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THE NATURE OF HYPERTEXT: BACKGROUND AND IMPLICATIONS FOR

LIBRARIANS

There has been much talk in recent years about the way electronic information is

breaking down the walls of the traditional library, muddying the boundary between what

is owned in the library building and what can be accessed from the larger world.

However, the advent of electronic hypertext is causing another kind of "breakdown," this

time among individual texts. Hypertext allows connections among words or phrases in

an electronic environment: highlighted text in one document links directly to other

documents or to other parts of the same document. Given the flexibility of hypertext, a

group of texts can form a highly complex environment with multiple paths for reading

and understanding. The boundaries between individual texts, so easy to identify in the

print environment, therefore lose their meaning. Hypertext is affecting the way users

read, write, and think about information.

Hypertext has been used in various environments, the most familiar being the

World Wide Web: a space to which any individual or organization, with the appropriate

computer connections, may add documents and links connecting documents. Hypertext

can also be used in closed environments, such as those produced by Intermedia or

Storyspace software for instructional materials. When considering the impact of

hypertext, it is important not to confuse the properties of hypertext in general with

particular environments.

This article will focus on the characteristics of hypertext as a medium, how it

compares and contrasts with print, and its impact on the academic teaching and

learning environment. It will also suggest a few of the implications for librarians who incorporate hypertext into library practice. It seems clear that hypertext is creating new conventions for scholarly communications; librarians need to be aware of the possibilities and challenges of this new technology.

PRINT AND HYPERTEXT COMPARED

Before considering the impact of electronic hypertext, it is first important to understand how traditional scholarly communication has been created and defined by the medium of print. As described by George P. Landow and Paul Delany, the printed text is "*linear*, *bounded* and *fixed*."[1] It has a particular focus, a clearly defined audience, and a single voice. Although printed texts can be browsed at random, they are given particular forms so that arguments can be developed and supported in a logical fashion. These texts are connected to the larger world of scholarship through their citations, but remain separate artifacts, and as such, have defined the way that scholarly communication has developed.

Another tenet of the print medium has been the creation of the canon: the chosen texts that are assumed to contain the central, authoritative "truths" of a discipline. By staying readily available in print, these texts retain their central role, while other less accessible texts take on secondary positions or slip from sight altogether. In addition, in the print world, the existence of different document types, such as dictionaries and encyclopedias for background information, or periodical articles for current, narrowly

focused research, provide signposts for organizing information and delineating an orderly path to knowledge.

The history of hypertext can be seen to begin in 1945, when Vannevar Bush wrote his seminal article "As We May Think." Bush outlined a method for organizing the growing "mountain of research"[2] to show connections within and among disciplines. He criticized traditional data storage, which forces documents to reside in a single part of a hierarchical structure. In his opinion, "The human mind does not work that way. It operates by association."[3] He theorized a system he called "memex," which would allow a researcher to connect any number of documents in multiple ways, adding "marginal notes and comments" to create a "an enlarged intimate supplement to his memory."[4] While Bush saw microfilm as the medium for his system, the memex is clearly the theoretical precursor of hypertext.

Bush saw memex functioning within the traditional framework of scholarly investigation: the user simply creates links and annotations in a more efficient manner than before. Theodor Holm Nelson, who coined the term hypertext, envisioned a system that would allow everyone access to all published material: the documentary universe, or "docuverse" of information.[5] Beginning in the 1960s, he saw the computer as the means to break away from sequential reading and writing. According to Nelson, all texts should be treated equally and with no censorship. In his opinion, "the purpose of computers is human freedom."[6]

Hypertext allows instantaneous, multi-linear connections among documents. For example, references, which in print exist at a physical distance, may be directly connected to the referring text. Also, the process of referencing footnotes to footnotes,

unfeasible in print, may be continued indefinitely in the electronic environment. In print, the process of creating a text with a logically argued thesis requires a degree of exclusion: documents peripheral to the central argument may be relegated to footnotes or may disappear from the text entirely. In hypertext, peripheral information finds a place: "no individual point of view need be excluded."[7]

When texts are linked together electronically, the sense of separate artifacts breaks down. As Jay David Bolter points out, "Hypertext encourages us to think of all texts as occupying the same writing space, and to regard any one author as simply adding new elements and links to that space."[8] Hypertext therefore breaks down the traditional hierarchy among texts by making each an easily accessible component of a given environment. Canonical works, secondary texts, scholarly commentary, and even student essays can be connected so that each appears equally authoritative and viable. Depending on which texts are chosen for a particular environment, the canon itself may ultimately expand or change. While some celebrate this democratization of communication, others worry that the techniques of close reading and careful writing fostered by print will be threatened, and that scholarly communication and critical thinking will be undermined.

It is important to realize that while the hypertext environment is democratic in theory, specific environments may be constructed to highlight certain documents or connections among documents. Particular texts may take on a central position, analogous to a traditional hierarchy, by the sheer quantity of links that lead us to them. Also, documents must still be selected: unless Nelson's goal of linking all texts into a

single docuverse is reached, the inclusion of certain texts still implies the exclusion of others.

It can be argued that the differences among types of print material are as great as those between print and hypertext. Consider the monograph with its linear structure, the dictionary designed for selective consultation, not to mention train schedules, menus, order forms, and flip charts. Our long print tradition has allowed the development of a large variety of formats and a complexity of conventions.

Although hypertext conventions are still being formed, it is clear that conventions will develop just as they have in the print environment. Is hypertext, in fact, so very different from print, or is it merely extending characteristics that have long been apparent in print communications? For example, a book's index provides opportunities to use the text in a non-linear fashion. As Bolter points out, "the index defines other books that could be constructed from the materials at hand. . . . An index transforms a book from a tree into a network."[9]

Since the 1970s, postmodern literary theorists have explored the relationships among authors, texts, and readers in a way that foreshadows hypertext. For example, reader-response criticism suggests that readers create their own texts by bringing their personal experience and preconceptions to the act of reading. For their part, the deconstructionists argue that texts expand to include interpretations, and that the process of interpretation is never-ending. Hypertext seems to confirm the critical notions about the elusive boundaries between texts and the questionable authority of authors. It could be argued that hypertext is a logical extension of characteristics

already inherent within and among texts. Hypertext simply makes these characteristics manifest.

The hypertext environment can be viewed as an extension of the long-held impulse to bring together a universe of knowledge through a single encyclopedic work or a library of materials classified to show their relationships. As Bolter points out, electronic books are not restricted to particular positions on library shelves, but instead "can merge into a larger textual structure at a thousand points of contact. . . . An electronic book . . . invites exploration as part of a vast network of writings, pointing the reader both to itself and to other books."[10]

USES OF HYPERTEXT

How can hypertext be best used? Bolter suggests that hypertext "can express cyclic relationships among topics that can never be hierarchical."[11] Clearly, indexes, directories and dictionaries fall into this category. Also, hypertext can be used to provide many layers of information on a topic, so that users with different levels of expertise can work through these levels to learn at their own pace. Hypertext is also valuable for comparing conflicting points of view, describing open-ended arguments, and depicting the cross-fertilization within and among disciplines. A well-organized hypertext environment can give shape to the pattern of scholarly inquiry, highlighting what Bolter calls "a structure of possibilities."[12] By showing how a subject expert formulates questions and makes connections, users at all levels gain an understanding

of the scholarly process. As Landow and Delany point out, "Hypertext thus helps novices to learn, quickly and easily, the *culture* of a discipline."[13]

Landow argues that hypertext can actually "teach a novice reader the habit of nonsequential reading"[14] that is so essential to scholarly activity. He cites the Intermedia project at Brown University which developed a hypertext framework for synthesizing course materials.[15] Students in two classes, Biology and English, were able to follow links to different authors and areas of research, to connect each course component to a wider context, and to view conflicting solutions and theories. According to Landow, who taught the English course, and Peter Heywood, who taught Biology, students using hypertext showed a superior ability to interrelate diverse materials. As one English student put it, they were "Learning to learn."[16] Interestingly, this hypertext system also gave students additional encouragement to complete the course readings; therefore, some of the students' improved performance could be explained by their more diligent approach to traditional learning tools.

It is important to realize that Intermedia was a complex and highly-organized project created by a large team of experts to complement particular classes and pedagogical approaches. As the report stresses, "it is the instructor working in conjunction with Intermedia's hypertext capabilities which is at the heart of most improvements."[17] In other words, hypertext is only as valuable as the context in which it is used; the hypertext environment must be carefully created with a particular purpose in mind, just as the print environment requires careful structure and organization. As Victor Raskin has put it, "All hypertext does is to present a format, a methodology, a tool for recording"[18] an established structure.

Landow emphasizes that it is no more possible to make generalizations about the efficacy of hypertext than it is about print; it is always necessary to pay close attention to the "rhetoric and organization"[19] of information. On the other hand, he believes that the possibilities of hypertext should not be dismissed by those who have no practical experience with this technique.

David H. Jonassen and R. Scott Grabinger examine a number of hypertext experiments and conclude that hypertext is a powerful tool for active, associative learning. However, they believe that learning only takes place if users "are accessing the information to fulfill a personally meaningful purpose and have a reasonable level of prior knowledge and interest in the topic."[20] Because of the multiple paths available through a hypertext environment, users must keep a clear goal in mind; if they lose sight of that goal and begin to browse at random, learning will not take place.

CREATING USEFUL HYPERTEXT

As the research on hypertext suggests, useful and effective hypertext environments must be carefully structured. To create hypertext of benefit to users, it is necessary to be aware of the issues central to the nature of hypertext and of the challenges it presents. It is important to consider how best to exploit the strengths of hypertext while minimizing its drawbacks. As Ilana Snyder points out, "Hypertext will succeed or fail not by its own agency but as a result of how it is used by the people and institutions that take it up."[21]

One of the strengths of hypertext, the speed with which it connects a variety of documents, may create challenges for the user. Traditionally, users have needed time to locate and access the many documents relating to a specific research question; while inefficient, the search process allows users time to think, to consider the benefits of a particular approach, and perhaps to make that one imaginative leap that results in a real contribution to knowledge. In a hypertext environment, there is a danger that the process of choosing links will discourage thought; it is faster and easier to follow preestablished paths than to stop and consider alternatives. While the connections suggested by linking may be great, they are not infinite, and are limited by the skills and knowledge of the developers of the particular hypertext environment.

While hypertext provides easy access to electronic texts, those items which remain outside the hypertext environment are more marginalized than ever. Users may be unwilling to shift their focus from easily-accessible electronic information to distant print resources: the difference between accessibility and availability becomes significant. In fact, users may not even realize that more information is available beyond the boundaries of the hypertext. Stephen Boyd Davis speaks of the "illusion of completeness": users may assume that a large hypertext environment includes all relevant texts and all points of view.[22]

While this problem is more a reflection of the hybrid nature of the present scholarly environment--caught between print and electronics--than a failing of hypertext as a technique, until all documents can be linked electronically, developers should indicate the limits of their hypertext environments in some way. Specifically, users need

to know when it is important to leave the hypertext and examine material available elsewhere.

Another strength of hypertext is the flexibility it allows users to explore information in their own way. However, according to Andrew Large, who reviewed the research on learner control of hypertext, there is conflicting evidence on the effectiveness of allowing users to make their own choices. While users like to have control, "designers should exercise caution in handing over too much control to the learner."[23] Ideally, designers should provide enough control to increase the usability of hypertext without curtailing the flexibility and wealth of associational links that allow users the freedom to work and learn in their own way.

According to Large, the research "suggests that it is too simple a question to ask whether or not learner control works better than program control."[24] It is also important to consider such factors as the learner's prior knowledge, ability, age, and motivation. Generally speaking, in any environment, the less users know about a subject, the more control they need. This fact is particularly important to consider when creating multi-level hypertext environments to appeal to users with various degrees of expertise. As users move through each level and pass to increasingly complex information, the appropriate quality and quantity of control will change.

The user's experience with hypertext itself is also an important factor. Research by Paul Kahn and Landow suggests that the experienced user expects a high degree of freedom and even enjoys a certain level of disorientation while navigating through hypertext.[25] In addition, users with good computer skills tend to rely on system-based

solutions, such as search tools, for navigation; subject experts, on the other hand, may be more attuned to stylistic devices that draw on the structure of the discipline.[26]

One way for developers to understand the different perspectives of users is to work collaboratively with them. As Steven W. Staninger points out, since hypertext encourages active participation on the part of users, the creation of hypertext "requires an intellectual partnership between the authors and the users."[27] Ross Atkinson suggests that users and therefore developers must function in three dimensions simultaneously: linearly within a given level, hierarchically among levels and referentially through citations.[28] A high degree of sophistication and collaboration is needed to create an environment that functions coherently in all three directions.

Hypertext can be seen to "defy the laws of time and space which typically govern the physical world."[29] As texts are broken down and linked to other texts in limitless ways, old notions of sequential reading are challenged. However, as users navigate through information, they must find their own paths, bounded by their own experience of space and time. They must decide upon a sequence for exploring the information in multi-dimensional space, and must understand one concept before moving to ideas that build upon that concept. It is therefore important for the creators of hypertext environments to consider the practical limits for manipulating texts and to allow for some measure of linearity so that users can find meaningful paths to understanding.

Hypertext allows for a wealth of references within and among texts. These references can theoretically join together all related texts and provide explanations for all concepts. The possibilities are endless: as Atkinson points out, "there is no beginning and no end to the referentiality of language";[30] all words refer to each other in

an endless network. However, the user may be quickly overwhelmed by too many choices, especially if these choices lead away from a chosen path through information. A balance is needed to maintain the usability of an environment while allowing its inherent referentiality to resonate as fully as possible.

As hypertext documents are linked in complex ways, texts are in danger of becoming separated from their authorities. As Corinne and Peter Jörgensen have pointed out, "the flexible presentation capabilities of hypermedia can obscure the original sources."[31] An added danger, when authors are not clearly indicated, is that the computer itself may be seen as the authority. During the Intermedia project, students frequently cited the Intermedia system as the source of information.[32]

A particular challenge for users is that of navigation, of understanding the meaning of "location" in a fluid electronic environment. In the print environment, the meaning and function of information is reinforced by its position within a text. For example, introductions and conclusions are clearly positioned, while page breaks and chapter headings provide further clues to meaning. In the electronic environment, these physical clues are absent, and texts may be organized using quite different principles. For example, a single text may simultaneously form part of an "introduction," a "conclusion," or an "additional reading," depending where and how it is used. Also, a text may form a central argument in one hypertext environment and a counterargument in another.

The physical location of information may be actually be counterintuitive to meaning and function, since a hypertext environment may call upon documents created by many different developers and housed on widely separated computers. Users

confronted with a variety of "addresses" for information and by differences in the look and organization of documents may have trouble seeing meaningful, unified patterns.

The act of navigation implies purposeful movement from a given point toward a destination. However, as Terence Harpold points out, "The freedom of movement in a hypertext brings with it an excess of narrative possibilities, some of which may lead you away from your original destination."[33] Users may begin with a central, chosen text, but by following links "away" from this text, or using keyword searches to leap to new locations, they are caught in an ongoing process of recentering and refocusing at each new position. Users may soon lose track of their place both in the hypertext environment and even in the scholarly canon as a whole. As Large comments, "If students are disoriented by the hypertext environment they will be compelled to redirect mental resources from learning to orientation."[34]

According to Landow, by moving among many different texts, the user experiences "other voices, other points of view" and a "blending and mixing of genres and modes."[35] Lacking the overriding authorial voice inherent in print, users may be confused by the abrupt movement from text to text and fail to make sense of the implied connections.

Another challenge for the user is determining the quantity of information available in a hypertext environment. Unlike a book or selection of printed materials, where the amount of information can be easily estimated, the extent of a hypertext environment is indeterminate. Users are therefore challenged to pace their studies and to recognize when they have reached a logical stopping point.

In an extensive hypertext environment, there is always another path to follow, another argument to consider. While such scope and flexibility may reflect the nature of scholarly activity, it may also overwhelm the novice student who needs to find a focus and meet a deadline. In time, the nature of written assignments may change; until then, students must be helped to translate the infinite possibilities of hypertext into the finite reality of a term paper. They must learn to find their way, to make selections among many choices, and to recognize when they have adequately explored their topic. Ideally, students should use hypertext to increase their understanding of the culture of a discipline and its connections to related subjects without losing sight of how specific arguments function within the general pattern.

IMPLICATIONS FOR LIBRARIANS

The advent of hypertext is affecting the way information is organized, used, and understood. However, its precise, long-term affects are not known. Some writers, such as Landow, believe that hypertext will eventually dominate print. In his opinion, "books . . . will gradually lose their primary role in humanistic scholarship."[36] However, even Landow admits that transitions from one dominant technology to another, such as from manuscript to print, always take a long time and have unpredictable results.[37] It is therefore important that those who work with hypertext avoid anticipating change prematurely. Specifically, librarians who collect, organize, and teach the use of information, must stay attuned to shifts in scholarly communication and the needs of their specific users. A few of the implications for librarians are considered here.

Collections librarians have a particular responsibility to think carefully about the role of hypertext, since they have the power to make irreversible changes in the composition of library holdings. For example, if certain materials are shifted from print to hypertext, this change may affect the information that users find and incorporate into their research.   Documents made prominent in a Web site or other hypertext environment may be heavily used, while relevant, high quality print materials are underused and undervalued. Collections librarians should work closely with hypertext developers to ensure that users identify and access appropriate materials, regardless of format.

Librarians who develop hypertext environments should draw the user's attention to the boundaries of the environment and the materials available elsewhere. Relevant resources not available electronically, whether specific texts or indexes and bibliographies for identifying texts, should be described and emphasized as appropriate. It may be helpful to include instructions on how to locate or use these materials in the library.

Developers should also strive to preserve a balance between order and disorder: to keep users from becoming lost or discouraged, while encouraging them to forge their own paths to knowledge. Atkinson suggests that while developers must provide some control over their material and impose a degree of order, they must also leave the user "the freedom to ignore such control."[38] Users should be encouraged to try alternative paths within a hypertext environment, perhaps by switching between browsing and keyword searching.

Developers also have an opportunity to make the structure of scholarly communication more explicit in their hypertext environments. They may benefit by working collaboratively with scholars in different fields to show connections among these fields. In addition, they should keep in mind how the organization of hypertext documents can emphasize or undermine the traditional hierarchy among texts, changing how the canon is viewed or suggesting texts for inclusion or exclusion.

As long as accurate citation of individual authorities remains a component of the communication process, developers must make sure these authorities are explicitly shown. Landow suggests converting bibliographical notes to in-text citations, developing a particular icon for citations, or placing bibliographic information in a separate frame in Web documents.[39] Erik Jul goes a step further to suggest "a closer and more dynamic link between bibliographic records [in the library catalog] and the resources they describe."[40] Specifically, bi-directional links could be created between resources and records. Jul goes on to point out that in an electronic environment, "all the spaciotemporal limitations that bounded cataloged cards disappear, and we are free to reconceptualize the relationships between surrogates and resources."[41]

Catalogers face the challenge of providing accurate and meaningful descriptions of hypertext documents when the boundaries between these documents are fluid and shifting. The catalogers involved in the Cataloguing Internet Resources Project at the University of Toronto's Faculty of Information Studies have identified two main categories for Web sites: those with "their own self-enclosed integrity" and those which "serve as a gateway for broader resources," such as computer programs which must be

downloaded.[42] In the latter case, the item descriptions extend beyond locally held materials to include particular remote resources.

Despite the challenges involved in cataloguing Internet resources, in many ways, the catalog provides a natural structure and context for hypertext links. In fact, the signposts provided by a controlled vocabulary of subject headings and authorities may create just the degree of control necessary to guide the user in meaningful ways. The catalog, in effect, can reintroduce an authorial voice into a chaotic environment.

Bibliographic instruction librarians should use hypertext in ways that emphasize its strengths. It is ideal for bringing together disparate materials; for example, to analyze the structure and content of a magazine article as compared with an article from a scholarly journal. It is also an excellent medium for teaching the research process, which is by nature non-hierarchical and recursive, and which requires active choices among a range of possibilities.

Librarians who teach the research process may also wish to encourage collaborative projects involving students, for example in the preparation of electronic pathfinders for specific projects. Such collaboration increases the participation of students and emphasizes active learning. It also gives students firsthand experience with the educational value of hypertext.

The process of comparing and contrasting print with hypertext raises questions about the nature of critical thinking. For example, does the linear print environment reflect something fundamental about the creation and acquisition of knowledge? Will users of hypertext be able to synthesize ideas into cogent arguments, or will they lose the ability for sustained reading and writing? If readers all choose their own paths

through hypertext environments, will they lose the common ground that has traditionally provided the foundation for critical thought and the sharing of information? Or, is the difference only one of degree: have readers always worked from different "texts" because of the different understanding and background they bring to the reading process? Attempts to answer such questions can increase the understanding of critical thinking both in print and electronic environments.

While it is too early to judge the effects of prolonged immersion in hypertext on reading, writing, and thinking, hypertext has the potential to encourage creative thinking and to forge new connections among disciplines. The key is to produce hypertext environments of high quality, while staying alert to changing conventions in scholarly communication.

CONCLUSION

While hypertext is not about to replace print any more than print has replaced verbal communication, the emergence of a new technology always has an effect on existing media. As hypertext develops, librarians must stay alert both to its emerging conventions and to the new perspectives it provides for understanding the traditional print medium, so both technologies are used to best advantage.

When the complexities of hypertext and the many unanswered questions are considered, the task of using, teaching, and creating hypertext environments may appear daunting. However, librarians should continue to improve their understanding of this medium and to incorporate it in ways that are most appropriate for their users. At

its best, hypertext facilitates the connections among ideas and disciplines, provides paths for learning and a basis for knowledge. It can provide librarians, who also function as facilitators, a powerful tool for pursuing their profession.

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