Designing and Evaluating of an iPad-based Reading Mode for Enhancing the Efficiency of Non-native Immersive Reading

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ABSTRACT

Nowadays, reading concentration is decreased due to the various information on the electronic devices, resulting in low reading efficiency, especially for non-native language reading. The study aims to carry out an iPad-based reading mode for improving the reading concentration of immersive reading. To achieve this objective, this research proposes i) deep research on several existing reading modes through eye-tracking evaluation and user interviews; ii) an innovative paragraph focusing reading mode for immersive reading; and iii) formal evaluation study to verify the usability and effectiveness of the proposed design. Particularly, the proposed reading mode can dynamically highlight the paragraphs of the article following the drag of the page, helping users to concentrate on the paragraphs they want to read intensively. Additionally, the evaluation shows that the proposed reading mode received the highest user preference, reading concentration and correct answer rate significantly, which confirms the application potential of this design.

Keywords: Interaction Design, Reading Mode Design, Immersive Reading, Reading

Efficiency

INTRODUCTION

With the development of Internet technology, more and more products and services become digital. Many jobs need to rely on various electronic devices, and the reading based on electronic screen is gradually rising. Compared with paper reading, it is easier to obtain information, but the time for immersive reading is decreasing (Liu, 2005). Users are easily distracted when reading on the screen, especially for non-native materials. This is due to the complexity of electronic equipment, the interference of massive information and the lack of physical contact with users. Therefore, how to design reading assistance to enable users to focus on the text content on the screen and improve reading efficiency has become particularly important.

RELATED WORK

As we mentioned earlier that immersive reading at the macro level is very helpful, but not sufficient, we now review some micro level strategies in further detail to improve the reading efficiency of an individual document.

Reading and comprehension

D Kingery and R Furuta found that font typeface, font size, screen resolution and display size have impacts on the legibility of screen text reading (1997). Luo Wei believes that immersion to the text is an important state for the reader when reading. With the rise of electronic reading, reading tools on the electronic devices that meet users' immersive reading needs become more and more important. Most interfaces of reading tools have too many interference elements, which may easily interrupt reading and then hinder readers from entering the immersion state (2013). Hirohito Shibata et al. found that interaction with text is an important factor affecting reading performance. When the user's interaction with the text is limited, the reading efficiency may be reduced (2013). These results show that the dynamically focused reading mode based on the iPad can improve reading concentration.

Reading assistance

Terje Hillesund proposed that users need the least interference from technical factors of electronic devices to achieve the immersive reading mode, so as to make the interference factors transparent (2010). Matthew K. Hong et al. found that readers showed visual tracking activities in reading process. They usually use thin objects (such as pens) or fingers as the instantaneous focus to guide visual attention and mark position. Based on this discovery, they proposed a desktop design scheme to strengthen reading behavior. Particularly, the text area will be temporarily highlighted following reader's visual tracking

(2012). The Microsoft edge browser has an immersive reading tool that simplifies the layout of web page and eliminates irrelevant information. Readers can open the "line-focused" mode to read focused on one line, three lines or five lines at a time. This is consistent with our research direction, but we will further explore the impact of focused text areas and operation mode on reading experience.

REQUIREMENT AND DESIGN

Pre-design Analysis

In order to better understand the impact of reading mode on electronic reading performance, we collected the data of three graduate students (aged 22-24 years) reading non-native texts with an eye tracker (Tobii lab high precision head mounted eye tracker). The research aims to understand the user experience of the current immersion reading tools on the browser, so as to provide information for the further design. Participants successively experienced and evaluated three reading modes: Jane Yue reading plug-in (paragraph-focused reading mode), the immersion reading mode of Microsoft edge browser (line-focused reading mode) and ordinary web page text reading.

Our researchers conducted a detailed analysis of participants' eye movement data. Through analysis, it is found that the pupil diameter of the three participants is the smallest when using paragraph-focused reading mode, which may be due to the less fatigue of readers in this reading mode. Furthermore, three participants all thought that they tend to be more immersive when using the first two focused reading modes than the ordinary reading mode.

Reading Mode of Paragraph Highlight

In order to help readers read more effectively, one of the important tasks is immersive reading, which needs to help users focus on the text. Furthermore, it needs to restore the natural reading state as much as possible, which is ignored by the existing reading modes. Therefore, based on the existing web page reading mode, we propose a dynamically focused reading mode based on iPad. This reading mode can highlight the article paragraphs one by one following the drag of the page by the finger, helping users to concentrate on the paragraphs they want to read intensively, and avoiding the interference of other elements in the interface.

EVALUATION STUDY

METHODS

In order to evaluate the impact of this iPad-based reading mode on non-native reading efficiency, concentration and user preferences, our research conducted a multi-dimensional verification study.

Participants. 24 non-native speakers who are proficient in English participated in the study (M(age)= 23.67, 12male, 12female). The participants are college students of Shanghai Jiao Tong University, with different majors. In the recruitment stage, participants completed the English vocabulary test (provided by Scallop Words), and students with a vocabulary of 8000-12000 were invited to participate in the study.

Materials. All participants need to use iPad mini 5 to experience three reading modes (Figure 1) in the experimental environment (quiet and empty room with standard sitting posture). The three reading modes are line-focused (similar to the reading mode on Microsoft edge browser), paragraph-focused (design mode) and normal mode. In order to balance the difficulty of articles and questions, the English articles we use are TOEFL reading articles with the same difficulty, and three questions (theme question, detail question and reasoning question) are selected for each article. The three articles are: A Result of a Research about Leaders (372 words), Newton's laws of motion (358 words), The Music of Films (353 words), and their Lexile Text Measures are 1210L to 1400L.
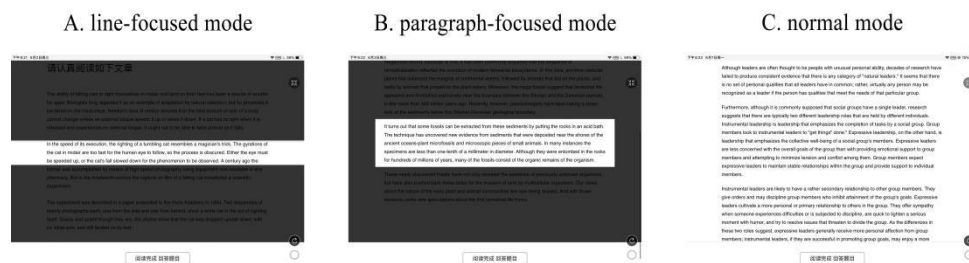

Figure 1. Three reading modes were used in the experiment.

Procedure. The study was evaluated by reading articles and answering questions in different reading modes, and filling in a subjective evaluation scale. Before the reading experience, the experimenters briefly introduced the use methods of the three reading modes and the process of the whole experiment. Then, participants read three articles in three reading modes. After reading each article, they need to complete the corresponding three reading answers and subjective evaluation questions. The combination of the reading modes and articles, and the order of the reading modes are balanced. After experiencing the three reading modes, participants chose their favorite reading mode. The subjective evaluation question evaluates the user's subjective concentration when using the reading mode and the subjective difficulty of the reading tasks, including: 1) How focused do I think I am in the above reading mode? 2) How difficult do I think the above reading tasks are? 7-point Likert Scales are used for both questions.

ANALYSIS

One-way within subject ANOVA with three groups and post hoc test (LSD) were used to analyze the question answer scores, subjective evaluation of concentration, user preference and subjective evaluation of reading difficulty under the three reading modes.

FINDINGS

Accuracy of question answer. Under different reading modes, the total scores of question answer shows significant difference (F = 3.706, p = 0.030) in Table 1. It is found that the total scores of paragraph-focused mode (designed mode) is significantly higher than that of normal mode (p = 0.011) and slightly higher than that of line-focused reading mode (p = 0.050). This shows that the designed mode can significantly improve the reading accuracy, which implies that users can more accurately grasp the content of the article and be more concentrated when using the designed reading mode.

Table 1: Analysis of users' question answers score

Reading mode (mean ± SD)			F	p
Line-focused mode (n=24)	Paragraph-focused mode (n=24)	Normal mode (n=24)		
1.67±0.96	2.21±0.72	1.50±1.10	3.706	0.030*

Subjective concentration. There was a significant difference (F = 7.874, p = 0.001) in subjective evaluation of concentration scores under different reading modes in Table 2. It was found that the subjective concentration scores of paragraph-focused mode and line-focused mode were significantly higher than those of normal mode. Therefore, the reading mode with functions helping focusing will make users feel more concentrated in reading, especially the designed dynamically paragraph-focused mode.

Table 2: Analysis of users' subjective concentration

Reading mode (mean ± SD)			F	p
Line-focused mode (n=24)	Paragraph-focused mode (n=24)	Normal mode (n=24)		
5.29±1.23	5.75±0.79	5.38±1.53	7.874	0.001**

User preference. The user preference shows significant difference (F = 5.890, p = 0.004)

in Table 3, and the scores of the designed mode is the highest ($p < 0.05$), which reflects that the usability and effectiveness of the designed reading mode has been recognized by users.

Table 3: Analysis of users' preference

Reading mode (mean $\pm$ SD)			F	p
Line-focused mode (n=24)	Paragraph-focused mode (n=24)	Normal mode (n=24)		
0.17$\pm$0.38	0.58$\pm$0.50	0.25$\pm$0.44	5.890	0.004**

Subjective difficulty. There is no significant difference in subjective evaluation of task difficulty under different reading modes, which means that the effects of different reading modes on task difficulty are consistent.

Therefore, the results of the evaluation study shows that the paragraph-focused mode proposed in this research can improve the efficiency and concentration of non-native language reading on the iPad. Users are willing to use this mode for reading and show high preference. At the same time, this reading mode does not increase the difficulty of reading. The above analysis confirms the effectiveness and usability of the dynamically paragraph-focused mode.

CONCLUSIONS

Based on the needs of immersive reading on the screen in the information age, we proposed an iPad-based reading mode of dynamically focused on text paragraphs, which finds the possibility to improve the reading concentration on tablet computers. However, at present, the interaction of this reading mode depends on dragging on the screen, which is far from the visual tracking when reading traditional print text. Further researches can be applied to mobile devices with floating touch technology to get closer to the interaction mode of natural reading. Additionally, the evaluation method is limited to reading non-native short article and it may be evaluated in more detail in further researches. In the future, we hope to apply this reading mode to develop relevant reading application software, so as to provide more choices for users who use electronic devices for immersive reading.

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