Processing letter position in transparent scripts: Insights from Korean hangul

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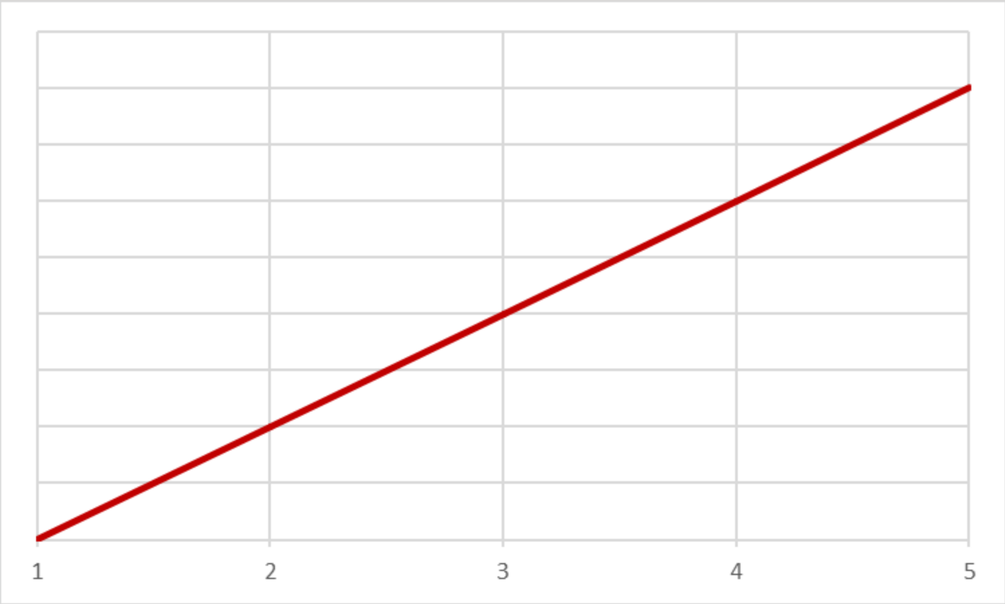
Strategies for Identifying Letters and Their Positions Within a Word

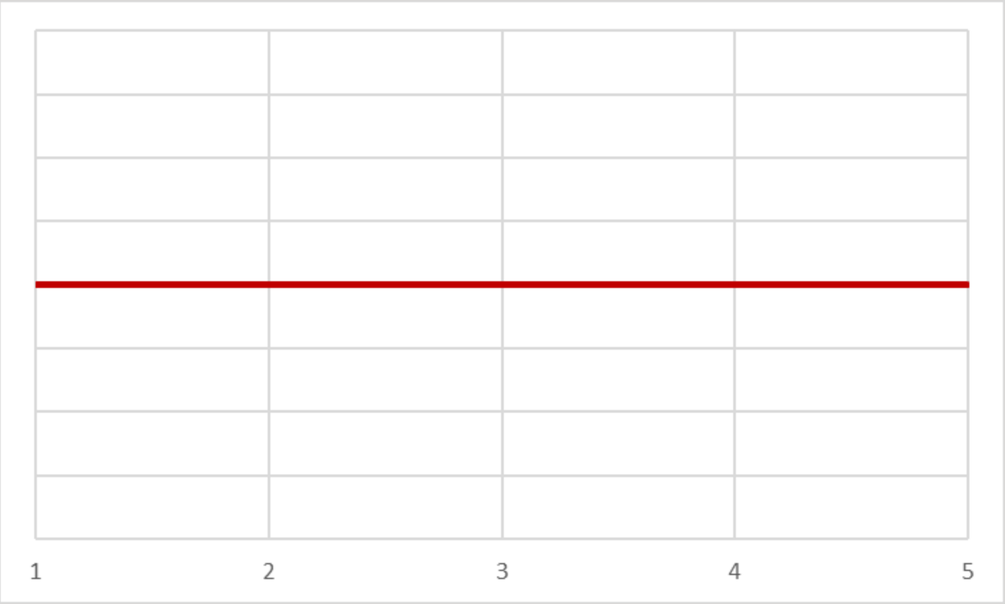
Serial scanning [Whitney 2001]

- letters are processed one by one in the writing direction



Parallel scanning [Grainger, Van Heuven 2004]

- letters are recognized simultaneously



Letter Visual Search Task [Hammond, Green 1982]

- **What for:** to reveal mechanisms underlying low-level word processing during reading [Green, Meara 1987]
- **What to do:** to decide whether a pre-specified target symbol occurs in a sequence
  - the target position varies (1–5)
- **What do we get:** reaction time and/or accuracy
- **What can we infer:** which positions in the visual string are perceptually privileged

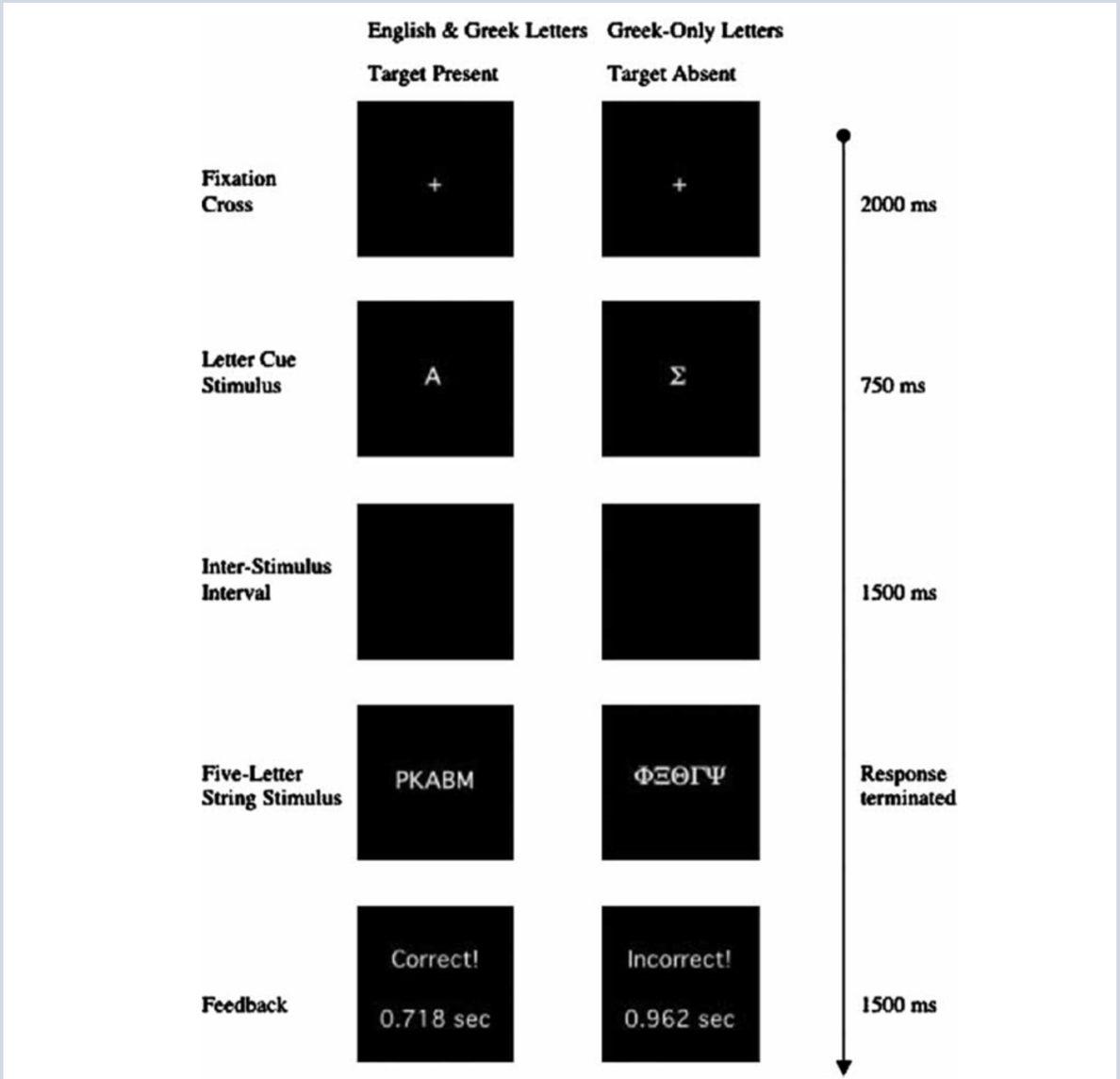


Figure 1. Schematic illustration of procedure used for target present and target absent trials of the letter search task.

Ktori & Pitchford [2008]

E.J. Hammond & D.W. Green

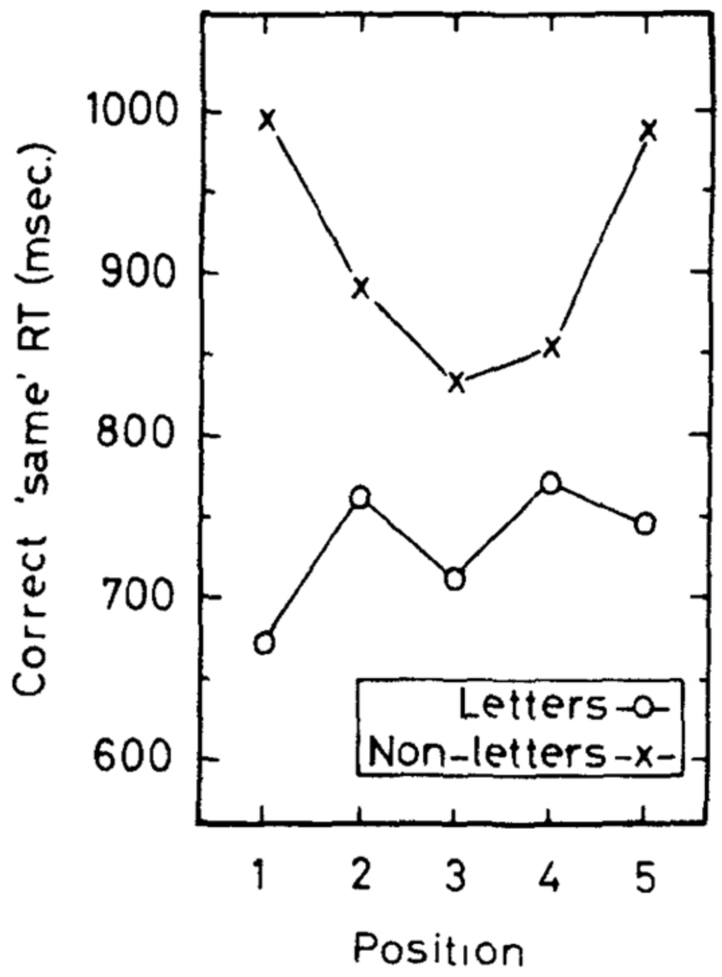


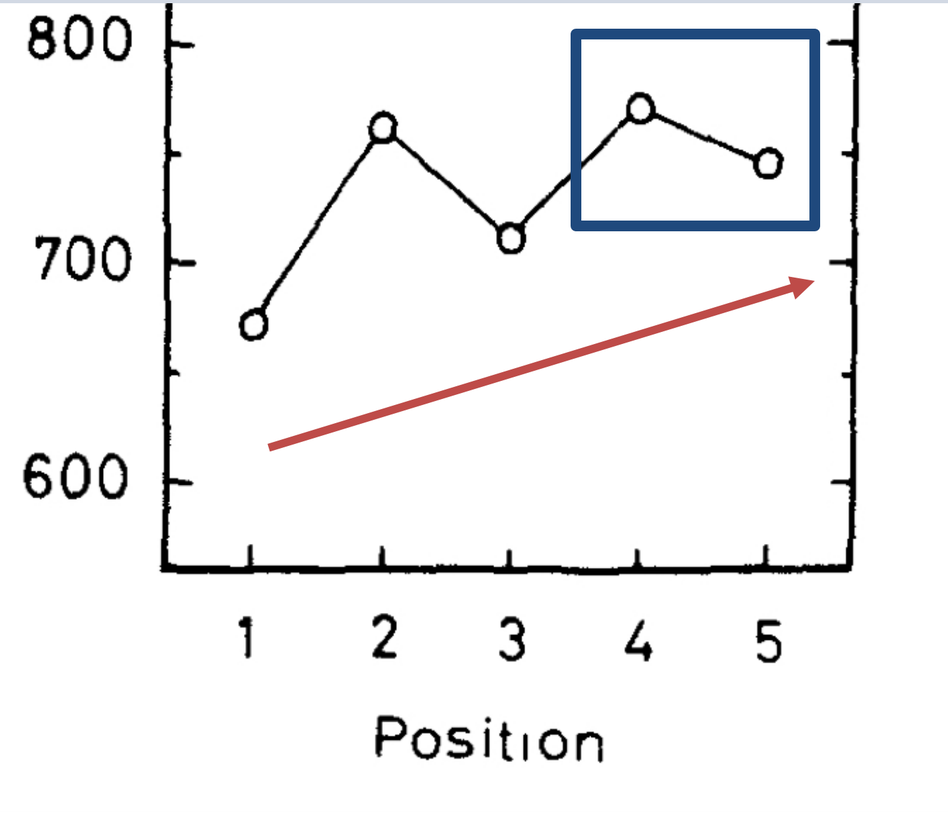
Figure 2 Mean latency for correct target detections as a function of the positon of the match within the string, and stimulus category

Evidence from English* and French**

- **Upward** M-shaped function
- **First letter** recognized fastest
- **Advantage a**t positions **3** (center) and **5** (final)

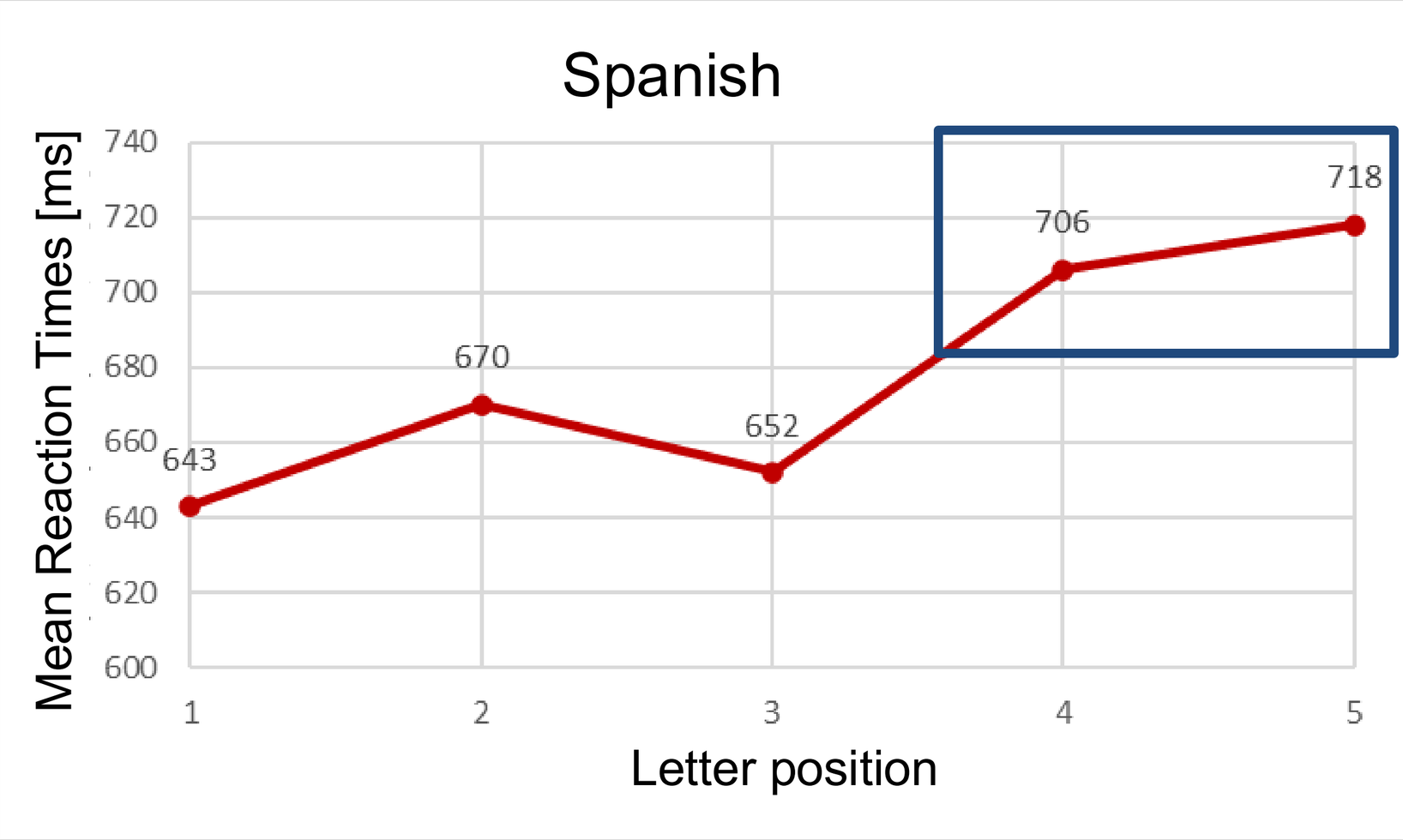
** Hammond & Green, 1982; Green & Meara, 1987*
*** Tydgat & Grainger, 2009*

Implications for letter-position strategies



- 5 < 4 ⇒ parallel strategy
- 1 < 2 < 4 ⇒ serial scanning

Evidence from Spanish* and Greek** findings



- **5 > 4 ⇒ no signs of parallel scaninng**
- **1 < 2 < 4 ⇒ serial scanning**

** Green, Meara 1987*
*** Ktori, Pitchford 2008*

Hypothesis by Ktori & Pitchford [2008]

Transparent orthographies (greater consistency in letter–sound mapping):

- RTs: **1<2<4** positions
- **no** advantage of position 5 over 4 **(5>4 or 5 ~ 4)**
- **serial processing**

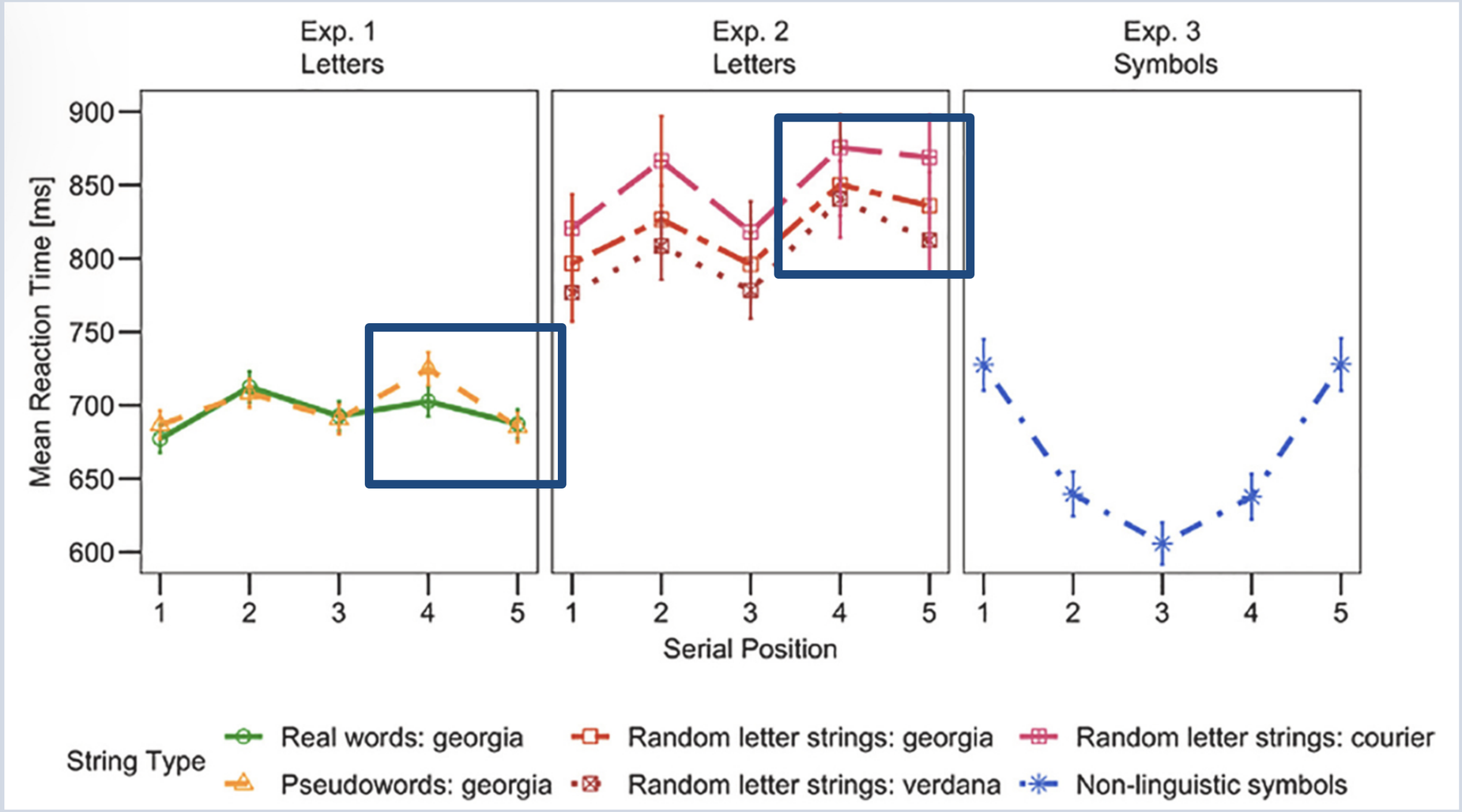
Example: Greek

Deep orthography (lower consistency in letter–sound mapping):

- RTs: **1<2<4** positions
- advantage of position 5 over 4 **(4>5)**
- **parallel + serial processing**

Example: English

Evidence from Russian*, a relatively transparent language



Position 4 > 5 ⇒ the hypothesis does not hold

** Alexeeva, Dobrego 2021*

Possible explanations and study goal

Unpredictable stress in Russian => vowel reduction

We need to test languages that have highly transparent orthographies

This study: Korean
- has shallow orthography [Marjou 2021]

Korean

- **Korean writing (Hangul)** is an **alphabet:** each letter corresponds to a phoneme.
- However, words are formed from **blocks** with a constrained **syllable structure**.

- Recent research favors the view of Korean as an alphabetic syllabary (Pae, 2011)

Korean alphabet (Hangul): 51 letters

14 basic consonants: ㄱ ㄴ ㄷ ㄹ ㅁ ㅂ ㅅ ㅇ ㅈ ㅊ ㅋ ㅌ ㅍ ㅎ

10 basic vowels: ㅏ ㅓ ㅗ ㅜ ㅡ ㅣ ㅑ ㅕ ㅛ ㅠ

5 double consonants used in the onset positions (digraphs): ㄲ ㄸ ㅃ ㅆ ㅉ

11 double consonants used at the final position (digraphs): ㄳ ㄵ ㄶ ㄺ ㄻ ㄼ ㄽ ㄾ ㄿ ㅀ ㅄ

11 compound vowels (diphthongs): ㅐ ㅒ ㅔ ㅖ ㅘ ㅙ ㅚ ㅝ ㅞ ㅟ ㅢ

To minimize symbol ambiguity and positional constraints, the stimuli used only 24 simple letters

Syllable Structure

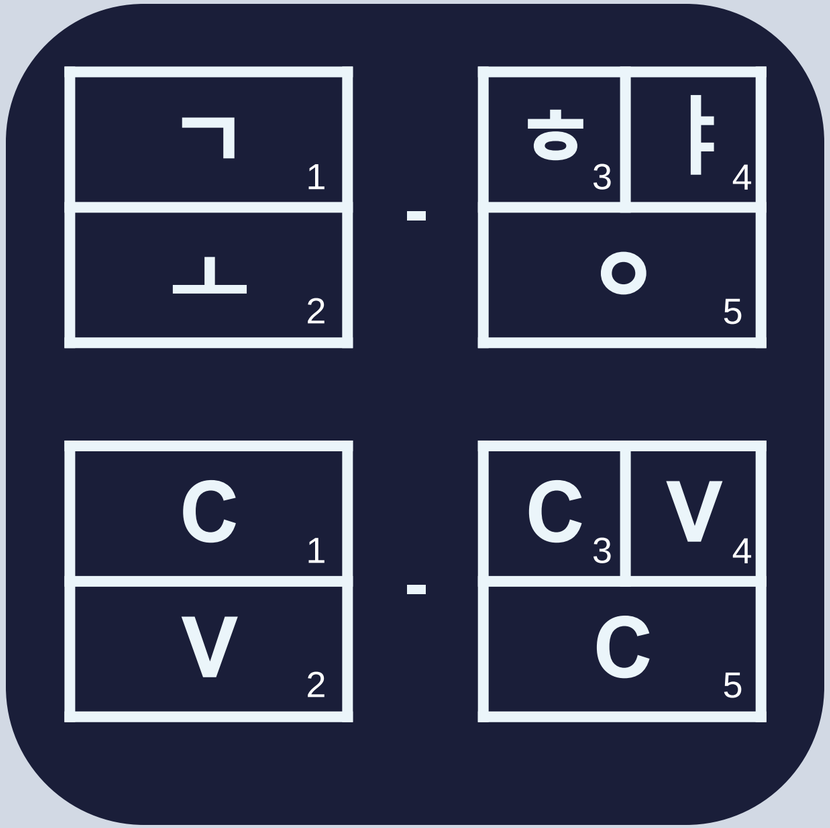
- Permissible syllables: CV, CVC, CVCC (C = consonant, V = vowel)
- Possible syllable structures for five-letter words:

/hak̚.gjo/
’school’

학교 CVC-CV

고향 CV-CVC

/koˌ.hjaŋ/
’hometown’

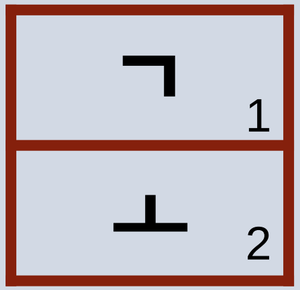


Letter positions within a syllable

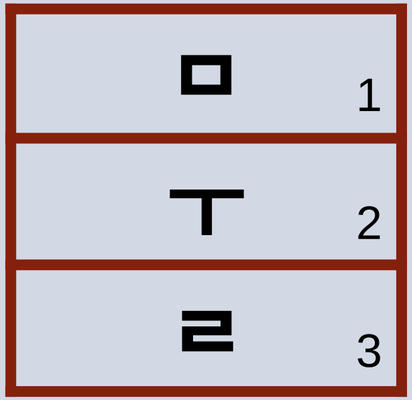
- Some vowels are based on a vertical stroke, others on a horizontal one
- Vowel shape determines block orientation

vertical syllable

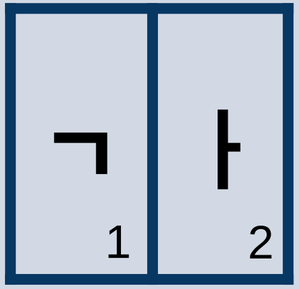
CV



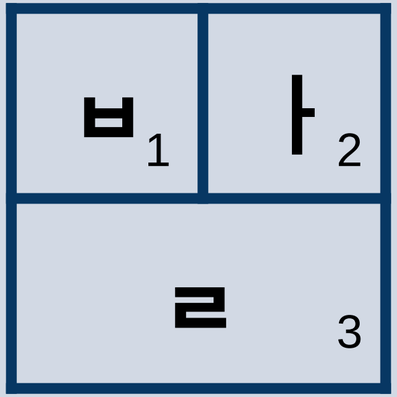
CVC



horizontal syllable

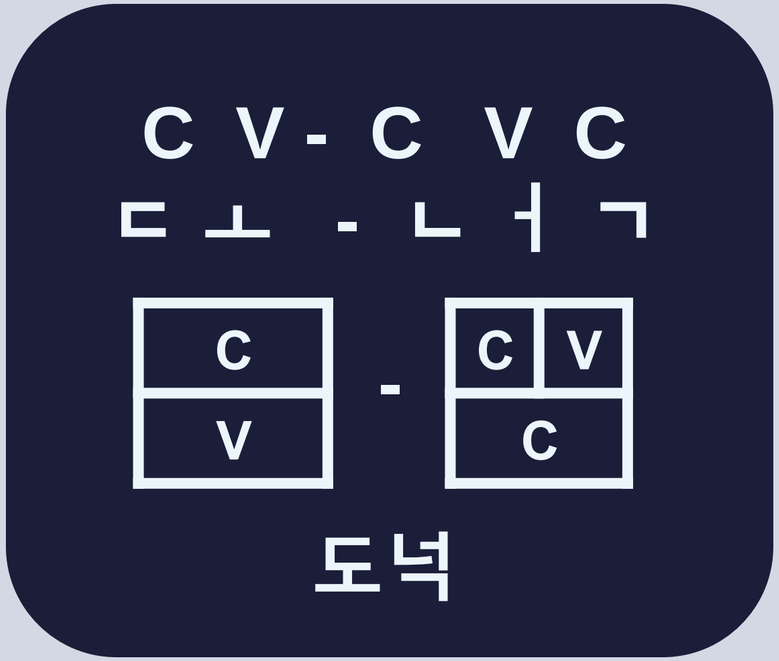


mixed syllable



Stimuli

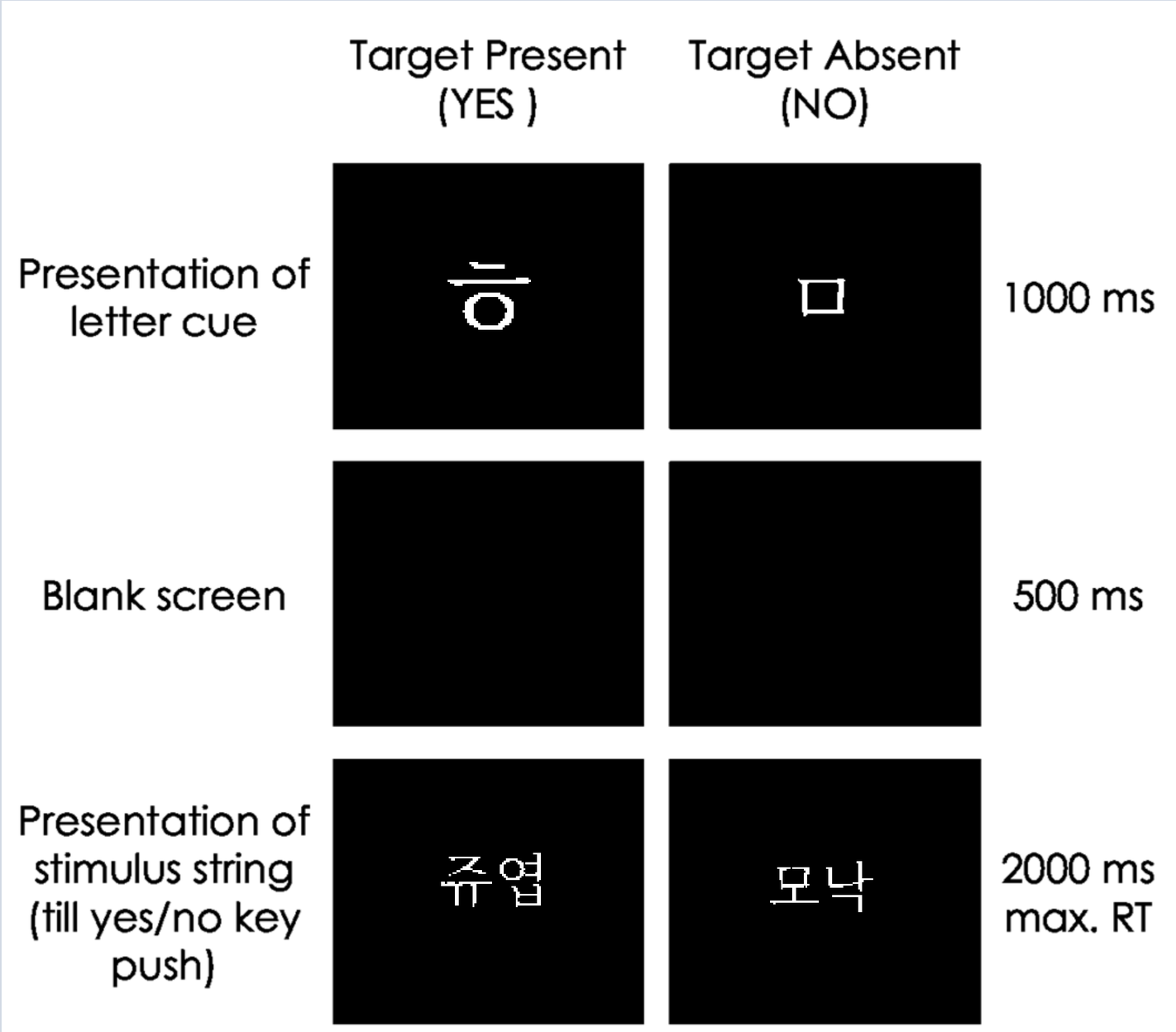
- For each vowel: one pseudoword for three positions (excluding 1 and 3); for each consonant: one pseudoword for four positions (excluding 2)
- Pseudowords generated in Python; syllable structures balanced
- **Total: 86 target strings and 86 fillers**



Participants

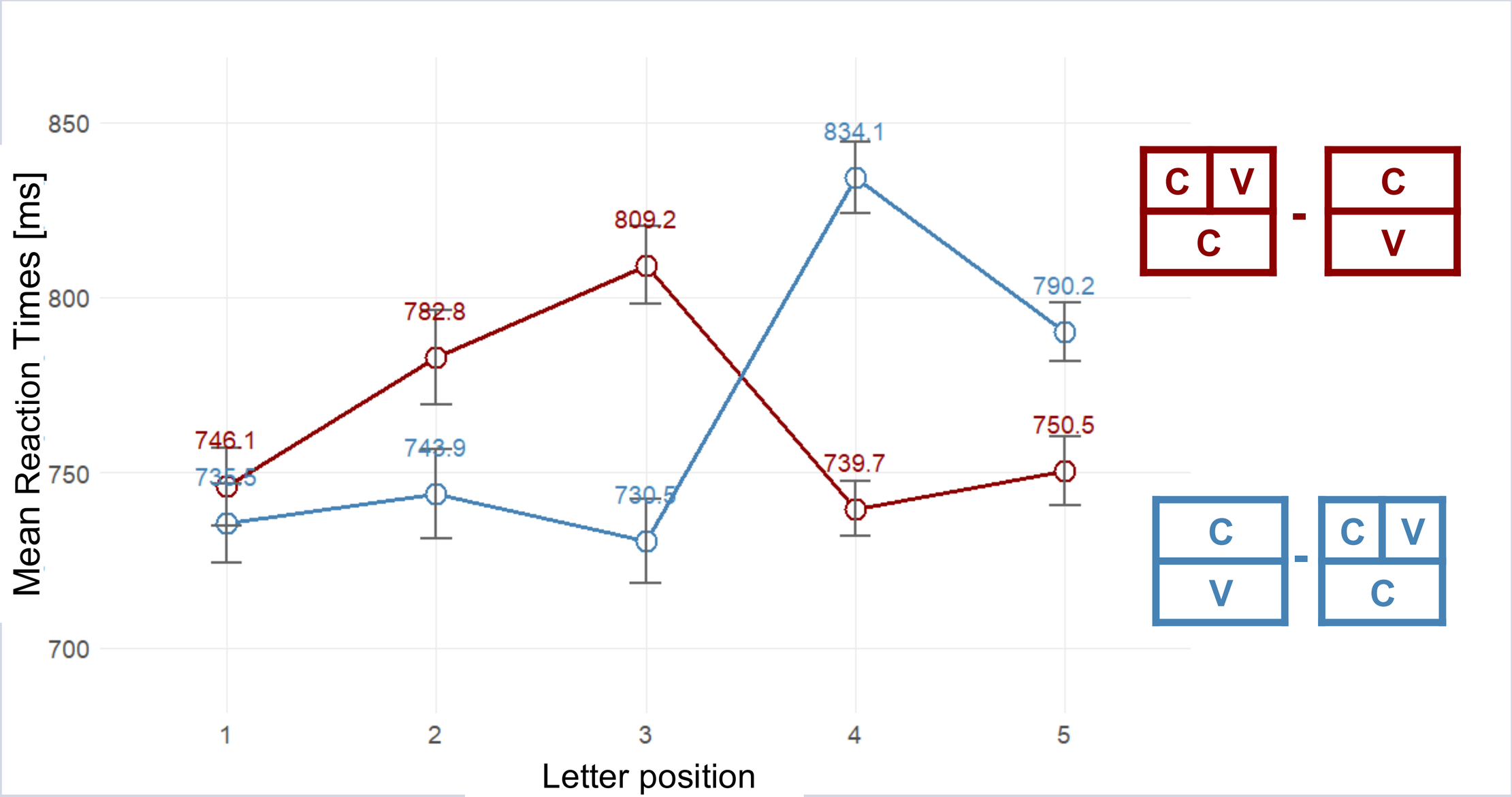
- Native Korean speakers with normal/corrected vision, no reading disorders, not bilingual.
- Number of participants: 55
- Ages: 19–60

Procedure*

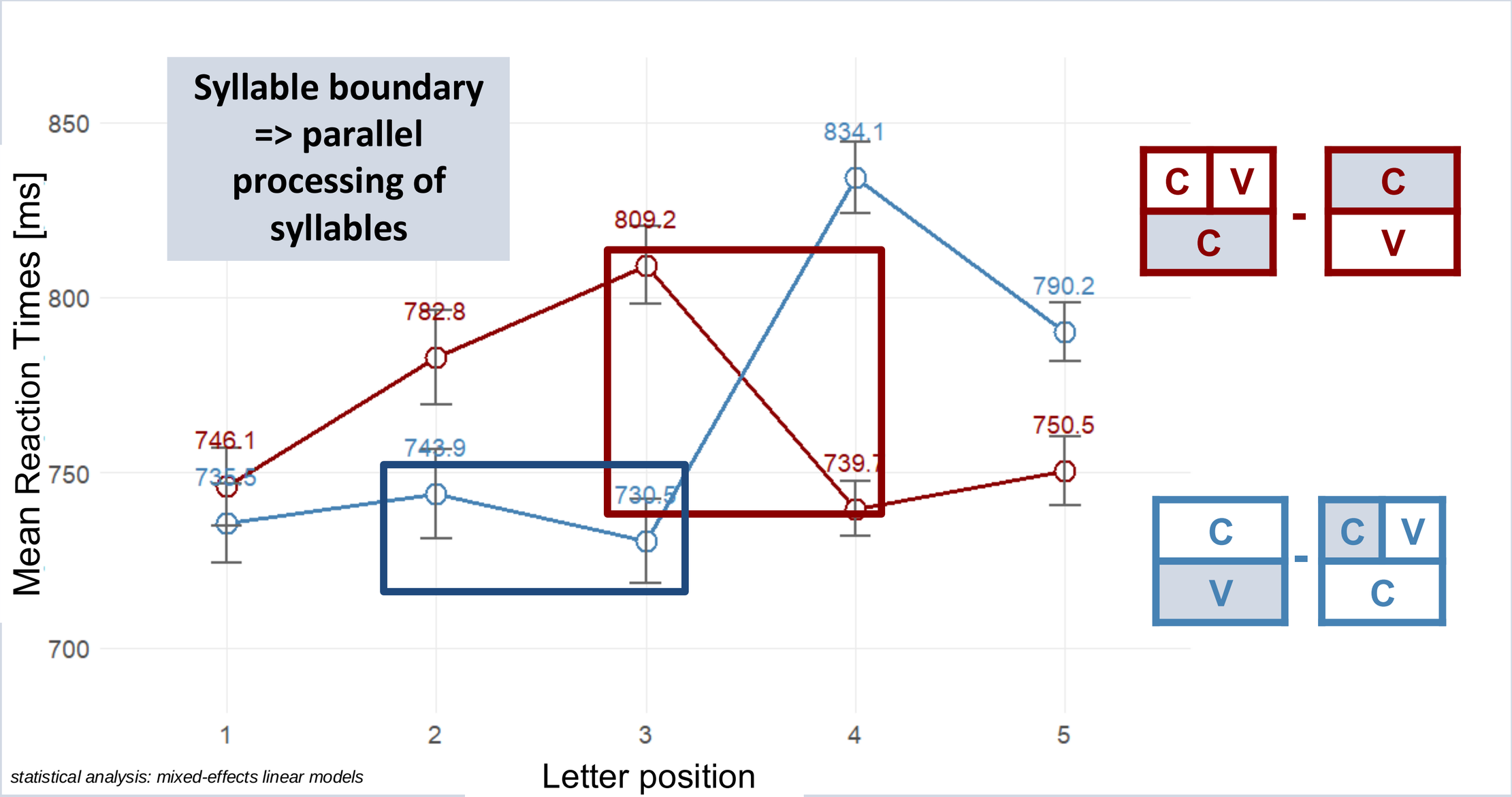


** Alexeeva, Dobrego 2021*

Visual search function for Korean



Visual search function for Korean



statistical analysis: mixed-effects linear models

Visual search function for Korean

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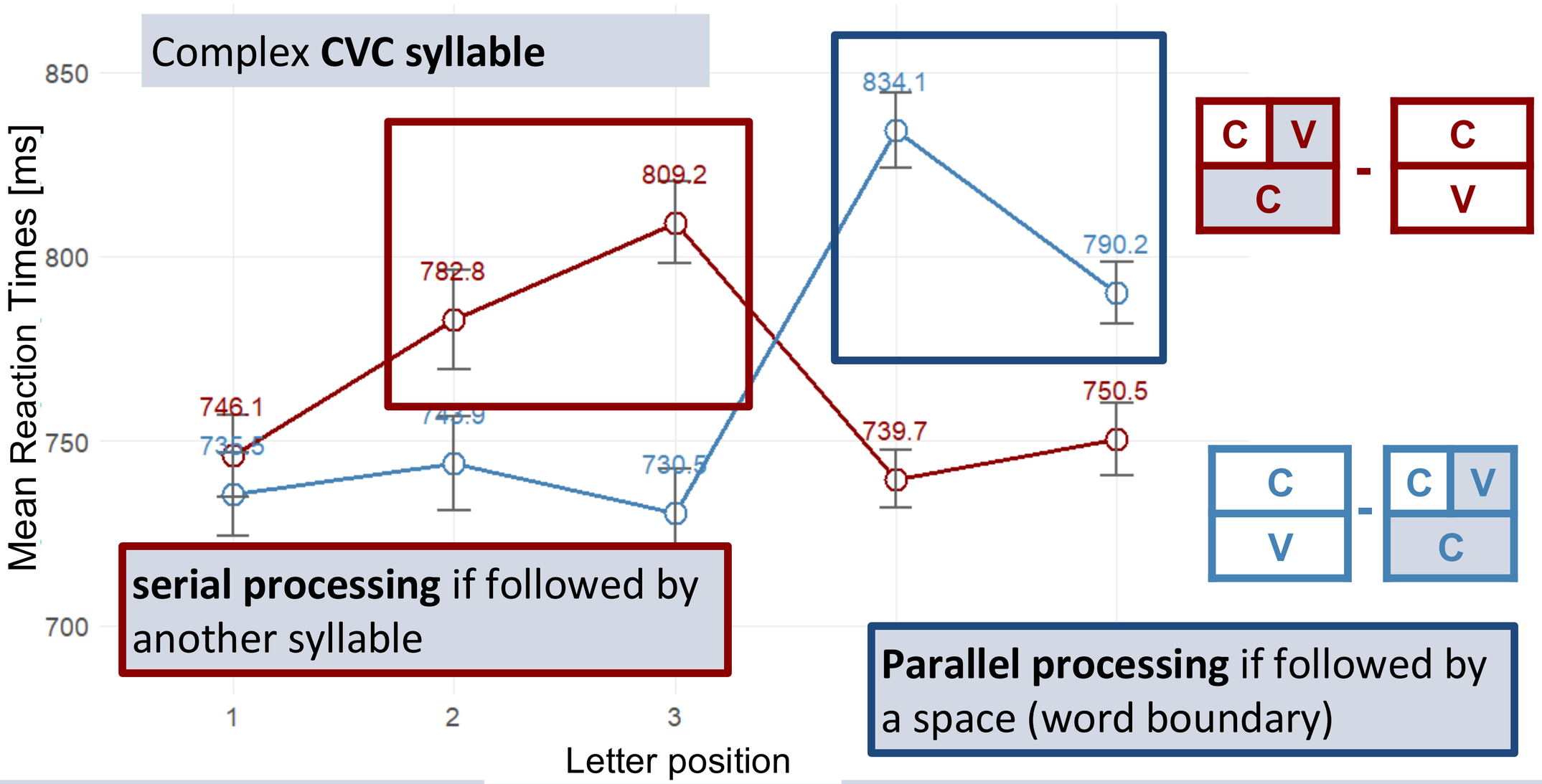
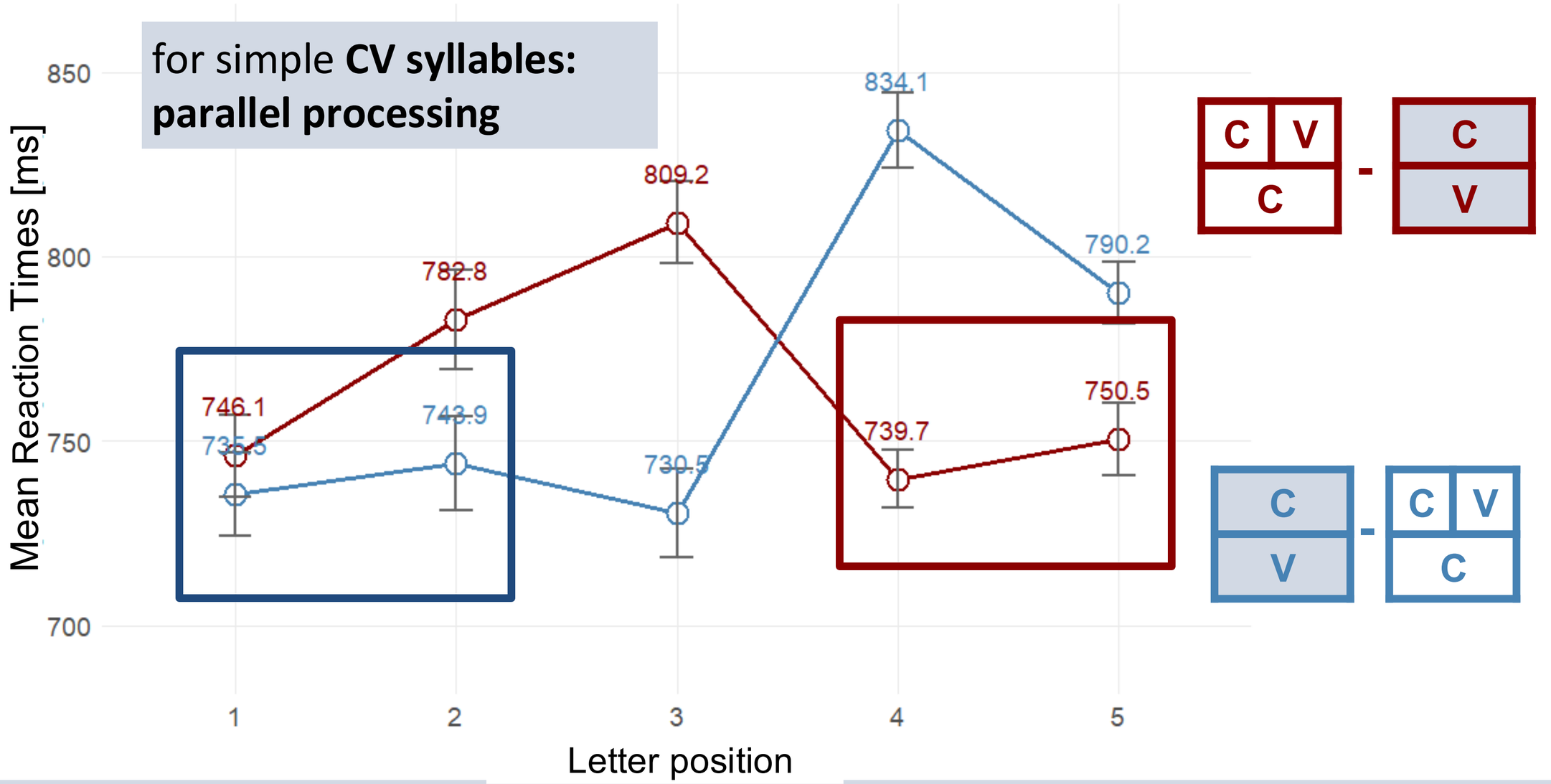


Visual search function for Korean

statistical analysis: mixed-effects linear models

for simple **CV syllables: parallel processing**



Conclusion

- No support for Ktori & Pitchford's claim **that orthographic type exlusively determines letter-processing strategy**
- In **Korean**, we observed **parallel** processing **at the syllable level**.
- **Within simple syllables (CV):** letters are recognized in **parallel.**
- **Within complex syllables (CVC):** the strategy seems to depend on the block's position in the word:
  - **parallel** when the block is **word-final** (followed by a space);
  - **serial** when **another syllable follows**.

* Alternatively, the effect may be driven by block orientation (requires further study)

- Overall, script-specific features seem more influential than a transparent/deep dichotomy

Thank you for your attention!

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