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Reading Text form a VDT

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1. Abstract

The goal of this phase of my research is to uncover the existing literature which relates the the reading of text over the medium of the visual display terminal (VDT). The search largely consists of articles published within the last six years. This paper will include a summary of the salient points made in these articles. Further, this paper will draw conclusions based on previous work and define directions in which research in this area might be directed.

2. Introduction

With the growth of the computer, the VDT has become a common medium for the display of various types of information. As computer power becomes increasingly available to people outside technical fields, VDT's will become a prevalent medium of information display. Specifically, the move toward the computerized office and eventually the paperless office will require that substantial amounts of text be read from a VDT. Yet, it is not clear what the optimal environment for reading from a VDT is. The first step is to define what is meant by an optimal environment.

In the context of this paper, an optimal reading environment will be defined relative to the environment which exists when reading hard copy. Therefore, an ideal reading environment would be one in which it is at least as comfortable and efficient to read from a VDT as to read from a book. Obviously, reading from a book, and reading from a VDT are not entirely comparable experiences (especially in the current state of VDT presentation). For example, most VDT are stationary and require the user to adjust their position to accommodate the VDT. Further, the VDT cannot be held in one's hands. Although reading from a VDT is largely a new medium, most research uses its analogy to the reading of hard copy as a guideline even though this analogy is only partial. The first step is to discover what work has been done with the medium of the VDT in terms of text display and compare this with text display in a hard copy format comparing the two using a set of criteria which encompasses both comfort and efficiency.

3. Feasibility

There were two types of studies done in this area. The first type of study simply tried to determine the feasibility of reading text off of a VDT for some period of time. These studies focus on the measurement of strain resulting from reading text from a VDT for various periods of time.

It does indeed seem feasible to read text from a VDT for some period of time. Recent research has concluded that there is no significant amount of additional physical strain associated with the reading of text on line [Muter 82, Dainoff 81, Nordqvist 83]. However, there are differences which exist between objective and subjective measures of strain. Namely, subjective measures of strain are higher than objective measures. This is a curious finding and needs to be explored, especially since the same study which observed a higher level of subjective strain was able to rule out aversion to computers in the office as a source of the subjective strain [Dainoff 81]. Any physical strain which was measured during research was concluded to be local to the eye itself and does not have any central nervous system component [Mourant 81]. It is hypothesized that one source of local eye strain is generated by the dot matrix formation of the fonts used on VDT. These fonts produce character images which are slightly blurred and result in the eye constantly trying to focus on an image that will never come into focus. It is believed that much of this strain can be alleviated by allowing informal breaks during a reading session [Dainoff 81]. This is a logical and natural practice to follow.

While not fatiguing to any large extent, reading from a VDT was generally found to be less efficient (where efficiency is measured in terms of reading speed and reading comprehension) than reading from a book [Muter 82]. Possible reasons for this include the relative unfamiliarity of the subject with this mode of text presentation. Hence part of the reader's attention was concentrated on the format of information presentation rather than on the actual information being presented. A second hypothesis would be that the experimental conditions provided did not allow flexibility with respect to the relative positioning of the text and the reader. Only one study dealt with the effects of distance and the reading of videotext. It was concluded there there was no significant correlation. Shorter distances, were however, preferred [Nilsson1 83]. While more work needs to be done in this area, the overall climate is favorable for reading text from a VDT is a viable option.

Finally, it must be recognized that almost all of the work just sighted deals with physiological factors of strain and not with the psychological factors involved. This is a major gap in the existing research. It is the difference between being able to present text so that it can be read and presenting text in a manner in which it can be enjoyed.

4. Presentation of text

4.1. Color

The next step is to explore work relating to the optimal way in which to display text. First, there is the question of color. It is generally believed that the use of multiple colors in the presentation of text is a valuable tool. Colors can be used to highlight particular areas of the text to emphasize importance. [Huchingson 81, Negropontel]. However, poor color choice draws the users attention away from the immediate goal of text comprehension and directs attention to the information processing questions involved with the actual display of the data [Nilsson1 83, Ohlsson 83]. In respect to this, the optimal color choices for standard text are blue and red on all backgrounds except black and magenta respectively (where the possible choices for colors were blue, red, cyanite, green, yellow, magenta,red and white) [Nilsson1 83]. Further, colors of "small wavelength distance" induce "superficial processing of information" which is claimed to be more easily distracted [Ohlsson2 83].

Additionally, a multi-color presentation provides the illusion depth [Ohlsson1 83]. The value of such an illusion is questionable. While it may add to the aesthetics of the presentation, the illusion may draw attention to itself and away form the task of reading. Such effects may simply be part of a transitory phase in adjusting to reading text from screen rather than paper. As the layout becomes more complex the use of numerous colors becomes more distracting and begins to interfere with reading [Ohlsson1 83]. Finally, while the use of color is effective in directing the reader's attention to a specific piece of information, this may come oat the price of distracting the reader from other aspects of the task which may be of lesser, but not negligible, importance [Huchingson 81].

4.2. Font

No mention is made in regard to the specific font type used to display text in any of the previously done research. However, work done by Nicholas Negroponte in conjunction with the architecture machine group at MIT suggests that the use of greyscale in font design results in a more readable font. By introducing grey factors into character design smoothness and higher definition is added to the character set [Negropontel]. Grey scale font design also eliminates the scintillation of line on a VDT screen. This reduces eye strain by removing the problem of constantly having to refocus on an object which is continuously varying in size and luminescence. Contrast is also lessened and jaggies disappear [Schmandt 80].

The size of the font is also important. The size of the font imposes constraints on the presentation of the text because in the majority of cases, there are physical limits on the size a window can be (i.e. the size of the screen has finite dimensions). That is, the larger the font, the fewer the number of characters which can be put on a single line and also the fewer the number of lines which can be viewed at once in a

given window of fixed size. Physiologically, a smaller font allows for more closely packed characters and therefore more closely packed words. More closely packed words reduce eye strain by cutting down on the occular work which has to be done in order to read a fixed amount of text. One's eyes have to move and refocus their attention less often. This is more efficient [Kolers 81]. Curiously, proportional spacing (spacing which does not treat characters as being in individual boxes of fixed width) was deemed to have no effect which can be measured objectively [Muter 82].

The importance of font in readability is probably not of major importance in an objective sense. Work done by E.B. Huey at the beginning of the twentieth century demonstrated that the readability of individual characters in a text did not reduce one's ability to read or understand text [Kolers 81]. While this does not directly reduce to a problem of whether one font is superior to another, it does seem to indicate that as long as the letters of a font are generally recognizable as those of a given alphabet, then the font choice will not effective objective measures of reading.

4.3. Window Size

Although there have been studies done on the optimal size of a page of text and of the optimal size of the lines on that page, these finding do not appear to extrapolate to the case of the VDT [Duchnicky 83]. One study has shown that in terms of reading speed and comprehension, windows which were at least 4 lines vertically and 80 characters horizontally were most effective. Since the study only measured line lengths of 1, 2,4, and 20, there is a large grey area where a better combination may be found (4 or 20 line windows,however, did not differ appreciably) [Duchnicky 83]. Line length also contains many grey areas. 80 character lines were clearly superior to lines of a lesser length. However, no studies have ever been done on line of length exceeding 80 characters per line [Kolers 81, Duchnicky 83].

Spacing also plays a role to some extent. Double spacing was found to be "marginally superior" to single spaced text [Kolers 81]. This may have some relation to the readability of line lengths exceeding 80 characters per line. That is, as the lines get longer double spacing may enhance the ability of the reader to hold his vertical position as he scans back to find the beginning of the next line.

One final note on the properties of the window are that a window which contains an even distribution of text over the entire window is more easily read than a window containing large patches of open space. This is largely due the the reduced contrast which such a presentation provides [Mourant 81, Kolers 81].

4.4. Static Page vs. Scrolled Text

This paper has dealt largely with a window representation of text. This does not however imply the that a static page format is being employed to display the text. In fact, there are two choices in the display of text. One choice is the static page format. The other option is to scroll the text past the

reader much like the credits of some movies are presented; starting at the bottom of the screen and slowly rising to the top of the screen. In implementing this type of scrolling on a VDT, jump scrolling is not readable. Rather, a raster type scroll must be used. That is, the screen scrolls up one raster line in a specified time cycle. This time cycle is specified by the user by indicating a position on some relative scale.

Although some people say they prefer the scrolled text over the static text, the scrolled text has some disadvantages. When the user is allowed to choose a scrolling rate which he deems to be comfortable, this rate is usually approximately 10-20% slower than a rate which would be more efficient for that person. People tend to underestimate their ability to process information; they play it safe and hedge their bet [Kolers 81]. Additionally, scrolled text is generally harder to think about or reorganize while it is being read because the reader is worried about information leaving the screen before he has gotten to it [Kolers 81]. Luckily, it seems that the natural bias of the average person is toward the static window presentation [Bury 82].

5. Conclusions

Thus there have been some general studies done on the reading of text VDT's. Yet, these studies are few and are very general. For instance, although it seems as though longer text lines are desirable to short lines, this contradicts some speed reading techniques which find a shorter line more desirable. Also, a 4 line screen may be adequate or reading text, however this is surely a function of the type of text read. A technical text or any highly intricate text with many related facts scattered over several pages would certainly require a larger window than 4 lines in order to be easily comprehensible.

One distinct problem with research in this area is that it assumes and relies on the analogy between videotext and hard copy. Unfortunately, this analogy only partially withstands the differences of the media over which the information is presented. For instance, work done by M.A. Tinker found that the optimal line length (in terms of reading performance) for text on the printed page was between 8 and 13 centimeters. Yet, for videotext, the lower bound seems to be 80 characters (almost 19 centimeters in length) [Duchnicky 83]. Thus previous work done on reading from the printed page must be used with caution in extrapolating to videotext.

As flat screen technology progresses, the nature of the VDT will also certainly change. All the studies cited have only considered VDT's which are static in terms of their physical orientation to the reader. However, even now portable computers are becoming available which will allow the reader to hold the VDT in his lap much like a person reading a book. This will certainly enhance the viability of reading from a VDT. Users could have a home database of assorted literature would could be read from an elaborate home setup of hardware and software, or the user could pull text on to his portable unit a read

it away from home via a scaled down version of his home facilities. Specifically, newspapers could be pulled across phonelines by users and read via their portable unit.

Many topics remain to be pursued. One obvious starting point would be to determine which hardware, both portable and stationary, would best be able to accommodate a system designed for reading of text. Many of the properties such hardware must contain can be gleaned from the findings of aforementioned studies. More importantly, what software must be developed in order to accommodate reading of text from a VDT? What features should this software have? What features should it not have? These are not really technical concerns, but rather psychological and social concerns.

Indeed, many of the attributes discussed in the studies have been objective. Yet, the objective measures of what constitutes an optimal presentation of text tell, at best, half the story. Functionality does not in general directly correlate with use or acceptance of a medium such as videotext. Instead, what must be explored are the subjective properties of reading (aside from the particular piece of prose). For example, the syntactic boundary of the page is deeply imbeded in our culture, primarily as a measure of length. Is such a boundary important? Does it have an acceptable analogy in videotext? Will a medium lacking such boundaries be accepted? Why?

No serious attempt can be made to "computerize" reading without addressing these subjective aspects. Yet, subjective measures are almost entirely ignored in videotext research. This is the most obvious route for any new study to take.

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