

New Technology and the Reading Process

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Abstract

The present paper discusses some the important issues involved in presenting text on screen. It is argued that reading is a complex cognitive and physical skill that requires careful analysis if technology is going to support rather than hinder the user. The need to consider texts individually in terms of how and why they are read as well as the type of information they contain is discussed. On the basis of a study of journal usage the implications of this approach for the presentation of electronic journals is described.

Introduction

Computer applications to support the storage, retrieval and presentation of information are now emerging which offer the ability to interact with published material in previously impossible ways. Hypertext is probably the most obvious and discussed example (e.g., McKnight et al 1989) but document delivery systems that provide readers with access to remotely stored material are also worth noting. Such facilities are likely to be increasingly offered to end-users in libraries, schools and universities as more cost effective means of storing and presenting information are sought.

These developments are of interest to Human Factors researchers concerned with user-technology interaction. Research in the domain of computer presented text has mushroomed in recent years, concentrating particularly on possible differences between reading from paper and reading from screen. Early findings suggested a performance deficit in terms of speed and accuracy for screen reading (e.g. Wright and Lickorish 1984) though recent research by Gould et al.(1987) suggests that under optimal conditions (i.e. improved image quality) these can be overcome. Therefore it appears that there is no inherent technological restriction to presenting text on screen (for a detailed review of these issues see Dillon et al 1988).

Important as this may appear, it is not enough that image quality is improved. Most of the work in this area is based on proof-reading tasks which hardly equate with the type of reading people normally engage in. Furthermore, given a straight choice between screen and paper based texts, readers will almost certainly choose the latter. How, then, is the situation to be improved?

The reader offers as good a starting point as any. By discovering their needs and uses of texts it should become possible to make informed decisions about the design of suitable electronic systems to support their tasks. Ultimately such systems may take many forms and it should not be assumed that one interface will suit all reading situations or that the real goal is to replace all paper with screens. This may never be possible and well-designed systems that occupy only part of the cycle of events involved in presenting information to a reader may prove a better solution.

At HUSAT (HUMAN Sciences and Advanced Technology, a research institute at Loughborough University in the UK) we have been investigating the problems associated with optimising screen presentation of text as part of the British Library-funded Project Quartet. As psychologists, our attention has naturally focussed more on the human side of the interaction and issues such as reading strategy, preference, and ability of readers to model text structures have formed the major areas of concern. The present paper outlines the major issues we have covered and details specific findings from one area of direct relevance to library applications: the academic journal.

Reading as a physical and cognitive skill

Psychologists have long recognised the complex nature and range of skills involved in text usage (see e.g., Huey 1908). On the physical side, the apparently simple operation of lifting up a text provides the reader with information on size, age, and assuming an informative cover, the likely quality of the contents. Manipulatory skills, acquired by readers early in life, support jumping back and forth to various parts of the text. Furthermore, these physical skills are transferable across most reading situations.

Cognitively, with little obvious effort, the reader is capable of scanning the text rapidly to decide upon relevance to current needs, range of issues covered, depth of coverage and level of detail. Evidence suggests that the reader builds a mental model of both the author's message and the organisation of the text itself (Rothkopf 1971, Johnson-Laird 1983) In the former case it is a matter of comprehension, in the latter, it is a case of appreciating the way this message is organised through the presentation medium. Both provide useful information for navigational and manipulatory purposes.

The physical and cognitive aspects of reading are inter-related. Without the ability to manipulate texts physically many of the reader's cognitive demands would be unfulfilled. This may seem a trivial point but in the design of electronic systems to facilitate reading it is important to identify and support both kinds of needs. Presenting black text on a white background, on a high resolution screen, may satisfy some human factors needs but will lead to user rejection if suitable manipulatory facilities are not available, or only partial use if optimal text structures are not considered. The Adonis document delivery workstation (see Richardson 1989) is such an example. Though image quality was good, manipulation was limited to single paging in either direction at slow screen fill rates. In a study of its suitability for likely end-users in libraries (Dillon 1988) only 2 users out of 10 thought the system good enough to read articles from. The remainder all cited the inability to navigate easily through the document as a major deterrent to use. On the other

hand, manipulation may be rapid and flexible, but if the structure of the text is not considered, readers may find themselves hopelessly lost in a maze of information.

Obviously further research is needed but the domain of text usage is so large and varied it is essential for this to be targeted correctly and vague generalisations about readers avoided. A lesson to be learned from previous human factors research in human-computer interaction is that designing technology according to particular users' tasks is far better than aiming to design generally "friendly" systems for any or all users (see e.g. Shackel 1981) In other words designers should not consider building a generic reading interface but should develop specific applications for particular scenarios. This poses the question as to how best to conceptualise or divide up the reading domain in this sense. The following section offers one view that may help: the analysis of text types.

Classifying texts according to reader-relevant criteria

The classification of texts implies developing a system for distinguishing and grouping texts into types. What these types may be depends largely on the purpose of the classification system. In the present context this would require grouping texts in terms of such aspects as affect their use. By developing such a system it should prove easier to target research findings to particular situations and tackle interface design problems in a structured manner.

Several attempts at classifying texts have been made (see e.g. de Beaugrande 1980, Wright 1980 and Waller 1987). While the purpose and details of these systems has varied, none are particularly concerned with understanding how to develop electronic versions of a text or appreciating how readers perceive and distinguish between texts. As a result of this, the present author carried out an analysis of text types using the repertory grid technique for knowledge elicitation (Kelly 1955) on a sample of researchers (Dillon and McKnight 1990). The results indicated that readers distinguish between texts in terms of three meaningful attributes:

- How they are read
- Why they are read
- What type of information they contain

For example a novel may be classified on these dimensions as being read serially, in depth, usually for leisure, and containing fictional text-based material. This distinguishes it from, say, a magazine which would probably be classified as read non-serially, for leisure interest and containing non-technical, general interest material of both a textual and graphical nature.

Such an approach can distinguish between superficially similar texts also. For example, two magazines may be read very differently according to the reader's motivations and the type of information they contain. In this way e.g., The Observer Colour Supplement is

not the same as PC User. Though both may be called "magazines" and contain similar amounts of text and graphics, they are likely to be read for different reasons and in different situations.

Obviously this does not provide a rigid classification. Rather it is best seen as a simple representation of the factors influencing readers' perceptions of texts. Characterising text according to How, Why and What variables provides a useful means of understanding the manner in which a given readership is likely to respond to a text and thus quickly facilitates sensible decisions about how they should be presented. Ultimately, these aspects indicate what readers see as important in their use of text and therefore, what should be considered by developers of electronic systems.

Analysing academic journals according to How, Why and What attributes.

It is not enough that these attributes are specified by the designer, they must be discovered by empirical investigations of real readers using task analysis techniques devised by ergonomists. The journal usage study reported here attempted to put this approach into practice. Fifteen subjects were interviewed to assess usage rates, motivations for use, range of journals, photocopying habits and so forth. They were then presented with a selection of unbound journals from their specified range of interest, asked to imagine this was the first time they had seen these editions and to interact with the journal as normal, articulating what they were attending to as they did so. Two experimenters were present to record protocols. This process was repeated for several journals and the record of the interaction was discussed with the subject to ensure accurate representation of their elicited strategy or usage pattern. Full details of this study can be found in Dillon et al (1989).

The results are presented in the form of a flowchart (see fig. 1). This represents a model of the manner in which journals are used and viewed by the subjects in this sample.

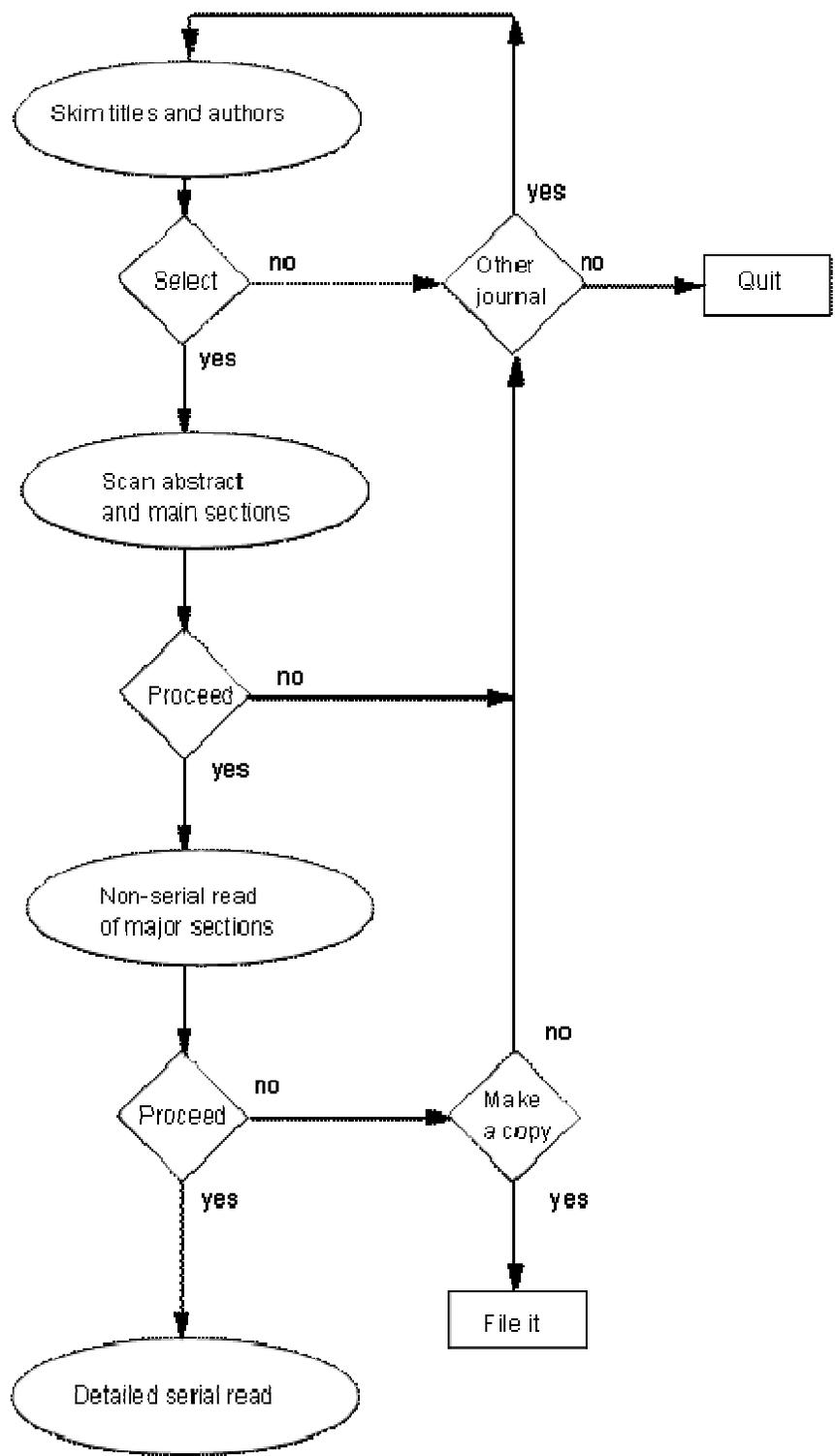


Figure 1. Model of journal usage

Firstly all subjects skim read the table of contents of the issue. A preference was expressed for contents printed on the front or back page which made location of relevant articles possible without opening the journal. If the reader fails to identify anything of interest at this point the journal is put aside and, depending on the circumstances, further journals may be accessed and their contents viewed as above. When an article of interest is identified then the reader opens the journal at the start of the relevant paper. The abstract is usually attended to and a decision made about the suitability of the article for the reader's purposes.

At this point most subjects reported also browsing the start of the introduction before flicking through the article to get a better impression of the contents. Here subjects reported attending to the section headings, the diagrams and tables, noting both the level of mathematical content and the length of the article. Browsing the conclusions also seems to be a common method of extracting central ideas from the article and deciding on its worth.

By this time readers seem to have completed one cycle of interaction with the article and make a decision whether or not to proceed with it. A number of factors may lead to the reader rejecting the article. The main reason is obviously content. The reader by now has a strong impression of the type of material contained in the paper and will be able to make an informed decision on the relevance of it to his needs. How accurate this impression is remains an empirical question. If the article is heavily mathematical it tends to be rejected by the readers in this sample. Poor sectioning, large method and results sections, small discussions and large size in terms of number of pages were all cited as factors that would influence a reader's decision on whether or not to reject an article.

If the article is accepted (or photocopied) for reading it is likely to be subjected to two types of reading strategy. The majority of subjects (10) scan read the article in a non-serial fashion to rapidly extract relevant information. This will involve reading some sections fully and only skimming or even skipping other sections. Typically the method and results sections of experimental papers are skim read while the introduction or introductory sections and the discussion/conclusions are read fully. Readers may highlight points or make notes at this stage.

The second reading strategy is a serial detailed read from start to finish. This was seen as "studying" the article's contents and though not carried out for each article that is selected, 11 subjects reported that they usually read selected articles at this level of detail eventually. Some subjects (3) expressed a preference for this reading strategy from the outset over scanning though acknowledging it to be less than optimal.

While individual preferences for either strategy were reported most readers seem to use both strategies depending on the task or purpose for reading the article, time available and the content of the article. Original and interesting work is more likely to be read fully than dull or routine papers. Reading to keep up with the literature requires less "studying" of articles than attempting to understand a new area. If reading the article with a view to

citing it in one of their own papers, subjects expressed a stronger tendency to read the article fully. However, even when reading at this level of detail some subjects still reported skimming particular sections that were not intrinsically relevant to their particular needs at that time.

Accordingly, journals may be broadly classified in the following manner.

How: Three levels of reading: quick scan of abstract and major headings; non-serial scan of major sections; and full serial read of the text.

Why: For work reasons such as keeping up with the literature, as a source of reference, and as a source of learning. They are also read for personal reasons when accessed out of interest with no immediate work demands.

What: Technical information about a specific domain; may have graphical components but are predominantly textual.

From a Human Factors perspective the variations in how articles are read suggest important distinctions in the type of presentation required to support the reader. Certainly, at what may be termed level three, the detailed serial reading stage, electronic presentation is likely to prove totally unsuitable with current technology. Subjects in this sample stated unequivocally that they prefer to obtain a paper copy of the text to read where and when they like, to write on and to store in their personal files for later reference. At the other two levels though, there are several interesting aspects of journal usage that have relevant design implications. The following section will detail these.

Design implications for electronic journal presentation

At the first level all subjects attend to the Contents page of journals and prefer these to be easily accessible. It would seem therefore that a facility to scan lists of titles and authors would be desirable. These should probably be grouped as they are on paper i.e., in "issues", but the ability to scan continually should be available.

Since the full contents of the paper are not attended to at this point it is better that users are given brief information about the paper and offered the chance of jumping around to various sections of the text. The default mode of article presentation should not be the same as the paper equivalent. A likely presentation style based on the present findings might be: the title of the paper, the author(s), the abstract, a list of section headings that are selectable and the references cited. Further information about the size of the article might also be useful. Indeed the GUIDE hypertext system offers an article structure that closely matches this specification.

Rapid browsing facilities are vital. At this initial stage of article selection and the second level (non-serial read stage) fast page-turning is common as readers jump back and forth through the article. The electronic version must support this activity by allowing both scrolling of the next page/previous page variety and rapid jumping to particular sections

e.g., from the introduction to the method or the discussion. It might be desirable to facilitate jumping to "landmarks" in the text such as tables or figures too. We have implemented a reading interface that will facilitate such interactions and investigations of user performance with and ratings of such a system for text presentation are reported in Richardson et al (1988).

The ability to print the article at any point would be desirable as obtaining hardcopies of selected articles is a major concern of most journal readers. Keeping a record of interesting articles which can be batch printed at the end of the interaction may be also be desirable. Given the observed reading styles of the present sample it might be useful to offer the facility to print sections rather than the full article. For example, readers might choose to print the introduction and discussion sections only. This would have the advantage of reducing costs of obtaining hardcopies and save on unnecessary use of paper.

Obviously these are relatively general considerations. More specific instances of journal usage e.g. searching the text for a reference or sentence about a particular point may require particular facilities and display characteristics which are not suitable for other tasks such as browsing the major sections. These are empirical issues which require much detailed research. The present discussion is not aimed at answering such questions but demonstrating how they fit in the broader perspective of text usage and the type of work that needs to be done to resolve such issues.

Conclusions

Presenting text electronically is a complex issue. Suitable formats for paper are unlikely to transfer simply to screens. Given the diversity of texts currently available to readers simple solutions are unlikely and the present work advocates considering each text in terms of how it is read, why the reader accesses it and the type of information it contains. In libraries the dominant texts are academic journals and books and it is likely that technology will best support storage and retrieval of these texts rather than presentation. However this should not be considered a shortcoming. Fast access to remotely stored texts would be a benefit to all. Screen presentation will remain an important issue so that the reader can perform the many other activities involved in text usage short of full reading. Issues related to alternative document structures and rapid navigational facilities may aid these processes. Only by understanding the readers and their task can we hope to exploit the technological developments to the full.

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