

Bridging the gulfs: from hypertext to cyberspace

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Journal entry 37. Thoughts of the Brain are experienced by us as arrangements and rearrangements – change – in a physical universe; but in fact it is really information and information processing that we substantialize. We do not merely see its thoughts as objects, but rather as movement, or, more precisely, the placement of objects: how they become linked to one another. But we cannot read the patterns of arrangement; we cannot extract the information in it – i.e. it as information, which is what it is. The linking and relinking of objects by the Brain is actually a language, but not a language like ours (since it is addressing itself and not someone or something outside itself).

Philip K. Dick, *Valis*.

Abstract

The purpose of this paper is to focus on two main conceptions at the origin of hypertext technology, and contrast the associationist and the connectionist views. From the starting point provided by this conceptual opposition, it surveys the relationships between users and developers of new computerized communication technologies as inscriptions at the interface. Upgrading Brenda Laurel's models of the interface, it proposes a new conception of the personal interface that acknowledges the virtual presence of the designer, and locates the space of the screen as a dialogic space of mutual engagement.

Defining hypertext

In this paper we look back at the early history of hypertext technology through the alternative visions of two pioneers of the field, Douglas Engelbart and Ted Nelson, and propose issues for the current agenda of personal computing technology for the end of the twentieth century. Following the works of [Halasz (1988) and [Conklin (1987), we describe the structure and the legacy of these visions to raise questions concerning the current status and future of the technology. Our work, however, differs substantially from this earlier research in that we take a sociological perspective on hypertext.

Our thesis here is that Engelbart's and Nelson's visions of hypertext reveal two cultures deeply embedded in the technology, but organized on the same operating principle. Their perspectives take two views on the user: An individual or a member of a community. Engelbart and Nelson are the prophets of these two trends deeply intertwined and absolutely indivisible, for which each of us is defined as a potential user, a class in itself or a member of an entity of greater importance. Both of them address the question of our relationship to the act of creation from diametrically – and therefore complementary and irremediably opposite, points of view.

Virtuality and metaphor are two much-discussed aspects of current interface technologies. Here we propose to link them (and a set of related concepts such as hypertext, hypermedia, user-illusion, intelligent agents, and narrative) in an historical analysis of the development of the technology, going from the seminal work of Douglas Engelbart and Ted Nelson to the current issues in the field. In this set of related concepts, we begin with the notion of hypertext. Hypertext appears historically central to the analysis we are making in this that it can be considered as the first move away from the unidimensionality of the culture of print.

Defining hypertext can be confusing. [Gygi (1990, p. 282) categorized available definitions of hypertext into two types, "broad-spectrum" (Group I) and the "more clinical variety" (Group II). She found Group I definitions in the popular press and in advertising and marketing literature, and Group II definitions in technical journals and research efforts at developing computer-supported hypertext systems. She gave the following examples:

Group I

- Hypertext works by association rather than indexing.
- Hypertext is a format for nonsequential representation of ideas.
- Hypertext is the abolition of the traditional, linear approach to information display and processing.
- Hypertext is nonlinear and dynamic.
- In hypertext, content is not bound by structure and organization.

Group II

- Hypermedia is a style of building systems for information representation and management around a network of nodes connected together by typed links (Halasz, 1988).
- Hypertext is: 1) a form of electronic document; 2) an approach to information management in which data is stored in a network of nodes and links. It is viewed through interactive browsers and manipulated through a structure editor (Smith & Weiss, 1988).
- Hypertext connotes a technique for organizing textual information in a complex, nonlinear way to facilitate the rapid exploration of large bodies of knowledge. Conceptually, a hypertext database may be thought of as a directed graph, where each node of the graph is a (usually short) chunk of text, and where the edges of the graph connect each text chunk to other related text chunks. An interface is provided to permit the user to view the text in such a database, traversing links as desired to explore new areas of interest as they arise, check background information, and so forth (Weiland & Shneiderman, 1988).
- Windows on the screen are associated with objects in a database, and links are provided between these objects, both graphically (as labelled tokens) and in the database (as pointers) (Conklin, 1987).

The definition of hypertext is the result of an historical process, in which the meaning of the term "hypertext" is progressively

stabilized through negotiations among actors of the field. The term “hypertext” is usually credited to Ted Nelson, who says that he coined the term in 1962 with the idea of hyperspace in his mind. According to Nelson, his influence was mainly found in the vocabulary of mathematics, where the prefix “hyper” means “extended and generalized” (Nelson, personal interview, 3/17/93). To Nelson, hypertext was a necessary tool for his work as an author, what he calls “the most fundamental tool of human thought,” a tool that:

allows you to see alternative versions on the same screen on parallel windows and mark side by side what the differences are. Not by scanning but by analysis of data structure. Now the system I started designing in the 1960s, allows you, would have allowed you, will allow you to see connections between the contents of different windows, like rubber bands between the middles of the windows (Nelson, personal interview, 3/17/93).

For Nelson then, hypertext was first conceived as a literary tool that enables the author of a text to extend his or her text to the multiple and successive versions of it, in order to compare them. It is a fundamental tool because “any piece of writing evolves to the very end of its creation. And the real issue is how can we hold partially organized materials for inter-comparison” (Nelson, personal interview, 3/17/93).

At the same time that Ted Nelson coined the term hypertext, Douglas Engelbart was beginning to implement his framework for the Augmentation of Human Intellect at Stanford Research Institute (SRI, in Menlo Park, CA). Although his framework itself did not directly mention hypertext, the core of Douglas Engelbart’s vision was based a very similar premise:

I just almost remember the events, about 1960 or 1961, I was starting looking at this kind of an augmentation system and saying if I really think that there’s gonna be drastic qualitative change throughout that, then we can’t start a research program which tries to cover everything, so where would be the most leverage? And I started ticking my mind in realizing we do have a totally different medium and that we know that your concepts and your mind don’t seem to be just linearly thinkious [sic] core through which you jump, and that you can jump and look at different abstract levels...we’ve got this extremely flexible way in which computers can represent modules of symbols and can tie them together with any structuring relationship we can conceive of (Engelbart, personal interview, 12/15/92).

The introduction of an hypertext-like capability in Engelbart’s framework responded, however, to a very different motivation than Nelson’s. Engelbart’s framework was based on the premise that computers should be able to perform as a powerful auxiliary to human communication and collaboration if they were to manipulate the symbols that human beings manipulate. For such augmentation to take place, a co-evolution of the computer and the human being was necessary – as in the biological notion of symbiotic association, where both entities co-evolve for an ever better fit: The computer should learn to manipulate the human language, and the human being should learn to use the computer. Our analysis (Bardini, forthcoming) of Engelbart’s vision is that it

is based on the assumption that language is more than symbolic representation, better seen as a social construction.

For Nelson, hypertext is a fundamental tool for individual creativity, and for Engelbart, hypertext is a necessary capability of a system designed to improve communication. These two alternatives parallel two different conceptions of the user, seen either as a creative individual or as a member of a community in a human organization.

Association versus connection

Full understanding of the origins of hypertext technology must go back to the ideas of Vannevar Bush on “association” and of Benjamin Lee Whorf on “connection”. Bush’s influence on hypertext is now widely acknowledged (Nyce & Kahn, 1991). Scholars of the technology usually consider his 1945 article “As We May Think” as the conceptual origin of the technology and unanimously quote the following lines as the first expression of the seminal idea of hypertext:

The human mind ... operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain (Bush, 1991, p. 101).

A deeper study of the work of Douglas Engelbart (Bardini, 1995) and Ted Nelson reveals that the emphasis on “association” and Bush’s legacy neglects half of the influence on them. Both Engelbart and Nelson acknowledge that they were very familiar with the work of Benjamin Lee Whorf (Engelbart, personal interview, 12/15/92; Nelson, personal interview, 3/17/93). Engelbart quoted Whorf in his 1962 report to the Director of Information Sciences of the U.S. Air Force Office of Scientific Research, the first comprehensive report on his augmentation framework. And Nelson learned about Whorf’s theory during the course of his studies in sociology at Harvard.

In a 1927 letter printed in his first edition (1956) of *Language, Thought, and Reality*, Whorf introduced the concept of the connection of ideas as “quite another thing from the association of ideas.” When the latter have “an accidental character” as the subject “jumps at the first idea that comes to [his] mind,” the latter corresponds to a “controlled association.” The difference mirrors the opposition of the purpose of hypertext technology, and the representation of the user embedded in it:

“Connection” is important from a linguistic standpoint because it is bound up with the communication of ideas. One of the necessary criteria of a connection is that it be intelligible to others, and therefore the individuality of the subject cannot enter to the extent that it does in free association, while a correspondingly greater part is played by the stock of conceptions common to people (Whorf, 1927, p. 37).

The comparison of their two positions on this axis allows us to understand the main ways in which they differ. The degree of freedom of the possible associations permitted in the system, ranging from free individual association to controlled connection, describes the level of rule envisioned by the

designer of the system, and to which the user must comply. The conception of the system thus mirrors the importance of the rules and limits imposed by the designer on the user. Ted Nelson stressed that his views differ from those of Engelbart in structure and hierarchy (Nelson, 1987):

To me hierarchy is a special case. I don't say that hierarchies are always invalid, it's just that because they're so convenient they've been used too much. And they represent many things very badly...So hierarchy is fine where it correctly and appropriately matches up. And forcing it where it doesn't is wrong. So the whole point is create the structures that map correctly whatever you do. And if you're mapping thought or trying to present ideas, the likelihood that they are non-hierarchical is greater (Nelson, personal interview, 3/17/93).

On the other hand, Douglas Engelbart stressed the importance of conventions that enable the user to improve the efficiency of his computerized work:

With the view that the symbols one works with are supposed to represent a mapping of one's associated concepts, and further that one's concepts exist in a "network" of relationships as opposed to the essentially linear form of actual printed records, it was decided that the concept-manipulation aids derivable from real-time computer support could be appreciably enhanced by structuring conventions that would make explicit (for both the user and the computer) the various types of network relationships among concepts (Engelbart & English, 1968).

There were thus two cultures, two world-views at the origin of hypertext. The first is represented by Ted Nelson and his Xanadu Project, aiming at facilitating individual literary creativity. The second is represented by Douglas Engelbart and his NLS system, a support for group collaboration. The opposition between "association" and "connection" mirrors the opposition between these two projects as two trends for future hypertext systems. Randall H. Trigg (1983; 1991) examined the legacy of these two seminal works and characterized further hypertext systems (second-generation systems such as Notecards, Neptune, or Intermedia) as network or outline-based. The network-based systems are the children or the grand-children of Ted Nelson's Xanadu, and the outline-based systems are those of Douglas Engelbart's NLS.

Computing metaphors

A common ground to all hypertext systems, regardless of their location on the association/connection continuum, is the issue of non-linearity of access to information. For Nelson and Engelbart, such non-linearity comes from the thinking or creative process. A tool that enables a more efficient creative process, whether it is individual or collaborative, should therefore allow a non-linear access and display of information. The difference between the two kinds of hypertext systems is the organization of access to non-linear representations of information. For Engelbart,

No human being can hold very many concepts in his head at one time. If he is dealing with more than a few, he must have some way to store and order these in some external medium, preferably a medium that can provide him with spatial patterns to associate with the ordering, e.g., an ordered list of possible courses of action. Beyond a certain number and complexity of interrelationships, he cannot depend upon spatial-pattern help alone and seeks other more abstract associations and linkages (Engelbart, 1961, p. 122).

The question of the design and representation of these "more abstract associations and linkages" is a fundamental question in user-interface design, and has attracted much attention since the end of the 1960s. The most important aspect of the efforts to design adequate user interface (understood here as adequate patterns of interaction between the user and the computer) has been the introduction of powerful metaphors, as David Smith explained in his Ph.D. dissertation (1977, pp. 23-24):

Images are metaphors for concepts. They provide an alternate reality which is simultaneously concrete in structure and analogic in representation...The visual medium is an extremely useful metaphorical tool not only because it has powerful representational capabilities but also because it has a rich set of topological transformations within its own domain. Two- and higher-dimensional media possess far more versatile structural operations than do one-dimensional media.

The opening of the visual dimension of the computer as a communication medium is often thought to be one of the major contributions of Alan Kay and his team (including David Smith) at Xerox Palo Alto Research Center (PARC) in the 1970s (Bardini & Horvath, 1995). A major contribution of this outstanding set of computer scientists is the "desktop metaphor," that many regard as today's "dominant paradigm of interaction with a personal computer" (e.g., Oren, 1991). First on the Star computer designed at Xerox PARC's System Development Division (SDD), then on the Lisa and the Macintosh at Apple Computer, and eventually on the IBM PC and its clones with Microsoft's Windows, the "desktop" is the most common "alternate reality" that allows personal computer users to visualize the computer environment in which they work. But this tremendous achievement is not without limitations, as its creators realized:

One of the most compelling snares is the use of the term metaphor to describe a correspondence between what the users see on the screen and how they should think about what they are manipulating. My main complaint is that metaphor is a poor metaphor for what needs to be done. At PARC we coined the phrase "user illusion" to describe what we were about when designing user interface. There are clear connotations to the stage, theatrics and magic – all of which give much stronger hints as to the direction to be followed (Kay, 1990, p. 199).

As Tim Oren (1991) says, the desktop metaphor was originally designed for systems like the Xerox Star with a few hundred files on 5 to 10 megabytes of storage: "The purely user-directed browsing style of the desktop is approaching its limits of utility, with the number of files on a single user's machine reaching 10,000 and with easy access to even more

information across networks.” The problem is, to paraphrase Ted Nelson, (personal interview, 3/17/1993), that we are now “trapped by the success” of the desktop metaphor.

As a representation of the working environment, the “desktop” metaphor is limited to two dimensions, by mimicking the physical desktop of the information worker. The main historical development that led to this situation was the progressive realization of the user as the individual owner of a personal stand-alone computing system (Bardini & Horvath, 1995). In the process, the connectivity of the system to similar systems and users was somehow lost, as can be seen in the (non-)functionality of Appletalk. The individual user definitively prevailed over the member of a users’ community. Most of today’s mainstream commercial computing products are at the “association” end of the continuum rather than on the “connection” side.