

Back to the Future: An Historical Perspective on the Pendulum-Like Changes in Literacy

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Abstract This article focuses on the pendulum-like change in the way people read and use text, which was triggered by the introduction of new reading and writing technologies in human history. The paper argues that textual features, which characterized the ancient pre-print writing culture, disappeared with the establishment of the modern-day print culture and has been “revived” in the digital post-modern era. This claim is based on the analysis of four cases which demonstrate this textual-pendulum swing: (1) The swing from concrete iconic-graphic representation of letters and words in the ancient alphabet to abstract phonetic representation of text in modern eras, and from written abstract computer commands “back” to the concrete iconic representation in graphic user interfaces of the digital era; (2) The swing from scroll reading in the pre-print era to page or book reading in the print era and “back” to scroll reading in the digital era; (3) The swing from a low level of authorship in the pre-print era to a strong authorship perception in the print era, and “back” to a low degree of authorship in the digital era; (4) The swing from synchronic representation of text in both visual and audio formats during the pre-print era to a visual representation only in print, and “back” to a synchronic representation in many environments of the digital era. We suggest that the print culture, which is usually considered the natural and preferred textual environment, should be regarded as the exception.

Keywords Symbol · Representation · Sign · Post-modernity · Technology · Reading · Writing · Digital literacy · Print · Scrolling · Authorship · Visualization

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Introduction

Over the last few decades, the proliferation of digital technologies, mainly multimedia and communication technologies, has led to the creation of new kinds of work environments, such as microworld simulations, databases, Internet sites, and digital games. Compared to the “old-fashioned,” traditional, non-digital environments, the uniqueness of the digital environments manifests itself in three major perspectives: (1) They utilize graphical elements to communicate with the user, (2) information is displayed in “unlimited” scrollable screens rather than discrete pages, and (3) the use of hypermedia technology creates a non-linear navigation in the information space (Shneiderman 1998). In order to perform effectively in these environments, users are required to master a wide range of motor, sociological and cognitive skills, collectively termed “digital literacy” (Lanham 1995; Gilster 1997; Pool 1997), which are regarded as critical “survival skills” for successful performance in the modern technological world (Eshet-Alkalai 2004).

In the contemporary research literature on present-day literacy, the print format is usually considered to be the “natural” reading format whereas the digital format is considered an exception within the long evolutionary lineage of the print culture (Spencer 2006; Quinn & Stark-Adam 2007). This approach is due to the lack of an appropriate historical perspective on the evolutionary trends of the “young” digital format (less than 50 years) compared to more than 500 years of well-documented evolutionary history of the print format (Birkerts 2004). In addition, most of today’s scholars are accustomed to the characteristics of print (Carrington 2005) and it is only natural for them to compare the digital innovative format with the familiar print format which they consider the “normal” reading environment. The tendency to compare the digital format with the print one also results from the visual similarities between the two. As Carrington (2005) argues, digital texts allegedly preserve many features that resemble the “traditional” printed text, such as the static appearance of a page and the standard left-to-right and top-to-bottom navigation (Carrington 2005, p. 476).

In this article, we present an innovative approach to the discussion of print versus digital formats by extending the boundaries beyond the era of print to the early pre-print era as well. As we argue in the paper, this extension leads to the realization that many of the innovative features of the digital era (e.g. scroll-reading, iconic representation of text and the disappearance of the author of the text) are rooted in the ancient, pre-print era. We will argue that these features, which seemed to have disappeared during history and especially in the print era, have been “revived” today and reappear in digital text format. Based on the historical perspective presented in our analysis, we suggest that many of the characteristics of modern writing, as we know them from the print textual format are, in fact, the exception rather than the “natural” textual format.








Our comparative approach illustrates the swing of the textual pendulum (Soffer 2005) or how the constant introduction of innovative technologies together with the disappearance of older ones create cyclical changes in the evolution of writing in which textual features disappear with the introduction of new technologies and are “revived back” with the introduction of newer technologies. As Soffer (2005) has

recently found, the comparison of the social perceptions towards text and knowledge in the medieval, the modern, and the post-modern eras reflects major similarities between the Middle Ages and the post-modern eras. In this article, we implement and expand Soffer's analytical framework into other periods, by comparing the writing culture and the technology of the pre-print, the print and the digital eras. Of course, with such a broad historical comparison, we do not expect to find an exact match but rather some parallels in the textual features in the pre-print and in the digital environments. These textual environments are so distinct and different from each other that a perfect match is unreasonable. However, by analyzing these four cases, we try to identify "echoes" or parallels between the text culture of one era and the text culture of the other.

In order to discuss the "pendulum approach" in the evolution of writing and reading technologies from the pre-print through the print to the digital era, the following cases are discussed:

1. *Graphical representation*: This case focuses on the pendulum-like swing in the representation of letters and words in history, from a concrete, graphic, intuitive and easy-to-understand representation to an abstract, non-intuitive and cognitively demanding representation of letters. We argue that in the digital era, as represented in the evolution of computer user interfaces, written communication has evolved in an opposite direction: from abstract, non-intuitive and cognitively-demanding to concrete-intuitive and easy-to-understand iconic communication.
2. *Scrolling*: This case focuses on the pendulum-like cycle of the scrolling layout for text design, which began during the pre-print era with the enduring dominance of scrolls as the common layout for text design, continued in the print era with the dominance of the page layout, and has now returned to the scrolling layout in the digital era, where the concept of the page is replaced by unlimited scrollable digital documents. We argue that in this case, page layout should be regarded as the exception for text-design layout rather than the common case of scrolls.
3. *The death of the author*: This case deals with the pendulum-like shifts through history in the ownership by authors of their texts: If, in the pre-print era, the perception of the author as the owner of the textual commodity had not yet evolved, during the print era, authors became the sole owners of their text. However, in the digital era, with the ability to easily reproduce and disseminate texts digitally, and with the rise of ideologies on "knowledge democratization" and knowledge-sharing (e.g. Postman 1993; Raymond 2003), the ownership by authors of their texts has again weakened. Our analysis suggests that the ownership by authors of their texts, as perceived by the "print culture," should be regarded as an exception in an historical perspective.
4. *Synchronic representation*: This case relates to the synchronic representation of words in both visual and audio formats (i.e. projecting the text and hearing its narration simultaneously), which is typical of many digital environments. In this paper, it is argued that this type of reading is characteristic of the read-aloud habits of the pre-print era, which then diminished in the print era, and has been revived in the digital era.



Case # 1: Graphical Representation

Some 5,000 years ago, the simultaneous invention of the alphabet in different regions across the globe, such as Egypt, Mesopotamia and China (Diringer & Regenburger 1968) led to a great revolution in the way humans communicated with each other. Writing provided humans with a new mode of communication which was used mainly to store organizational knowledge, such as state and religious documents (Diringer & Regenburger 1968). In its first stages, writing was based on ideograms: pictorial representations of ideas or objects. For example, in the hieroglyphic writing of Egypt, the picture  stands for a “mummy,”  stands for “sun” or “day,”  stands for “eye” or “see,”  stands for “village” and  stands for “bring” (Gelb 1963). Later, around 2000 B.C., the principle of representing ideas by graphical symbols was elaborated with the invention of phonetic writing in which pictures represented the consonant which begins the word rather than whole words or ideas (Gelb 1963). Accordingly, for example, in the ancient Semitic writing (around 1700 B.C.), the consonant “D” was represented by a drawing of a fish  (*Dag*, in Semitic languages, such as Hebrew) and the consonant “M” by a drawing of water-ripples  (*Ma'im* in Semitic languages, such as Hebrew).


The main advantage of this type of writing lies in its semantic nature, in the fact that the representation of consonants by meaningful concrete pictures made it very intuitive and easy to understand, such as reported by Eshet-Alkalai (2004) who found that dyslexic children who could not read any writing gained command of the ancient Semitic writing after short training. However, the complications that were involved in the task of drawing these concrete symbols on clay or stones led to a simplification of the evolutionary trend of the alphabet in which these symbols were made easier to read over a period of thousands of years into more abstract and easy-to-write forms. This “abstraction-simplification” evolutionary trend of the alphabet is best illustrated by the evolution of the consonant “D” in which the concrete drawing of fish was abstracted around 1000 B.C. into the drawing Δ of the Greek letter “delta” by omitting most of the fish’s outline and leaving its triangular tail. This evolutionary trend, of increasing abstraction of the alphabet, continued for hundreds of years, resulting in the present day abstract alphabet (Diringer & Regenburger 1968). It can be concluded that the alphabet, as a major means of communication, has evolved from a concrete to an abstract means of communication and from an intuitive-semantic and easy-to-understand communication to one that requires the reader to make complicated cognitive transformations of the abstract symbols into their concrete meaning (Eshet-Alkalai & Chajut 2007).

If letters and symbols are the building blocks of traditional writing, then the building-blocks of the “alphabet” of the digital era are the graphical icons that compose the user interface and provide users of these environments with graphic-based operation instructions (Nielsen & Tahir 2002; Shneiderman 1998). In the following paragraphs, the evolution of the “digital alphabet” as represented by

the evolution of digital user interfaces, is compared and contrasted with the evolution of traditional writing.

In their early days (1980s and earlier), computer interfaces were based on textual commands, which users had to memorize and type in in their exact sequence to properly operate the work environment. For example, in order to copy files from a diskette in drive A: to a diskette in drive B:, the following command had to be typed accurately: “*copy A:*. * B*”: These early computer interfaces were based on a syntactic “meaningless” representation of actions by abstract, text-based commands. This kind of communication puts a heavy cognitive load on the user, slows the ability to read and execute instructions and so renders the environments less user-friendly (Aspillaga 1996). In the beginning of the 1990s, with the proliferation of computer graphics and multi-tasking capabilities, concrete graphical icons began to be used in user interfaces in order to represent commands and to execute actions, leading to today’s graphic user interfaces or GUI (Nielsen & Tahir 2002) For example, the icon  replaced the COPY command, discussed above, and the icon  replaced the PRINT command. The evolution of digital written communication can be summarized in the following four trends:

- A change from textual to pictorial representation of information
- A change from abstract to concrete representation of information
- A change from syntactic to semantic representation of information
- A change from cognitive, non-intuitive to intuitive communication

From the above comparative discussion of the written and the digital communication, the existence of two reciprocal lineages in the evolution of communication becomes evident: While in ancient times, traditional communication through alphabet writing evolved from concrete-graphic to abstract alphabetic signs, in the digital era, it has evolved in an opposite direction, from abstract-syntactic textual to concrete-semantic graphical communication. It is interesting to note that today, because of the rapid introduction of new technologies and the disappearance of older ones, many of these graphic icons and signs gradually lose their original power as meaningful representations of commands (Traub & Lipkin 2004). This can be seen, for example, in the case of the icon  , which loses its concrete significance as the SAVE FILE command with the disappearance of the diskette as a medium for information storage.

Case # 2: From Scroll to Page and Back

We begin this case with a discussion of three consecutive processes that took place in the pre-print era and altered the reading and text-navigation habits of humans (Gilster 1997):

1. The transition from scroll to page as the medium for text design
2. The invention of books
3. The invention of page-numbering

These inventions are discussed below in light of their “pendulum behavior” which has ended, at least partly, with the return to scrollable documents during the digital era.

The Transition from Page to Scroll

For thousands of years, until the end of the Roman period, in the 3rd century A.D., scrolls were used as the major medium on which texts were written (Gilster 1997). The text layout of the scroll dictated a very slow reading pace in which the reader was exposed to the text and was forced to read it gradually, line by line, as the scroll was unscrolled (Diringer & Regenburger 1968). In this reading mode, the reader could capture in one glance only the few lines which were actually exposed for reading, and, therefore, had no idea of the next paragraph. Contemporary studies have shown that because of these limitations, the scroll reading mode is about 30% slower, and results in a much lower level of text-comprehension than the “normal” reading of pages (Quinn & Stark-Adam 2007).

The Invention of Books

During the 3rd century A.D., scrolls were replaced by a new invention for text-layout: the page, (Gilster 1997) which involved restructuring the limitless scroll’s layout into limited, predefined sheets. But the effect of the transition from scroll to page was much greater than the mere introduction of a new text layout: It led to a large-scale revolution in the way people read texts. The reader could grasp a large bulk of a text in a single glance. This led to the rise of a new reading mode: the “skimming mode” of our days, in which the reader skims quickly through chunks of a text by capturing large text sections in a single glance (Gilster 1997). As noted above, unlike in the line-by-line slow and ineffective scroll-reading mode, the skim-reading mode was found to be much faster and more effective (Quinn & Stark-Adam 2007).

Shortly after the invention of the page, the first books were published by binding page-bundles together (Diringer & Regenburger 1968; Gilster 1997). Books offered readers a new mode of navigation through a document: If in the scroll, navigation was done by unscrolling the document, the books allowed readers, for the first time, to flip through the text page by page, thus introducing the “browsing” or “leafing” mode of navigation through documents (Gilster 1997).

The Invention of Page-Numbering

The next revolution in reading and navigation through text was made around the 6th century A.D., with the introduction of page-numbering in books (Gelb 1963). Page-numbering allowed readers, for the first time, to refer or to return to specific places in the book, to add a table of contents and to insert, in the text, references to paragraphs or pages somewhere else in the book.

The three revolutions described above about the pre-print era (i.e. the transition from scrolls to pages, the invention of books and the introduction of

page-numbering) slowly matured during the print era until they became established in the book format of today. But during the digital era, the textual pendulum began swing back with the revival of the scroll concept for text layout in the “pageless” structure of hypertext Internet html documents. Unlike the design of pages in a book, html documents are designed as long, limitless scrolls, in which reading is accomplished by scrolling down the document. In addition, Internet documents completely abandoned the concept of page-numbering, as in the pre-print era. Consequently, these documents led to an abandoning of the browsing or “leafing” modes of navigation through documents, which was typical of the print era, and brought back the scrolling navigation mode of the pre-print era (Spencer 2006; Quinn & Stark-Adam 2007). As for the reading mode of the digital era, many studies (e.g. Spencer 2006; Quinn & Stark-Adam 2007) have shown that in hypertext documents, readers tend to scan the text line-by line as the text is scrolled down, much in the same way they did in the ancient scrolls of the pre-print era. In summary, it can be said that in the digital era, we face the revival of the text-reading and text-navigation modes which resemble the pre-print era. We argue that, in this case, the hegemony of the page layout of the print culture should be regarded as the historical exception compared to the long-lived and more commonly used scroll, both in the pre-print and in the digital eras.

Case # 3: The Death of the Author

In pre-print medieval times, little importance was given to the status of the authors as the creators and proprietors of documents and texts they wrote. Written documents from these days were perceived as representing common human knowledge rather than the talent and property of a certain person (Katsh 1989). Consequently, information was considered common property. The concept of “author’s rights” or “copyright” did not exist then, and “the Idea of an author attempting to collect money from a scribe copying his work would have seemed ridiculous” (Van Der Merwe 1999, p. 304). This perception demonstrates the concept of collective authority rather than the veneration of individual authors. Texts were a mosaic of other texts, adopting and borrowing other textual formulas and themes (Ong 1995). In many instances, the authors of medieval texts were unknown, as McLuhan (1968) argues, “The manuscript culture was producer-oriented, almost entirely a do-it-yourself culture, and naturally looked to the relevance and usability of items rather than their source” (p. 131). In this pre-print medieval manuscript culture, authorship considerations were secondary to matters which related to the production and use of books. In this spirit, it was common for librarians and book-users to create their own, personalized books by binding together different documents which were written by different authors (McLuhan 1968). Since the words of the author were considered secondary to the ease of reading the text, glosses and footnotes were often recorded in documents by their copyists, for their own purposes (Van Der Merwe 1999, p. 304; Ong 1995).

The invention of the printing press in 1455 caused a revolution in the way information was stored and distributed. For the first time, it was possible to

reproduce identical copies of documents, to start mass-producing books and to distribute knowledge easily. This, ultimately, led to a gradual change in the perception of authors and their ownership of texts they wrote (Eisenstein 2005). The invention of the printing press marked the end of an era in which knowledge and information were perceived as a common human resource and property (Van Der Merwe 1999). The wide distribution of books and their penetration into wider social echelons marked the beginning of the perception of books and knowledge as an economic commodity. The rise in the economic value of books ultimately led to the perception of texts as the author's property (Katsh 1989; Van Der Merwe 1999), as Eisenstein (2005) argues, "Competition over the right to publish a given text also introduced controversy over new issues involving monopoly and piracy. Printing forced the necessity of making new legal definitions that distinguish between common and private knowledge. A literacy 'common' became subject to 'enclosure movement,' and possessive individualism began to characterize the attitude of writers to their work" (p. 94).

The print culture, with its accompanying market forces, highlighted, for the first time, the pivotal role and responsibility of authors in the production of knowledge: their names were printed on the covers of the books (Katsh 1989; Ong 1989) and they were held responsible for the content of the book (McLuhan 1968; Eisenstein 2005). This trend, of creating a strong linkage between authors and their books, was accompanied by new practices of praising the authors by printing their portraits on the covers and by publishing special memoirs of selected writers' works (Briggs & Burke 2005). This trend culminated in the eighteenth century, with the establishment of the first intellectual property and copyright laws which formally recognized the authors as the sole proprietor of their books (Katsh 1989).

The proliferation of digital editing and communication technologies during the digital era marks the beginning of the pendulum swing "back" to the weakening of the linkage, which was established in the print era between authors and their works. Besides offering an inexpensive and efficient substitute for the print technology and for the production of books, digital and communication technologies allowed unlimited possibilities for editing, reproducing and disseminating texts (Katsh 1989). With these technologies, it has become possible to copy, edit, change and completely reshape the nature and the meaning of almost every piece of information, either text or graphics, and to easily distribute it to the large public in cyberspace. As noted by many authors (e.g. Rose 1988; Lessig 2004), this process has led to a slow but clear obliteration of the central role of the author as the text's creator and proprietor in cyberspace, where the distinction between authenticity and forgery has become difficult to establish (Park 2003; Eshet-Alkalai 2004).

The unlimited possibilities to edit and disseminate information have raised debates concerning the nature of originality and plagiarism in the digital era, and the right of information consumers to change and distribute knowledge that was produced by others (Rose 1988; Lessig 2002, 2004). One of the derivatives of these debates is the recent wide-scale discussion of authors' digital copyright laws on the Internet (Litman 2006).

Unlike the print and modern era's perception, which regarded the author as the owner of the text, the proliferation of information-editing, communication and

knowledge-distribution technologies in the digital era has boosted perceptions that aimed to increase the democratization of knowledge (e.g. Ferdinand 2000), which is similar to the medieval perception which perceived knowledge as public property (Van Der Merwe 1999). The linkage between knowledge democratization in the digital era and the weakening of the authors' role and identity as the creators and proprietors of their texts is probably best illustrated in the emerging wide range of Wiki technologies, especially in Wikipedia-an encyclopedia whose values are written by anonymous contributors from the general public, and can be edited and altered freely by anyone, without any academic control (Leuf & Cunningham 2001). Wiki technologies are based on the philosophy that knowledge is an outcome of a voluntary, free and uncontrolled collaborative effort of the public, i.e. that texts can and should be written collaboratively by large groups of people, and that the identity and ownership of the author are marginal or irrelevant (Ebersbach et al. 2006). Consequently, the free and anonymous text-editing capabilities offered by Wiki technology have led to the elimination of the authors' responsibility for the accuracy and quality of the texts, making the role of the author almost obsolete. As Miller (2005) argues in her article "Wikipedia and the Disappearing 'Author'," Internet technology has challenged the concept of authorship. The modern belief in the right of authors to control their work, which went hand in hand with the passive perception of the readers, changed in the digital era when readers became writers or editors of the texts of others". This idea also goes hand in hand with the post-modern philosophical approach of "The Death of The Author" (Barthes 2005; Foucault 2005), which challenged the existing perception of the text as determined by its author by emphasizing the pivotal role of the reader in the construction of the meaning of the text. Along the same line of Wiki technology, we face the rise of the Open Source Movement in recent years which promotes the idea that not only text but also all kinds of knowledge, including knowledge-rich products (e.g. software, music and visuals) should be regarded as a public commodity which is available to the public for free use (Lerner & Tirole 2001).

In summary, the collaborative and open web-based technologies described above restore, to a large extent, the pre-print era's perceptions and practices of knowledge as a free common human asset which is developed through a collaborative effort and shared by everyone. This perception involves a weakening of the link between authors and their intellectual creations which also resembles the authors' status in the pre-print era.

Case # 4: Synchronic Representation

During the pre-print medieval time, the common situation for reading was the read-aloud mode, even when the text was read in private (McLuhan; Chaytor 1950; Manguel 2001). Consequently, books of these times were written under the assumption that the text would be voiced and restored orally (Ong 1982). As a result of the need to restore written texts into the vocal sphere, the text composition during the pre-print era was governed by rhetorical rather than literary and grammatical considerations (Chaytor 1950) and therefore, it usually had a loose structure and

lacked a “narrative of wholeness,” described by Morrison (1990) as “a beginning, middle, and end” (p. 154). The read-aloud habit and the loose text structure led authors to assume that, in their writing, the text would be interpreted and modified by the readers who would add their own flavor and personal annotations while reading aloud. This was part of an oral communication culture, in which “writing, reading, and oratory remained inseparable” (McLuhan 1967, p. 90). In this culture, where “readers were few and listeners were many” (Chaytor 1950, p. 10), manuscripts mainly helped to distribute knowledge to the oral world.

During the pre-print era, texts were rare and readers were not proficient in writing and reading. The oral text-reading practice of this era required the reader, during the reading process, to cognitively translate the representation of the word from its visual to its vocal representation. This simultaneous synchronization, between visual and audio, helped the pre-print readers to cope with their lack of reading and writing experience. This act of pre-print synchronized reading resembles the reading of today’s children in their first stages of reading: They read the text slowly, spelling out every word to make sense of it as they read. As McLuhan (1967) argues about reading in the pre-print era, “It was as if reading each word was a challenge or a problem for the readers, which they had to resolve” (pp. 82–83).

The read-aloud oral culture and the demand for synchronization skills, which were typical of the pre-print era, diminished in the print era with the introduction of print technology. With the availability of an increasing number of book copies, the emphasis shifted from reading aloud to the faster silent reading, which quickly became the dominant reading mode of the print era, relying on the visual representation of the words rather than on the synchronization between their visual and vocal representations which was dominant in the pre-print era. “As the Gutenberg typography filled the world,” declares McLuhan, “the human voice closed down” (1967, p. 250).

The proliferation of the multimedia technologies in the digital era demonstrates a partial swing in the textual pendulum “back” to a reading mode that contains elements which were typical of the pre-print oral culture. Many multimedia environments collectively termed “Real-Time Environments” (Eshet-Alkalai, in press) act as “real-time reading machines” by presenting to the reader simultaneously the verbal and the visual representation of words (Singleton et al. 2000). Typical of such real-time “reading machines” are the computer-based story-telling “Living Books” (Underwood & Underwood 1998). In Living Books, as the story is being told, every narrated word is highlighted separately on the computer screen, simultaneously to its narration. Snyder (1999); Lewin (2000) and Eshet-Alkalai & Chajut (2007) showed that this kind of word-by-word synchronic representation is very effective in young children gaining reading and language comprehension skills. A similar effect was also found in subtitled TV, where the spoken text appears in written form simultaneously in the subtitles (Pemberton et al. 2004).

In summary, the digital era’s real-time multimedia environments represent the partial swinging of the text-pendulum from the silent, “visual-only” reading habit of the print era back to the read-aloud mode habit of the pre-print era, which employed synchronization between the visual and verbal representation of text (Snyder 1999).

Discussion

The proliferation of the new digital technologies is related to revolutionary changes in the perception of text in its broad social context. As we have seen in this paper, a comparison between the characteristics of the digital and the pre-print era's texts reveals some interesting parallels between the ancient and the present-day digital literacy. These similarities are evident mainly in the use of "accessories": textual techniques or perceptions, which are meant to help users cope with the complexity of literacy. For example, the use of concrete-iconic symbols in writing during the pre-print era reduced the demanding cognitive load of reading and helped readers intuitively understand the meaning of words. Similarly, the substitution of text-based commands with graphical icons in today's computer interfaces helped users to intuitively operate commands or understand instructions, which are represented graphically. In the same way, the weak pre-print perception of authorship enabled focusing on production considerations and on knowledge distribution, as these were both complex technological tasks. Today this weak perception of authorship is part of the attempt to democratize knowledge through the use of the Internet and other communication technologies. In addition, the simultaneity of both visual and audio representations of text was helpful for the inexperienced readers and writers of the pre-print era in coping with the demanding tasks of reading and writing. Today, this simultaneity has been revived with the advantages of multimedia technologies which help readers by presenting both audio and text.

The "revival" of old, pre-print text features with the introduction of new, digital, technologies, reflects the undermining of the modern rigid assumptions about text which went hand in hand with the print technology. While the modern print perception often regards the text as a fixed and visual testament of the empirical reality, being "a datum, separate from any utterer or hearer or reader" (Ong 1992, p. 308), the post-modern atmosphere is much more tolerant towards textual heterogeneity. In such a tolerant post-modern digital environment, the strong perception of authorship—the crowning glory of the modern scientific responsibility and quality assurance—can be joined by new perceptions of sharing knowledge which are characterized by weak authorship perception. The fixed, numbered, printed text, which is so related to the modern disciplined printed text perception is joined by a much more fluid textual perception: of scrolled text that contains hyperlinks. In computer interfaces, the written commands are replaced by graphic icons. And along with the modern concept of reading silently, which reflects the modern superiority of visual over audio, new digital reading and learning programs have combined these two senses to help readers cope with the reading challenge from digital displays.

Perhaps more than the cases discussed in this article teach us about the digital technological era, they provide us with some interesting insights about the literal culture of print and modernity. This is a rigid culture, which often regards the textual document as a fixed and exact object, whose author is responsible for its content. This modern perception has made the above-mentioned accessories (iconic writing; weak authorship perception and synchronic reading) irrelevant. They started to flourish parallel to the textual print modern culture only when the post-modern atmosphere and digital technology gained momentum.

The fluidity of the post-modern perceptions, along with the unique technological capabilities provided by the digital environments, makes it possible for the users to enjoy the best of both worlds: to enjoy the textual characteristics of the print era, and at the same time, to enjoy the characteristics that resemble the textual pre-print culture. For example, a digital text can be read silently by the reader but with a simple mouse-click, it can also be read aloud by a digital program. Similarly, in the digital era, readers and writers can write using the traditional alphabet but at the same time, they can make use of the available extensive icon digital libraries in order to create graphical communication, without the need for drawing skills. In other words, these technologies and the philosophical perceptions are a part of open up greater textual possibilities for their users. The “revival” of ancient textual characteristics is part of this tolerant culture.

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