

THE EFFECTS OF DIFFERENT
DESIGN FACTORS ON
COMPREHENSION PERFORMANCE
AND SUBJECTIVE EVALUATION
FOR READING CHINESE
ON LED DISPLAY

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The Effects of Different Design Factors on
Comprehension Performance and
Subjective Evaluation for Reading Chinese on
LED Display
不同顯示方式
對發光二極管電子顯示屏之
中文閱讀表現及影響

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ABSTRACT

Dynamic display systems are widely used in information communicating technology. Most of these display systems employ cathode ray tubes, liquid crystal displays, gas plasma displays, or light-emitting diodes (LED) as the output device. LED display simply acts as a display output unit like a computer screen, which provides a means of delivering messages or advertisements to customers or people. In order to overcome the limitations of screen size of the display units, numerous means of presenting moving materials on dynamic display have been invented. The advanced display technology offers a selection of colors, display methods, display rates, and highlighting methods, which have improved the presentation of textual information. The text display method, character type, text display direction, text color, and other features can be freely chosen by designers or operators. Thus, the different combinations of the selected factors would affect the readability of electronic text. However, all the previous findings on optimal dynamic text display and readability of electronic text were focused on small screens, such as cellular phones, pagers, and desktop phones. There has been an obvious lack of consideration of reading situations in which the displays are located at a distance from the observers, especially when reading Chinese characters. Therefore, there is a need to understand the effects of the display factors on the readability of electronic text in order to design better display interfaces on large displays written in Chinese.

Three experiments were conducted in this research on investigating the effects of display factors on comprehension performance and subject preference for reading Chinese characters on LED displays. In each experiment, objective performance measures and subjective evaluation measures were collected. The objective performance measure consisted of the comprehension score, which denoted the accuracy of subject responses to a set of multiple-choice questions in a comprehension task following the reading passage. The preference rating was a subjective evaluation of the testing display format given by the readers reflecting individual preference, which should also be considered when designing an optimal display method. The subjective evaluation questionnaire investigated the subjects' preferences towards a reading interface by having them evaluate reading comfort, reading ease, eyestrain, musculoskeletal strain, mental demand, usability, and overall preference.

Experiment 1 was performed by examining the effects of display method, display text rate, and observation angle on comprehension performance and preference on LED displays. The results indicated that a display rate of 160 characters per min (cpm) was found to be superior to 240 cpm and 320 cpm in terms of higher comprehension scores and better subjective evaluations. The interaction between display method and text display rate had a significant effect on reading comprehension. Observation angle and display method were found to be non-significant for both comprehension performance and subjective evaluation.

Experiment 2 investigated the effects of display method, number of message lines, and display color on comprehension performance and preference for LED displays. The results showed that green text was superior, with higher comprehension scores than amber and red. The condition with the RSVP display method resulted in higher comprehension scores than the scrolling with pauses method. However the scrolling with pauses condition had better subjective evaluation ratings than the RSVP method. A multi-line display was found to be superior to a single-line display, yielding higher comprehension scores and subjective evaluations.

Experiment 3 was conducted to evaluate the effects of text direction and highlighting methods of color coding and font format on comprehension performance and preference for LED displays. The results indicated that subjects achieved better comprehension in the highlighting conditions with color coding (red) than those without color coding. It was also noted that regular format with color coding (red) resulted in the best comprehension. Font format and text direction did not significantly affect comprehension or subjective evaluations. Furthermore, the validity of highlighting was also examined and the results showed that the condition with 100% validity of highlighting was found to result in better comprehension performance than other validity levels and conditions with no highlighting.

The three experiments successfully revealed the design factors that would affect the readability of electronic text. According to readability and preference ratings of the subjects in different conditions, the optimal display method, color, highlighting method, and its validity for comprehending the delivered messages were investigated. These results provide useful design recommendations for using LED displays for advertising and delivering messages to the public.

In summary, this dissertation 1) investigated the effects of display factors on comprehension performance and subject preference for reading Chinese characters on LED displays, 2) investigated the comprehension performance under the conditions of different highlighting validities and highlighting methods, 3) established general ergonomics guidelines applicable to various display configurations for determining the optimum dynamic text display methods, and 4) provided information for formulating further research plans for determining the optimum dynamic text display methods on LED display boards.

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