RESEARCH ARTICLE

Evaluating Interactive Highlighting Techniques in Digital Reading: An Empirical Study of Hover-Based Line, Sentence, and Paragraph Highlighting

Szabolcs Vatány [a], **Thi Huyen Nguyen** [b], **Anikó Illés** [a], **and Ann Bessemans** [c]

a Doctoral School, Moholy Nagy University of Art and Design; b Data Science Institute, Hasselt University; c Faculty of Architecture and Art, Hasselt University, READSEARCH research group

Corresponding author: Szabolcs Vatány (vatany.sz[at]gmail.com)

Abstract: Maintaining user engagement and supporting comprehension remain key challenges in digital reading environments. This study examines the impact of interactive hover-based text highlighting—on the line, sentence, and paragraph levels—on reading speed, comprehension, perceived attention, and user preferences during interlude reading. In a study with 80 participants, we compared these interactive techniques to static text presentations. While no statistically significant differences were observed in comprehension or reading speed across the tested highlighting methods, participants' subjective ratings showed significantly higher perceived attention sustainment with sentence- and paragraph-level highlighting compared to the static condition. These findings suggest that while such techniques may not enhance measurable reading performance, they can positively influence user experience. This work informs the design of digital reading interfaces by presenting the potential of user-preferred interaction mechanisms to support attentional engagement. Future research should investigate the long-term effects and adaptation to mobile contexts, as well as assess the relevance of these techniques for readers with attentional variability.

Implications for practice: Designers of digital reading interfaces should note that while interactive hover-based highlighting does not directly improve comprehension or reading speed, it can meaningfully enhance readers' perceived focus. Highlighting by grammatical units—sentences or paragraphs—was both preferred and rated as more attention-sustaining than line-by-line highlighting, which divided users. This distinction matters: aligning highlights with how readers naturally process meaning appears more effective than segmenting by visual lines. However, highlighting alone should not be expected to boost learning outcomes. Its practical value lies

@: ISSUE〉 ARTICLE〉

Cite this article:

Vatány, S., Nguyen, T. H., Illés, A., & Bessemans, A. (2026). Evaluating interactive highlighting techniques in digital reading: An empirical study of hover-based line, sentence, and paragraph highlighting. *Visible Language, 60*(1), 58–83.

First published online April 26, 2026.

© 2026 Visible Language — this article is **open access**, published under the CC BY-NC-ND 4.0 license.

https://visible-language.org/journal/

Visible Language Consortium:
University of Leeds (UK)
University of Cincinnati (USA)
North Carolina State University (USA)

in supporting sustained engagement, particularly when integrated alongside comprehension-oriented strategies in e-reading tools and digital textbooks.

Keywords: attention sustainment; digital reading; interactive highlighting; reading comprehension; typographic design; user experience

1. Introduction

1.1. Problem Statement and Motivation

Reading remains one of the primary ways through which people acquire information, learn, and find entertainment—in short, a core means of creating meaning and interpreting the world (Smith, 2004). The ability to read is fundamental to both social connections and personal development on intellectual and social levels. Reading enables participation in civic life, access to information and education, and the ability to communicate across distances and time through written correspondence and digital media (Bessemans, 2012). In a literate society, struggling with reading or being unable to read has significant consequences for quality of life, including reduced employment opportunities, limited access to healthcare information, difficulty navigating administrative systems, and social isolation, which is often used as an indicator of well-being (Poulsen et al., 2005). The rise of digital technologies and the World Wide Web has transformed reading habits, blurring the boundaries between personal, work, and study-related reading, particularly through screen-based formats. People now frequently switch between reading emails, social media, news articles, and work documents on the same device, often within the same session, fundamentally changing the nature of reading from discrete activities to a continuous, fragmented practice embedded throughout daily life (Mangen & van der Weel, 2016). The way text is displayed on screens significantly affects readability and the ability to maintain focus over time, compared to print-based media (Carr, 2020). According to prior studies (Hisgen & van der Weel, 2022), sustained reading over longer periods is essential for developing critical thinking skills. In today's highly media-saturated digital environment, interfaces are often visually busy and rich in stimuli. This creates a challenging setting for sustained concentration and can negatively affect readers' attention and comprehension.

While traditional approaches to improving reading focus on static text presentation, HCI research has explored interactive reading interfaces. For example, LiquidText introduced multitouch highlighting and flexible content manipulation to support active reading (Veras et al., 2014), and ScholarPhi augmented scientific papers with in-situ definitions to aid reader comprehension (Head et al., 2021). Intelligent skimming tools like Scim even highlight salient content to guide readers' attention during quick reviews (Fok et al., 2022). Building on this work, our study examines a new hover-based highlighting technique in short-text reading, extending prior findings by focusing on sustained attention. Moreover, foundational eye-tracking research (e.g., Rayner's studies of reading) has long shown how managing visual attention can impact comprehension (Rayner, 1998), which our design-centric approach leverages and tests in an interactive setting. As the digital environment is highly interactive, we perform most of our activities by using the mouse or the keyboard. Integrating a small, supportive gesture into the process of digital reading might help sustain attention and thereby enhance comprehension.

Our review covers existing research on digital reading, attention sustainability, and comprehension enhancement. It points out the gaps in current methods and the uncovered potential for innovative approaches, such as hovering over text fragments and highlighting them, to strengthen and sustain reading attention and enhance comprehension. By our interpretation, previous studies indicate that reader interaction with text may foster engagement and thus improve comprehension, but empirical evidence on specific interactive methods remains limited.

We believe it is important to support the field of readability with valuable insights from research stemming from the design aspects of digital surfaces and reading, such as the stated problem of sustaining attention in digital contexts. The use of design practices in relation to typographic possibilities is still not explored deeply enough compared to their potential. Design patterns can help in defining strategies for readers to better access, grasp and understand information.

1.2. Research Questions and Hypothesis

This study addresses four research questions: (1) Does hover-based highlighting of text fragments improve reading comprehension? (2) Does hover-based highlighting affect reading speed? (3) Is using a participant's preferred highlighting method related to their performance on these measures? (4) How do readers evaluate each highlighting method regarding attention sustainability? These questions together aim to identify how the introduced interactive highlighting techniques influence both reading behavior and perceived attention.

We hypothesize that hover-based reading methods will enhance sustained reading attention, and thus comprehension, but make reading time longer because of the extra effort required for interaction with the cursor. We also hypothesize that the sentence method might be the most preferred due to its potential to help with line changes and maintain focus on the same small unit of content during reading. Connected to this assumption, we expect the line method to underperform in comprehension even if it helps with line changing, as it is not a meaningful grammatical unit but only a visual one. We also expect that participants using their favorite method should perform better in the measurements of reading comprehension compared to other examined methods.

2. Relating Works on Reading

2.1. Interlude Reading

In readability studies, reading situations are often categorized based on the reading purpose, such as reading for enjoyment or for gaining knowledge (Kaakinen et al., 2018). Also, the capabilities of the reader can vary based on their age, reading skills, professional skills, or possible learning or reading disabilities. Another way these can be categorized is based on the length of the time it takes to read the text, which can specify the way of examination as a glanceable reading has to be investigated differently than a reading in some paragraphs or in the case of long-format texts (Beier et al., 2021; Sieghart & Gorbach, 2024).

We frame our investigation on readability within the context of short-term reading sessions. The term we are going to use is *interlude reading*. This term is established and defined by Wallace and colleagues as nestled between glanceable and long-form reading on the axis of time spent with reading a text, as the form of reading that occurs in short interludes (Wallace et al., 2020). Situations include, for example, reading short articles while waiting for public transport, or checking the news between two tasks at work.

Reading just for a short period is a very common situation nowadays. Since the advent of digital technologies, the amount of textual information has exponentially grown, creating an oversupply of materials to read online. As a result, readers tend to prefer shorter texts to long articles, which are faster to read, so it is possible to consume more information in a shorter and more compressed manner. This theory is further supported by the widespread appearance of short articles on online news portals, which are only a few paragraphs long (Barnhurst, 2013).

These short text formats fit well with the use of new devices, which offer the possibility of reading almost anywhere through phones or smartwatches, creating more opportunities for interlude reading during short breaks between two activities. As these situations happen usually in a busier environment, sustaining reading attention is more difficult, even for a short period of time.

We selected interlude reading as the primary context for our investigation due to its growing prevalence in digital environments, where users frequently engage with short texts during brief periods of availability (e.g., while commuting or multitasking).

This context provided a practical and controlled scope for evaluating hover-based highlighting techniques. However, our choice of interlude reading does not imply that such techniques are only suitable for short-form content. Rather, we used this scenario as a representative use case to examine how interactive highlighting affects attention and comprehension. The highlighting fragments tested—lines, sentences, and paragraphs—were chosen to match the typical structure of short texts, but we acknowledge that different fragment strategies might prove valuable in extended or deep reading contexts, which remain outside the scope of this study.

2.2. Sustaining Reading Attention

Reading itself is a complex cognitive process demanding a high level of attention to achieve good text comprehension. Attention can be disrupted by surroundings, noise, and visual elements, affecting the reading flow and thus reading comprehension. Previous studies of readability found that sustaining reading attention can be harmed by the appearance of hyperlinks and can pose an extra challenge to comprehension. Navigating through hypertexts while reading is likely to place additional demands on working memory compared to traditional linear reading (Cuddihy & Spyridakis, 2012; Salmerón et al., 2018; Wylie et al., 2018).

This distraction is even more accentuated because of the notification and pop-up systems of the devices we use for reading, especially during interlude reading. This results in poorer performance on concurrently performed tasks because limited attentional resources must be shared between tasks (Stothart et al., 2015).

As most interfaces and digital surfaces are visually oversaturated by multimodal content, they demand sustained attention from readers—a challenge intensified by call-to-action texts and buttons that constantly invite interaction. Compared to a physical book, on a digital surface, we not only tend to read, but also perform several other tasks like working, shopping, social interaction, etc. This multifunctionality enhances the spread of attention even when we are not performing any of these activities, making sustained reading attention even harder.

We hypothesize that active interaction, specifically hover-based highlighting of text fragments, may support sustained attention in highly interactive digital environments.

2.3. Supporting Reading with Interaction

Although printed reading always involved physical interaction, such as turning pages or pointing at text, digital reading introduced new forms of direct interface interaction, where input devices actively alter how text behaves and is presented. Since the digital paradigm shift, reading has undergone significant transformations in how, when, and why people engage with text, as on-screen texts displayed on electronic devices offer the possibility to interact with the surfaces using different inputs like a mouse, keyboard, touchscreen, or voice command. Although this possibility has existed for some time, highly interactive reading approaches have not achieved widespread adoption, except in smaller phenomena such as digital and electronic literature.

The simplest and established interaction form with digital texts while reading is links on digital texts, usually used for navigation, word explanation or a digital glossary of the text content, with the use of clicking on links or hovering over them. Certain interactive features, such as digital glossaries and embedded questions with feedback, enhance comprehension by supporting the development of mental models (Clinton-Lisell et al., 2023). These features assist in bridging knowledge gaps and reinforce connections within the text, improving learning outcomes.

Interactive functions such as animations and story-related games can boost engagement and vocabulary development in younger readers. However, poorly aligned interactive features may distract from core reading tasks, highlighting the need for age-appropriate design (Hare et al., 2024). Contrary to earlier assumptions of a screen inferiority effect, no statistically significant difference in comprehension between digital and print mediums for narrative texts was detected when interactive features are not present. However, multimedia and interactive additions (dictionary, glossary, virtual tutor) positively affect comprehension by increasing engagement and promoting deeper processing of content (Schwabe et al., 2022).

3. Method

3.1. Participants

The study was conducted in two university-affiliated research laboratories located in Belgium and Hungary. Participants were recruited through university mailing lists and social media announcements targeting university students, staff, and members of the local community. To minimize bias in the assessment of attention-sustaining and preferred reading methods, participants were eligible only if they met specific criteria:

- Have at least intermediate English proficiency, meaning that they can read and understand written English texts fluently enough to follow study materials and instructions;
- Be a regular digital reader, defined as someone who habitually reads on-screen texts for information or leisure, engaging with digital reading interfaces several times per month or more often;
- Demonstrate an understanding of the study procedures before participation. The study information sheet and consent form were provided in written English

and explained verbally in English by the researcher. Each participant confirmed their understanding before starting the test;
- Be able and willing to complete the study;
- Be between 18 and 75 years of age.

Exclusion criteria included:

- Self-reported uncorrected visual impairments or severe reading difficulties;
- Professional expertise in typography, type design, or readability research that could bias subjective ratings;
- Difficulty understanding English instructions during the pre-test explanation;
- Insufficient reading fluency to comfortably read and comprehend standard informational texts.

In the study, 80 participants who met the inclusion criteria were enrolled. Thirty-nine (39) of the participants took part in the experiment in a research lab office room in Belgium, and 41 of the participants took part in the experiment at a collaborative space in Hungary. The study protocol was reviewed and approved by the Social and Ethical Committee of UHasselt Faculty of Science (reference no. REC/SMEC/2023-2024 40). All participants provided informed consent before participation and were free to withdraw at any time without penalty.

Most participants (55%) were women (44 participants). Participants in the age group 18–25 years accounted for 36.3% (29 participants), while the 25–40 years and 40–60 years represented 51.3% and 12.4% of the total number of participants, respectively. Of the 80 participants, 29 (36.3%) were Dutch native speakers. About their profession, 62 participants (77.5%) had no relation to typography, type design, graphic design or readability research, and 18 (22.5%) had some relation to these fields through coursework and interest, none held a degree above BA level in these fields (mostly Graphic Design BA students).

3.2. Materials and Tools

The materials used in the experiment consisted of four open-source text sections and their corresponding comprehension questions, obtained with permission from the study “Towards Individuated Reading Experiences: Different Fonts Increase Reading Speed for Different Individuals,” conducted by Wallace and colleagues (2022). The texts were downloaded from the Readability Consortium website (The Readability Consortium, n.d.). The four text levels were classified between 7.0 and 8.6 Flesch-Kincaid grade level English texts. After consulting with the researcher responsible for the measurement of the material, we decided to increase the number of multiple-choice options from three to four for each question, adding one distractor to reduce the chance of correct guessing. The text setting was based on the suggested general text setting for desktop digital devices and websites, as the study primarily focuses on digital text reading. Each text consisted of two paragraphs and was between 897 and 962 characters long. Each text sample fitted entirely within one screen view (no scrolling required) to prevent visual discontinuity or navigation effects. This ensured that all participants viewed and interacted with the full text in a single frame. The letter size was set to 16 px, as this size is commonly used in similar reading studies and falls within the range recommended for body text in digital interfaces (Wallace et al., 2022). The width of the text block was 750 pixels to achieve around 70–80 characters (8–12 words) per line, a text setting recommended for digital texts by Web Content Accessibility Guidelines (WCAG) 2.1 (W3C, 2018). The text was aligned left (ragged-right) to avoid uneven word spacing that occurs with fully justified alignment, which could influence readability. The letter color was 100% black on a 100% white background. The text line height was set to 1.5 times the font size according to WCAG 2.1 suggestions. The font used in the experiment was a custom humanist–modernist sans-serif typeface (regular weight) designed by Szabolcs Vatány, a member of the research team. Its use ensured full control over typographic consistency and legibility across all stimuli. The font's purpose in this study was not to examine typeface effects but to provide a neutral, reliable text presentation and to maintain complete control over text display and rendering. The test environment was designed as a single-window application opened in full-screen mode. The pages with the reading tasks contained only the texts and a button under the text to navigate to the next screen (Figure 1). These were separated by explanation and input pages.

All participants read from standardized 13- or 14-inch MacBook Pro devices provided by the research team, ensuring similar display resolution and luminance. Screen brightness was set to 100% on all devices to maintain consistent luminance levels. The font size and layout were locked in pixels, ensuring identical text scaling across both screen sizes. Participants sat approximately 50–60 cm from the screen, at a comfortable self-chosen distance, with the laptop placed on a table. They were instructed to adjust the screen angle for comfort but not to change the zoom level or window size. They could use either the built-in trackpad or a provided Bluetooth mouse. Although participants could choose between input devices, we did not record which option they used. This decision was made because the primary aim of the study was to examine the effects of the highlighting conditions in a context that reflected participants' natural reading habits and their typical interaction with digital devices. While the number and speed of cursor hover events were tracked, these data were not included in the present analysis, as they were not directly relevant to the research questions investigated in this study, which focused on reading comprehension and reading speed.

In each section, the text was designed with one of three interactive methods: line-by-line, sentence-by-sentence, or paragraph-by-paragraph or normal static reading (denoted as "Static"), which served as the reference condition and displayed all text at

100% black with no interactive highlighting. Specifically, for the line-by-line method, the participant reads a text by hovering over each line of the text with the cursor for succession from the start to the end of the text, while the hovered line is kept 100% black and the other lines are reduced to a 30% transparency. The other two interactive reading methods work the same way, but they involve hovering over each sentence (i.e., sentence-by-sentence, as shown as an example in Figure 1) and each paragraph (i.e., paragraph-by-paragraph) of the given text, whereas in the normal static reading condition hovering is not possible and no text is highlighted.

3.3. Procedure

We used a 4×4 Latin square model in which we had four sections (texts) with four reader groups compiled randomly.

Both testing environments were well-lit and moderately quiet shared workspaces. A modest level of background activity and ambient noise was intentionally maintained to reflect typical conditions in university or office study environments. This ensured that participants read within a realistic context that included minimal everyday distractions, allowing for a more ecologically valid assessment of attention-sustaining effects.

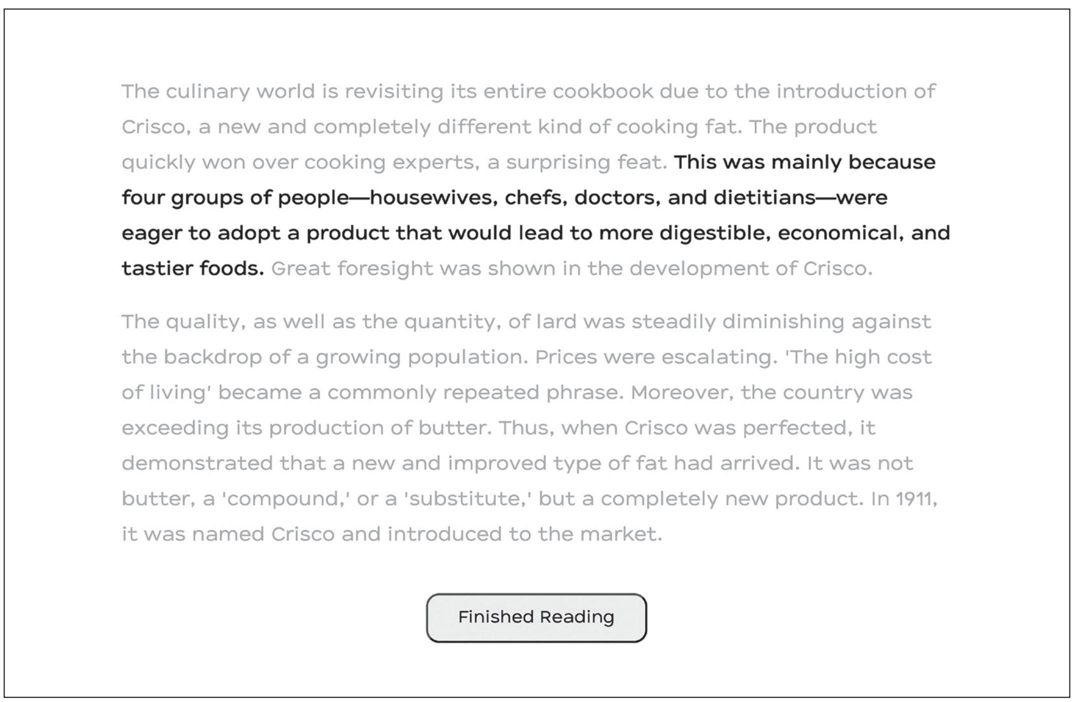

Figure 1. Screen used to display sections for participants reading with the four methods. In this example, the third sentence of the sample text is hovered over and highlighted using the sentence-by-sentence method.

The flow of the testing process started with a short explanation of the testing flow for the participants to have some idea of what they should do during the test. After starting the process on the laptop, they were faced with a letter of consent. After accepting it, the next screen was a preparation screen explaining which method they should use to read the next text and a "Start reading" button. After clicking the button, the participant was presented with the first task, which required them to read the text on the next screen using one of the reading methods. Participants were asked to move the cursor naturally across the text to activate the hover highlights, but they were free to proceed at their own pace. To finish the task, under the text displayed, they had to click the "Finish reading" button and were presented with two comprehension questions, each shown separately on consecutive pages after clicking the "Next" button. Each comprehension question offered four possible answers. They could select one of the answers and navigate further by clicking the "Next section" button to the next task screen.

After finishing the four sections, participants were presented with a post-reading survey and asked to indicate how much they felt the reading methods helped to maintain attention while reading compared to the static text, using a five-point scale, where two points on the left indicated "Harder than regular", the middle point indicated "Same as regular static text" and two points on the right indicated '"Easier than regular" (Figure 2). Afterwards, on the next page, participants selected one of the four reading methods (static, line-by-line, sentence-by-sentence, paragraph-by-paragraph) as their favorite, if they had one, and indicated if they felt motivated to read using that method.

During the study, we recorded each participant's reading time for each method, their answers to the questions for each text provided and their ratings of the methods in terms of attention-sustaining ability, preferred method and motivation answers. The basic information on the demographic characteristics of the participants was also collected. All of these were tracked by our self-developed platform and exported at the end of each test.

3.4. Data Analysis

To explore the effects of the reading methods (static, line-by-line, sentence-by-sentence, paragraph-by-paragraph) on reading comprehension, we investigate the influence of the reading methods on the correctness of answering a question (i.e., the probability of having a "true" or "false" answer, compared to the correct answer) within each participant after reading the sections provided. We also want to investigate how the reading methods affect the time spent on each section (i.e., text) of a participant.

Because each participant answered multiple questions across different conditions, their responses were not statistically independent; the data, therefore, required a model accounting for within-participant dependency. It is, therefore, of paramount

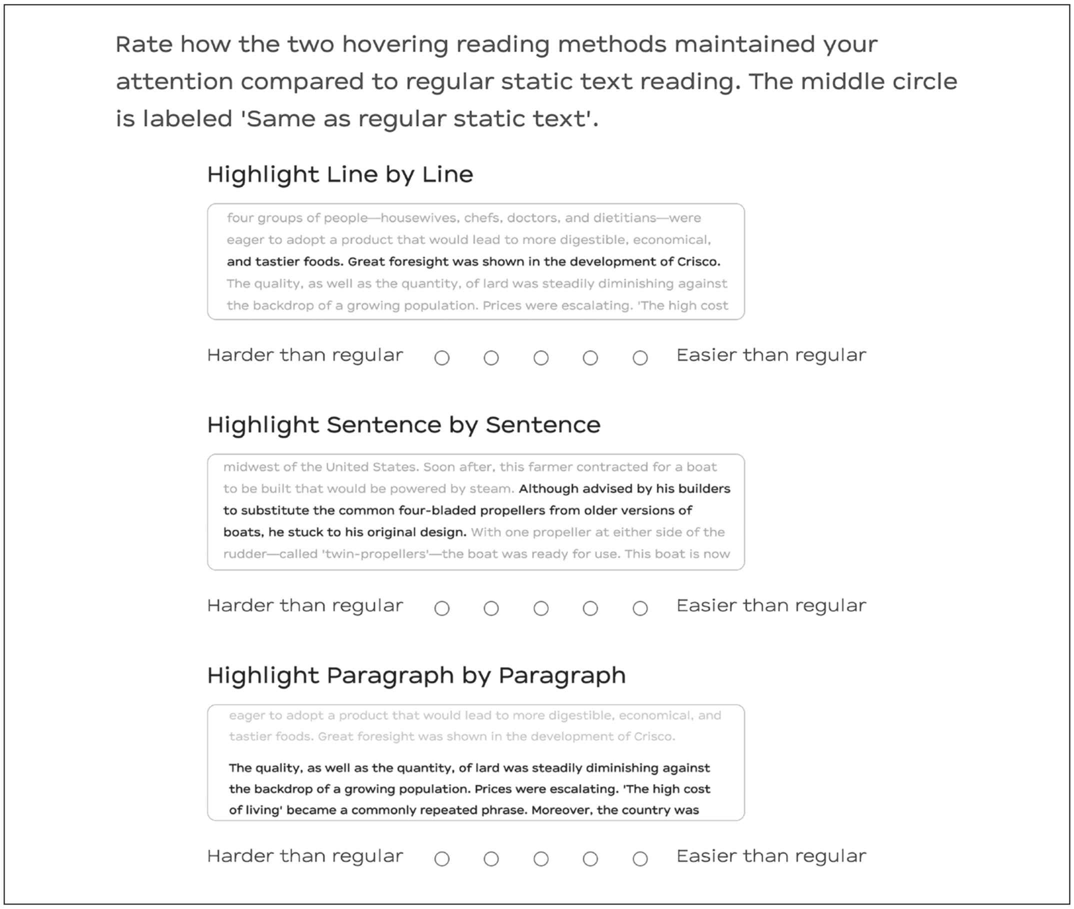

Figure 2. Screenshot of the testing platform where participants rated whether the three interactive reading methods supported or hindered their ability to maintain reading attention compared to the static method.

importance that the statistical analysis accounts for the dependency in the data and the study design to ensure the accuracy of the statistical inference. To address our study objectives, we apply (generalized) linear mixed models, including both fixed effects and random effects (Demidenko, 2004; Faraway, 2014). In essence, a (generalized) linear mixed model is a statistical tool that is particularly useful to deal with repeated measures or clustered data where observations are not independent, which is the case in our study. Specifically,

- The fixed effects represent the relationships between the independent variables and the dependent variable. In our study, the independent variables are (i) the text provided in each section, (ii) the reading method of the text, (iii) the reading test group to which the participant belongs, and (iv) the participant’s indicated favorite reading method as an exploratory, post-hoc factor to examine whether self-reported preference related to performance, recognizing that this variable was not experimentally controlled and may reflect rather than cause performance differences. The dependent variable is the correctness of the answer by a participant or the time spent on each section by a participant.

- The random effects, on the other hand, account for variability in the data that cannot be captured by the fixed effects. In our study, the random effects are attributed to participants and the questions they answered.

We analyzed comprehension (correct vs. incorrect answers) using a logistic mixed-effects model and analyzed reading time using a linear mixed-effects model on log-transformed times. These models included reading method, text section, group, and the participant's preferred method as fixed effects, with participant and question as random effects to account for repeated measures.

Analysis of the rating regarding attention-sustaining on reading methods. The participants were asked to give their evaluation on the difficulty, as shown in Figure 2, for each reading method (line-by-line, sentence-by-sentence, or paragraph-by-paragraph) in terms of how much it helped them maintain attention compared to the regular static method. They were also instructed to treat the midpoint of the scale as "Same as regular static text." To compare the proportions of participants' evaluations of the difficulty of each reading method relative to the static baseline, we applied a multinomial test followed by pairwise binomial tests, using the exact test formulation commonly associated with Read and Cressie's method (Read & Cressie, 1988) for categorical data. All the analyzes were performed in R, a language and environment for statistical computing. The statistical significance level was set at 5%.

4. Study Results

4.1. Descriptive Analysis

This part of the paper provides an overview of the study results through descriptive statistics, focusing on participants' number of correct answers, reading time, and rating regarding attention-sustaining related to the four reading methods: line-by-line, sentence-by-sentence, paragraph-by-paragraph, and static (control).

Number of correct answers. The reading comprehension of a participant was measured through two single-choice questions for each text. Overall, the paragraph-by-paragraph method had the highest percentage in the number of correct answers (84.4%), as shown in Table 1.

Mean reading time. In our study, the reading time is assumed to be the time participants spent on each section. As shown in Table 2, the sentence-by-sentence method generally resulted in the longest reading time with 78.32 seconds.

Table 1. Number of correct answers by reading groups, sections, methods and favorite methods.

Category	Group	Correct answers (160 total)	Correct answers (%)
Reading group	Group 1	131	81.88
	Group 2	122	76.25
	Group 3	127	79.38
	Group 4	129	80.62
Text number	Section 1	131	81.88
	Section 2	126	78.75
	Section 3	131	81.88
	Section 4	121	75.62
Reading method	Line-by-line	122	76.2
	Paragraph-by-paragraph	135	84.4
	Sentence-by-sentence	123	76.9
	Static	129	80.6
Favorite method	Line-by-line	84/112	75.0
	Paragraph-by-paragraph	135/168	80.4
	Sentence-by-sentence	197/240	82.1
	Static	93/120	77.5

Selection of the favorite method. The sentence-by-sentence method was the most preferred, chosen by over a third of the participants (37.5%), as shown in Table 3.

Rating regarding attention-sustaining by reading method. Participants rated each interactive reading method on a scale in which the two points on the left indicated that the method was considered harder than regular static reading, the two points on the right indicated that it was easier, and the midpoint represented the static reading. They generally rated the paragraph-by-paragraph and sentence-by-sentence methods easier, with many indicating a neutral or positive rating. Conversely, the line-by-line method was perceived as hardest, with higher percentages of negative ratings. The distribution of these ratings is illustrated in the associated density plot (Figure 3).

Table 2. Mean reading time in seconds by reading groups, texts, methods and favorite methods. “Meas.”: measurements.

Category	Group	Correct answers (160 total)	Mean reading time in seconds
Reading group	Group 1	131	66.98
	Group 2	122	82.38
	Group 3	127	74.92
	Group 4	129	74.64
Text number	Section 1	131	65.86
	Section 2	126	82.34
	Section 3	131	81.80
	Section 4	121	68.91
Reading method	Line-by-line	122	71.04
	Paragraph-by-paragraph	135	74.78
	Sentence-by-sentence	123	78.32
	Static	129	74.78
Favorite method	Line-by-line	84/112	77.22 (56 meas.)
	Paragraph-by-paragraph	135/168	76.26 (84)
	Sentence-by-sentence	197/240	74.56 (120)
	Static	93/120	70.58 (60)

Table 3. Number of participants selecting their favorite reading method.

Group	Participants	Percentage (%)
Line-by-line	14	17.5
Paragraph-by-paragraph	21	26.2
Sentence-by-sentence	30	37.5
Static	15	18.8

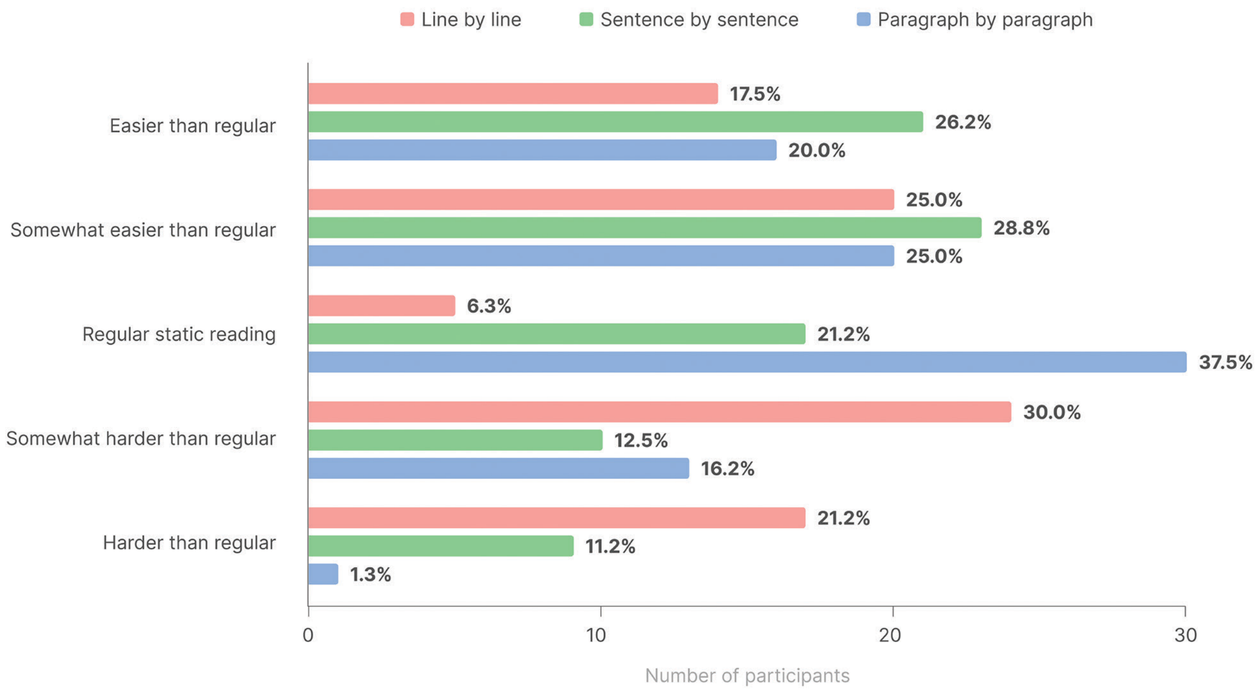

Figure 3. Distribution of participant ratings for each reading method on the attention-sustainment difficulty scale.

4.2. Results from Fitted Regression Models

To summarize the outcomes of the fitted models, none of the tested reading methods produced statistically significant effects on comprehension accuracy or reading time. While minor numerical variations were observed across sections and methods, these differences did not reach the threshold of significance.

The influence of reading methods on the correctness of the answer of a participant. According to the fitted logistic Model 1, there were some numerical differences in comprehension accuracy across the four text sections, but none were statistically significant. Table 4 shows detailed estimates and *p*-values.

When comparing reading methods, Model 1 found no significant effect on correctness. All pairwise comparisons between methods showed $p > 0.25$ (see Table 4 for complete statistical details). The data showed no reliable differences in comprehension accuracy across highlighting conditions. If anything, the data trended in a direction where paragraph-level highlighting performed somewhat better than the others and line-level highlighting performed worse, but this pattern must be interpreted with caution as the results are not statistically significant. We also examined whether the order of exposure to methods (the reading test groups) influenced performance. No statistically significant differences in accuracy were found between the four groups.

Table 4. Estimated fixed-effect parameters, their 95% confidence intervals (CIs), and corresponding *p*-values for both models. The “Original estimates” column shows values on the log-odds scale for the logistic model (Model 1) and the original scale for the linear model (Model 2). The “Exponential scale” column shows odds ratios for the logistic model only (not applicable for the linear model). The 2.5% and 97.5% columns represent the lower and upper bounds of the 95% confidence interval, respectively. The numbers in bold indicate statistically significant results at 5% significance level… [Caption continues on the following page.]

		Original estimates			Exponential scale			
	Parameter*	**Est.**	**2.5% CI**	**97.5% CI**	**Est.**	**2.5% CI**	**97.5% CI**	***p*-value**
Model 1 (correctness)	Intercept 0	1.809	0.191	3.427	6.105	1.211	30.779	**0.025**
	text_number 2	−0.367	−2.333	1.599	0.693	0.097	4.950	0.709
	text_number 3	0.425	−1.612	2.461	1.529	0.199	11.721	0.677
	text_number 4	−0.509	−2.473	1.456	0.601	0.084	4.289	0.605
	reading_method (L-by-L)	−0.329	−0.909	0.252	0.720	0.403	1.286	0.257
	reading_method (S-by-S)	−0.290	−0.871	0.292	0.749	0.418	1.339	0.319
	reading_method (P-by-P)	0.276	−0.342	0.894	1.317	0.710	2.444	0.372
	reading_test_group 1	0.187	−0.520	0.894	1.205	0.594	2.444	0.597
	reading_test_group 2	−0.412	−1.095	0.271	0.663	0.335	1.312	0.228
	reading_test_group 3	−0.042	−0.739	0.655	0.959	0.478	1.924	0.904
	favorite_method (L-by-L)	−0.275	−1.050	0.500	0.760	0.350	1.648	0.478
	favorite_method (S-by-S)	0.381	−0.301	1.062	1.464	0.740	2.893	0.264
	favorite_method (P-by-P)	0.227	−0.487	0.940	1.254	0.614	2.560	0.525
Model 2 (time)	Intercept 0	4.086	3.836	4.336	59.511	46.352	76.405	**0.000**
	text_number 2	0.198	0.122	0.274	1.219	1.130	1.315	**0.000**
	text_number 3	0.184	0.108	0.260	1.202	1.114	1.296	**0.000**
	text_number 4	0.017	−0.058	0.093	1.018	0.943	1.098	0.646
	reading_method (L-by-L)	−0.049	−0.125	0.027	0.952	0.882	1.027	0.195
	reading_method (S-by-S)	0.040	−0.036	0.116	1.041	0.965	1.123	0.292
	reading_method (P-by-P)	−0.021	−0.097	0.055	0.980	0.908	1.057	0.586
	reading_test_group 1	−0.099	−0.326	0.129	0.906	0.722	1.137	0.386
	reading_test_group 2	0.081	−0.143	0.306	1.085	0.867	1.358	0.468
	reading_test_group 3	−0.048	−0.275	0.178	0.953	0.760	1.195	0.671
	favorite_method (L-by-L)	0.154	−0.109	0.418	1.167	0.897	1.519	0.241
	favorite_method (S-by-S)	0.048	−0.177	0.273	1.050	0.838	1.314	0.667
	favorite_method (P-by-P)	0.092	−0.145	0.328	1.096	0.865	1.388	0.438

Table 4 (caption continued from previous page). [* The parameters corresponding to the text_number take the text_number 1 as the reference text. The reference method for the parameters of the reading_method variable is the STATIC method. The reference group for the reading_test_group variable is the reading test group 4. The reference method for the favorite_method variable is the static method.] "Est.": estimated; "L-by-L": line-by-line; "S-by-S": sentence-by-sentence; "P-by-P": paragraph-by-paragraph.

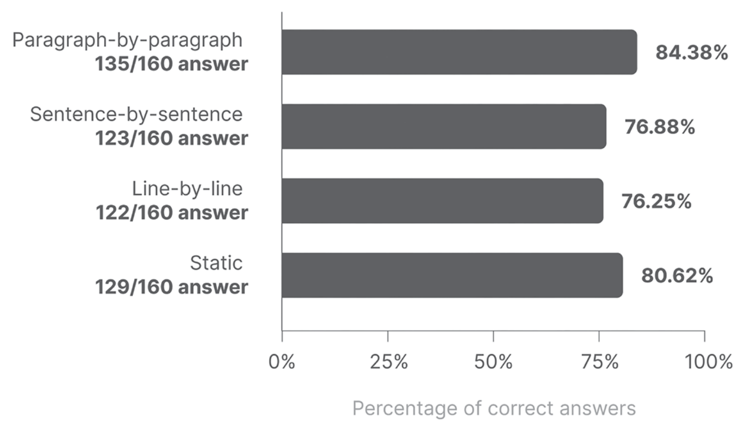

Figure 4. Correctness of the four methods.

Group 1 (order: line → sentence → static → paragraph) had higher odds of a correct answer than Group 4 (order: static → line → paragraph → sentence), whereas Group 2 (order: sentence → paragraph → line → static) and Group 3 (order: paragraph → static → sentence → line) had lower odds than Group 4. These variations were not significant (p-values all > 0.05), indicating that the sequence in which participants experienced the methods did not meaningfully affect their comprehension scores.

Finally, we examined whether participants' stated preference for a particular highlighting method was associated with their overall comprehension performance. We found no significant relationship (all $p > 0.26$). These findings indicate that merely preferring a particular method was not reliably associated with better or worse comprehension performance. These results are summarized in Figure 4.

The effects of reading methods on the time spent on each section by the participant. Model 2 analyzed the time each participant spent reading each section (Table 4). The results indicate that participants tended to spend more time on later sections compared to the first section. Specifically, Section 2 took about 21.9% longer to read than Section 1 (95% CI: 13.0–31.5%), and Section 3 took about 20.2% longer (95% CI: 11.4–29.6%). These increases were statistically significant, suggesting that participants became more engaged or required more time on the second and third texts. Time spent on Section 4 was only 1.8% higher than on Section 1, and this difference was not significant.

In contrast, the reading method had no significant impact on the time spent per section. Participants using the interactive highlighting methods read at nearly the same pace as in the static condition. Mean reading times were 71.04s for line-by-line, 78.32s for sentence-by-sentence, 74.78s for paragraph-by-paragraph, and 74.78s for static (Table 2). These small numerical differences were not statistically significant ($p > 0.05$ for all pairwise comparisons). Thus, none of the highlighting methods measurably accelerated or slowed down reading relative to static text. In practical terms, participants spent roughly the same amount of time reading each section regardless of whether hover-based highlighting was present.

Similarly, no reliable differences were observed in reading time across the different test groups (method orderings). For example, Group 2 (order: sentences → paragraph → line → static) spent about 8.5% more time per section than Group 4 (order: static → line → paragraph → sentence), while Group 1 (order: line → sentence → static → paragraph) and Group 3 (order: paragraph → static → sentence → line) spent approximately 9.6% and 4.7% less time per section than Group 4, respectively. These differences were not statistically significant, implying that the sequence in which participants encountered the methods did not systematically affect reading speed.

We also examined whether participants' self-reported favorite reading method was associated with their overall reading time. Participants who indicated a preference for one of the interactive highlighting techniques tended to spend slightly more time on sections overall than those who preferred static reading, but these differences were not significant. For instance, participants favoring line-by-line spent more time per section on average than those who favored static text ($p = 0.241$); those preferring sentence-by-sentence spent somewhat more time ($p = 0.667$), and those preferring paragraph-by-paragraph spent 9.6% more ($p = 0.438$). None of these effects reached statistical significance, indicating that preference was not reliably associated with faster or slower reading. As with comprehension, these patterns likely reflect subjective appeal rather than objective efficiency.

In summary, time-on-task remained consistent across all highlighting conditions and participant groups. Apart from the increased times for Sections 2 and 3 (possibly reflecting engagement or fatigue)—but notably not for Section 4, which was read at a similar pace to Section 1—hover-based highlighting neither significantly sped up nor slowed down reading. These results are summarized in Figure 5.

Analysis of the rating regarding attention-sustaining for reading methods. Beyond objective performance measures, participants rated each highlighting method on how it affected their ability to sustain attention, compared to normal static reading. These subjective evaluations (whether a method made it "harder," "the same as regular," or "easier" to maintain attention) differed significantly across the four methods (multi-

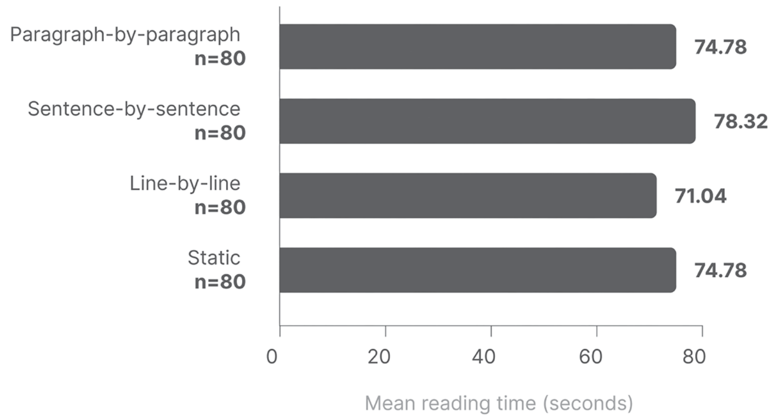

Figure 5. Time of the four methods.

nomial test, all $p < 0.05$). We conducted pairwise comparisons to identify which specific perceptions were driving these differences. The key findings for each method are as follows:

- Line-by-line: Participants' opinions on this method were polarized. A much larger proportion of participants rated the line-by-line highlighting as "harder" to sustain attention than regular reading, compared to those who said it was "about the same" (this difference was significant, $p < 0.001$). Likewise, significantly more participants rated line-by-line as "easier" than regular reading, compared to the "same" category ($p < 0.001$). In other words, although a slightly greater number found line-by-line highlighting more distracting than found it helpful, this difference was not statistically significant.

- Sentence-by-sentence: Participants generally perceived the sentence-by-sentence method as beneficial for sustaining attention. Significantly more participants rated it as "easier" compared to "harder" or "the same" ($p < 0.05$), suggesting that sentence-level highlighting was more often viewed as helpful than distracting or neutral. In summary, most readers found sentence-level highlighting helped them concentrate better, and a few found it detrimental; only the minority felt it was no different from normal reading.

- Paragraph-by-paragraph: Participants also viewed paragraph highlighting favorably. Significantly fewer participants rated the paragraph-by-paragraph method as "harder" compared to "easier" ($p < 0.05$). While the proportion who rated it "the same as regular" was lower than those who rated it "easier," this difference was not statistically significant ($p = 1.00$). Overall, this suggests that participants found paragraph highlighting either helpful or at least as effective as static reading, with relatively few perceiving it as more difficult.

In summary, these self-reported ratings indicate that sentence-by-sentence and paragraph-by-paragraph highlighting were generally seen as making it easier to sustain attention compared to regular static text. The line-by-line method, on the other hand, received mixed feedback—readers either loved it or disliked it in terms of attention, and a significantly higher number leaned toward it being more challenging rather than neutral. Overall, the interactive highlighting techniques (especially at the sentence and paragraph levels) were perceived to aid concentration for many users, even though our objective measures did not show a clear performance benefit. These results are presented in Table 5.

5. Discussion

This study addressed four research questions about hover-based highlighting in digital reading, examining effects on comprehension (RQ1), reading speed (RQ2), the relationship between user preferences and performance (RQ3), and readers' evaluations of attention sustainability (RQ4). Our evaluation revealed no statistically significant differences in reading comprehension or reading speed between the interactive highlighting techniques and the control condition. In other words, no highlighting approach measurably improved how well participants understood the text or how quickly they read it. There were slight performance differences in raw scores—for example, one

Table 5. Results of the rating regarding attention-sustaining for reading methods using pairwise binomial test.

Reading method	Rating	Number of participants	Pairwise binomial test results: comparison between…		*p*-value
Line-by-line	Harder	41 (51.3%)	**Harder**	**Same as regular**	**<0.001**
	Same as regular	5 (6.2%)	Harder	Easier	1.00
	Easier	34 (42.5%)	**Same as regular**	**Easier**	**<0.001**
Sentence-by-sentence	Harder	19 (23.8%)	Harder	Same as regular	1.00
	Same as regular	17 (21.2%)	**Harder**	**Easier**	**<0.05**
	Easier	44 (55%)	**Same as regular**	**Easier**	**<0.05**
Paragraph-by-paragraph	Harder	14 (17.5%)	Harder	Same as regular	0.068
	Same as regular	30 (37.5%)	**Harder**	**Easier**	**<0.05**
	Easier	36 (45%)	Same as regular	Easier	1.00

highlighting technique yielded nominally higher comprehension accuracy and the other showed a minor difference in reading time—but these trends did not reach significance. These variations in comprehension or speed across conditions may reflect small and unreliable effects, though the lack of statistical significance could also indicate no genuine effect, potentially attributable to the sample size and the short length of the texts used in this study.

However, our results did show a clear effect on readers' subjective focus. Participants reported significantly higher attention-sustainment specifically when using sentence-by-sentence and paragraph-by-paragraph highlighting techniques, compared to the static condition. Participants had mixed perceptions of line-by-line highlighting, with some rating it as more distracting while others found it helpful. In particular, the highlighting condition that segmented text by grammatical units (such as sentences or paragraphs) received higher ratings for sustaining attention than the condition highlighting equal-length visual chunks (e.g., one line of text at a time). This suggests that while comprehension scores remained similar, the way text was highlighted had a meaningful impact on how well readers felt they could maintain focus. The grammatical segmentation highlight may have helped readers concentrate by presenting ideas in coherent units, leading to a statistically significant improvement in self-reported attention compared to the visually segmented highlights.

Participants' preferences further reflected these attention findings. In post-reading surveys, most readers preferred the grammatical segmentation highlighting technique over the purely visual line-by-line highlighting. Many commented that the grammatically segmented highlights made it easier to follow the narrative and stay engaged, whereas the line-oriented highlights sometimes felt arbitrary or distracting when a sentence spanned multiple lines. This clear user preference is consistent with the higher reported engagement and perceived focus associated with the grammatical highlighting conditions. In essence, readers tended to favor the technique that helped them feel more attentive and immersed in the content. Notably, participants' preferences for particular highlighting methods were not reliably associated with better performance, suggesting that subjective appeal and objective effectiveness may be distinct dimensions of reading support. Even methods that did not improve measurable performance were valued by some readers for keeping their reading on track, indicating an important benefit in terms of user experience.

Our results hint that highlighting by meaningful linguistic units (grammatical segments like a sentence or a paragraph) may better support readers' natural processing of text than highlighting by line. In contrast, visual segmentation (highlighting one line at a time) provided some attentional benefit for certain readers but was counterproductive for nearly as many—reflecting its polarized reception. The absence of significant comprehension differences suggests that no highlighting method automatically improves understanding in a short reading task, but the improved perceived attentional engagement with grammatical highlights could be practically important in scenarios requiring prolonged concentration.

5.1. Future Research

Building on this work, future studies might employ more sensitive, robust or longer-term experimental designs to determine whether performance differences emerge under extended reading conditions or among specific populations such as language learners or readers with attentional challenges. Further experiments could also compare alternative interaction types (e.g., tapping or keyboard control) to assess usability across devices. These directions would provide a more robust basis for evaluating when and how interactive highlighting benefits reading performance. Additionally, objective measures like eye-tracking could be used in future experiments to validate whether highlighted segments truly guide visual attention and reduce mind-wandering. By addressing these questions, future research can deepen our understanding of how and when interactive highlighting can most effectively support digital reading.

5.2. Design Implications

Our findings carry implications for the design of digital reading applications and study tools. Designers might consider incorporating interactive highlighting features that align with readers' cognitive processing of text. In practice, highlighting entire sentences or paragraphs—rather than arbitrary visual blocks—could potentially support comprehension and sustained attention by presenting information in semantically coherent chunks. User preference for grammatical segmentation highlights in our study suggests that many readers appreciate highlights that follow the natural flow of language, finding them more engaging and less disruptive. Therefore, giving users some control over how text is highlighted—or intelligently choosing the method based on content type—could improve overall satisfaction and engagement with textual platforms. It is also important to remember that highlighting alone did not boost test performance in our study, so such features should be seen as aids to engagement and focus rather than guaranteed learning enhancers. Effective UX design for educational reading tools might combine interactive highlighting with other support (e.g., annotations, summaries, self-quizzing prompts) to convert the moment-to-moment focus that highlights provide into deeper processing of the material. In summary, digital reading systems stand to benefit from thoughtful highlight design: emphasizing meaningful text units, accommodating individual preferences, and ultimately using highlighting not as an end, but to foster active reading and sustained engagement.

6. Conclusion

This study investigated three interactive hover-based highlighting techniques—two aligned with grammatical text segmentation (sentence and paragraph) and one based on visual segmentation (line-by-line)—to examine how they influence reading comprehension (1) and reading speed (2) in a digital reading context. The results showed no significant differences in comprehension or reading speed across highlighting conditions, suggesting that hover-based highlighting does not directly enhance these measurable aspects of reading performance. This finding does not support the first two hypotheses predicting improved comprehension and slower reading due to the added interaction effort. Moreover, readers expressed a clear preference for the grammatical highlighting methods, indicating that they found it more helpful and less distracting than the line-by-line highlighter. These results suggest that while interactive highlighting may not directly boost immediate comprehension outcomes, it can enhance user engagement and focus during reading.

Implications of our findings point toward the value of aligning interface design with cognitive reading processes. Highlighting text in meaningful units (like sentences or paragraphs) appears to resonate better with readers, potentially aiding concentration without imposing a penalty on reading efficiency. Designers of e-reading tools and digital textbooks might explore integrating smart highlighting features that maintain or increase reader attention, as our findings suggest this could offer experiential benefits even without measurable performance gains. At the same time, educators and learners may consider that highlighting alone is unlikely to enhance learning, but it may support comprehension when used alongside active reading strategies. Future work will further clarify the role of interactive highlights in learning: for example, examining long-term retention, adapting highlighting to individual needs, and testing these techniques in real-world educational settings. By advancing our understanding of how highlighting format influences reading, this research lays the groundwork for developing more effective digital reading experiences that keep readers focused and engaged, ultimately supporting better comprehension over time.

7. References

Barnhurst, K. G. (2013). Newspapers experiment online: Story content after a decade on the web. *Journalism, 14*(1), 3–21. https://doi.org/10.1177/1464884912448898

Beier, S., Berlow, S., Boucaud, E., Bylinskii, Z., Cai, T., Cohn, J., Crowley, K., Day, S. L., Dingler, T., Dobres, J., Healey, J., Jain, R., Jordan, M., Kerr, B., Li, Q., Miller, D. B., Nobles, S., Papoutsaki, A., Qian, J., ... Wolfe, B. (2021). Readability research: An interdisciplinary approach (Version 1). *arXiv.* https://doi.org/10.48550/ARXIV.2107.09615

Bessemans, A. M. M. (2012). *Letterontwerp voor kinderen met een visuele functiebeperking* [PhD thesis]. Leiden University. https://hdl.handle.net/1887/20032

Carr, N. G. (2020). *The shallows: What the Internet is doing to our brains.* W.W. Norton & Company.

Clinton-Lisell, V., Seipel, B., Gilpin, S., & Litzinger, C. (2023). Interactive features of E-texts' effects on learning: A systematic review and meta-analysis. *Interactive Learning Environments, 31*(6), 3728–3743. https://doi.org/10.1080/10494820.2021.1943453

Cuddihy, E., & Spyridakis, J. H. (2012). The effect of visual design and placement of intra-article navigation schemes on reading comprehension and website user perceptions. *Computers in Human Behavior, 28*(4), 1399–1409. https://doi.org/10.1016/j.chb.2012.03.002

Demidenko, E. (2004). *Mixed models: Theory and applications.* Wiley. https://doi.org/10.1002/0471728438

Faraway, J. J. (2014). *Linear models with R* (Second edition). CRC Press, Taylor & Francis.

Fok, R., Kambhamettu, H., Soldaini, L., Bragg, J., Lo, K., Head, A., Hearst, M. A., & Weld, D. S. (2022). Scim: Intelligent skimming support for scientific papers. *Arxiv.* https://doi.org/10.48550/ARXIV.2205.04561

Hare, C., Johnson, B., Vlahiotis, M., Panda, E. J., Tekok-Kilic, A., & Curtin, S. (2024). Children's reading outcomes in digital and print mediums: A systematic review. *Journal of Research in Reading, 47*(3), 309–329. https://doi.org/10.1111/1467-9817.12461

Head, A., Lo, K., Kang, D., Fok, R., Skjonsberg, S., Weld, D. S., & Hearst, M. A. (2021). Augmenting scientific papers with just-in-time, position-sensitive definitions of terms and symbols. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems,* 1–18. https://doi.org/10.1145/3411764.3445648

Hisgen, R. G. W., & van der Weel, A. (2022). *De lezende mens: De betekenis van het boek voor ons bestaan.* Uitgeverij Atlas Contact.

Kaakinen, J. K., Papp-Zipernovszky, O., Werlen, E., Castells, N., Bergamin, P., Baccino, T., & Jacobs, A. M. (2018). Emotional and motivational aspects of digital reading. In M. Barzillai, J. Thomson, S. Schroeder, & P. van den Broek (Eds.), *Studies in written language and literacy* (Vol. 17, pp. 141–164). John Benjamins Publishing Company. https://doi.org/10.1075/swll.17.06kaa

Mangen, A., & Van der Weel, A. (2016). The evolution of reading in the age of digitization: An integrative framework for reading research. *Literacy, 50*(3), 116–124. https://doi.org/10.1111/lit.12086

Poulsen, P. B., Buchholz, P., Walt, J. G., Christensen, T. L., & Thygesen, J. (2005). Cost analysis of glaucoma-related-blindness in Europe. *International Congress series, 1282,* 262–266. https://doi.org/10.1016/j.ics.2005.05.091

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124*(3), 372–422. https://doi.org/10.1037/0033-2909.124.3.372

Salmerón, L., Strømsø, H. I., Kammerer, Y., Stadtler, M., & Van Den Broek, P. (2018). Chapter 4. Comprehension processes in digital reading. In M. Barzillai, J. Thomson, S. Schroeder, & P. van den Broek (Eds.), *Studies in written language and literacy* (Vol. 17, pp. 91–120). John Benjamins Publishing Company. https://doi.org/10.1075/swll.17.04sal

Schwabe, A., Lind, F., Kosch, L., & Boomgaarden, H. G. (2022). No negative effects of reading on screen on comprehension of narrative texts compared to print: A meta-analysis. *Media Psychology, 25*(6), 779–796. https://doi.org/10.1080/15213269.2022.2070216

Sieghart, S., & Gorbach, R. P. (Eds.). (2024). *Gutes design für leichte sprache: Theorie und praxis zur DIN SPEC 33429* (1st ed.). utb GmbH. https://doi.org/10.36198/9783838563077

Smith, F. (2004). *Understanding reading* (6th ed). L. Erlbaum Associates.

Stothart, C., Mitchum, A., & Yehnert, C. (2015). The attentional cost of receiving a cell phone notification. *Journal of Experimental Psychology: Human Perception and Performance, 41*(4), 893–897. https://doi.org/10.1037/xhp0000100

The Readability Consortium. (n.d.). Resources. https://thereadabilityconsortium.org/resources/

Veras, R., Paluka, E., Chang, M.-W., Tsang, V., Shein, F., & Collins, C. (2014). Interaction for reading comprehension on mobile devices. *Proceedings of the 16th International Conference on Human-Computer Interaction with Mobile Devices & Services,* 157–161. https://doi.org/10.1145/2628363.2628387

Wallace, S., Bylinskii, Z., Dobres, J., Kerr, B., Berlow, S., Treitman, R., Kumawat, N., Arpin, K., Miller, D. B., Huang, J., & Sawyer, B. D. (2022). Towards individuated reading experiences: Different fonts increase reading speed for different individuals. *ACM Transactions on Computer-Human Interaction, 29*(4), 1–56. https://doi.org/10.1145/3502222

Wallace, S., Treitman, R., Kumawat, N., Arpin, K., Huang, J., Sawyer, B., & Bylinskii, Z. (2020). Individual differences in font preference & effectiveness as applied to interlude reading in the digital age. *Journal of Vision, 20*(11), 412. https://doi.org/10.1167/jov.20.11.412

World Wide Web Consortium (W3C). (2018). Web content accessibility guidelines (WCAG) 2.1. https://www.w3.org/TR/WCAG21/

Wylie, J., Thomson, J., Leppänen, P. H. T., Ackerman, R., Kanniainen, L., & Prieler, T. (2018). Chapter 3. Cognitive processes and digital reading. In M. Barzillai, J. Thomson, S. Schroeder, & P. van den Broek (Eds.), *Studies in written language and literacy* (Vol. 17, pp. 57–90). John Benjamins Publishing Company. https://doi.org/10.1075/swll.17.03wyl

Authors

Szabolcs Vatány is a doctoral student at Moholy-Nagy University of Art and Design Budapest, where his research focuses on digital readability and typography. He holds an MA in Graphic Design and has several years of professional experience as a UX designer. His background spans interface design, type design, and multiple areas of graphic communication. His work often explores the intersection of design, disability, and education, including projects aimed at improving accessibility and developing educational technologies. He has also led university courses on related topics, integrating design practice with inclusive and research-based approaches.

Thi Huyen Nguyen is a Doctor of Preventive Medicine with an MSc in Epidemiology and a PhD candidate in Statistics. She has over eight years of combined experience in public health, infectious disease modeling, and clinical research. She specializes in statistical modeling, data analysis, and reproducible research workflows, with applications spanning public health and non-health domains such as cognitive accessibility and design perception. Her work bridges quantitative methodology with real-world problem solving, fostering interdisciplinary collaboration across academic, governmental, and international partners.

Anikó Illés, PhD, is a psychologist and aesthete, professor of Moholy-Nagy University of Art and Design Budapest. Her main research interest is about issues concerning visual culture, such as psychology of art (appreciation of artworks, creativity, analyzing artworks), pedagogical aspects of art and museums, analyzing visual images as a research method for several topics in the fields of education and social psychology (schooling, educational gap, perceived social mobility of children, national identity). She was the Secretary General of International Association of Empirical Aesthetics (2020–2025). She was a Fulbright researcher at Montclair State University, NJ, USA (2020).

Ann Bessemans (prof. dr.) is a leading expert in legibility and an award-winning typographic and type designer. She is the founder of READSEARCH, the legibility research group at PXL-MAD School of Arts and Hasselt University (Belgium), where she is affiliated with the Faculty of Architecture and Arts and the Data Science Institute (DSI). In addition to her academic work, she

also operates as an independent designer and consultant. At PXL she teaches typography and type design. Bessemans is the program director of the international Master program "Reading Type & Typography." With a PhD (under the supervision of Gerard Unger) from Leiden and Hasselt Universities, her data-driven legibility research, supported by multiple Microsoft grants, aims to improve typeface design for diverse reading needs, including those with impairments. She actively engages in various academic and research roles, actively participating in the board of directors at ATypI.