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Reading behavior in the digital environment

Changes in reading behavior over the past ten years

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Abstract

Purpose – This study attempts to investigate reading behavior in the digital environment by analyzing how people's reading behavior has changed over the past ten years.

Design/methodology/approach – Survey and analysis methods are employed.

Findings – With an increasing amount of time spent reading electronic documents, a screen-based reading behavior is emerging. The screen-based reading behavior is characterized by more time spent on browsing and scanning, keyword spotting, one-time reading, non-linear reading, and reading more selectively, while less time is spent on in-depth reading, and concentrated reading. Decreasing sustained attention is also noted. Annotating and highlighting while reading is a common activity in the printed environment. However, this "traditional" pattern has not yet migrated to the digital environment when people read electronic documents.

Originality/value – Implications for the changes in reading behavior are discussed, and directions for future research are suggested.

Keywords Reading, Behaviour, Print media, Electronic media

Paper type Research paper

Introduction

The advent of digital media and the growing collection of digital documents have had a profound impact on reading. It was argued that the development of digital libraries "is participating a general societal trend toward shallower, more fragmented, and less concentrated reading" (Levy, 1997).

Previous studies attempted to explore reading in the digital environment through examining the evolution of reading or observing how people read documents (especially electronic documents) within a specific period of time. The goal of this study is to explore reading in the digital environment from a different perspective. Instead of observing how people read electronic documents, this study attempts to investigate reading behavior in the digital environment by analyzing how people's reading behavior has changed over the past ten years. Understanding changes in reading behavior would help in designing more effective digital libraries and empower users in the digital environment.

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Review of related literature

The impact of digital media on reading has increasingly been the object of empirical and theoretical exploration by researchers from a wide range of disciplines, notably psychology, computer science, education, literacy studies, and library and information science. Each discipline has developed its unique research focuses and methodology. It is not the purpose of this study to review all the different approaches and studies. Nevertheless, an examination of the related literature reveals that there are some essential studies that deserve closer attention.

With the growing amount of digital information available and the increasing amount of time that people spend reading electronic media, the digital environment has begun to affect people's reading behavior. A number of scholars argue that the arrival of digital media, together with the fragmentary nature of hypertext, is threatening sustained reading (Healy, 1990; Birkerts, 1994). Birkerts (1994) further notes that the younger generation growing up in the digital environment lacks the ability to read deeply and to sustain a prolonged engagement in reading.

Bolter (1991) states:

The shift from print to the computer does not mean the end of literacy itself, but the literacy of print, for electronic technology offers us a new kind of book and new ways to write and read.

Digital media contribute to a transformative shift in reading. They also introduce a number of powerful advantages that are traditionally absent in the printed environment, such as interactivity, non-linearity, immediacy of accessing information, and the convergence of text and images, audio and video (Landow, 1992; Lanham, 1993; Murray, 1997; Ross, 2003). Lanham (1995) compares the difference between print literacy and digital literacy. He asserts that:

In the world of print, the idea and its expression are virtually one. The meaning takes the form of words; words generate the meaning. Digital literacy works in an inherently different way. The same digital code that expresses words and numbers can, if the parameters of expression are adjusted, generate sounds and images. This parametric variation stands at the center of digital expressivity, a role it could never play in print.

Digital literacy could potentially enhance our ability to make information more suitable to a targeted recipient (e.g. persons with disabilities). Whether people like digital media or not, reading and literacy are being redefined by the arrival of digital technology. The introduction of new media brings both positive and negative possibilities. In a study of the impact of new media on people's reading habits between the 1970s and the 1990s, Knulst *et al.* (1996) find that:

The new media require users to articulate their preferences more explicitly [...]. Using a control panel, the user can impose his will down to the smallest detail, and is thus confronted each time with the results of his own preferences. In multimedia-land people are not encouraged to wait until they know more about a subject before they click on to the next, or to open themselves up to unknown points of view. And this is precisely one of the great achievements of the reading culture.

Printed media and digital media have their own advantages and limitations. The challenge is to determine the applicability of a particular medium in a given context or process. For example, electronic media tend to be more useful for searching, while paper-based media are preferred for actual consumption of information. Reading is still

the most efficient method for communicating words. A more complex society will demand increased rather than decreased reading. The remaining question we should deal with is the medium through which reading is done. It seems unlikely that the computer will in the future replace the printed book as a reading medium in the way that it replaced the typewriter as a writing tool. Ross (2003) suggests that we need to pay more attention to how readers actually engage different media, their reason for choosing one format over another, and the satisfactions with each format. In a recent study of reading practices at the National University of Mexico, Ramirez (2003) finds that nearly 80 percent of students prefer to read a digital piece of text in print in order to understand the text with clarity. Nearly 68 percent of respondents report that they understand and retain more information when they read printed media. However, only 4 percent of respondents report the opposite. Lower resolution on a computer monitor is one of the major factors that people print out documents (especially lengthy documents) for reading. Hartzell (2002) also notes that reading from a monitor is up to 30 percent slower than reading the same text on a printed page. Murphy *et al.* (2003) focus on the persuasiveness of printed texts and electronic texts. They note that undergraduate students who read online text find the text more difficult to understand, less interesting, and the authors less credible than those who read the printed version.

Adler *et al.* (1998) describe the work-related document (printed and electronic) activities of 15 people from a variety of professions over a period of five consecutive working days. They find that document-activity time accounted for an average of nearly 82 percent of working time, ranging from 23 percent (for nurses) to 94 percent (the accounting assistant). A recent study of the document activities in the International Monetary Fund (IMF), a document-intensive organization, finds that 51 percent of document activities involve paper only, 14 percent involve digital documents only, and 35 percent a combination of paper and digital documents (Sellen and Harper, 1997). Clearly, there will be a co-existence of paper and digital documents in the future, simply because each medium tends to support certain activities that are not easily replaced by the other.

Reading is not a single activity. It is a complex and variable behavior. It involves different purposes and requires different skills in handling documents. McKnight (1997) offers a number of excellent insights in reading behavior of electronic media. He observes that people do not like to read from screens. They prefer to print out electronic documents for reading, even printouts from dot matrix printers. He argues that the recent trend in mounting electronic documents in Adobe's PDF format also discourages screen reading and encourages printing. People tend to print out documents that are longer than can be displayed on a few screens. People also know how to organize and manipulate paper documents, but manipulating electronic documents requires a different set of skills.

People like to browse and find things by accident. Nunberg (1994) notes:

Browsing a document database will never be quite as informative as browsing a bookstore or library stacks, since electronic documents don't bear physical traces of their provenance the way print books do – the price we pay for delivering them of their bodies. But it may not be much different from browsing around in a video rental outlet.

Olsen's (1994) study finds that serendipity was identified as important by 82 percent of people in her survey.

Flipping and scanning (a reading pattern associated with printed documents) is not only a means for locating information in a document, but also a means to get a sense of the whole text. Scrolling on a computer screen does not support this mode of reading and information processing. Readers tend to establish a visual memory for the location of items on a page and within a document. Scrolling weakens this relationship (Olsen, 1994). There is a historical analogy of this reading pattern. As Manguel (1996) notes:

The unwieldy scroll possessed a limited surface – a disadvantage we are keenly aware of today, having returned to this ancient book form [codex] on our computer screens, which reveal only a portion of text at a time as we “scroll” upwards or downwards.

For comprehensive reviews of literature related to reading, please see Radway (1994) and Ross (2003).

Methodology

The digital environment has begun to affect how people read. However, few studies have explored this fundamental issue. Researchers are only at the very early stage of discovering changes in reading patterns. Many previous studies attempted to explore reading in the digital environment by examining the evolution of reading or observing how people read documents (especially electronic documents) within a specific period of time. While these approaches are useful in discovering how reading behavior changes, they are limited. For example, the evolution approach allows us to see changes in reading from a historical perspective, but is limited in providing us with detailed information on how reading activities are actually changing. On the contrary, the observation approach gives us detailed analysis and description of how people actually read, but fails to provide a broad picture of how reading behavior changes in the digital environment.

This study attempts to explore reading in the digital environment from a different perspective. Instead of observing how people read electronic documents, this study attempts to investigate how people’s reading behavior has changed over the past ten years by self-reported measures of their overall reading experience (including work-related reading and leisure reading). Since this study is dependent on participants having an accurate recollection of their overall reading habits over the past ten years, careful attention was paid to the adequacy of long-term memories in the design of survey questions and answering scales. It seems unrealistic to ask people to report *detailed* changes: however, it is feasible to ask people to report *general* changes (e.g. increasing, decreasing, no change). If participants do not remember, they can select the “don’t know” category. A pilot study of over 20 individuals was conducted in the spring of 2003 to pre-test the survey questions. The pilot study also confirms the above assumption. Final questions of this study were developed based on the pilot study as well as on other related studies.

Participants were asked to respond to the following questions based on their overall reading experience over the past ten years:

- (1) time spent on reading;
- (2) percentage of time spent on reading printed documents;
- (3) percentage of time spent on reading electronic documents;
- (4) percentage of time spent on browsing and scanning;

- (5) percentage of time spent on keyword spotting;
- (6) percentage of time spent on in-depth reading;
- (7) percentage of time spent on concentrated reading;
- (8) percentage of documents read one time (one-time reading);
- (9) reading things selectively;
- (10) non-linear reading (e.g. jump);
- (11) sustained attention;
- (12) frequency of annotating printed documents while reading;
- (13) frequency of annotating electronic documents while reading;
- (14) frequency of highlighting printed documents while reading;
- (15) frequency of highlighting electronic documents while reading;
- (16) frequency of printing out electronic documents for reading; and
- (17) preference of document media when reading.

The response categories for questions (1)-(5) include “more time”, “less time”, “no change” and “don’t know”; the response categories for questions (6)-(11) include “increasing”, “decreasing”, “no change”, and “don’t know”; for questions (12)-(16) the response categories include “always”, “frequently”, “occasionally”, and “never”; and the response categories for question (17) include “electronic media”, “printed media”, and “either one is fine”.

The amount of time spent on reading varies widely among different age groups. This study focuses on people who are between 30 and 45 years old. Since the purpose of this study is to explore the impact of digital media on reading behavior, people who have extensive experience in reading digital documents were selected. Two hundred and fifty copies of questionnaires were distributed in the summer and fall of 2003: 160 copies were distributed by mail to engineers, scientists, accountants, teachers, and managers in various organizations, and 90 copies were distributed to graduate students at San Jose State University in class. Therefore, this is a sample of convenience rather than a random sample. Participants were informed that the purpose of this study was to explore the impact of digital media on reading behavior. They were asked to fill out the questionnaires based on their own experiences with reading. Among 119 returned copies, 113 were complete and six were incomplete. The results of those 113 complete questionnaires are presented below.

Findings and discussion

Time spent on reading

In the digital age, people are spending more time on reading. Even though the amount of time spent on reading is highly related to work and family responsibility, 67 percent of the participants in this survey report that they spend more time on reading, with about one-third of the participants indicating no change in reading time (see Table I). Two major factors can contribute to the increase in reading time:

- (1) information explosion; and
- (2) digital technology.

Digital documents are easy to search, and also allow more opportunities in accessing more information. For example, a document on the web has an average of nine links (Almind and Ingwersen, 1997). This means that when a user accesses a web document, he/she at the same time has a chance of accessing nine other documents. Another problem that needs to be noted here is that people are confronted with the sheer volume and variety of information. How much time they choose to spend on reading is a very important decision, given the fact that they cannot increase the time on reading infinitely.

As indicated by Table I, the majority (83 percent) of participants in this survey report that the percentage of time devoted to reading electronically is increasing. This finding is quite consistent with other studies and statistics. The arrival of digital media has changed how we spend a significant portion of our time reading digital documents, time that otherwise would have been spent reading printed documents. According to the *United States Statistical Abstracts*, the total expense on printed media is shrinking while the total expenditure on electronic media is increasing. The trend in the growing consumption of electronic media and shrinking expenses on printed media is further supported by the fact that more time is spent on online/internet access and less time on conventional daily newspapers and consumer magazines.

Screen-based reading

Around the year 1750, there was a dramatic change in the way people read documents. Before this time, people were reading *intensively*. They had only a few books to read and they read them over and over again. By the early 1800s, however, people started to read things *extensively*. They read all kinds of material, especially periodicals and newspapers, and read things only once before racing on to the next item (Darnton, 1989). From the evolution of reading, it is not difficult to imagine that browsing or scanning is becoming a principal reading pattern in today's information-intensive environment. With an increasing amount of time spent on reading electronic documents, the screen-based reading behavior is emerging. The screen-based reading behavior is characterized by more time on browsing and scanning, keyword spotting, one-time reading, non-linear reading, and more reading selectively; while less time is spent on in-depth reading and concentrated reading, and sustained attention is decreasing (see Table II).

One participant notes: "I skim much more html pages than I do with printed materials." Changes in reading behavior are not only driven by information explosion and the arrival of digital media but also by social forces. Michie (1996) states that:

Changes	Time spent on reading	Time spent on reading electronic documents
More time	67.3	83.2
Less time	0	10.6
No change	31.9	0.9
Don't know	0.9	5.3
Total	100.1	100

Note: Figures given are percentages; figures may not add up to 100 percent because of rounding

Table I.
Timing spent on reading

Table II.
Screen-based reading
behavior

Percentage of time spent on	Increasing	Decreasing	No change	Don't know
Browsing and scanning	80.5	11.5	8.0	0
Keyword spotting	72.6	2.7	16.0	8.8
One-time reading	56.6	8.0	29.2	6.2
Reading selectively	77.9	2.7	16.8	2.7
Non-linear reading	82.3	0	15.9	1.8
Sustained attention	15.9	49.6	29.2	5.3
In-depth reading	26.6	45.1	23.0	5.3
Concentrated reading	21.2	44.2	26.5	8.0

Note: Figures given are percentages; figures may not add up to 100 percent because of rounding

Fewer and fewer people now shift greater and greater workloads, driven ever faster by competitive anxieties, accentuated by rapid-creation interoffice and worldwide computer nets. The signs of competitive anxiety can already be observed in the workplace – shrinking attention span, abbreviation of working memory, top-of-the-head response, increasing emotionality, weakening of deliberative, deductive and ruminative thought, and aversion to the written word other than to scan it, annotate and pass it on.

More browsing/scanning and keyword spotting. As indicated in Table II, over 80 percent of the participants in this survey report a greater percentage of time spent on browsing and scanning. A study of 350 scientific journals published over 40 years (1944-1988) reveals “experimental results increasingly being foregrounded in titles, abstracts, introduction, and section headings but methods and procedures sections increasingly being relegated to secondary status” (Berkenkotter and Huckin, 1993). Because of the growing number of scientific journals and expansion of the volume of these journals, readers of scientific journals cannot keep pace with the literature and are forced to skim journal articles the way that many readers skim newspapers. This trend tends to be more intensified in the web environment. Most people tend to read the first screen of text only. A total of 90 percent of people reading a web page do not scroll down (Goldsborough, 2000). Scanning offers an effective way to filter through the vast amount of information. One participant points out: “I find that my patience with reading long documents is decreasing. I want to skip ahead to the end of long articles.” Another participant reports that younger people do not have patience to read every word. They merely skim and look for needed information while reading. According to a study by the Poynter Institute (2000), web users tend to “do a lot of brief scanning, foraging quickly through many article summaries, but when their interest is caught they will dive into a particular topic or article in depth.”

Over 72 percent of respondents report more keyword spotting in their reading. It seems very likely that people employ keyword spotting as a strategy to locate needed information as a way to cope with the overloaded information environment. “People are doing more and more ‘picture’ reading, looking for illustrations to explain charts and pictures. Any document with texts only will bore many savvy IT users,” noted one participant.

Increasing one-time reading and selective reading. Over 56 percent of the respondents note that the percentage of documents they read one time (one-time reading) is increasing. Since time devoted to reading is limited and they cannot keep

pace with the growth of information production, this means that a smaller percentage of documents will be read (Liu, 2003). On the other hand, a greater percentage of documents will be read only one time. According to Gordon (1997), 85 percent of printed documents are never referred to again.

Approximately 78 percent of the participants report that they read more selectively. In the information-abundant world, attention becomes a scarce resource (Levy, 1997). People tend to be more selective when they face an overwhelming amount of information. We cannot afford to pay attention to every single piece of information simply because it is there. We have to allocate our attention more selectively. In a search for relevant information, readers tend to exhibit more frequent and more overt selectivity, which in turn leads to both more partial understanding and deeper understanding (Topping, 1997).

Increasing non-linear reading and declining sustained attention. Time spent on non-linear reading is increasing, as reported by over 82 percent of participants in this survey. Nearly half of the respondents in this study mention declining sustained attention in reading (see Table II). The arrival of hypertext enables more non-linear reading (e.g. jump). The more links encountered, the greater the potential differences in reading path. Hyper-reading (e.g. jump) may also affect sustained attention and contributes to more fragmented reading, since each page has to compete with many other pages for the user's attention. Birkerts (1994) and Stoll (1995) note that the digital environment tends to encourage people to explore many topics extensively, but at a more superficial level. Hyperlinks distract people from reading and thinking deeply about a single subject. In a study of readers who read either a stimulated literacy hypertext or the same text in linear form, Miall and Dobson (2001) also found that "hypertext discourages the absorbed and reflective mode that characterizes literacy reading."

Decreasing in-depth and concentrated reading. Shallower and less in-depth reading is another feature of "hyper-extensive" reading. About 45 percent of participants in this study indicate that they are facing decreasing in-depth reading and concentrated reading (see Table II). One participant notes: "It is hard to concentrate on reading documents on the web. I need to learn how to ignore distracting colorful or blinking graphics. Having to continually close unwanted pop-up windows is also very distracting." Another participant mentions that his/her reading concentration is interrupted by other tasks (e.g. e-mail) when multiple windows are open. Eveland and Dunwoody (2001) find that it is very difficult for readers to devote full attention to reading because they have to decide which text to read, which hyperlink to follow, and whether to scroll down a page.

Annotating and highlighting: printed versus electronic documents

People like to annotate when they read, especially for in-depth reading. Olsen's (1994) study found that 63 percent of interviewees liked annotating or underlining articles. A study by King Research Inc. also revealed that 33 percent of people photocopy their personal subscriptions and 56 percent photocopy library collection in order to annotate and/or highlight printed documents (Griffiths and King, 1993). Annotating and highlighting while reading is a common activity in the printed environment. Has this "traditional" pattern migrated to the digital environment when we read electronic documents? The answer is no, as indicated by the following survey results.

Table III shows that nearly 54 percent of participants “always” or “frequently” annotate printed documents, compared to approximately 11 percent who “always” or “frequently” annotate electronic documents. It is also interesting to note that over 51 percent of respondents report that they never annotate electronic documents. However, none of them report never annotating printed documents. Among 113 participants in this survey, only three individuals report that they annotate digital documents more frequently than paper documents. In contrast, 85 respondents report that they annotate paper documents more frequently than electronic documents. The pattern of highlighting printed documents versus electronic documents is quite similar to annotating, as indicated by Table IV.

Why are people less likely to annotate or highlight digital documents? It seems that many people search or browse digital documents, but when they need to read some documents in depth, they will print out and then annotate printed documents. This argument is further confirmed by the results presented in Tables V and VI. Annotating electronic documents is certainly possible, but it does require much more resources and additional skills rather than a simple pencil or highlighter (McKnight, 1997). O’Hara and Sellen (1997) also find that annotation on paper is smoothly integrated with reading, but online annotation is distracting. One respondent reports that “highlighting and annotating digital documents does not come naturally and takes practice.”

Table III.
A comparison of
annotating printed and
electronic documents

Frequency	Printed documents	Electronic documents
Always	21.2	2.7
Frequently	32.7	8.0
Occasionally	46.0	38.0
Never	0	51.3
Total	99.9	100

Note: Figures given are percentages; figures may not add up to 100 percent because of rounding

Table IV.
A comparison of
highlighting printed and
electronic documents

Frequency	Printed documents	Electronic documents
Always	27.4	2.7
Frequently	34.5	5.3
Occasionally	38.1	32.7
Never	0	59.3
Total	100	100

Note: Figures given are percentages; figures may not add up to 100 percent because of rounding

Table V.
Frequency of printing
electronic documents for
reading

Frequency	Percentage
Always	10.6
Frequently	71.7
Occasionally	17.7
Never	0
Total	100

Marshall (1997) notes that “support for a smooth integration of annotating with reading – is the most difficult to interpret from a design point of view; yet, it is potentially the most important.”

Printing for reading

According to Table V, over 80 percent of participants report that they “always” or “frequently” print out electronic documents for reading. But none of the participants report that they “never” print out electronic documents for reading. Table VI further shows that nearly 90 percent of participants prefer paper as a reading medium to digital media. Only approximately 3 percent of participants favor electronic over printed media for reading. “I have spent more time on electronic media than before. However, I still keep the old-fashioned way of reading serious papers through printed media. Electronic readings are just for fun or browsing popular information,” noted one respondent. Another respondent also pointed out: “Preference of type of document media depends on the kind of reading. I rarely print emails anymore, but I prefer printed books to e-books.” In a recent study, Liu (2006) found that “Even though the use of electronic sources and online reading habits vary by discipline, the frequency of printing out electronic documents is surprisingly similar across all disciplines.”

From the very beginning, readers demanded books in formats adapted to their intended use. Of all the shapes that books have acquired through the ages, the most popular have been those that allowed the book to be held comfortably in the reader’s hand. For example, the early Mesopotamian tablets were usually square but some times oblong pads of clay, approximately three inches across, and could be held comfortably in the hand (Manguel, 1996). The tradition of holding a book in the hand while reading can partially explain why those views of replacing printed documents with electronic media are overly optimistic. Strassmann (1985) also stresses that the human nervous system has a special control mechanism for the coordination of the hand with the focusing muscles of the eye. It is much easier to read something that is held in the hand than something that just lies on a table.

Implications and conclusion

In an increasingly digital environment, readers (especially younger readers) are likely to gradually develop the screen-based reading behavior, and to increasingly use a variety of strategies (e.g. browsing and keyword spotting) to cope with the information-abundant environment. On the other hand, readers will continue to use printed media for much of their reading activities, especially in-depth reading. In-depth reading usually involves annotating and highlighting. People’s preference of paper as a medium for reading (especially in-depth reading) also implies that paper is unlikely to disappear in the digital age. In the digital age, printing for reading remains one of the

Document media	Percentage
Electronic media	2.7
Printed media	89.4
Either one is fine	8.0
Total	100.1

Table VI.
Types of document media
respondents
prefer to read

major driving forces for the increasing consumption of paper (Hart and Liu, 2003; Liu and Stork, 2000; Sellen and Harper, 2002). A number of digital reading devices have been designed to support reading electronic documents efficiently. Future research efforts can be placed on increasing sustained attention of reading in the digital environment.

This study attempts to investigate how people's reading behavior has changed over the past ten years by self-reported measures of their overall reading experience. It targets people who are between 30 and 45 years of age. The inherent limitations of self-reported measures and the small sample size of this study mean that the results cannot be generalized across different age groups. Since an entire generation that has grown up with new technology is likely to have different expectations and behaviors toward the use of digital media, studies on the demographic variables are needed to fully validate the findings. Future studies are also needed to explore changes in reading habits in relation to learning.

Most data in this study are taken from the US experience. It is generally believed that global reverberations from the impact of digital media on reading will be felt in the US first. However, it is difficult to know what is unique about the American experience when analyzing the impact of digital media on reading behavior in other cultures. Nevertheless, an analysis of relevant indicators would provide a sensitive yardstick for anticipating reading behavior in the digital environment. Future research can also extend the findings of this study by investigating similar research problems in different cultural contexts.

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