Usability News

July 2000, *Vol. 2 Issue 2*

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Usability News is a free web newsletter that is produced by the Software Usability Research Laboratory (SURL) at Wichita State University. The SURL team specializes in software/website user interface design, usability testing, and research in human-computer interaction.
Barbara S. Chaparro, Editor

Is RSVP a Solution for Reading from Small Displays?

By Michael Bernard, Barbara Chaparro, & Mark Russell

In the last five years, we have witnessed a virtual explosion in the number and variety of hand-held devices that use small-screen interfaces (SSIs). These devices, which may include everything from personal digital assistants (PDAs) to cellular telephones, offer the convenience of portable, or even wearable interfaces. This convenience, however, comes at a price; the amount of information that can be displayed on the screen at one time is very small. Moreover, manual scrolling, tabbing, and paging are required to present successive displays of information. This, of course, limits the usefulness of these devices, especially if the information that is viewed is more than just a small amount. These limitations serve as a critical usability concern as more and more consumers use hand-held devices for such things as reading e-mail, browsing the web, and reading documents.

In addition, one of the strengths of SSIs, which is that it is 'hand-held,' can also serve as hindrance if the user does not have both hands available to hold and advance the text. Studies have found that manual scrolling tends to produce poorer comprehension and reading efficiency than automatic presentation methods for SSI (Chen & Chan, 1990). With automatic presentation of text, manual scrolling is not necessary and the reader views the text at pre-set speeds. Text can be presented with as little as one word at at a time or entire paragraphs at a time. Text that presents one word at a time in a fixed location is known as RSVP (Rapid Serial Visual Presentation). RSVP can allow for the presentation of text in a very small area with little or no degradation of reading performance. For example, Rahman and Muter (1999) compared the RSVP method of presentation to sentence-by-sentence presentation and to normal page format and found both the RSVP and the sentence formats to be just as efficient (defined as reading speed x reading comprehension) as the normal page format. Readers reported in this study, however, that they preferred the RSVP format the least.

As most hand-held devices strive for ease-of-use for the walk-up-and-use consumer, acceptability of text presentation methods are critical. Consumers will not purchase devices that require extensive practice. With this in mind, we sought to investigate the effectiveness and acceptability of three types of automatic text presentation methods for SSIs.

The text presentation methods consisted of:

1. serially presenting one word at a time at the center of the screen - rapid serial visual

presentation (RSVP)
2. serially presenting three lines of text on the screen (three-line) at one time
3. serially presenting ten-lines (ten-line) of text on the screen at one time.

These methods were chosen because they all appeared to be viable and practical approaches to reading text on a SSI. Both the three-line and the ten-line conditions had text widths of 65 millimeters, which is the width of an average PDA screen. In addition, the ten-line condition was created such that the height of the 10-lines approximated the same size as found in a typical PDA screen (45mm high). The presentation rate of text consisted of three different speeds: 250 words per minute (wpm) - which is considered the average reading speed of individuals on paper, 450 wpm, and 650 wpm.

METHODS

Twenty college students (5 men and 13 women between the ages of 17 and 41) volunteered for this study. Of them, 70% read from a computer screen on a daily basis and 25% had used an electronic organizer (PDA) in the past. All subjects reported that they had 20/20 or corrected equivalent vision.

The text was displayed on a 1024 x 768 resolution color monitor and used a word presentation software program called Ace Reader™;, which provided both the text and the associated comprehension test questions. Each text passage ranged from 127 to 269 (M = 204) words. The text was displayed in 14-point Arial bold font. The order of presentation of the text passages, the text presentation formats, and the text presentation speeds were counterbalanced across subjects. All subjects experienced all presentation methods at all speeds.

Three-line and ten-line format

The three-line and ten-line text presentation methods were identical with regard to procedure. Under both of these conditions, the participants first read a practice passage and then answered five comprehension questions related to the practice passage. They then read three test passages, each followed by five comprehension questions. After each condition, participants were asked to complete a questionnaire that asked them to rate their satisfaction with their reading experience.

RSVP format

The RSVP condition's testing procedure was identical to the formats discussed above, except that the RSVP format serially presented one word at a time in the center of the screen. Also unique to the RSVP condition was a delay of approximately 500 millisecond after the presentation of each sentence. Past studies (e.g., Rahman & Muter, 1999) have found that adding a small delay at the end of each sentence increases comprehension. The RSVP condition also had five additional practice passages at different presentation speeds (250, 350, 450, 550, and 650wpm) at the beginning of this condition in order to familiarize the participants to this type of presentation method.

RESULTS AND DISCUSSION

Reading Comprehension

Results from a 3 x 3 (presentation method x speed) repeated-measures analysis of variance

indicated a main effect of speed ($F(2,76) = 28.19$, $p < .001$). As the speed increased from 250 wpm to 650 wpm, reading comprehension significantly decreased. A marginal main effect ($p = .08$) was found for presentation method. RSVP and 10-line presentation methods demonstrated higher overall levels of reading comprehension (across all speeds) than the 3-line presentation method (M = 69.03%, 67.35%, and 62.53%, respectively). Figure 1 shows the mean comprehension scores for each method at each speed.

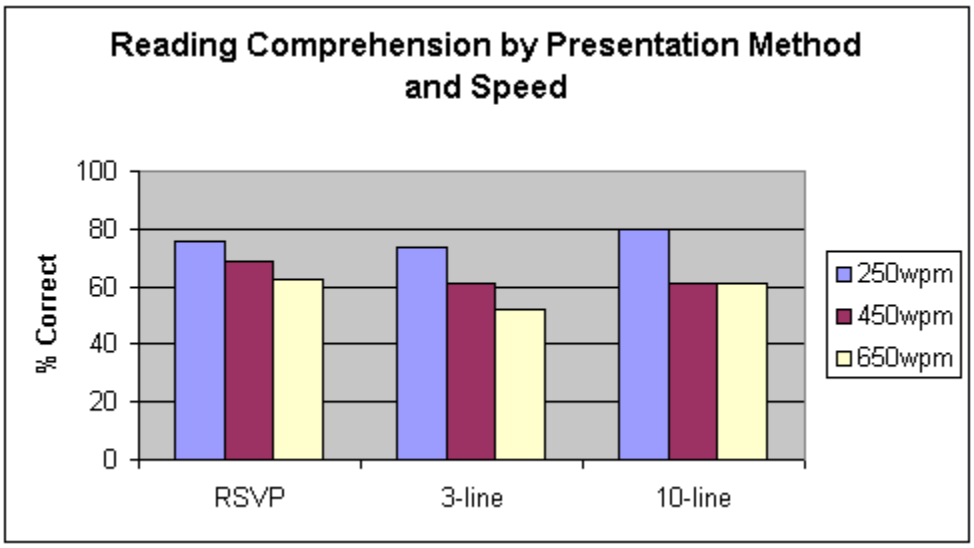
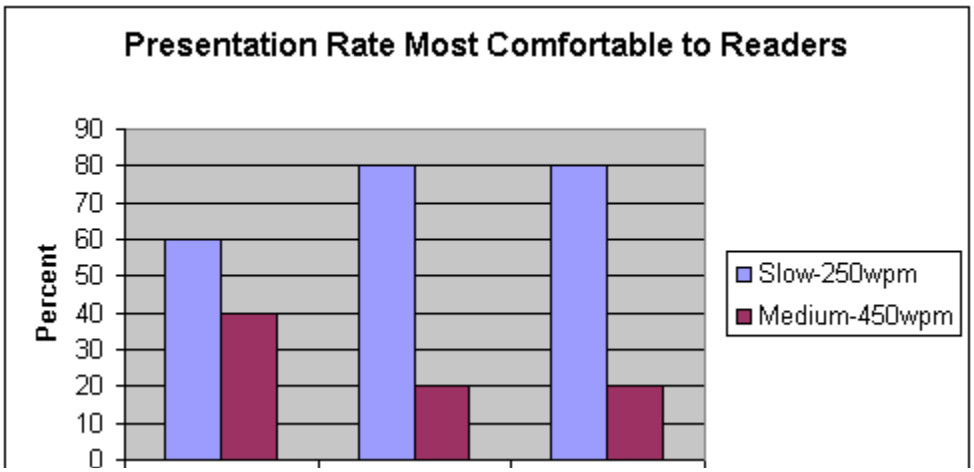


Figure 1. Reading Comprehension by Presentation Method and Speed

Satisfaction

Surprisingly, the readers were equally satisfied with the three methods of presentation. This included ease of reading, physical and mental fatigue, ability to concentrate on the text, confidence in comprehension, and desire to read in that format. One difference that was found involved the amount of self-reported eyestrain experienced. Readers indicated that the RSVP method of presentation resulted in higher eyestrain than the 10-line method.

In addition to the above measures, readers were asked at which text presentation speed they were most comfortable (Slow, Medium, and Fast mapped to 250wpm, 450wpm, and 650wpm, respectively). This data is shown in Figure 2. The majority of the readers reported that they were most comfortable at the slowest speed, 250wpm. Interestingly though, a higher percentage of readers (40%) chose the medium speed as the most comfortable in the RSVP condition. Nobody indicated that they were most comfortable at the fastest speed of 650wpm.



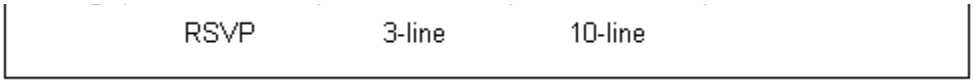


Figure 2. Presentation Rate Most Comfortable to Readers

Preference

After the experiment, users were asked to rank the methods of presentation according to their preference. None of the methods resulted in being the "favorite." Mean ranks for the RSVP, 3-line, and 10-line methods were 2.15, 1.95, and 1.90, respectively. This is very interesting, given that all of the readers had no experience with RSVP prior to the experiment. We thought that readers would have been most comfortable with the 10-line or 3-line since it was more familiar.

As devices continue to decrease in size, while at the same time offer more functions such as web browsing and e-mail, it is imperative that alternative methods of reading text are investigated. Results from this study are encouraging for the use of automatic text presentation and SSIs, especially for RSVP. Even with no experience with RSVP reading, participants were able to read just as accurately and were just as satisfied as when reading either 3-lines or 10-lines at a time. In addition, more participants were comfortable at faster speeds with RSVP than the other methods. For devices such as cellular phones and pagers, small portions of text displayed at one time may be the only viable method of presentation. This study supports the use of RSVP as a practical method of text presentation for these screen sizes. However, more research is needed to investigate this further - it is not yet known the effects of practice, font types & sizes, or how these results will generalize to an actual hand-held device under various real-world settings. These are a few of the areas SURL will continue to examine.

Note: A presentation based on this work will be presented at the Human Factors and Ergonomics Society's 45th (2001) Annual Meeting in Minneapolis/St. Paul, MN.

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