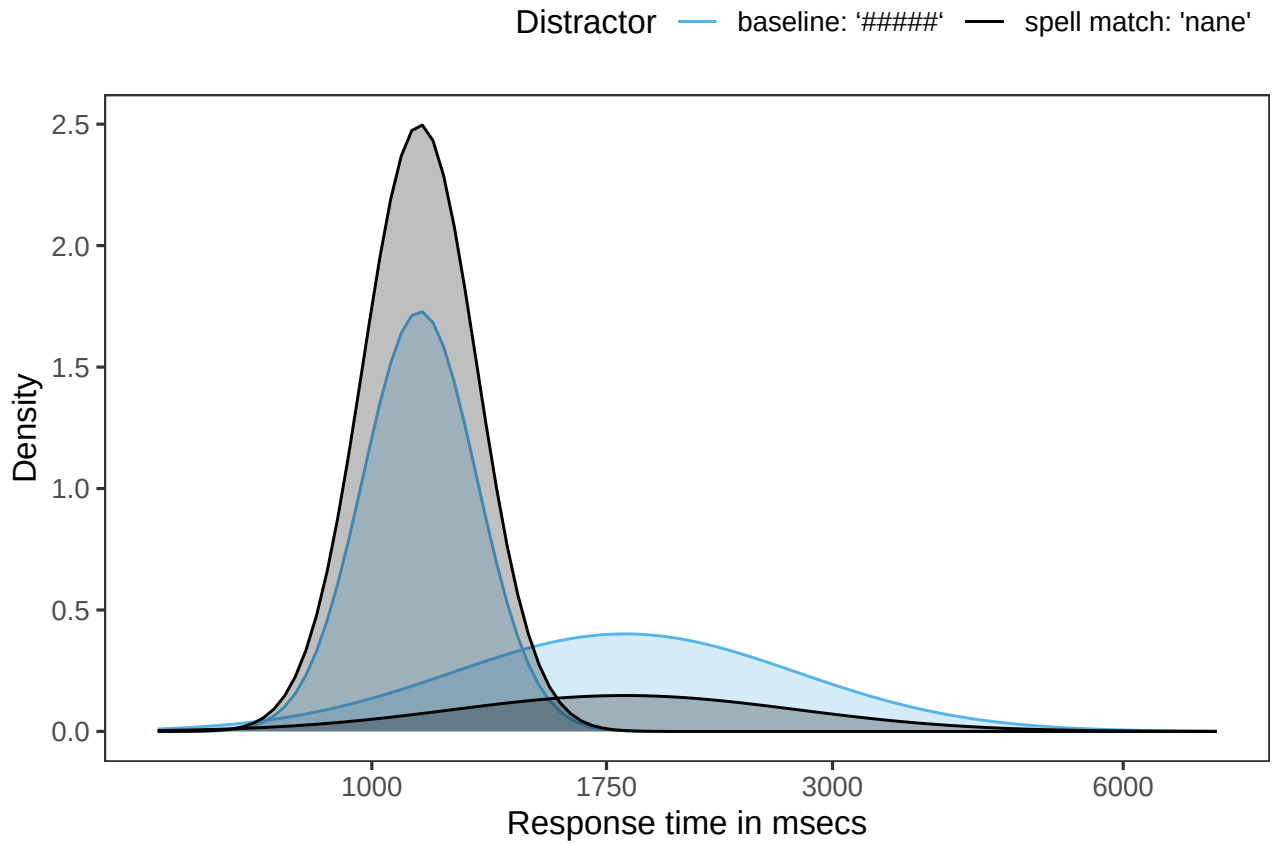


Mixture model distributions (talk to me about details)

Writing as mixture process (Roeser et al., 2021)



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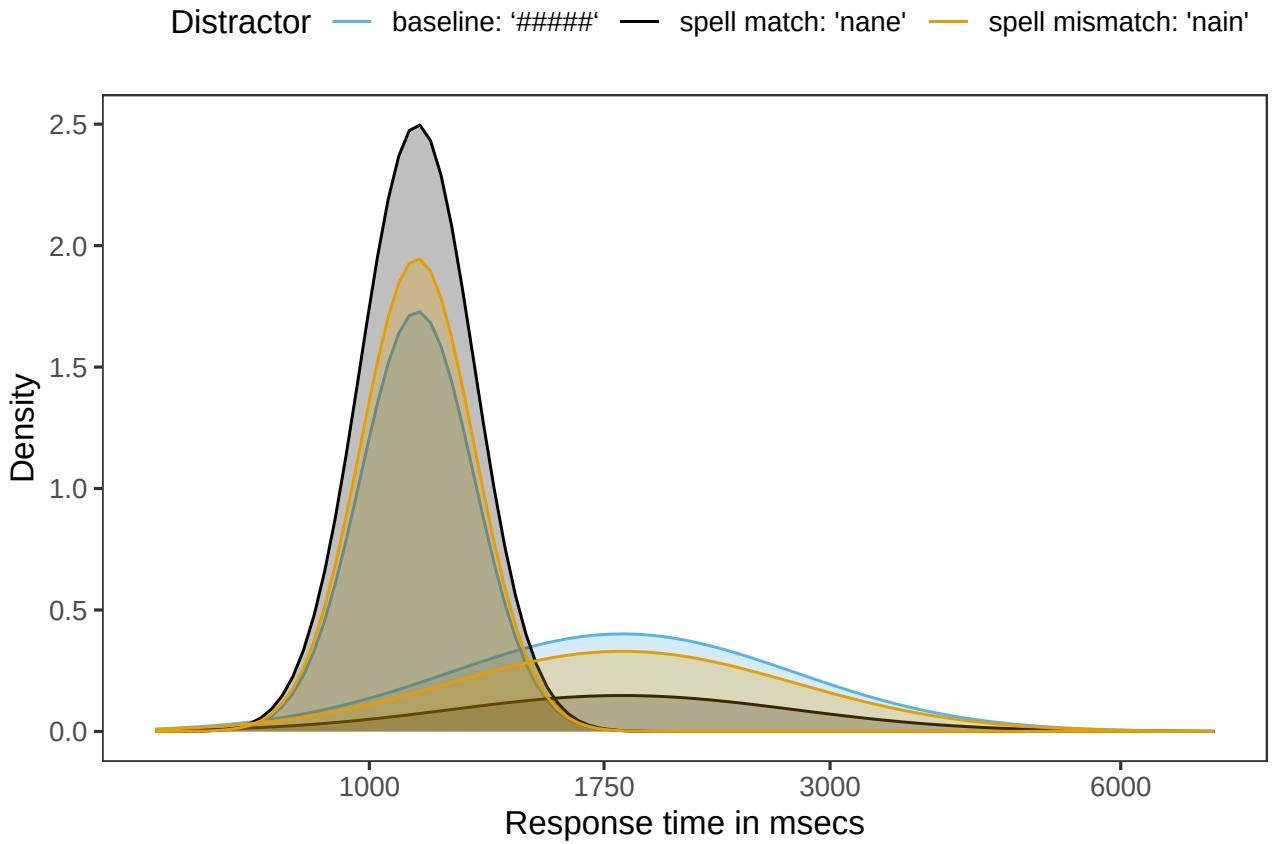
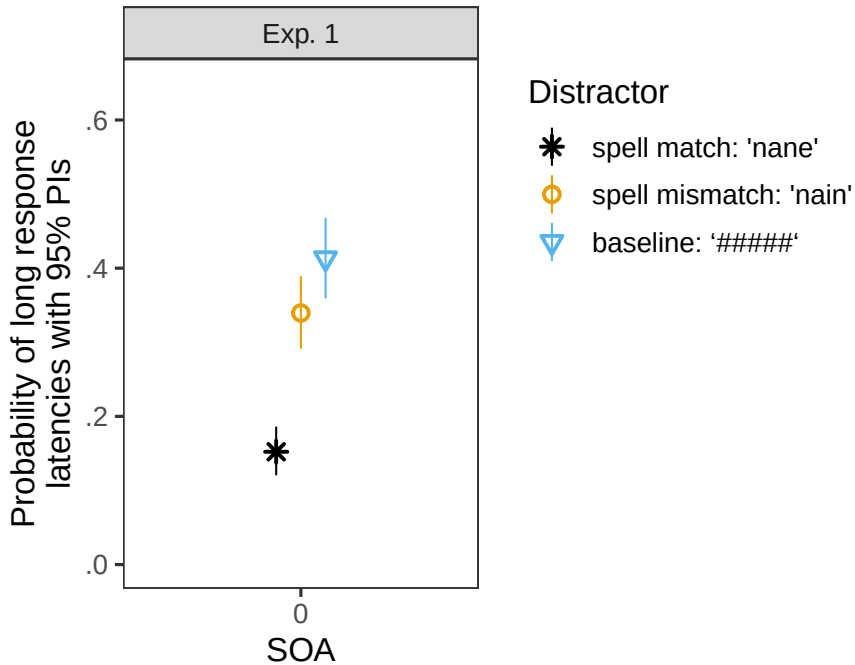
Writing as mixture process (Roeser et al., 2021)



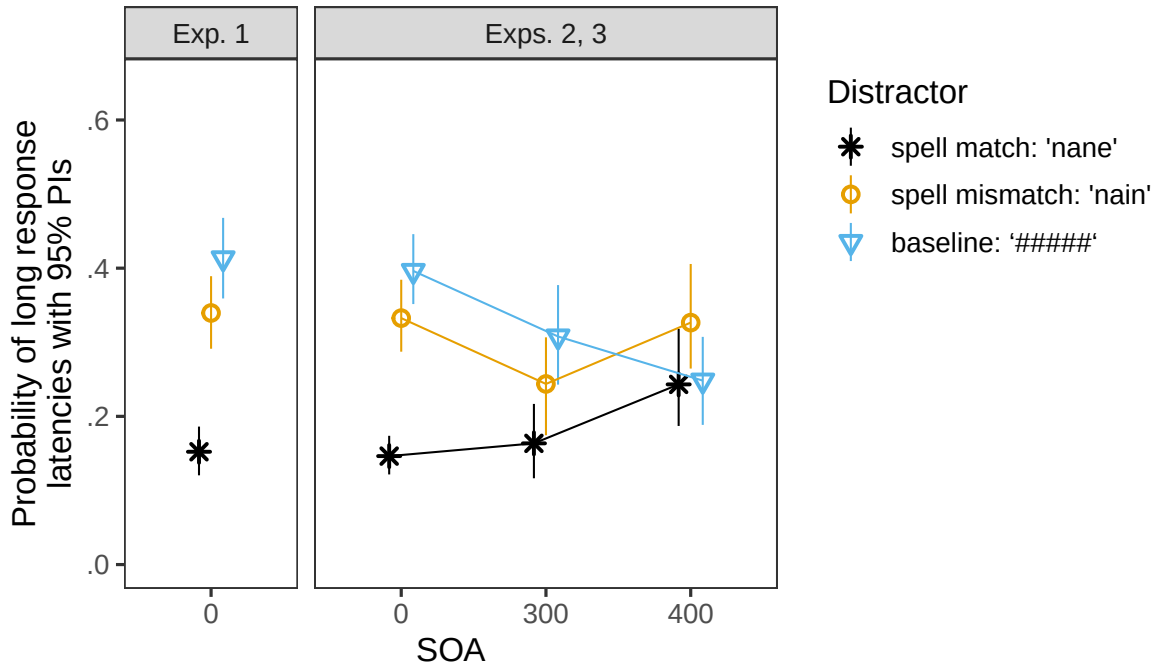
Mixture model distributions (talk to me about details)

Mixture model results



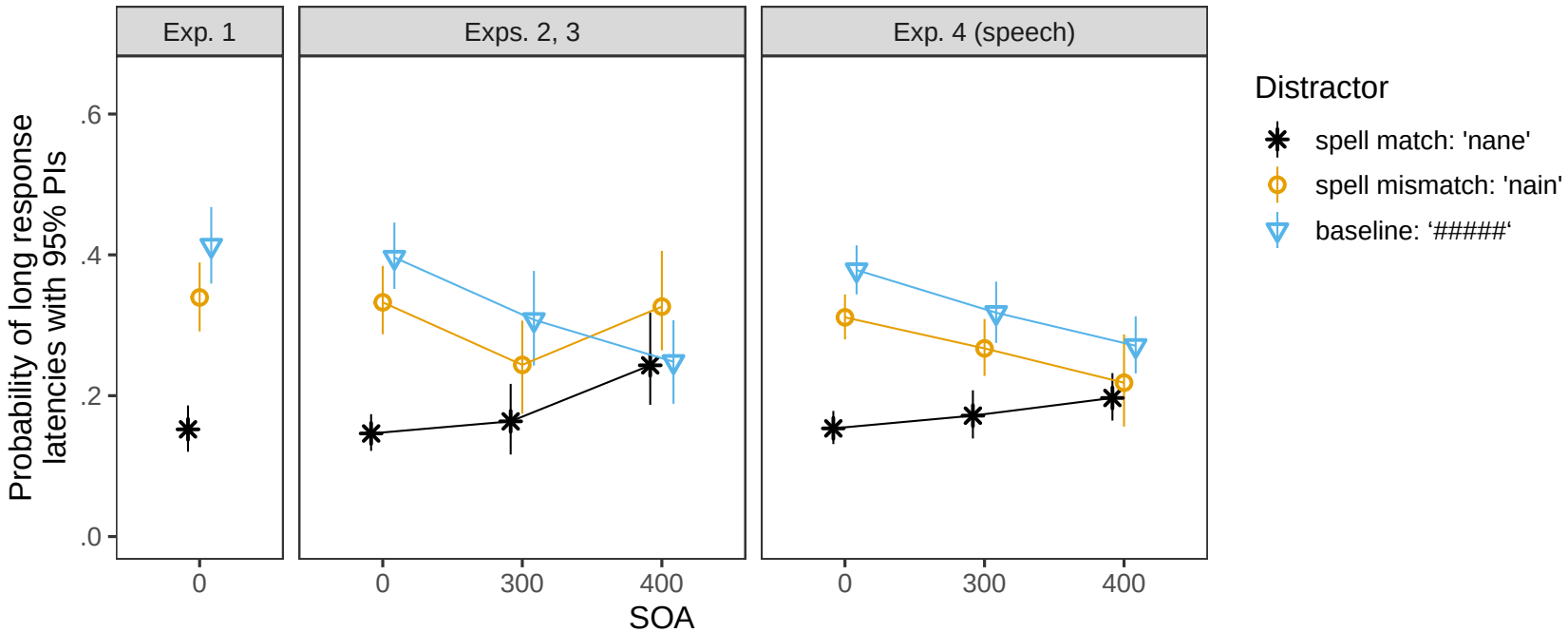
Example target word: "plane"

Mixture model results



Example target word: "plane"

Mixture model results



Example target word: "plane"

Research question: Part II

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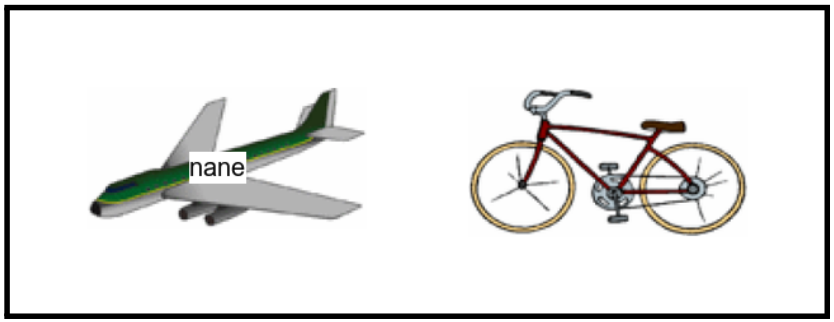
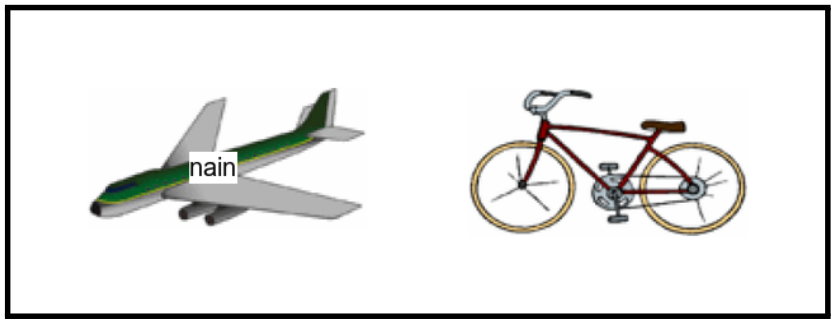
To what extent does difficulty with word spelling affect planning and execution of words adjacent to a difficult-to-spell word?

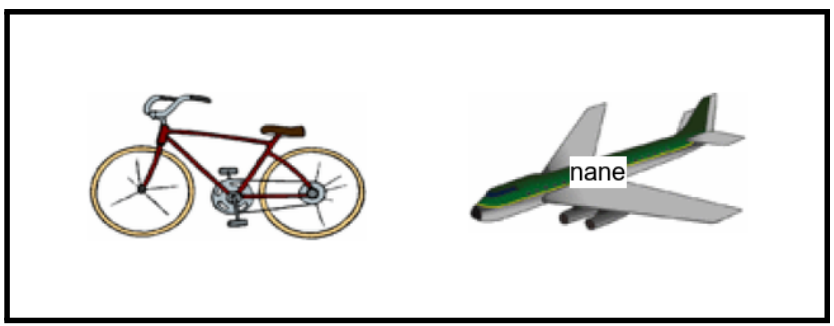
Design



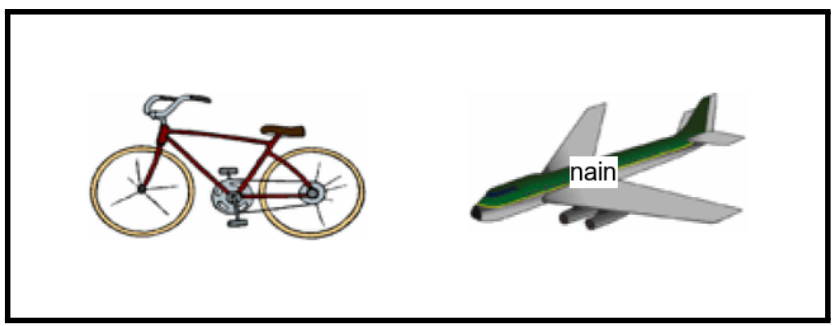
(a) Target initial, spell match



(b) Target initial, spell mismatch



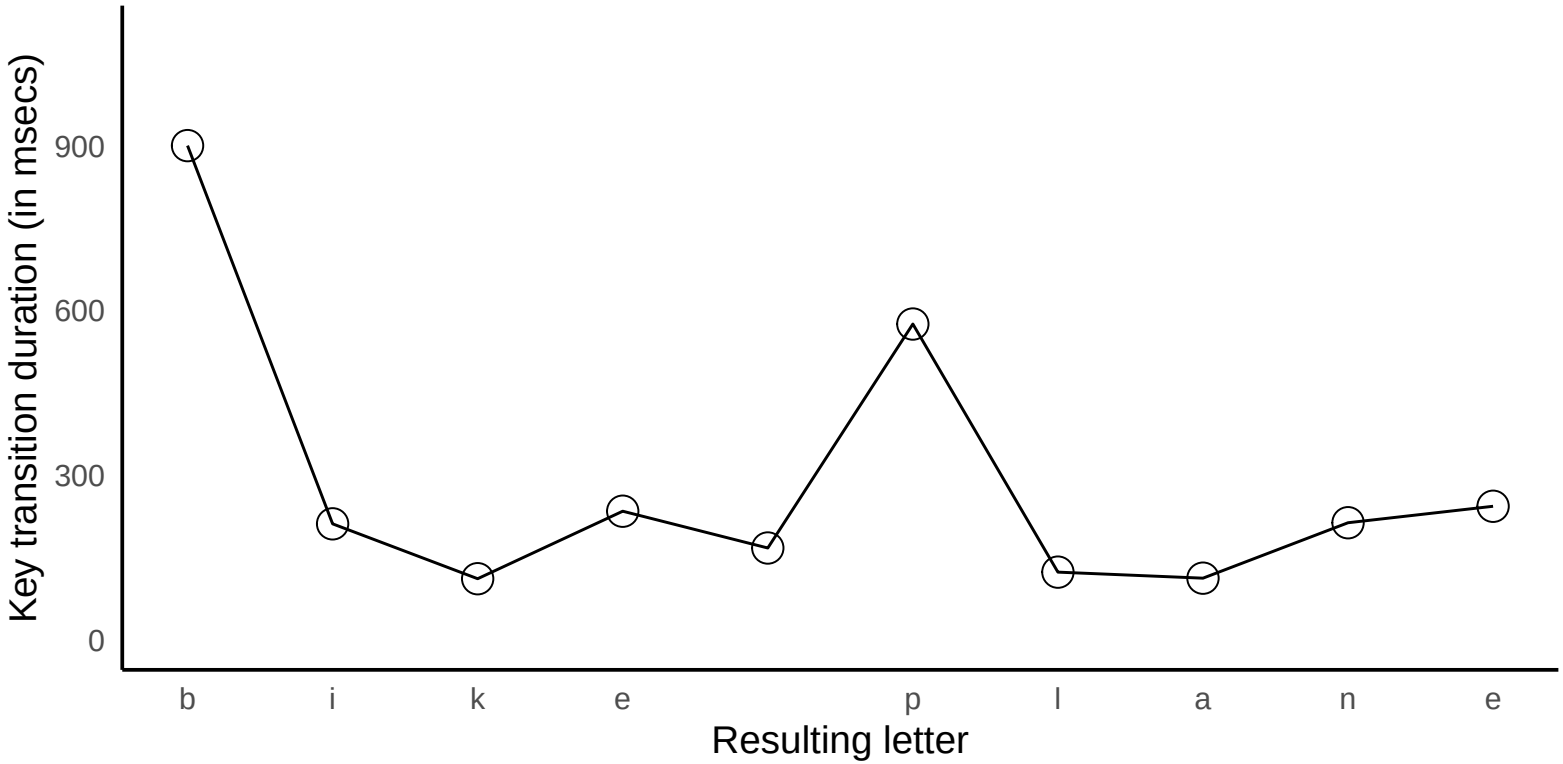
(c) Target final, spell match



(d) Target final, spell mismatch

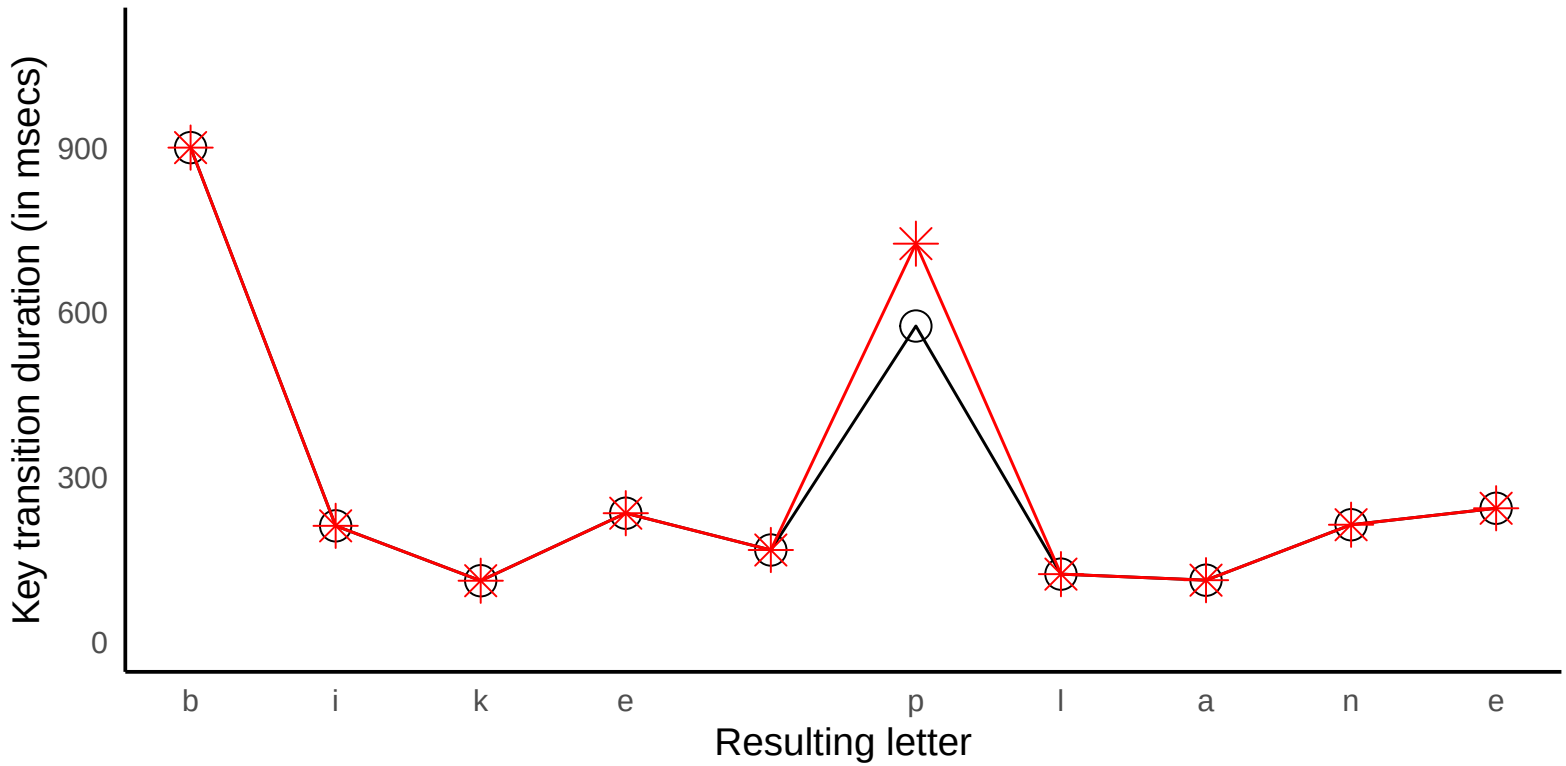
Target phrase "plane bike", "bike plane"

Predictions



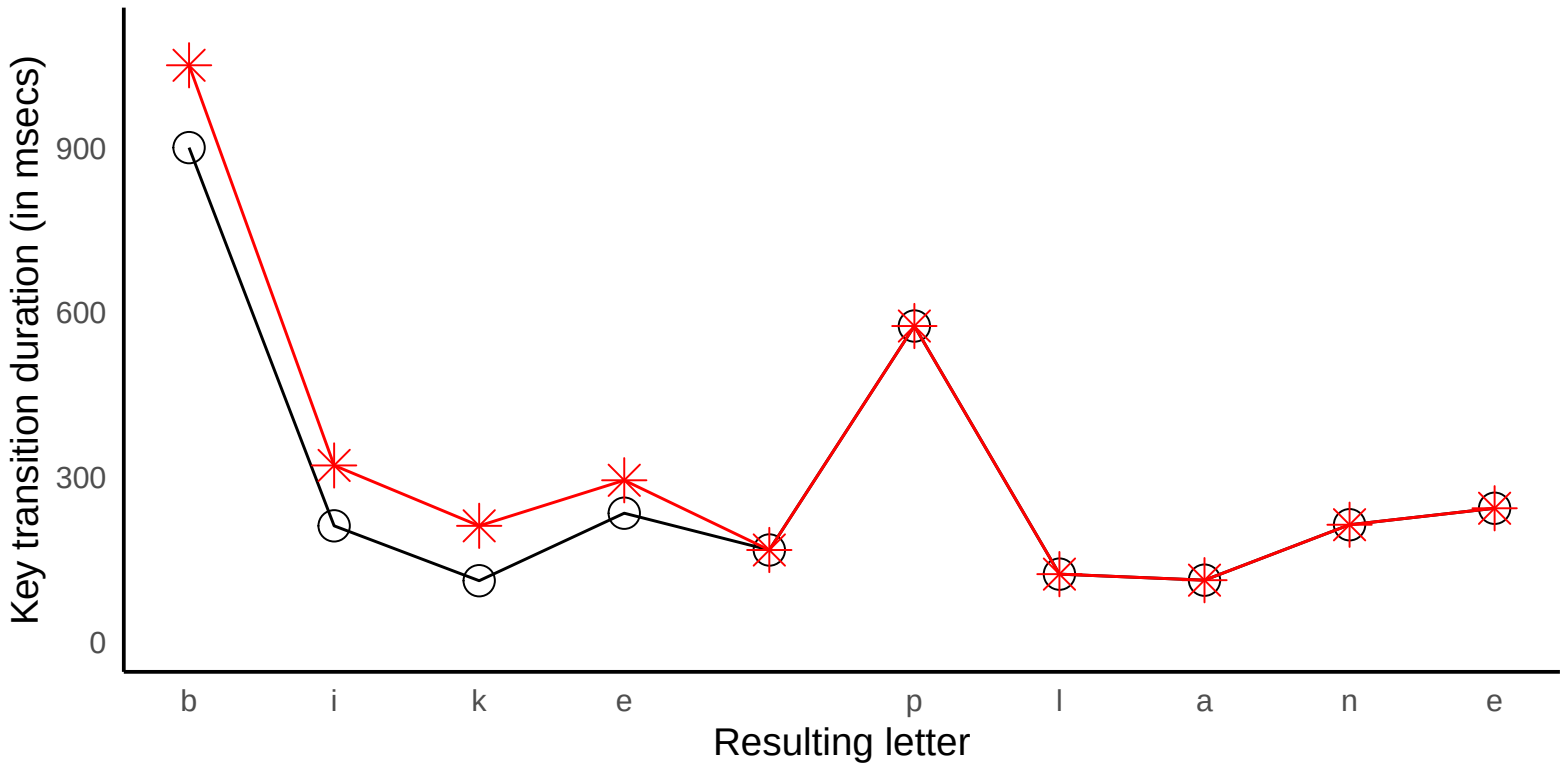
Keystroke intervals for “bike plane”

Predictions



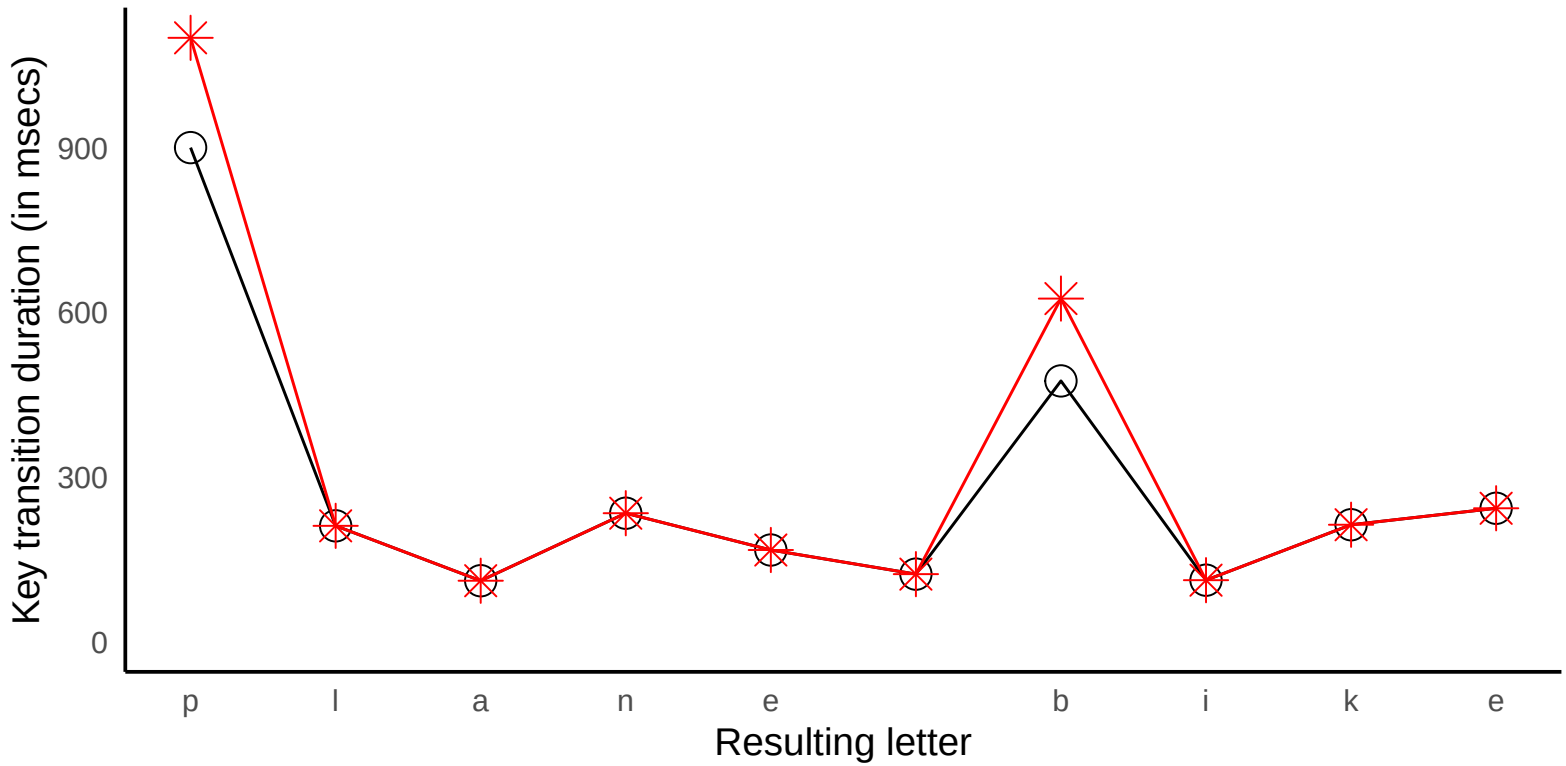
Keystroke intervals for “bike plane”

Predictions



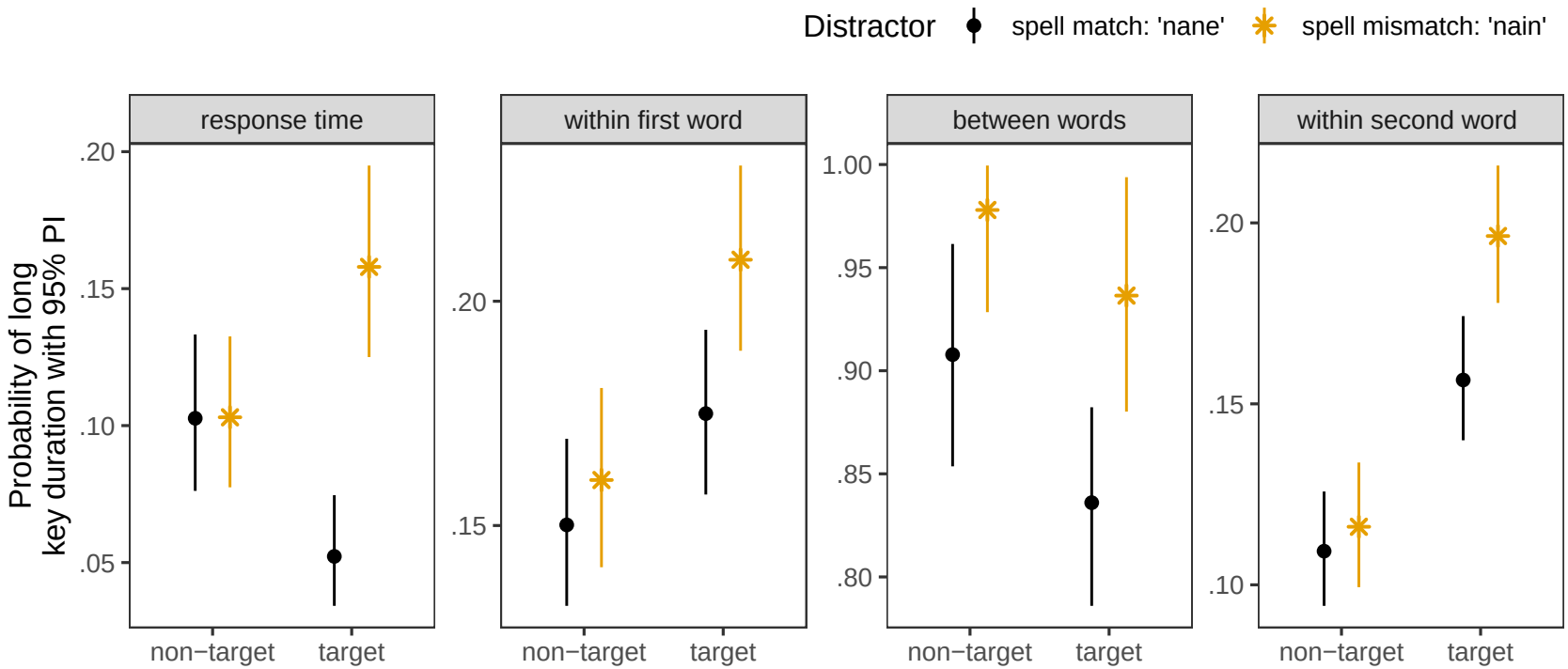
Keystroke intervals for “bike plane”

Predictions



Keystroke intervals for “plane bike”

Mixture model results: Experiment (1 and) 2



Example target phrase: “plane bike”, “bike plane”

Orthography is planned in parallel to production

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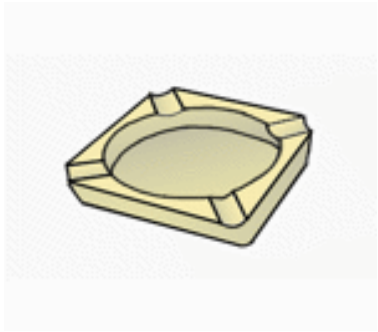
- No evidence that orthography of upcoming word affects the previous word.
- Whether or not parallel planning occurs depends on the time available for parallel planning (Griffin, 2003).

Mixture model results: Experiment 3



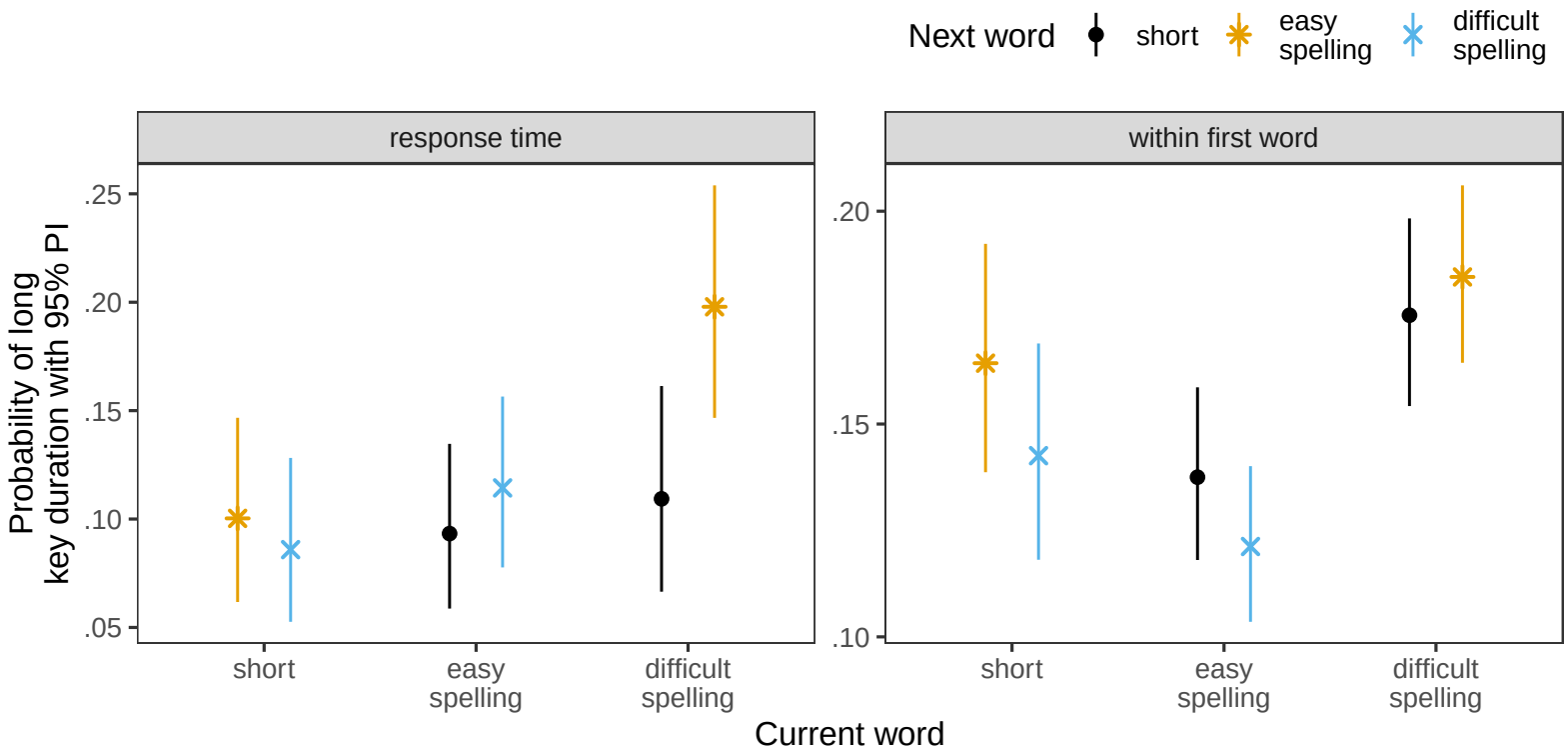

(a) difficult spelling, short word


(b) easy spelling, short word

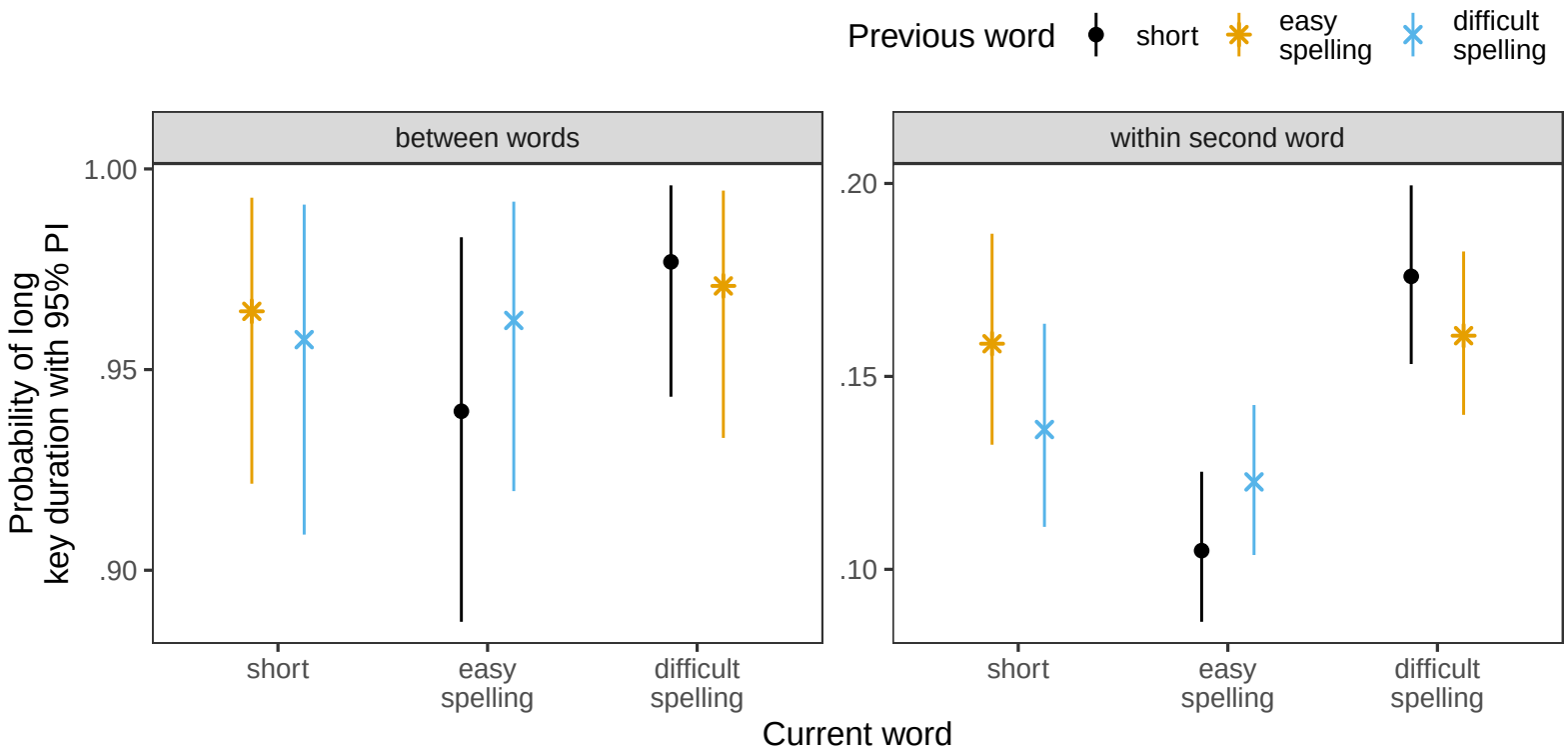

(c) easy spelling, difficult spelling

Design: Word type (levels: difficult spelling ["ashtray"], easy spelling ["racket"], short ["comb"]) $\times$ order (levels: first word, second word)

Mixture model results: Experiment 3



Mixture model results: Experiment 3



Orthography is planned in parallel to production

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- Spelling difficulty increased pausing probability before and after word onset.
- Pre-planning of orthography depends – to some extent – on the location of the difficult-to-spell word.
- Parallel planning of upcoming words is only available if the current word and the next word are easy to spell.
- Difficulty with word spelling spills over to planning of subsequent words.

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Thank you for listening!

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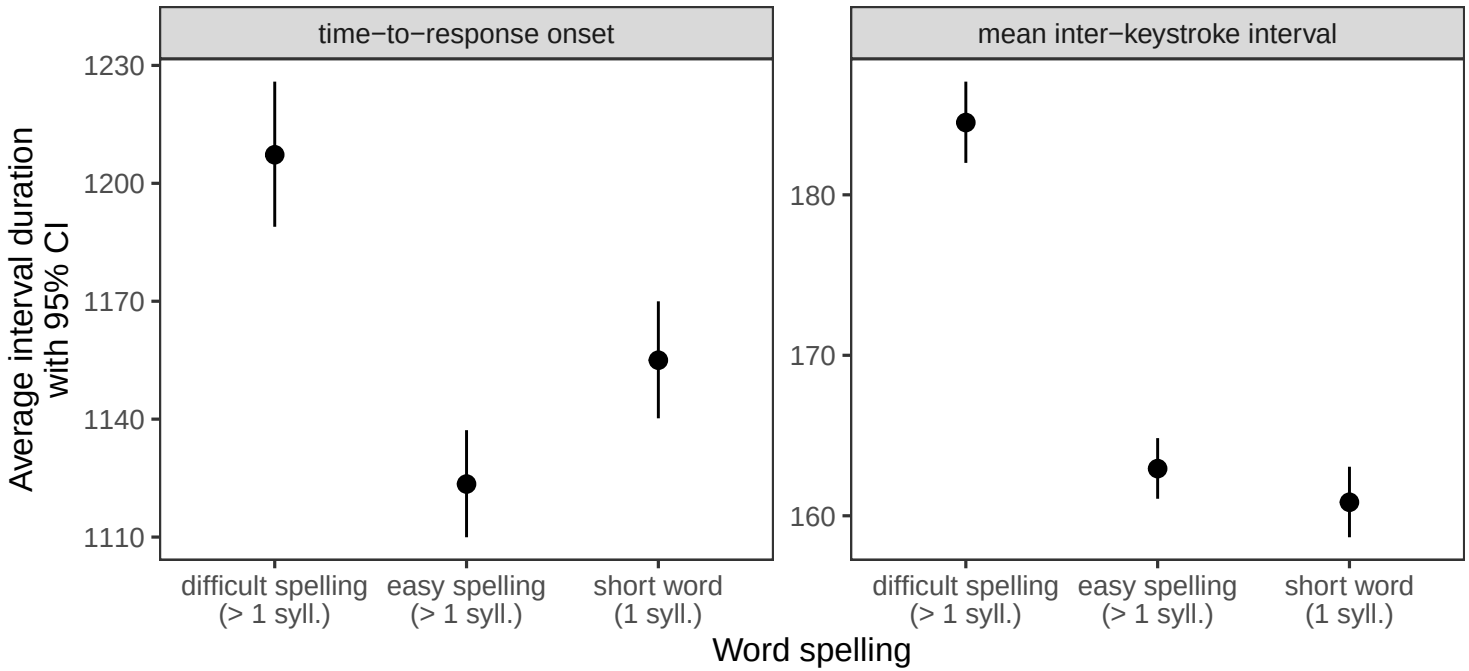
Spelling diversity



Data from Torrance et al. (2018)

Spelling diversity

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- Spelling diversity data taken from Torrance et al. (2018).

$$H = \sum_{i=1}^{K} p_i \times \log_2(\frac{1}{p_i})$$

where k is the number of different spellings and p_i is the proportion of ppts producing the i^{th} spelling (Lachman, 1973).

Writing as mixture process (Roeser et al., 2021)

$$
\begin{aligned}
\text{rt}_{ij} \sim\ & \theta_{\text{distractor-type}} \cdot \log\mathcal{N}(\beta + \delta + \text{ppt}_i + \text{item}_j, \sigma^2_{e'}) + \\
& (1 - \theta_{\text{distractor-type}}) \cdot \log\mathcal{N}(\beta + \text{ppt}_i + \text{item}_j, \sigma^2_e)
\end{aligned}
$$

where:

$$
\begin{aligned}
\text{ppt}_i \sim\ & \mathcal{N}(0, \sigma^2_{ppt}) \\
\text{item}_j \sim\ & \mathcal{N}(0, \sigma^2_{item})
\end{aligned}
$$

constraints:

$$
\begin{aligned}
& \delta, \text{ (and all } \sigma\text{s)} > 0 \\
& \sigma^2_{e'} > \sigma^2_e
\end{aligned}
$$