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Digital Hypertexts vs. Traditional Books: An Inquiry Into Non-Linearity

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Digital Hypertexts vs. Traditional Books:

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Nobody is going to sit down and read a novel on a twitchy little screen. Ever.

Annie Proulx (journalist and fiction novelist), 1994

By our count, we're looking at least 660,000 Kindles [electronic e-book reader launched by Amazon in 2007] by end of 2008.

Richard McRoskey (journalist), 2008

This is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning.

Winston Churchill (Prime Minister of UK), 1942

ABSTRACT

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By Federica Fornaciari

The current study begins with an awareness that today's media environment is characterized by technological development and a new way of reading caused by the introduction of the Internet.

The researcher conducted a meta analysis framed within Technological Determinism to investigate the process of hypertext reading, its differences from linear reading and the effects such differences can have on people's ways of mentally structuring their world. The relationship between literacy and the comprehension achieved by reading hypertexts is also investigated.

The results show hypertexts are not always user friendly. People experience hyperlinks as interruptions that distract their attention generating comprehension and disorientation. On one hand, hypertextual jumping reading generates interruptions that finally make people lose their concentration. On the other hand, hypertexts fascinate people who would rather read a document in such a format even though the outcome is often frustrating and affects their ability to elaborate and retain information.

TABLE OF CONTENTS

Abstract ……..... iii

List of Tables ……..... v

Chapter One – Introduction ……..... 1

Chapter Two – Literature Review ...……..... 9

Chapter Three – Methodology …..……..... 21

Chapter Four – Results ……..... 28

Chapter Five – Conclusions ……..... 42

Bibliography ……..... 57

LIST OF TABLES

Table One ……..... 30

Table Two ……..... 32

Table Three ……..... 33

Table Four ……..... 35

Table Five ……..... 36

Chapter 1 - Introduction

Today the world of mass media is extremely complicated. If we glance at all the new media possibilities it feels like being in the middle of a revolution; the media are changing extremely rapidly. There is so much information coming from any direction that people cannot stop and go in-depth. Otherwise, they risk being overwhelmed. Hypertexts, hyperlinks, e-books, Kindle and Google are just some of the new words that have emerged as a result of the revolution that is happening in the media environment of contemporary visual society. Communication tools and expressive forms are evolving exceptionally fast. It is a fascinating time to be in the communication field.

As Baricco (2006) highlighted, deepness and immobility were the values for the printed society. Experience and knowledge were necessarily the result of sitting down, motionless, and studying a book. People were used to "experiencing" media in-depth, and the main tool for achieving that knowledge was doing one thing at a time. Monotasking was the keyword, that is, doing one single thing but doing it as deeply as possible (Baricco, 2006). The book was the symbol of such a society. Levy (2007) defined the book as a technological tool that is a "more reliable storage device than a hard disk drive, and it sports a killer user interface. It is instant-on and requires no batteries. Many people think it is so perfect an invention that it can't be improved upon, and react with indignation at any implication to the contrary."

In McLuhan's (1964) view, the introduction of the printing press led to the rise of scientific method, and later to our technological society by forcing the thinker to put words in linear order and their arguments in logical progression. What are the consequences of the Internet in the way

people gather information, communicate, know and experience the world? What is going to happen to readers?

When the Internet came along people started to become accustomed to a new way of reading and organizing their thoughts. Flipping through the pages became an obsolete action, perhaps destined to fall into oblivion. The Internet is arguably the most powerful innovation that has happened in the world of media since the introduction of the printing process. Ong (1988) argued that in contemporary society there is a sort of return to orality since our new media share many characteristics with the visual and oral world. New technologies are pushing readers toward non-linearity or multi-linearity, and their hypermedial nature replicate orality by displaying images, words and sounds at the same time. What are the consequences of hypertexts, hypermedia and the Internet in the evolution of society? What is going to happen to old media with the development of new media? These questions stimulate a reflection about the relationship between the features of a medium and its power to generate changes in the intellectual structure of the entire society.

Young people born after the introduction of the Web have not developed a strong relationship with traditional paper texts. Their reading reality has always been somehow hypertextual. Does that make any difference in the way those individuals mentally structure their world?

While the “printed society” was based on values such as deepness and motionlessness, contemporary digital society seems to be based on speediness and the ability to browse following a trajectory. Surfing is a great word as it relates to the Web; surfers cannot stop and they have to be quick in order not to sink. In our hyper-technological society shaped by the Internet people

browse instead of read. They consume dozens of documents skimming the surface looking for something that satisfies their need for knowledge or their curiosity. As will be discussed below many scholars have analyzed the new way of using the media; hypertextual society provides people with the habit of following a trajectory without diving in-depth. Contemporary surfers are replacing old fashioned divers. The scope and direction of these changes are unclear but they may affect somehow the evolution of knowledge. New communication forms need to be extremely rapid to meet surfers' needs and habits.

The symbol most representative of this media revolution is probably the hyperlink; it can be considered the cornerstone of the media change and the focal point of the Internet revolution, as Brin and Page (1998) foresaw when they decided to base the algorithm for Google on the distribution of hyperlinks within the Web. Google is strictly related to Web researching, and it highlights the fact that the experience and the meaning are gathered wherever there is a movement connecting a variety of stimuli. As Baricco (2006) pointed out, Google's operating principle emphasized that the value of any document is generated by the history of its motions, which is by the number of links bringing the viewer to such documents. Hyperlinks represent, therefore, the fulcrum of a paradigm shift involving the reading process.

This lesson pointed out by Google generates a question; how will such change in the ways people experience knowledge modify their communications habits? How can it be related to people's way of mentally structuring their world? Is there any relationship between surfing the Web and people's concrete behavior in everyday life? Will they apply the scheme of speediness and trajectory to every other field of their lives? Here is the gist of the problem.

According to Baricco (2006), with the Internet experience and knowledge come from following a horizontal trajectory that skims the surface without sinking into the Web. People read chunks of documents, and their online activity is a jumping reading that brings them through many pages. They read some information of these pages and keep clicking on hyperlinks that are the stepping stones of their surfing experience. Therefore, hyperlinks need to be focal points generating energy that gives speediness to people's online navigation. How do people learn and experience things? How do chunks of information get digested and transformed into knowledge? How do people make sense of what they read, see, and go through?

In contemporary visual society the experience is somehow related to motion and comprehension is linked to the skills people have for "connecting the dots" of their surfing activity. Those skills include retentiveness, synthesis ability, computer literacy, and familiarity with hypertexts, among others. As Baricco (2006) emphasized, multi-tasking is a way of acting strongly related to Internet society.

Go back for a minute to today's adolescents who grew up in a hypertextual world of Internet driven communication. Most of them multitask to the extreme. They condense as many actions as possible and go through them as quickly as possible. They watch television, talk on the phone, eat lunch, chat on the Internet and write their assignments all at the same time. As Baricco argued (2006) their media consumption appears to be confused and crowded because they are used to connecting different experiences through a trajectory that transforms a variety of activities into a single gesture. They are testing a multi-tasking path, moving through different actions that bring them to a sort of unique understanding stimulated by new technologies. They do in real life what they have been doing on the computer since they were born: they multitask

and they surf, skimming the surface of many gestures without letting those gestures stop their motion.

But this ease in the interaction with the Web is not necessarily omni-pervasive: Not everybody is Web literate enough to benefit fully from the medium. Information overload is a term we have heard many times as it relates to the Internet. Hyperlinks should portray a sort of tree-scheme aimed to helping people find the best path that will satisfy their momentary research interests, but many people do not precisely know how hyperlinks work.

According to Baricco (2006) the main activity people carry out with the Internet (beyond writing email) is "Googleing." Why? Because Google is the easiest tool that helps them look for the information they need. Hyperlink-literate people could probably reach the same information through hyperlinks but Google is a sort of shortcut that people use to reach what they need as quickly as possible (thereby satisfying the need for speediness).

Are hyperlinks really user friendly? Are they self explanatory? How many people feel at ease while clicking on a highlighted word? Do they really know what they are going to find behind such buttons? People used to linear reading might experience confusion in reading hypertexts because they are not trained to look for the information they need. Hypertexts' non-linear and non-hierarchical paths may disorient them because choosing one hyperlink instead of another may cause them to exclude relevant information. Many times people get lost in the Web and find themselves reading documents they were not looking for; the result may be a sense of frustration generated by the impression of wasting time without reaching the information sought. Hypertext reading is a never ending digression generating experience and knowledge. The issue related to

hyperlinks is whether such tools really make it easier for people to navigate through the Web or not. “I am getting lost on the Web” is a phrase we frequently hear.

Besides the Internet, another powerful tool enhancing the issue of hypertexts and hyperlinks is the Kindle, Amazon’s revolutionary wireless e-book reading device. According to Bezos, its creator, "books are the last bastion of analog. Music and video have been digital for a long time, and short-form reading has been digitized, beginning with the early Web. But long-form reading really hasn't” (as cited in Levy, 2007, November 26). Quittner (2008, July 9) argued there are not precise data about how many Kindles are out there. “What is sure is that it quickly sold out shortly after it was unveiled on Amazon at the end of 2007 and that an acceptable approximation of sales is about 55,000 per month in 2008.” The Kindle represents a milestone in hypertexts’ popularity and may be the symbol for a revolution that will change the way readers read, writers write, and publishers publish.

Wolf (2007) argued that the brain’s design made reading possible and reading’s design changed the brain processing of information in multiple, critical, still evolving ways. She argued that in the same way as writing reduced the need for memory, the proliferation of information and the particular requirements of digital culture may modify some of written language's unique contributions and generate profound consequences for our future. As we come to understand how the evolution and development of reading have changed the very arrangement of our intellectual life, we begin to realize that we truly are what we read. Also, technology can be a facilitator that eventually modifies some humans’ skills (i.e. if people do not have to remember anything because they can check it out with their iPod touch in a second, how are they going to use their memory?).

The ways hypertexts will influence our mind is not clear yet, but a change may be connected to people's literacy and their skills for hypertexts processing and reading. Literacy is likely to have a role in the comprehension process.

According to Wolf (2007), the mind of someone who does not learn to read works differently. In her book she reported that Portuguese scientists examined two different groups of rural dwellers that had been educated to read as children or who had managed to bypass that stage. They could both speak the language but non-readers found it difficult to repeat non-sense words, and they would try to replace them with similar-sounding words that actually meant something. In some analogous ways hypertextual reading might generate changes in people's brain design; that is why it is extremely important to teach digital natives to make the most of new technology without losing the education that comes from thousands of years of reading. To do so it is necessary to underline the differences between linear reading and non-linear hypertextual reading. Where does the divergence lie? "In the hyperlinks" is one possible answer.

There are two ways of looking at a hyperlink; it can be defined as an interruption in the process of reading or as a point of energy generating movement. As suggested earlier, good links should be a sort of stepping stone that stimulates the movement. It does not happen all the time. Also, computer literacy might have some role in how the reader experiences hyperlinks; if people are not trained to read maps, having one will not prevent them from getting lost.

Do people experience hyperlinks as an interruption that distracts their attention? If the answer is yes, then how will they process such an interruption? Will they be able to focus their concentration while jumping from a document to a video to a picture and back to the document again, or will they lose some attentiveness on the route? How will this jumping reading affect

their skills to elaborate and retain information? According to Klinberg (2008) if people do not focus their attention on something, they will not remember it. Moreover, as cited in Nordenson (2008) some studies show that interruptions cause significant impairments in performance on IQ tests.

What is necessary is a study of readers in order to understand how they read online and to what degree they are able to process the information they read in hypertexts. Evidence suggests that the introduction of hypertexts that deconstructs the linear order and calls into question the logical progression of arguments will have consequences on the structure of our knowledge. Moreover, if the value for the Internet society is speediness and the experience comes from following a trajectory, then hyperlinks have to push readers instead of slow them down and disorient them. A study of readers' reaction to hyperlinks is crucial at this time.

Investigating this field is necessary both to address the consequences of the spread of the Internet and e-books, and to help design tailor-made hypertexts that completely satisfy readers' needs. The writing of hypertext should be based on what is known about the process of reading and take into consideration the positive features of the Internet and hypertexts in order to benefit from them. Writing for hypertexts does not mean simply displaying on a computer screen linear stories as they are formatted for printed media.

Chapter 2 – Literature Review

This research is meant to investigate whether the reader will experience the content differently reading linear and hypertext versions of the same text, and what relationship exists between literacy and the comprehension achieved by reading hypertexts. The following review of literature provides an overview of the research that has been done in the field to determine the relevance of the subject investigated and provide a starting point for the current study. The purpose is to investigate the changes occurring in the reading experience due to the introduction of nonlinear hypertexts in order to foresee unanticipated consequences of the spread of the Internet and e-books.

The framework for the current study is Technological Determinism, mainly represented by Harold Innis and Marshall McLuhan, which is based on the idea that we shape our tools and our tools, in response, shape us.

In *The Bias of Communication* (1951) Innis argued that civil evolution is tied to the innovations occurring in the field of communication, and communication tools have strong consequences both for spreading knowledge and shaping culture and society. On one hand Innis related verbal communication with a fluid movement of ideas and a sequential continuity not interrupted by rigid structures. On the other hand he associated written communication with stability and firmness, generally destructive of creative activity. Innis claimed that there is a strong bond connecting specific modes of communication and people's perception of space and time. His theory was based on the assumption that in any given era the major form of communication is strongly associated with a particular type of knowledge. His focus was on the

time-space bias due to the modes of transmission.

Innis (1951) developed a theory of communication that included Oral Tradition and Written Tradition. The first was meant as an oral communication that was elitist and intellectual, mainly depending on face-to-face dialogue between scholars and disciples. Innis (1951) did not exclude a written component for the Oral Tradition and argued that "creative thought" was "dependent on the oral tradition" as writing is too fast and cannot be compared to the complexity of speech.

Innis (1951) introduced the idea of light and heavy media to describe how each civilization has developed a "bias" created by the prevalence of a type of communication. He associated oral cultures with a sense of control over Time, while written cultures are related to a control over Space. Time and space were key categories for Innis. According to Olson (1989), Innis felt that "durable" media (such as stone and clay) favored the temporal dimension because they are designed for permanence, whereas more portable media (such as papyrus and paper) favored the spatial dimension because they are designed for movement. Also, temporal culture favors eternal aspects of human civilization such as spiritual matters, while spatial culture favors contemporary, secular matters. As a new medium, is the Internet time or space-biased? What consequences can such a medium have on human civilization?

According to McLuhan (1964), media technology influences the way we think, feel, and act as individuals in a society; as a consequence, historical and social developments are both strongly influenced by technological changes. McLuhan assumed that whenever there is an innovation people try properly to understand and predict its advantages and disadvantages; but often it is possible to discover the effects of a medium only looking backward long after its introduction.

In *Understanding Media* McLuhan (1964) outlined the idea that people usually focus on the obvious and miss the structural changes concerning their lives that are introduced subtly and slowly. Affirming that "the medium is the message" McLuhan meant that people do not have to be distracted by the content of a medium, but rather they have to focus on the medium itself. Both the power and the effect of a medium are generated by its features, and a change in societal or cultural environment as the effect of a new medium is already a new message. These effects can be either positive or negative; what matters is that being able to foresee the effects allows people to re-shape consciously the medium. McLuhan's theory is relevant because it focuses attention on structural changes; he argued that the print revolution begun by Gutenberg has been the forerunner of the industrial revolution, and he stated that the introduction of print has brought fragmentation to society. How can a change in technology affect society? The process can be outlined as follows: Printed books are a new medium, people would read them in private and consequently they will be alienated from each other. This oversimplification can give the idea of what McLuhan meant.

At present, people are absorbed in communication as they live the vast majority of their day dealing with the Internet and new technologies. People interact nonstop and their interactions are no longer limited to in-presence dealings: They communicate with individuals thousands of miles away and they *interact with texts*. In the latter lies the peculiarity of hypertexts and their potentiality to cause changes in people's reading and thinking skills and, maybe, in the society as a whole.

According to Straubhaar and LaRose (2006), "in McLuhan's view the introduction of printing press led to the rise of the scientific method, and later to our technological society by

forcing thinker to put their word in linear order and their argument in logical progression" (p. 51). What can be the consequence of the introduction of hypertexts that deconstructs the linear order and calls into question the logical progression of arguments? To answer this question it is necessary to look backward and analyze the effects of great communication revolutions and then to provide a precise description of what a hypertext is in order to understand better the features of the current communication change.

According to Ferris (2002), the main communication revolutions include the introduction of symbolic language, writing, and print. Such transitions generated a change both in people's habits and in the language itself; for instance writing enhanced abstract and analytic thought and allowed re-reading or "backward scanning." Writing is characterized by permanence and completeness, and written language is more planned and less redundant than spoken language. Similarly, verbal communication changed with the arrival of the printing process, "reinforcing the linearity and sequentiality of writing while focusing on the hierarchical thinking that was essential to the eventual flourishing of modern science." Eventually, with hypertexts the text became more immediate, fragmented, fluid and interactive. Computers re-introduced many characteristics of oral communication into electronic writing exhibiting a lack of linearity and eliminating distance between users. Moreover, the text became more immediate offering greater chances for individual participation and interactivity, and impacting linearity and grammatical conventions. Electronic writing is nonlinear, vanishing, and interactive; it requires an active role for readers who make decisions about destination and content experiencing an active and engaging process. "The reader becomes the author's partner in determining the meaning of the text," and the writing process becomes more difficult since the writer has little control over the trail readers will choose to follow.

McAdams and Berger (2001) argued that hypertext's features improve the process of reading. Nevertheless, users often experience disorientation due to the lack of hierarchy and linearity, and they may feel unsatisfied when reading hypertexts which are poorly drawn. The writing of hypertext should be based on what is known about the process of reading and avoid simply displaying linear stories as they are formatted for printed media. Hypertext readers experience a large degree of control over the text since their decisions will shape a unique path. The outcome can be access to a more complete version of a story, as hypertexts can show many elements in relationship to one another; but, on the other hand different people will experience the same text differently depending on their previous knowledge of the subject and their skills in using hypertexts. Moreover, hyperlinks do not always represent a connector; they may also generate a division causing the readers to feel disappointment, reward or disorientation. Only a well-designed hypertext enables the user to experience agency. Therefore the reader's experience is grounded on the writer's link decisions and expertise.

Birkerts (1994) argued that hypertexts are killing the author, weakening the quality of writing, and displacing order in favor of chaos. He assumed that online readers experience disorientation and hypothesized that hypertexts can destroy literature and discourage individuals from reading. The printed book is the ideal medium for the written word: It exalts and preserves the language fixing into permanence our entire collective, subjective history. Birkerts argued that books provide us with a space for reflection and a basis for interpreting other people's behavior. Therefore, the lack of permanence characterizing the digital space and the reader's disorientation generated from hypertexts are likely to have negative consequences in reading habits and society.

Snyder (1996) agreed that hypertexts radically challenge linear authorship and reading as

they broaden and modify both existing writing practices and thought processes. Snyder compared hypertexts' flexibility and non-linearity with the preestablished order of the printed book in which readers follow a preset trail taking them from the beginning to the end in the way the author decides. She underlined hypertexts' imaginative and playful potential and argued that "hypertext is essentially a network of links between words, ideas and sources that has neither a centre nor an end" (p. 18). These characteristics make hypertexts a tool that "offers an opportunity for teachers and students to produce, circulate and receive texts in an unparalleled and exciting confluence of literature, writing and technology" (p. 122). Nevertheless, traditional teaching has to be updated to these new features: Hypertext requires a more sophisticated pedagogy able to diminish the distinction between professors and students. Snyder is extremely optimistic and hypothesizes that hypertext will ease individual and collaborative learning, result in new ways of teaching, stimulate students' critical thinking, improve writing classes, and engender new academic genres.

In *Writing Space: The Computer, Hypertext, and the History of Writing,* David Bolter (1991) examines in detail the features of writing and the differences between writing for print and for hypertexts. Both the process of writing (coding) and reading (decoding) change depending on the medium to which they are aimed. Bolter (1991) starts from the assumption that writing is a technological tool used to create meaning through the organization of discrete symbols either verbal or visual. Observing computer based writing Bolter argues that "electronic writing will be felt across the whole economy and history of writing; this new technology is a thorough rewriting of the writing space" (p. 40). He argued that a shift from paper to digital writing space will have effects both in writing habits and in people's culture, literacy, knowledge, memory, and intelligence.

Bolter was interested in investigating how the changes in the features of our recording devices could bring about an alteration on people's reading comprehension and on their thinking structure. He argued that from the stone tablets to the medieval codes to the printed books (through many other middle passages) people have experienced specific systems for the sequencing of information. Encyclopedias and libraries, but also punctuation and page numbers, can be seen both as facilitators of the reading process and as technological components affecting people's reading habits and skills.

With electronic writing, Bolter argued, we link chunks of topical information. Hypertexts are characterized by the associative paths well exemplified by the Internet, which is a network almost infinite, incomplete, and constantly changing. With the Internet, the boundaries between authors and readers are fading. Reading becomes a kind of writing since the reader decides his own path through a hypertextual world designed/written to be flexible, vibrant, and visually challenging. People are abandoning the idea that communication consists of words alone; the electronic writing space is characterized by a lack of conventions allowing people to shape their texts in a dynamic way and includes choreographing relationships between video, verbal, and audio elements. Bolter stressed the idea that now more than ever it is necessary to investigate the history and future of visible language. Hypertexts are freeing people from books' restrictions. Therefore, people's perception and use of the writing space is going to change. "The organization of writing, the style of writing, the expectations of the reader, all these are affected by the physical space the text occupies" (p. 85).

Spires and Estes (2002) addressed the issue of reading comprehension analyzing the effects of the introduction of a web-based environment in learning and teaching activities. The key concept was that hypertexts and print books have differences concerning textual boundaries,

mobility and navigation. The reader of hypertexts is allowed to choose among multiple paths through a body of text and is not forced to proceed from the top to the bottom and from the beginning to the end. Hypertexts turn out to be multilinear rather than nonlinear, allowing their readers to "forge cross-connections among subtopics, to make directional choices" (p. 116). According to Spires and Estes "the freedom of choice and interest that drives the reading process in hypertext can become diverted by potential cognitive overload – hypertext may tend to amplify trivia and highlight seductive details that lead directly to recall of inappropriate knowledge" (p. 117). Such freedom of choice can disorient students learning in a web-based environment; therefore, teachers have a responsibility to help them to experience hypertexts positively. Internet literacy is necessary to navigate successfully and avoid frustration.

To address the issue of literacy and its impact on hypertext reading, Kumbruck (1998) investigated the differences between linear and non-linear reading habits. His research attempted to explore the cognitive effects of hypertext reading on people's knowledge structure. He highlighted that theoretical and empirical studies of hypertext reveal cognitive advantages in reading hypertexts: Their nonlinear structures correlate cognitively to the nonlinear structures of thought and liberate readers from writer's control giving them a chance to experience agency. Kumbruck's study demonstrated that reading hypertexts has different effects on expert and non-expert readers. The latter had great difficulty understanding hypertexts, while experts could profit from them.

To explain the differences between hypertexts and linear texts reading Landow (2006) analyzed the features of their unlike structures. Hypertexts are composed of several parts of texts tied together through hyperlinks having no preconceived reading paths. The lack of center

characterizing hypertexts may be an obstacle both for the reader and the writer used to traditional linear texts. Readers are allowed to make their unique path following their peculiar interests and drawing a new center of investigation with every new reading of the same hypertext. This de-centerable and re-centerable system transforms any document into a transitory center where the reader's role is deliberate. He or she can manage the text according to interests, needs, and organizing principles. Hypertext is open and fuzzy-bordered, and its writer has little – if any – control over the text.

The hypertext reader, according to Murray (1999), experiences agency rather than authorship. He or she is given the chance to take meaningful actions that generate different results on the reading experience; the reader participates in the text modifying its environment, challenging its boundaries, and setting a unique rhythm and context. But hypertext does not diminish the author's agency since the reader can only act within the possibilities that have been established by the author of the hypertext. A user's freedom lies between predetermined edges.

How do hypertexts make their readers experience agency? What characteristics determine a higher comprehension of hypertexts? Harpold (1991) tried to identify what features of hypertexts help users achieve efficiency and pleasure while reading. The analysis involved many aspects of hypertexts and focused on the assumption that, unlike traditional texts, hypertexts are consumed in ways that subvert the relation to syntax closure. The major feature of cyber navigation is that it diverts from a predetermined course enabling the reader to discover a variety of pathways through the textual labyrinth. These digressions can either fulfill or disorient the reader who can forget his or her departing point, get lost along the way, or follow misdirecting links that bring that reader to an unexpected place. An increasing attention focused on hypertexts writing is necessary to give people usable pages that provide them with compelling rather than frustrating

experiences.

Olson (1994) conducted a careful analysis of a history of literacy practices to point out that changes in literacy practices modify the forms of human mental processes. He argued that literacy is not the focal topic to investigate; the issue is whether or not literacy throughout history has shaped the cultural forms of people's reasoning. Olson underscored the assumption that a change in the writing process can generate a preferential method of reading and, as a consequence, a change in the cognitive structure of human minds affecting the way in which people were used to read before the change happened.

Sutherland-Smith (2002) investigated students' perceptions in reading Web texts and print texts. Starting from the assumption that reading hypertexts permits nonlinear, nonhierarchical and nonsequential thinking strategies she found that there was a significant difference in students' reading process depending on whether they read on the Web or on paper. According to Sutherland-Smith (2002), diverse types of cognitive requirements are needed to read successfully linear and nonlinear texts. She defined web literacy as a sum of navigation skills and the ability to find, access, scan, analyze, process and store Internet information. Web literacy expands critical reading skills as hypertexts incorporate visual and non-textual features much more than paper texts do. Reading hypertexts implements non linear and non sequential strategies of thinking, is interactive, and enables a blurring of the relationship between reader and writer. Sutherland-Smith (2002) argued that it is necessary to provide people with an adequate Web literacy to allow them to benefit from the almost infinite amount of information accessible online.

Dresang and McClelland (1999) investigated how technology changed the way in which people learn and read. They focused on children's learning and reading behavior when they

approach the digital format. Children have never lived in a paper-based world therefore they might be more affected by the development of hypertexts. Dresang and McClelland (1999) focused on the consequences of technology on both the content and the structure of books for youth and observed that children using hypertexts interactively organize information and make their own connections in a non-traditional, non-linear way. Children are usually a more reactive group which means the media often have stronger effects on them (Dresang & McClelland, 1999).

If changes in the structure of information can modify people's knowledge structure, how will that affect the reading comprehension process? Coiro (2003) explored the changing nature of understanding using a well-articulated model of reading comprehension outlined in the RAND Reading Study Group's report of 2002. She argued that "web-based texts are typically nonlinear, interactive, and inclusive of multiple media forms. Each of these characteristics affords new opportunities while also presenting a range of challenges that requires new thought processes for making meaning" (p. 459). She underlined that hypertexts' interactive nature gives readers greater responsibility as they decide their own paths and build personal adaptations of the information. While linear texts are shaped by their authors, hypertexts readers "flip through the pages" in a personalized order. Interactivity and dynamism characterize digital hypertexts and readers will be exposed to multiple and diverse perspectives. Coiro argued that the comprehension process is different on the Internet since hypertexts "ask readers to extend their use of traditional comprehension skills to new contexts for learning, while others, like electronic searching and tele-collaborative inquiry projects, demand fundamentally different sets of new literacy not currently covered in most language arts curriculums" (p. 463).

Many scholars have been involved in this field of study, but several issues need to be investigated further. After a literature review the focus of this research appears to be timely and crucial. Indeed, it is necessary to examine the features of a change in reading experience due to the use of non-linear texts in order to foresee unanticipated consequences of the spread of Internet and e-books. It is also fundamentally important to investigate the function of literacy in hypertext readers' comprehension so as to address an improvement in the field of education to allow people to benefit from the modern technological revolution. The ultimate goal is a step forward in the understanding of how a change in reading habits and strategy can modify the way people think, gather information, and interact.

Chapter 3 - Methodology

The aim of this research is to investigate the different experiences coming from reading linear and hypertext versions of the same text and the relationship existing between literacy and comprehension achieved by reading hypertexts. Specifically, the following questions guided this research:

1. What different experience comes from reading linear and hypertext versions of the same text? (For example in terms of comprehension, finding the information needed, ease or disorientation, readers' engagement, reading time, etc.)

2. What relationship exists between literacy and the comprehension achieved by reading hypertexts?

The first issue is based on the assumption that there is a difference between traditional and hypertext reading. In order to analyze these unlike reading experiences it is necessary to address a number of variables. First, the current study will measure readers comprehension defined as the capacity to answer successfully questions about the text read and the ability to find the information needed. Then the study will address the ease or disorientation experienced by readers, their engagement measured as level of identification or involvement with the text, and their reading time. The assumption of differences existing between linear and non-linear reading has been confirmed by many scholars and is evident after the literature review.

Afterward, the current study will investigate the relationship between one's literacy and the comprehension achieved when reading hypertexts. Literacy is defined as the sum of a variety of skills including capacity to encode or decode meanings, writing and reading skills, overall

understanding of texts, computer/technological literacy, familiarity with hypertexts, processing skills, print and visual literacy, and critical/translation ability. After a review of the literature the assumption is that there will be a positive correlation between literacy and hypertexts comprehension, but the topic needs to be further investigated.

A variety of studies have addressed such issues. Therefore, the best way to proceed in answering these research questions is a meta-analysis will combine the relevant studies about the subject and highlight what is known and what needs to be further investigated.

According to Wolf (1986), meta-analysis can be considered as a different approach to the narrative literature review built on both previously developed and new methods. It can be defined as the review of a set of empirical findings from individual studies designed to integrate, synthesize and make sense of them. This is a method of analysis that mingles the results of a number of studies in order to investigate broadly the underlying processes. Meta-analysis is likely to be more objective than traditional literary reviews because it scrutinizes empirically the effects of research quality on study outcomes. Moreover, it may find inconsistencies in the literature and provide insight into new directions for research.

A meta-analysis is necessary to integrate, summarize, and review previous quantitative and qualitative studies. Such a study can investigate a wide variety of questions whenever a reasonable body of primary research studies exists, and creates a large project where many participants interact. Another benefit is its objectivity, and its value depends on some contextualization of the objective data.

Typically a meta-analysis includes five to ten studies in a specific field that are objectively selected following neutral criteria. The data set for this research includes five studies that have

been systematically retrieved from the databases Academic Search Premiere, Dissertation & Theses, and Communication & Mass Media Complete. These are the main databases including studies in the field of mass media communication. Therefore, it is possible to affirm that research scrutinizing these databases will gather almost the entire number of studies on the subject of interest.

A first selection will be based on keywords. To be selected a study has to be about hypertexts and/or book reading, linearity and non-linearity, reading comprehension and the role of literacy. The key words used to retrieve the studies are: hypertext reading, linear reading, non-linear reading, reading comprehension, and literacy. The key words have been used one at a time, except for "literacy" which has been combined with "reading comprehension." For every key word the field of research selected has been "all text." These key words retrieved a large number of studies. Therefore, a further narrowing is necessary.

Once a first panel of studies is retrieved, the researcher eliminated irrelevant articles. To be eligible a study had to address directly or indirectly the research questions. In order to satisfy this principle the researcher selected the studies through their titles and abstracts. Either one of these fields had to contain a key word. All the studies that did not contain any key words in the title or in the abstract were removed from the data set.

The second step involved browsing the study to find some evidence that the research may directly or indirectly answer one or both the research questions. To do so, the researcher read the research questions (or the hypotheses) that guided the studies selected. If the questions or the hypotheses addressed one or both the research questions for the current research, the study was kept in the data set. Otherwise, it was considered for the literature review.

After this the researcher went through the reference lists of the selected articles and retrieved the studies that were not found through the databases Academic Search Premiere, Dissertation & Theses, and Communication & Mass Media Complete.

The researcher ran through the process again with the second panel of studies. At this point all the research selected represented a rough data set that had to be re-analyzed following content neutral criteria in order to retrieve the five studies used for the meta-analysis.

The first criterion used was recency. The data set had to incorporate recent studies. Hypertext is a phenomenon that has been deeply modified after the introduction of the World Wide Web that made a huge number of hypertexts available to everybody. That is why a research addressing the experience of hypertexts reading is much more relevant if it occurred only a few year after the introduction and development of the Web. To be selected in the data set a research project should have been published after 2000.

Second, the data set needed to include studies that directly or indirectly addressed both the relationship existing between traditional and hypertexts reading and the role played by literacy in the process of hypertexts' reading comprehension. It is important that each of the studies directly or indirectly give answers to both research questions.

In order to verify that, the researcher took the first study, read the first research question, and looked for answers using the information available in the study. If there were answers to the questions (or at least to some aspects of them), then the researcher proceeded and used the study to answer the second research question. If the article/dissertation provided the information needed to address both the questions, then it was placed in the data set.

The last and most crucial criterion for the selection was transparency, which can be defined as the ability of a study to present clearly the methodology used and report thoroughly on the data achieved. It means that the study must show numbers, tables, charts, samples of in-depth interviews and any other kind of data collected. Transparency means intelligibility and clearness, and it is essential to allow an objective analysis of others' findings. To test transparency the researcher took one of the studies selected and tried to find numerical data to answer the research questions. The same process was repeated for every study selected.

Also, transparency means showing the materials used for the research. Therefore, to be selected a study needed to display the entire set of tools used during the investigation (i.e. questionnaires, experimental materials, online tutorial, agreements, texts and hypertexts used for the experiments, etc.).

Transparency is necessary because a meta-analysis has to rely upon second hand objective data and not merely upon others' conclusions or interpretations of such outcomes. Any explanation needs to be supported by the objective data underneath it. A meta-analysis needs to scrutinize both data and conclusions in order to draw its own conclusion in a way that is as objective and neutral as possible. Moreover, a study presenting data in a clear way bespeaks professionalism and gives more credibility to the data analysis and the conclusions. Transparency alone ascribes authority to research.

The researcher further improved the design using the following criteria: First, the studies with small samples were excluded to avoid overemphasizing small studies. Second, variables such as completeness of information, follow-up study, and language used were considered.

Researchers using poor language, small samples, uncompleted or reckless information had to be excluded from the panel as irrelevant.

Moreover, the researcher included both quantitative and qualitative data in the data set to give a wider perspective to the meta-analysis. This is important mainly because variables such as reader ease or frustration cannot be easily identified through quantitative data.

At the end of the standardized process five studies had been selected: four dissertations and a research paper. Dissertations are usually thorough analysis presenting data in a clear, transparent and objective way. They normally provide readers with detailed tables and charts showing the findings, and include as appendices all the tools used for gathering data and information. This transparency makes them suitable for the purposes of a meta-analysis. Moreover, the research paper chosen completely satisfied the criteria.

Once selected the studies for the panel, the researcher will take the first and look for all the information usable to answer the two research questions guiding the current study. The answers will be found using both the data presented in the paper/dissertation and the statistical analysis run by the researchers for the studies selected. This meta-analysis will not re-run the statistical analysis. The objective data and the researchers' analysis and conclusions will all be used for the meta-analysis. After scrutinizing the first study for answers to the two research questions, the second study will be analyzed, and so forth until the entire panel will be covered.

Quantitative data and statistical information will be collected and entered into two tables (one for the data, and one for the statistics). Qualitative data will also be collected and analyzed by looking for patterns which will eventually be grouped into a third table. At the end of the process

tables containing a variety of quantitative data, statistical analysis and qualitative patterns will be created.

The following step will be used to analyze the researchers' conclusions in order to summarize others' thoughts based on the quantitative and qualitative data. Indeed, given the nature of the study design, the findings (mainly the qualitative data) could be subject to different interpretation. Also, the researchers' conclusions will be scrutinized and compared with the data to emphasize the strengths and weaknesses of the studies.

At the end of the process the research will provide a wealth of information derived from unlike sources (numerical data, interviews, statistical analysis, others' conclusions etc.). Such variety will give a more complete view of the topic investigated.

Chapter 4 - Results

As a result of the process, the five studies chosen for the data set are: *Reading Hypertext and the Experience of Literature* (Miall & Dobson, 2001), *A Comparison of Students' Use of Surveying, Predicting and Setting Purposes for Reading as a Reading Comprehension Strategy in Linear Text and Hypertext* (MacDonald, 2004), *Hypertext - Attraction and Distraction: The Effects of Hypertext Link Positioning and Node Content on Inter-Sentence Integration* (Hardy, 2001), *Fifth Grade Students' Shifts in Knowledge of Hypertext Structure* (Swanson, 2002), and *Reading in an On-Line Hypertext Environment: A Case of Study of Tenth-Grade English Students* (Dail, 2004).

Miall & Dobson (2002) conducted an experiment aimed at analyzing the characteristics of hypertexts reading and the differences between it and conventional linear reading. One hundred thirty participants were divided into two experimental groups. For the first experiment, 70 participants were divided into a control group and an experimental group. Readers in the control group were given a linear text displayed on a computer screen and separated into nodes; they had to press a "next" button to get from one paragraph to the one following. Participants in the experimental group were given a simulated hypertext also displayed on a computer screen. Each chunk of text included two or three highlighted words (hyperlinks), and the participants had to choose a hyperlink to get to the following paragraph. All the participants ended up reading the same text since the hypertextual condition was a simulation and every hyperlink brought them back to the same following paragraph. The participants in the experimental group were not given a "back" button; therefore, they had no way to discover the hypertext was actually simulated.

The researcher recorded reading time per node, link choices, and out loud comments made by participants.

The results emphasize that hypertexts readers took more than four seconds longer per node as compared to linear readers. This is considered a significant difference (linear M = 38.37secs, hypertext M= 42.73secs, $t(20) = 3.16$, $p < .01$). Moreover, from the spoken comments the researchers found that hypertexts readers felt confused during their reading as if they were missing something. A typical comment was that "the story seemed to be very jumpy" and "it seemed like there were bits of information missing." The participants consistently made such comments about hypertextual reading. Analyzing results from all 70 participants in the experiments, 75 percent of hypertext readers reported some level of complexity following the story. Only 10 percent of linear readers made analogous comments even though the texts reads were the same.

The experiment was replicated with 60 participants reading on a computer screen a linear or hypertextual version of a text. The structure of the experiment was the same as the previous but the text given was different. The purpose of doing so was to confirm the results as being independent from the content of the text read.

In the second experiment the reading times were still significantly different (linear M = 45.13, hypertext M = 52.92, $t(9) = 12.438$, $p < .001$). Analyzing the spoken comments and putting them into categories, the researchers found more evidence supporting the existence of differences between linear and hypertextual reading. Table 1 represents the results of the differences tested by Chi-square. Since the texts reads by the two groups were different only in their structure

(linear/hypertext), the differences shown in the results are due to the presence or absence of the hypertextual format.

Table 1. Frequency of linear and simulation readers' comments classified by groups

Group	Constituent categories	Chi-square
Style	imagery (22/14)*; visual (10/6); foregrounding (4/11); defamiliarization (3/12)	X^2 (3) = 11.28, $p < .02$
Self of reader	identification (23/13); reader emotion (19/12); autobiographical, general (16/28); involvement+ (5/6)	X^2 (3) = 7.60, $p < .1$
Story	story is confusing (4/11); story fails to flow (2/15); segments of the story appear to be missing (0/13); story, dislike (5/6)	X^2 (3) = 8.96, $p < .05$
Computer reading	computer reading, enjoy (11/2); computer inhibiting (12/9); computer reading, dislike (12/21); computer distracting (7/13)	X^2 (3) = 10.82, $p < .02$
Linking	link choice enjoyed (5/6); links promote attention to text (11/2); links promote control (8/13); links distract attention from text (9/8); link choice disliked (7/15)	X^2 (4) = 10.31, $p < .05$

*The numbers in brackets represent frequency of comment by linear/hypertext readers.

(From Miall & Dobson, 2001)

It is relevant to note that the hypertext readers made fewer comments on the imagery generated by the story; they felt more defamiliarization and less identification. The story in its hypertextual format appeared to be confused, out of order, and failed to flow as readers felt they had missed some information. Hypertext readers consistently commented that, as they realized the information was not in order, they learned how to piece it all together after having read the entire story. Also, the ability to put together the plot appears to have resulted in a principal cause of the pleasure of the reading experience achieved by hypertext readers.

Choosing between links appeared to be very frustrating both because the readers felt they were missing information due to their choices and because the text reached sometimes failed to correspond to their expectations. Readers were often unable to find the information they were expecting and they only enjoyed the experience when they were able to control the hypertext.

MacDonald's (2004) study was designed to compare students' application of one particular reading comprehension strategy (surveying, predicting and setting purposes for reading) in linear text and hypertext. The students who participated in the experiment were used to the surveying activity since it had been taught for several years at their school. The first purpose of the study was to analyze the differences in the use of reading comprehension strategies for hypertext and linear text. The researcher was also looking for significant differences and possible correlations between reading ability, computer self-efficacy, and student ratings of motivation/persistence, study habits and the like.

The study collected and analyzed both quantitative and qualitative data; the sample included 41 middle school students (from Benchmark Middle School; a private school in Media, Pennsylvania) who had been trained with a practice session on how to use a hypertext before being asked to survey either a hypertext or a linear text, and to justify their choices.

Reading comprehension was measured both in an open-ended format and in an objective format. Information on students' general academic ability, reading ability, computer self-efficacy and other types of literacy were collected prior to the study using questionnaires, ERB test scores and academic records. Qualitative data were collected to compare students' experiences with the traditional text to their hypertext experiences. Participants were given a hypertext version and a

linear version of the same text. Afterwards, they answered a questionnaire about the text they read. Even though time limits were not set, the researcher recorded the time spent answering.

Analyzing the findings, a significant difference was found between the comprehension scores in the hypertextual and linear reading ($t = 6.001$, $p = < .001$) with a correlation between the two scores of $r = .433$ at $p = .005$. As represented in Table 2, students' scores for the linear text were higher than for hypertext version.

Table 2. Descriptive statistics for surveying and comprehension measures.

		Mean	**Standard deviation**	**N**
Linear text	Survey measures	100.732	25.533	41
	Comprehension measures	131.366	23.026	41
Hypertext	Survey measures	122.220	28.549	41
	Comprehension measures	107.405	24.836	41

(From MacDonald, 2004. P. 58)

A significant difference was also found between the survey scores ($t = 3.776$, $p = .001$). Students demonstrated better comprehension of the linear text and better use of the survey strategy in the hypertext. Moreover, the study revealed a correlation between the use of a survey strategy and comprehension in hypertext, while such a correlation was not found for linear texts. Participants' age and number of years spent in the school did not correlate with comprehension scores nor with surveying scores. Only the number of years spent in the middle school are significantly correlated with both linear and hypertext comprehension; indeed the experiment found linear/comprehension correlated at $r = .38$ at $p < .05$ and hypertext/comprehension correlated at $r = .41$ at $p < .01$.

As shown in Table 3, multiple regression analysis found that the measure of hypertext surveying, ERB scores, numbers of year in the middle school and motivation were significant in improving hypertext comprehension.

Table 3. Multiple regression analysis of hypertext variables.

Independent variable	**R^2**	***T***	***p***	**Beta**
Hypertext surveying measures	.243	2.554	.015	.297
ERB standardized test scores	.388	4.051	.000	.459
Years in the middle school	.516	2.574	.014	.301
Motivation/Persistence	.578	2.292	.024	.259

Note: p = < .001

(From MacDonald, 2004. P. 65)

Of those, only ERB scores and years in the middle school were found to be relevant for linear text comprehension. A further analysis showed that there was a significant difference in hypertext comprehension (t = 2.236 at p = .031) between students scoring above the mean on the ERB test and those scoring below the mean.

Finally, an analysis of students' preferences for linear text or hypertext was conducted using students' written reports. The preference was related to three variables--preference for surveying, for reading and remembering, and for being assigned. Only students who indicated a clear preference were used for the analysis, while students' who did not have a clear inclination were not counted. The results showed that 51 percent preferred the linear text for surveying (hypertext: 39 percent), 49 percent preferred the linear text for reading and remembering (hypertext: 39 percent), 49 percent preferred the hypertext for being assigned (linear: 34 percent).

Participants in the study better comprehended the linear text but they more accurately applied the survey strategy in the hypertext. Moreover, a positive correlation emerged between the use of the surveying strategy in hypertext and the comprehension of the text.

To address the issue of hypertext reading, Hardy (2001) performed a pilot study and two experiments. In the pilot participants read a computer text in which hyperlinks were placed before or after designated sentences. Participants were then asked to recall facts or to integrate information from the texts read. Afterwards Hardy conducted two experiments to investigate whether the interposition of hyperlinks between pairs of sentences would diminish readers' ability to integrate information included in such sentences.

In the first experiment, twenty-four pairs of sentences were designated through a passage. The sentences could be separated by a link that is inside the first sentence (the link can bring to a related or to an unrelated sentence), consecutive without hyperlinks, or linked by a hyperlink at the end of the first sentence. Before reading the passage, participants had to answer to five general questions to find a correlation between hypertext reading skills and text comprehension.

As shown in Table 4 inter-sentence integration was more successful when no links were interposed between sentences. When a link was placed between sentences, the content of the node appeared irrelevant; indeed, the mean of the link between/node related conditions was higher than the mean of the link between/node unrelated conditions, but the results were not significant.

Table 4. Average mean percent correct responses for questions in each condition.

Experimental conditions	Sentences separated	Related node text	M % correct	N Correct out of 6	Std. Error	Std. Stat.
No link	No	N/A	.48	2.90	.1956	1.55
Link between/Node related	Yes	Yes	.47	2.82	.2005	1.59
Link between/Node unrelated	Yes	No	.42	2.52	.2009	1.59
Link after sentence1/ Node=Sentence2	No	Yes	.51	3.06	.2047	1.63

(From Hardy, 2001. P. 47)

The researcher wanted to learn whether general literacy and variables such as learning ability and reasoning skills had a role in learning performances in hypertext environments. The subjects were, therefore, separated into two groups using the scores on the general test questions. The results of the experiment found that in the group having higher skills the average mean of correct responses was .75, while in the other group it was .44. There was a significant difference in correct responses between the two groups [$F(1.61) = 84.37$, $p < .01$]. Also, general skills and orientations are effective determinants in learning performances in a hypertext environment.

In the second experiment the researcher analyzed displacement effects and node content effects using the pair of sentences designated for the first experiment.

The results show that inter-sentence integration was more successful when there were no links between sentences than in the link between/node unrelated condition where the link was represented by a word unrelated with the linked sentence [$F(1,120)=15.9$, $p<.001$].

Also, as similarly reported for the first experiment, general skills and orientations appear effective in learning performances in a hypertext environment. It is evident when comparing scores achieved on the general questions with the ability to handle interruptions generated by links. As shown in Table 5, participants having higher scores on the general questions had also a higher means of correct responses on inter-sentence integration.

Table 5. Average mean of correct responses in relationship with general question scores.

Conditions	**Group A – High average (N = 15)**	**Group B – Low average (N = 12)**
No link	.71	.63
Link between/Node related	.62	.62
Link between/Node unrelated	.52	.45
Link before/After	.63	.52
Text between/Text related	.63	.50
Text between/Text unrelated	.57	.38
General questions	.80	.47

(From Hardy, 2001. P. 70)

For the non-hypertext condition, when related text was inserted between sentences, there was an increase in the number of correct responses from 1.0 to 1.11 to 1.33 as the number of inserted sentences increased from two to four to six. The difference between the "two sentences in between" condition and the "six sentences in between" was significant [$t(26) = -1.803$, $p<=.10$].

These results show interruption effects in the inter-sentence integration associated with hypertext structure generated by the displacement of text, and the interruption is directly related

to the content of the node (unrelated text and unfamiliar words generate a lower ability to integrate sentences).

Swanson (2004) conducted a qualitative study designed as participant observation where the researcher has been accepted as a natural part of a classroom culture, observing 18 fifth grade students. The students in the classroom were good readers and had access to a computer lab for teacher-guided computer experience at least one hour per week. The main purpose of the study was to investigate the role that prior knowledge and text structure play in the reading process, and in understanding the role that hypertext has within the reading learning process.

Participant observation was combined with interviewing (both before and after students were given a lesson about hypertext structure), field notes, taped reflections, student journals and a student product in order to understand how participants dealt with hypertext structure.

At first students were asked to evaluate their degree of comfort with hypertext using a scale from one to ten (with one being the least comfortable and ten being the most comfortable). Analyzing the results the researcher pointed out that the mean for knowledge and use of hypertext prior to the lesson was 5.42. The median was 4.75 and the mode was 4.0. After the lesson, the mean was 8.89, the median was 9.25, and the mode was 10.

In the pre-lesson interviews, students stated that their approach and strategies were the same for reading books or hypertexts since those were considered very similar activities. In the post-lesson interviews, they changed their approach, stating that different strategies were needed for hypertext reading. Typical comments were “Now I look for different kinds of print, punctuation, things you can click into, bullets” or “I can look at [and read on] a computer in a completely different way now” (p. 69).

Moreover, participants' pre-interviews and journals emphasized the fact that the students did not think about the accuracy of information published on hypertexts. Since the layout appeared to be similar to that of dictionary or encyclopedias the accuracy was also considered similar. An emblematic comment was "I am pretty sure this is true because they wouldn't put something up there [in a hypertext] unless it is true" (p. 72). After the lesson, all the participants understood that accuracy was a fundamental issue to evaluate before trusting information found on the Internet. To do so, they indicated variables such as the identity of the author and URL (universal resource locator), but also layout, pictures and links were significant.

Before the lesson half of the participants had a basic understanding of navigation within hypertext. Those who used the Internet did not have valid comprehension of its usefulness and did not navigate it with ease. When asked how they read hypertext most declared that they would locate the information first and they would read from left to right, from the top to the bottom having found the information.

After the lesson all the students learned to navigate the hypertext capably and with ease. They felt more comfortable and acknowledged that the reading of hypertext was supposed to be a "jumping around" as readers are asked to select their own reading trail. Knowing and understanding the structure of hypertext helped them feeling at ease while reading and gave them a better comprehension of the text.

For those students who experienced a bigger change in their understanding of hypertexts after the lesson, it is relevant to note that such change was combined with an improvement in their willingness to use the particular medium. One of the participants argued that he made great strides thanks to the lesson, but he still needed more practice to understand better and use the

procedure of the hypertext to improve further his results. For those students who already had some knowledge of the navigation devices but did not have reading strategies for hypertexts, the lessons greatly enhanced the effectiveness of researching information through hypertexts.

All the participants consistently experienced an improvement in their use of hypertexts and in their attitude toward the Internet.

Dail's study (2004) was based on the idea that technology represents a recent change in the literacy demands and practices in today's classrooms. In her study a tenth-grade English language arts class was observed to identify the processes tenth-grade students use when reading online hypertext. Cookies were used to track students' trail throughout the hypertext and reading comprehension questions attempted to measure their understanding of the hypertext.

Transcribed videotapes, think-aloud protocols and follow-up interviews with selected students further addressed the hypertexts reading processes. Two surveys were used as the primary data source to measure students' attitudes as computer users and their experiences with computers.

Cookies were used as a tool for tracking students' movements while reading the online hypertext in order to describe the participants' processes of reading hypertext on the computer. The data provided by the cookies were used to compare the estimated amount of time a student spent navigating the site to that student's score on the comprehension questions, and the amount of time spent answering those questions. Finally, data addressing computer literacy, students' ease using the computer, and their reasons for using the Internet were collected.

After an analysis of the cookies it appeared that the student who received the lowest score on the comprehension questions spent approximately seventeen minutes navigating the hypertext

and six minutes answering the comprehension questions. That student visited each of the hypertext's links in the order in which they were sequenced on the hypertext's home page. After reading the main hypertext he accessed one external hyperlink. By comparison, the student who received the highest score on the literal questions spent seven minutes navigating the hypertext and ten minutes answering the comprehension questions. His navigation path was entirely internal to the site for the hypertext reading. He reported he did not follow any of the external links because he wanted to focus only on the basic information needed. The latter student accessed each of the hypertext's links, but he did it in an order that was different from the one established on the hypertext's home page. He decided to follow one external link only after reading the main hypertext.

For the other students the amount of time spent reading the hypertext and answering the question was variable and did not profile specific trends. But the one who spent the least time navigating the hypertext (two minutes) was the one who spent the most time answering the questions (nineteen minutes). As highlighted from the cookies, he jumped from link to link without spending any significant time interacting with the material contained within the links.

The researcher measured students' comprehension of online hypertexts using a scale in which 0 was the lowest score possible and 12 the highest. The average score the students received was 5.23 (with a maximum score of ten and a minimum of one).

The findings of this study indicated that students needed direct instruction to manage better reading strategies in this new literacy context. The study extends facets of another work by Lawless and Kulikowich (1998) by applying overriding components of it to an online reading

scenario in order to examine the ways in which students interact with and comprehend the hypertext document.

As a whole, the participants were a collaborative group of students who dynamically used the computer and the Internet in both their private and their educational lives. Each student carried diverse experiences related to computers and the Internet, and they had unlike attitudes toward such means. However, the majority declared themselves at ease with the idea of using computers.

Consistently, all the five studies pointed out differences existing between linear and hypertextual reading. Hyperlinks are often experienced as an interruption that generates a lower comprehension of the text and affect the readers' ability to integrate the meaning of the sentences. These links are frequently causing a separation instead of providing a tie between chunks of text. The experience of an uncomfortable "jumping" read has been underscored, as well as the bothersome feeling of missing some information through link choice. Moreover, reading skills, academic grades and computer literacy are all positively associated with the experience coming from hypertext reading.

Chapter 5 - Conclusion

The current study started from the assumption that people do not always feel at ease when navigating on a hypertext, as they often do not know how to profit successfully from the hypertextual structure. The data collected have confirmed expectations that hyperlinks and hypertexts are not always user friendly or self explanatory.

The opening assumption was that people who are used to linear reading do not have the strategy necessary to navigate easily the Internet or to access the information 'hidden' in a hypertext. Lacking the proper literacy, hypertext reading generates frustration because readers are not able to find the information they need. Hypertexts' non-linear and non-hierarchical structures disorient them. Choosing between hyperlinks people can exclude relevant information, get lost in the Web or end up reading documents they were not looking for. The outcome will be a sense of dissatisfaction generated by the feeling of wasting time in a never ending digression. The concern associated with hypertexts is whether they really make it easier to find information, and whether the statement "I am getting lost on the Web" is the exception or the rule.

Hypertexts' structure is based on hyperlinks, which can be experienced as an interruption to the reading process or as a launch pad speeding up the movement. As suggested earlier, good links should be a sort of stepping stone that stimulates reading progress. More often than not, as emphasized in all the five studies analyzed in the current meta-analysis, it does not happen.

After a quick review of the data one impression is that people usually experience hyperlinks as an interruption that distracts their attention generating a lower comprehension of the text and a higher disorientation due to a lack of familiarity with hypertext structure. People with good

reading skills tend to use linear strategies for hypertextual reading, and such practices generate frustration due to the different structure of hypertexts. A call for updating reading strategies is evident.

On one hand hypertextual jumping reading generates interruptions that finally make people lose their concentration. On the other hand hypertexts seem to fascinate people who would rather read a document in such a format even though the outcome is often frustrating and affects their ability to elaborate and retain information. Klinberg (2008) argued that if people do not focus their attention on something they will not remember it. Hyperlinks are distracting elements in a hypertext that disturb people's ability to focus their attention and, as a consequence, negatively affect their memories and the comprehension process.

The aim of the current study was to investigate the different experiences coming from reading linear and hypertext formats of a text and the relationship existing between literacy and comprehension achieved while reading hypertexts. Specifically, the objective was answering two research questions: What different experience comes from reading linear and hypertext versions of the same text? What relationship exists between literacy and the comprehension achieved by reading hypertexts?

The first issue was based on the assumption of a difference between traditional and hypertext reading. The assumption has been confirmed by the data. In order to address the first research question, a number of variables have been considered including ability to answer questions about the text read, level of comprehension, ability to find the information needed, ease or disorientation, engagement or identification, and reading time.

Addressing the differences between hypertexts and linear texts as related to the time necessary for reading, Miall and Dobson found in both their experiments a significant difference. Hypertextual readers constantly needed more time to read the same information. Moreover, the participants in the study consistently experienced the hypertextual reading as jumpy and uncomfortable. They felt some information was missing. Comments such as "the story seemed to be very jumpy" and "it seemed like there were bits of information missing" have been collected from the recorded quotes.

This outcome is probably related to the content of the text read since Miall and Dobson used literary texts which were somehow difficult to read. But the lack of comprehension occurred only with hypertextual reading as the control group did not emphasize such obstacles. This likely means that participants in the study had the skills required for profitable linear integration comprehension but not for hypertextual comprehension.

According to Miall and Dobson's outcomes, hypertexts as a vehicle for literary reading appear to distance the text from the readers. This is because participants experienced a lack of engagement and identification, increased confusion, lack of fluency, a longer time needed for reading, and a reading comprehension strategy which was less effective than in the linear format. Also, when readers reported enjoyment, their pleasure was generated from the possibility of driving the hypertext construction through link choices and from the ability to put the story together (since the plot was experienced as being out of order).

The power of choosing between links generated two opposite reactions: On one side people enjoyed the authority and the ability to construct their own text controlling the hypertext. On the other side choosing between links appeared to be annoying because readers felt they were

missing information due to their choices. Moreover, the text reached sometimes failed to correspond to readers' expectations.

The latter outcome may be the consequence of using a simulated hypertext. Miall and Dobson created simulated hypertexts using texts that were shaped for linear reading; also, the text associated with the hyperlinks did not have a direct relationship with it, and this may have caused frustration at not being able to reach the information expected. Anyway, with large amounts of hypertexts of poor quality on the Internet, the lack of correlation between link choice and information reached reasonably mirrors reality.

As shown in Miall and Dobson's study, hypertexts have their own structure that differs from linear structure. The outcomes show that designing a hypertext does not just mean putting a linear text on the screen. It is necessary to make a re-design that takes into consideration the characteristics and the potentiality of the new medium in order to achieve a new text that can be better understood and remembered, generating profitable reading comprehension.

Miall and Dobson's study emphasized that the hypertextual experience causes defamiliarization and lack of identification with the information read. A significant majority of hypertext readers underscored that such reading was confusing and difficult to follow. Nevertheless, hypertexts seemed to be more challenging and generated a higher level of satisfaction--once understood; the ability to rebuild the information putting together the plot is the main source of pleasure generated from hypertext reading.

Hypertexts readers cannot relax and put themselves in the author's hands in a passive relaxing reading. They always need to be active as choosing between hyperlinks is a continuous challenge that can generate both satisfaction and frustration. The outcome is consistently

underscored in the data collected for the current meta-analysis. In MacDonald's study a typical comment was, "I found the textbook easier because it was hard for me to survey on the hypertext because I had to keep clicking to see the next section. It was much easier just to flip the page and see everything at once" (p. 81). It is interesting to note that in MacDonald's study more students preferred the hypertext for being assigned, even though they preferred the linear text for surveying, reading and remembering. The hypertexts seem to be viewed as more difficult and challenging, but also as more attractive.

Hardy found disturbing effects in the inter-sentence integration associated with hypertext structure. Such an outcome can easily trigger frustration when the reader is not able to integrate successfully information as a consequence of hyperlinks-generated interruptions.

Swanson's study emphasized that reading hypertexts took many exposures before participants became comfortable with it. On the first attempts, participants found that the words were familiar but everything else about reading hypertexts was different. The structure was multi-linear and more complicated than the textbooks' structure; without appropriate literacy students were confused and unable to comprehend and enjoy the material effectively.

Dail's study underscored readers' frustration when their navigation did not produce the results they expected. This outcome highlights that students' expectations play a role in how they respond to the media they use and to the information they find while navigating on the Internet. Frustration was apparent in students walking away from computers, or staring at an inactive computer screen waiting for something to happen.

MacDonald pointed out a significant difference between linear and hypertextual reading comprehension, with better scores registered for linear readers. Also, a difference was recorded

as it related to survey strategy; better scores were highlighted for hypertextual readers who were more effective in applying the strategy. As it related to the role of literacy in hypertext reading comprehension, MacDonald's study stressed a significant correlation between years spent in the middle school and both linear and hypertext comprehension. This may be an indication that people who have received a thorough instruction in the use of reading comprehension strategies for linear texts are able to generalize such skills and use them for hypertext reading comprehension. Such literacy can generate independent readers and learners.

It is interesting to note that MacDonald's study found a correlation between survey strategy and comprehension in hypertext but not in linear text. MacDonald attempted an explanation arguing that surveying linear text is such an automatic process for students in the middle school that it does not generate better comprehension, while hypertextual surveying is a novel activity that requires higher levels of attention.

According to MacDonald's' outcomes, literacy appears to be significant in both linear and hypertextual comprehension. Motivation is relevant only in hypertext comprehension. This means that hypertext comprehension depends strongly on how people feel toward such text: A positive bent for hypertext is likely to generate a better understanding of it. Comprehension is the responsibility of readers who are the authors of their understanding process.

MacDonald found that a small majority of students expressed a preference for surveying linear text (51 percent) over hypertext (39 percent); analyzing the qualitative data, both participants who chose the linear or the hypertextual text justified such a choice because they found it (the linear or the hypertext) easier to navigate. Ease of navigation was also mentioned as a reason for students who preferred the linear text for reading and remembering. Participants

found the textbook easier to read because it was not necessary to go back and forth to access all the information needed. Students who expressed a preference for hypertexts said they found it "motivating." It is interesting to note that a majority of students preferred being assigned to hypertext even though they found it more difficult to navigate and more demanding.

The issues of interruption, jumping reading and information missing when reading on a hypertextual format were consistently pointed out in Hardy's study. The results clearly emphasized the problem of inter-sentence integration when sentence pairs are displaced from one another by hyperlinks. Results significantly showed that integration was more likely when sentences were read uninterrupted. The results of this study enhanced the idea that hyperlinks generate interruption and thereby make it harder to remember and process information included in hypertexts. Variables such as node length and content of the node have some role in inter-sentence integration even though such variables are not found to be significant.

Hardy's study also pointed out that literacy, learning ability and reasoning skills have a significant role in learning and integrating performances in a hypertext environment. Moreover, the ability to handle interruptions appeared positively correlated with general skills. This means literacy has a fundamental role in hypertext processing. Hypertext comprehension and profitable reading are based both on overall skills and familiarity with such jumping reading. The unusual and complex structure of hypertext requires higher physical and cognitive efforts, and subjects having superior ability are more likely to handle successfully the information included in such texts.

Hardy's experiment showed that hyperlinks generate an interruption effect in hypertext reading and negatively affect comprehension. This negative effect is peculiar to hypertexts as in

the linear condition when text related to the sentences read was inserted between those sentences there was an increase of comprehension, shown by a significant difference in correct responses. Hardy suggested that hypertext readers should use different strategies than they use when reading linear texts. It is necessary to introduce hypertext education in students' curriculum. Indeed, even though today's multimedia learning with hypertext is thriving, there is no general theory of learning with such media. The structure of hypertexts and the characteristics of readers are both factor that influence inter-sentence integration and reading comprehension.

Swanson supported this outcome, highlighting that students need to have appropriate schema and reading strategies in order to read advantageously this new type of text. Before the lesson about hypertexts' structure, participants recognized they did not have the literacy necessary to profitably read hypertexts. They affirmed they were using the same strategies as they did for linear reading. After the lesson, they recognized different strategies for hypertexts reading, and they felt their approach was more profitable and their strategy more suitable. This outcome emphasized once more that literacy plays a crucial role as it relates to hypertext reading.

Participants in all the five studies happened to feel "lost" or "confused" when reading hypertext. They consistently stated cohesiveness in the text was missing, and some of them felt their approach to reading on the web was not suitable. The outcomes from all these studies emphasized that students need proper strategies in order to comprehend and benefit from hypertexts.

In Swanson's study participants tried to read the hypertext as if it was an encyclopedia or a dictionary; they were reading using linear strategies. This study showed that additional strategies should be taught to approach hypertext's unfamiliar structure and differentiate it from linear

text's. Participants in this study were not familiar with strategies for non-linear reading even though they were using computers frequently. It means that specific literacy for hypertext processing is not automatically acquired when interacting with a computer; rather, people have to be taught the skills they need in a hypertextual world in order not to feel constantly confused and unable to comprehend the material effectively. A suitable curriculum should include hypertext structure, accuracy evaluation, physical layout and navigation strategies.

Hypertext literacy is a tool that helps people feel at ease while reading online and enhances their ability to understand better a hypertext. Moreover, superior skills for processing hypertexts make people more likely to enjoy such text and more interested in using the Internet. Literacy is fundamental to allow people to benefit from the online hypertextual, never-ending source of information that is the Internet.

Just a few lessons about hypertexts improved students' efficiency of task, creativeness of products, reading comprehension scores, ease in navigation and comfort levels. As Swanson pointed out, students should have experiences to understand the new language, syntax, vocabulary and procedure of the hypertext world. They need to be taught effective schema and navigation strategies to read successfully and comprehend hypertexts.

According to Swanson's findings, students who were exposed to hypertexts added graphics and decoration to written text in their projects. It suggests that exposure to these new formats helped students construct more creative products. Participants in the study demonstrated a positive attitude towards hypertexts: Swanson's study underscored that students "would prefer to start their research on the Internet because it was fun, easy to get the material and fast."

Dail emphasized that technology has modified the way the classroom environment appears. Indeed textual forms such as hypertext are quickly playing a larger role. This is an important variable to consider when studying hypertext since their spread is becoming more and more relevant in today's learning environment and everyday life. Through observations of students and collection of a variety of data emerged different trends regarding the processes students use in reading hypertext. In Dail's study, the students received no direction reviewing or addressing hypertextual reading strategies prior to accessing the Internet to search for information.

Dial's results showed different patterns in hypertext reading comprehension. A first category was represented by students who spent less time reading the hypertext. They needed more time for answering the questions and eventually scored lower in the comprehension questions. Data from the think-aloud protocol of such students underscored that they gave up on reading texts that confused them and they had poor strategies as readers. Some of these students often slouched in their seats and assumed confused facial expressions such as squinting. These students were not used to navigating on hypertexts, they disliked reading, and they did not have a good knowledge of computers.

A second category included students who approached reading specific hypertexts based on their interest and resulting knowledge as readers. According to their conversations with the researcher and their responses on surveys, students in this category participated in online activities (such as reading Web pages, searching for information, and writing emails) in a computerized environment on a regular basis.

These differences emphasized the role of literacy in hypertext reading comprehension; students who did not have skills for reading, did not know how to interact with a computer, and

did not have prior knowledge of hypertext structure had lower grades in the comprehension questions and experienced higher frustration. Dissatisfaction was registered when the computer and the Internet did not function as the students expected, and such outcomes stressed again the importance of computer literacy and knowledge of hypertext structure for successful hypertext reading comprehension.

The appropriate literacy includes being prepared to navigate the Internet, knowing the structure of hypertexts, using software applications, and solving small technical problems. Students who demonstrated frustration were not profitably interacting with the software application or were not able to overcome technical problems. It is important to note that the majority of the students described in Dail's study were self-taught consumers of the Internet.

Student practices in a hypertext medium pointed out their need for instruction on how to read and make successful decisions in an online environment. While many students had problems understanding the hypertext, they showed an enthusiasm to read in this "charming" medium.

All these studies revealed that people are typically attracted to hypertexts, but at the same time fear such texts since they lack the literacy necessary to enjoy them.

The study of hypertext structure, non-linear reading and online literacy needs to be introduced in students' curriculum, since in today's society being online is not a choice anymore. Many people live the majority of their time online. People risk wasting a lot of time and missing a lot of opportunities if they don't have the suitable literacy for successfully accessing information with the online medium and handling hypertextual structure.

The Internet is a wide source of information comparable to the Library of Babel that Borges was dreaming of in 1941: A universal library containing the entirety of human knowledge. The

increasing number of online resources risks amplifying the gap between people who are able to access information online and people who are not. The potentialities of the Internet are enormous. Therefore, it is necessary to provide people with the literacy they need to benefit fully from such a resource. Curricula need to be updated.

Students need to be taught non-linear reading strategies, as linear literacy does not appear adequate to provide them with the competencies necessary to proficiently read hypertexts. After the current study it is evident that hypertexts' structure has major differences from linear texts' structure, which makes a difference in reading strategies necessary. Students who used linear strategies for reading hypertexts consistently spent more time reading in the non-linear format and had less effectiveness. This was because their reading comprehension process was less successful as compared to traditional linear reading. People are attracted to hypertexts but they need the necessary literacy to profitably use them.

On the other side, an improvement of hypertext design is also needed. Writer for hypertexts should understand that the process of reading is different in an online environment. Hypertexts properly drawn probably would not disorient the reader as much as they seem to do in today's online environment. Indeed, as emphasized in the current study, readers' frustration is associated with the problem of not finding the information needed and from the impression of wasting time with a story that does not flow properly. Such problems are related to a lack of non-linear reading strategies but are also a function of poorly draw hypertexts that simply put linear texts on the screen without considering that the text needs a re-design for a different medium.

Moreover, referencing Innis' *The Bias of Communication* (1951), the Internet can be considered a light medium. The documents that are on the Internet do not even need to be

transported. They are accessible virtually everywhere. The Internet is likely to change people's perception of time and space. The Internet is a portable medium and has a unique characteristic as its portability is not material but rather virtual. We can potentially access the same information from every part of the world, where there is a connection to the Web. It means that the Internet owes its portability to its accessibility, as people do not need to bring a computer around the world to access information. The aspect of durability is more difficult to investigate as it is not clear whether the information stored on the Internet is durable or not. The medium has a space bias that can have consequences for society. It may also have a time bias, but its durability is not demonstrated yet as the Web is a new medium, and there is not clear information about the corruptibility of information stored on the Internet.

Limits of the current study

Time constraints obliged the researcher to select only five studies for the current meta-analysis, while a comprehensive meta-analysis should select seven to ten studies to explore fully the existing data in the field of inquiry. Nevertheless, the sample of studies selected was acceptable considering the time constraints and the lack of relevant studies addressing the research questions. Moreover, three of the five studies selected replicated experiments, providing two sets of data each. Also, they provided a variety of quantitative and qualitative data that are fundamental to the analysis of a complex phenomenon such as the hypertext experience.

Another limitation of the current study is that the data set include some obsolete studies, considering the fast pace of technology's development. The Internet has spread enormously from 2001. And data collected in 2005 also need to be updated as people got to be more and more exposed to the Internet and online documents in the last few years.

Directions for further research

As little research has been done in this area and data involving technology need to be updated rapidly, it is necessary to conduct further research involving the hypertext experience.

Considering that today's adolescents were born in a hypertextual world, it would be helpful to replicate Miall and Dobson's study selecting two different experimental groups: The first would include individuals aged 17-21, assuming that people belonging in this age group received their primary education in a hypertext world and never lived in a paper-based world. The second experimental group would include people aged 35-40 who were plunged into a hypertextual world later on in their life, but in today's society are somehow exposed to hypertext for their jobs and lives. Such a study would investigate whether age is a relevant variable as related to hypertext reading comprehension. This is based on the assumption that people who were born in a hypertextual world could have a different approach to the Internet than people who received their primary education in a paper-based world.

The reader of a hypertext is extremely active and his or her reading skills are continuously challenged since the process of reading request a contemporaneous activity of deciding which is the path to follow. It is necessary to investigate whether these new texts can bring to an unlike reading process and, consequently, to a different understanding process. The relevance of this research is evident now, when the world of mass media is in the middle of a revolution due to the introduction of the Internet. Are people still asked to use linearity and logical progression or rather are they forced to use non-linearity and non-hierarchical paths? How will their reading skills be affected?

Such a study would start addressing whether hypertexts are likely to have consequences in the way people read, study, learn and mentally structure their world.

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