Visual syllable cues facilitate reading: Evidence from pseudoword reading and eye tracking

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Introduction: The Graphemic Syllable

It has been suggested that written syllables are constrained by visual properties expressed in the so-called length hierarchy of letters ranging from long letters in syllable boundary positions to compact letters in nucleus positions (Fig. 1; Primus 2003; Fuhrhop et al. 2011).

The length hierarchy is proposed to be roughly equivalent to the sonority hierarchy in spoken language (Primus 2003) and provides visual cues to facilitate syllabic segmentation during reading. Given that current psycholinguistic models on visual word processing and reading (e.g., Coltheart et al. 2001) do not consider salience of syllabic boundaries, the aim of the present study was to find evidence for the influence of visual cues to graphemic syllables in reading.

In order to investigate the role of letter length in the sublexical processing of graphemic words, we performed a pseudoword reading experiment, in which German-speaking participants had to read out loud strings of quadrisyllabic pseudowords that included at most one long consonant letter in different syllable boundary positions: between the first and second syllable, second and third, and third and fourth syllable.

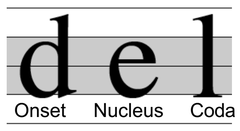

Fig. 1: Shape of an ideal graphemic syllable (long consonants at syllable boundaries, compact vowel as nucleus)[2]

Research Questions:

a) Do visual length cues to graphemic syllables facilitate reading?

b) Does the position of the letter lenght cue (first, second or third syllable boundary) affect the size of its impact?

Method: Pseudoword reading with eye tracking

Participants: 20 native German speakers (13 female, mean age 14.3 years)

Apparatus: EyeLink 1000 (SR Research), sampling rate 1000 Hz

Task: Oral reading of quadrisyllabic pseudowords, presented in rows of seven

Stimuli:

168 Pseudowords
84 with only short letters at syllable boundaries and 84 with one long letter at a word-internal syllable boundary

Syllable boundary	Short	Long
1	Navumsere	Nafumsere
2	Narusensa Fenasmaro	Narudensa Fenatmaro
3	Ganorusmo	Ganorutmo

Analysis: AoI = whole pseudoword

DV 1 = First Fixation Duration
DV 2 = Dwell Time (summed fixations in AoI)

Linear Mixed Effects Modells (LMMs) for both DVs using R and Jamovi

Fixed effects: letter length (short vs. long)
syllable boundary position (1, 2, 3)

Random effects: Intercepts for Subjects and Items

Results

First Fixation Duration

Fixed Effect Omnibus tests

	F	Num df	Den df	p
letter length	0.00647	1	3085	0.936
syllable boundary	3.49727	2	3087	0.030
letter length ✻ syllable boundary	4.24313	2	3086	0.014

Post-hoc analysis:
Length effect significant for 3rd syllable boundary position only (t=2.24).

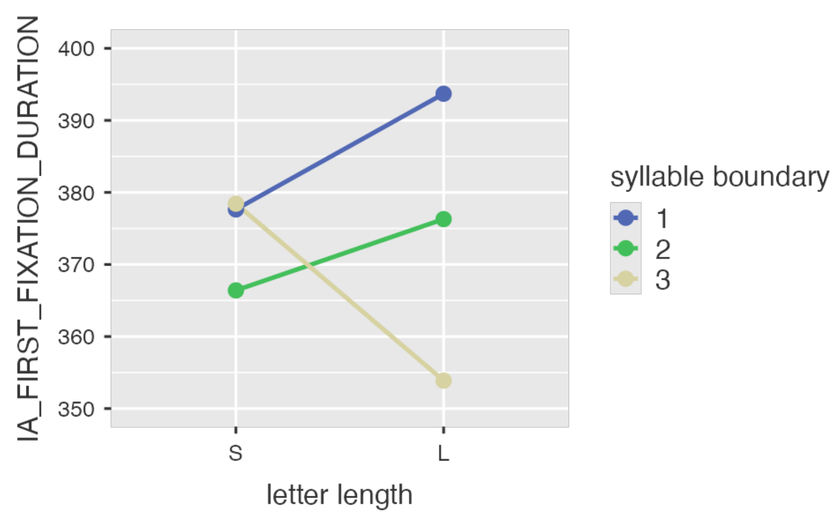

Fig. 2: Mean first fixation duration per pseudoword type with short (S) or long (L) letters at syllable boundaries in milliseconds.

Dwell Time

Fixed Effect Omnibus tests

	F	Num df	Den df	p
letter length	5.11	1	2932	0.024
syllable boundary	9.78	2	161	<.001
letter length ✻ syllable boundary	2.46	2	2933	0.086

Post-hoc analysis:
Length effect significant for 2nd (t=2.36) and 3rd syllable boundary position only (t=2.42).

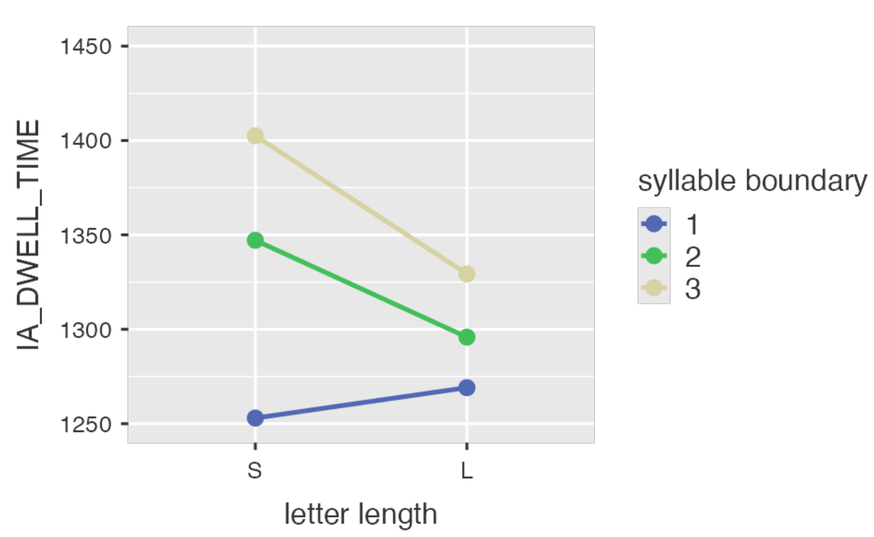

Fig. 3: Mean dwell time per pseudoword in milliseconds. Abbreviations: S = short letter and L = long lettter at syllable boundary

Summary of Results

- There is no general benefit for long letters at syllable boundaries.
- Long letters at syllable boundaries late in the word (second and particularly third boundary) seem to facilitate word reading.

Discussion and Conclusion

- Results suggest that, in support of the visual length hierarchy, **long letters facilitate syllabic segmentation** during reading.
- Effect seems to **depend on the boundary position** and holds particulary for boundaries that occur later in words.
- Findings suggest that **letter form properties should be considered in models of reading**.

1 Fuhrhop, N., Buchmann, F., & Berg, K. (2011): The length hierarchy and the graphematic syllable. Evidence from German and English. Written Language and Literacy 14, 275-292.
2 Primus, B. (2003): Zum Silbenbegriff in der Schrift-, Laut- und Gebärdensprache – Versuch einer mediumübergreifenden Fundierung. Zeitschrift für Sprachwissenschaft 22, 3-55.
3 Coltheart, M., Rastle, K, Perry, C. Langdon, R., & Ziegler, J. (2001): DRC: a dual route cascaded model of visual word recognition and reading aloud. Psychological Review, 204-256.

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