Information Discovery in Ambiguous Zones of Research

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Abstract

Electronic environments for information discovery are considered in relation to open-ended and dynamic research practices in the humanities, but a system suitable for these scholars would have many other applications as well. Considerations of flexible electronic environments that would support research are based on the holistic view of information processes and the requirements that information systems enable connections, as well as the trustworthiness and authenticity of information. The proposed electronic environment consists of flexible networks of connections between information of different granularity. Strong and weak information paths are established through use, which contributes to the development and informational value of the system. Organizational support, as well as new forms of information provision and services, are required to enable novel approaches to information discovery and research.

Research practices in the humanities have been a challenge for information systems. Scholars' unpredictable and dynamic research paths, the use of a variety of materials in any form and from any period, and particularly the subject matter of their work—human lives, artifacts, imagination, and creativity—remain elusive for any information system to capture. This article considers the possibility of developing an electronic environment that would enable information discovery in the humanities, but any system that is suitable for these scholars would have other academic and general applications.

Considerations of possible electronic environments in this paper are based on findings from the literature and from a study into the roles of

electronic texts in the humanities. This paper does not report research results of the study, but it occasionally refers to examples from the study.

The paper has four main sections. The first two provide a framework for the discussion about possible information systems by considering information processes and issues related to information discovery and use. On the basis of the ideas considered in the two sections, the third section proposes an approach to designing environments for information discovery, while the fourth overviews some issues of research support.

INFORMATION PROCESSES

Although "information" has achieved considerable prominence in the last decades, the word can refer to a number of different meanings in various disciplinary communities. The understanding of the concepts of "information" and "data" proposed here is derived from definitions provided by Bates (2006; 2005), Spink and Saracevic (1998), and Buckland (1991). Information means a pattern of organization, which can be contained in any physical manifestation, and it is given meaning by a human being under certain contextual conditions. The concept of information includes the physical manifestation, the process of making sense of that information or "being informed," and contextual considerations. Data means information produced, selected, and/or assembled for further processing—specifically, for further research, in the context of scholarly work.

Conscious rational information-processing has been traditionally a focus of attention, but there is a need to stress that the process of "giving meaning" to information includes conscious and unconscious processes as well as rational and emotional ways of knowing. In the nonlinear research practices in the humanities where serendipity has an important role in information discovery, researchers may be seeking information all the time at an unconscious level (Cole, 1997, p. 58). Investigation of a large body of materials, common in an open-ended enquiry in the humanities, may rely on unconscious processing and on the development of insight as an important aspect of understanding. Insight implies an unconscious phase of processing because it often means "the sudden emergence of an idea into conscious awareness"(Schooler, Fallshore, & Fiore, 1995, p. 560). Contrary to the views that give primacy to the language in the process of understanding, Schooler et al. found that verbalizing may disrupt processes leading to insight.

Holistic views of information processes suggest a significant role of affect, which was rarely investigated by information studies although the information literature has acknowledged the importance of feelings in information processes (Kuhlthau, 1999, 1993, 1988; Brooks, 1980). One aspect of affect and information-processing marked by a lack of understanding is esthetic emotions (Scherer, 2002), which are particularly relevant in disciplines that deal with creative works.

In addition to physical and intellectual aspects, unconscious information-processing and a broad spectrum of emotions are sources of insights in humanists' individualistic and dynamic research practices. Research in electronic environments may promote some forms of nonverbal, sensory, and affective ways of knowing. The study into the roles of e-texts indicated that online interactions encourage a blurring of the boundaries between different media and formats. These interactions also may have some influence on blending between academic and creative modes of expression. Fast interactions with multimedia are likely to stimulate sensory experiences as well as affective and creative responses to stimuli, which can further promote fusion between sensory, rational and affective ways of knowing.

Information Discovery and Use

Users in general, and humanists and social scientists in particular, conduct evolving searches. Bates (1989) called the way in which scholars start with a query, and then move to a variety of sources, constantly adjusting the query in small increments, a "berry-picking model." Bates found that the ability to access substantial qualities of information is very important in this type of searching, which develops through the selection of bits of information. Key issues in evolving discovery concern the way in which systems provide connectivity and assure the trustworthiness of retrieved information, which can be selected for use.

Systems of Connections

The retrieval of large amounts of dispersed information enables different configurations of information. Lyotard (1984) wrote about performativity that can come from arranging the data in a new way: "This new arrangement is usually achieved by connecting together series of data that were previously held to be independent. This capacity to articulate what used to be separate can be called imagination" (p. 52). Discovery of analogies was seen as the basis for creative thinking by Ford (1999) and Cory (1999). Cory argued that a support for discovering analogies was a way to support research in the humanities.

Mechanisms for establishing connections in the current systems have many limitations. Brockman et al. (2001, p. 18) suggested that libraries needed to do much more "to assemble information resources in a way that allows scholars to search across them, rather than digging down into separate, exclusive 'silos'. . . ." The current retrieval systems often limit the discovery of connections by maintaining outdated divisions. Palmer and Malone (2001) showed that subject descriptions inhibited access to and isolated knowledge about women and women's work by removing connections with a wider body of knowledge, which was replicated on the Internet. Jakubowicz (2007) wrote that a fundamental problem in digital

research was a separation between "a) the collection, collation, manipulation and preservation of data and information, and b) the transformation of information into knowledge through the application of human creativity and its dissemination through new global information networks" ("Conclusions," para. 1).

The critique of hierarchical systems that isolate information and impose certain ways of thinking is often related to Deleuze and Guattari, who contrasted rhizomes and trees as metaphors for two different systems. In models that correspond to hierarchical arborescent systems

> an element only receives information from a higher unit, and only receives a subjective affection along preestablished paths. This is evident in current problems in information science and computer science, which still cling to the oldest modes of thought in that they grant all power to a memory or central organ. (Deleuze & Guattari, 1987, p. 18)

A rhizomatic system, on the other hand, does not work in hierarchical structures and allows full connectivity: "it brings into play very different regimes of signs, and even nonsign states. . . . It is composed not of units but of dimensions, or rather directions in motion" (Deleuze & Guattari, 1987, p. 23).

Rhizomatic structures are more akin to the way the human nervous system works. Bush (1945) contrasted an artificial system of indexing based on hierarchical structures and established paths with the way in which the human mind works:

> It 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. It has other characteristics, of course; trails that are not frequently followed are prone to fade, items are not fully permanent, memory is transitory. (Bush, 1945, section 6, para. 2)

Although Bush wrote during the time before personal computers, the problems with hierarchical information systems remained in new electronic environments. Burnett and McKinley (1998, p. 294) proposed that the "rhizomorphic model of information contexts better accounts for both the richness and the chaos encountered in seeking information . . ." At the same time, hierarchical systems have a long tradition of aiding information retrieval more or less efficiently.

Although flexible and open systems are needed for discovery, different levels of control over the system are still required and desirable. Liu summarized the gist of objections to open nonhierarchical models of information systems: "While knowledge workers may vote for rhizomatic democracy in principle, they also want firewalls for their personal computers; and they kill Bermuda grass on their lawns" (Liu, 2004, pp. 374–375).

In the context of scholarly research, the assurance of quality and authority is particularly important. While scholars need to work in an environment that can provide exploration and discovery, they also need a clear understanding of the provenance and quality of information that will become their research data.

Reliability and Authenticity
Considering the meaning of authenticity, Bearman and Trant wrote:

> At its extremes, authenticity carries with it all the philosophical problems of truth, but here we will try to confine the assertion that something is "authentic" to a number of more "provable" claims: that it is unaltered from the original; that it is what it purports to be; and/or that its representation is transparent (the rules are stated and, possibly, reversible). (1998, II Asserting and Assessing Authenticity, para. 1)

The authors stressed that convincing scholarly arguments depended on judgments about authenticity of source materials—their origin, completeness, and internal integrity.

Electronic documents are sometimes perceived as untrustworthy because they can be published by anyone and because forgeries are much easier. On the other hand, electronic representations of a hard copy provide minute details, which are not accessible to most people or which cannot be seen by the bare eye. The recent digitization of Leonardo da Vinci's *The Last Supper* (2007) in sixteen billion pixels is an example of an electronic representation that provides details inaccessible to viewers of the original.

An obstacle in using and publicly acknowledging rigorously developed electronic sources is the lack of widely accepted criteria for evaluation. The quality of print editions varies significantly, but scholars regularly use a set of criteria to judge the quality of these editions. Critically important for judgment of the authenticity of an electronic document are its provenance and a detailed declaration of transformation identifiable in metadata (Gladney & Bennett, 2003), but this information is not always available.

While systematic and exhaustive documentation would have a significant role in assuring reliability, it is unlikely to resolve all different requirements for authenticity. The electronic copy of *The Last Supper*, for example, provides remarkable detail, but it cannot replace the experience of seeing the original.

Authenticity of electronic editions is often judged by print editions, even when electronic editions provide unique functionality. This is not the case with electronic projects such as *Electra*, which presented some women's works for the first time: "In this instance it offers an unlikely route into authenticity, or rather to that earlier moment of inauthenticity which as editors and textual critics we decided to label the real thing" (Sutherland, 1993, p. 65).

An important question is who actually presented not only an electronic copy but also the "real thing," if they are not the same, and how have they been presented. The official authority of the author, publisher, or a curating institution is often important in establishing the trustworthiness of information, but it does not necessarily guarantee authenticity. As Haraway pointed out, representation is rarely a reproduction. Haraway used an example of the jaguar and fetus, which cannot represent themselves: "Both the jaguar and the fetus are carved out of one collective entity and relocated in another, where they are reconstituted as objects of a particular kind—as the ground of a representational practice that *forever* authorizes the ventriloquist" (Haraway, 1992, p. 312). When Haraway questioned the right of a scientist to represent "the nature," she questioned representation authorities. The question is particularly acute in the framework of electronic environments in which a variety of representations with different origins keeps open questions of who represented something, in what way and for what purposes.

ENVIRONMENTS FOR DISCOVERY

Like any environment, the information electronic environment provides a context in which information processes happen. This environment can be seen in terms of Nardi and O'Day's information ecology characterized by "a complex *system* of parts and relationships. It exhibits *diversity* and experiences continual evolution. Different parts of an ecology *coevolve,* changing together according to the relationships in the system" (Nardi & O'Day, 1999, Characterizing Information Ecologies, para. 2). The environment in this sense is local and defined by an individual circle of interactions and interests. Although an electronic environment can consist of several software programs, documents on a person's computer, and a few online correspondents, the focus here is on larger, usually online, environments, which can include several databases and tools, or the entire Internet.

The design of electronic environments for the information discovery suggested here is based on the following premises:

1. Anything in an information system that can be informative to a person is information, including the whole document and its various aspects.
2. Design for dynamic research has to integrate multisensory experiences and different ways of working that enable rational and affective ways of knowing.
3. Scholarly research requires integration of a variety of sources, formats, and media as well as a provision for information use.
4. A goal is the interaction between the researcher and information rather than interaction with the system.
5. Flexibility and openness, and control and limitation are both needed.

The evolution of the proposed electronic environment is realized through flexible networks of connections that grow and change with the use.

Information Network
Information about a phenomenon or entity is dispersed and contained in many different forms. For scholars in the humanities, it is also contained in many different forms of representation, such as different editions of a text or variants of a manuscript. The image below (Figure 1) illustrates the complexity of establishing connections between information contained in different forms.
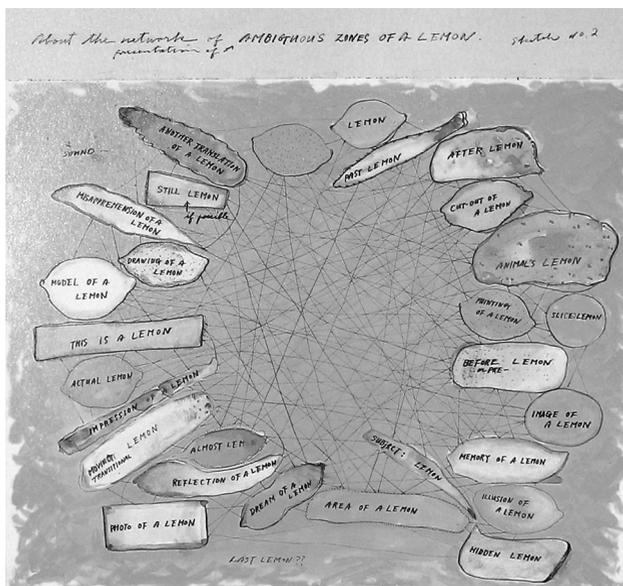

Figure 1. About the network of ambiguous zones of a lemon (Arakawa & Gins, 1988, p. 21)

For computer systems, the image above illustrates challenges of representing and connecting numerous entities and their ambiguous zones of meaning. Three main aspects of the challenge concern (a) trustworthiness of representation, (b) establishing connections between related information and metadata, and (c) identification of zones of meaning, which are nothing else but patterns of organization of information. The first challenge is to establish the meaning of the claims that something is a true representation. The last two issues relate to the identification and linking of all potentially relevant information.

Trustworthiness An essential step in establishing the trustworthiness of a representation is documenting that the label "photo of a lemon" or "image

of a page" are true or, more often, in which way they are true. Documentation about representation processes and detailed metadata are often needed to demonstrate that the representation and represented are identical in every important way, so the trustworthiness of a document can be based on the strength of evidence that the representation is what it claims to be.

A more complex issue concerns the context of representation. Scholars in the study of interactions with e-texts commented on the absence of information about many nations and cultures that do not belong to the dominant few. There is also a question concerning who represents smaller and/or less powerful groups and cultures even when they are present online. The question is pertinent to evaluating artifacts from other cultures in Western digital collections. Trustworthiness and authenticity of representation are then cultural and political issues, and as such, significant as topics for scholarly investigation.

A comparison of different representations is a way of establishing what and how they represent. Inclusion of a variety of representations with different origins is a powerful way of strengthening the trustworthiness of the system. For example, a high-quality representation of a literary manuscript on a library website can provide accurate details of the original document. The same document on websites of an alternative acting group and a local historical society provide insights into cultural framing of the manuscript. Mistakes and omissions in different representations can have informational value. Very often, characteristics of a particular representation can be assessed only by comparison with other representations. The meaning of a purple lemon is constructed in comparison with numerous representations of the yellow fruit.

Connections among Information and Metadata In order to enable investigation of the complexity of meanings and their relationships, it is necessary to establish connections between representations and related information. If the question is difficult in any situation, it is particularly complex in the humanities in which every text and its smallest part can be associated with a variety of meanings and other texts. Figure 1 illustrates the difficulty of the task, but it also suggests that a solution may exist in establishing as many connections between information as possible and naming them through extensive metadata produced by humans and machines.

A challenge is that the difference between information and metadata is not necessarily clear. Data was defined earlier as information selected for further processing. *Metadata* means "data that describes other data" or, simply, "data about data." Metadata provide secondary information about data and, in information jargon, they usually refer to distinct forms such as bibliographic records, or Dublin Core metadata and the TEI (Text Encoding Initiative) headers inserted in electronic records.

From the perspective of an information professional who works with electronic media, differentiation between information and different

metadata is relevant, but it does not address the complexity of their relationships. The study of scholars' interactions with e-texts suggested that bibliographic records can become an integral part of the interaction with the text or, in some situations, they can become primary data themselves, so formal metadata does not necessarily have a distinct function of secondary information. Furthermore, metadata do not have to be formal records. If a poem provides information, its bibliographic record is formal metadata, but metadata can also be anything that gives information about the poem. An essay, a song or a commentary in a blog written in response to the poem are also metadata. One of the participants in the study into the roles of e-texts talked about "poetic metadata," indicating that creative works can provide secondary information or metadata. Poetic metadata is then a special form of a secondary descriptor. A record attached to a preserved lemon in a botanical museum, and a painting of a purple lemon can both provide secondary information about the exhibit. Different media, formats, and genres can play the role of metadata.

The same text can be either information or metadata depending on the context (Figure 2). It could be useful to distinguish between forms of primary and secondary information as well as between unselected and selected information:
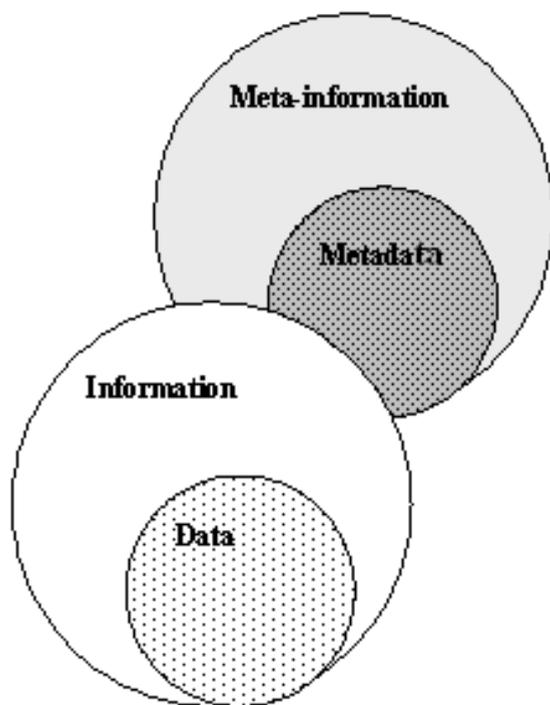

Figure 2. Information & data, meta-information & metadata

- Information is any pattern of organization and data is information selected for further processing.
- Meta-information is any secondary information, and metadata is selected and/or processed meta-information.

The proposed distinction information—meta-information, data—metadata can assist in handling large amounts of information and their descriptors. One way of approaching the problem of the enormous number of possible links is through the analogy with the human nervous system, which deals with billions of possible connections by strengthening used paths. If *information* and *meta-information* refer to informative potential and possible connections, *data* and *metadata* refer to selected information and used paths. Like the nervous system, the information network can promote differentiation between potentially strong and used paths from rarely used or unestablished paths.

Connections strengthened through use can serve as a constantly developing guide through the system where both strong and weak connections may be required by the user. Although needed in many search situations, the used paths are not necessarily the most desirable ones. Weak connections may be more relevant for research purposes. If the researcher wants to find all instances of a hidden lemon, presented as weakly connected and on the margins of Figure 2, established paths may be used to reduce a number of options by excluding strong and central connections. Well-established paths can also provide reference points so they can be used to direct searching outside strongly connected area. All types of paths can aid the researcher's investigation of patterns of connections.

Zones of Meaning and Granularity of Information Identification of the zones of meaning as a challenge in establishing information networks relates to the granularity of information. In order to achieve informativeness of all aspects of representation, information has to be presented on different levels: the physical document and its context as well as the content and its parts. The information profession usually deals with representations on the document level. At this stage, the informativeness of the whole document is usually described by bibliographic details. The provision of context develops through the provision of materials and links, which can contextualize documents. This is a good beginning, but in order to study the lemon, the user has to be able to identify and access representations of its seeds. Hockey (2006) referred to McCarty's idea of morselization of information, which would identify little morsels of information with one's own metadata. Connections between a wide variety of information and meta-information of different granularity have the potential to provide powerful information retrieval and linking as well as to allow manipulation of small segments for use.

Working with different levels of granularity of information imposes significant challenges in retrieval and selection of vast amounts of information. Bates (2006) wrote about different types of information and suggested the development of information genres. Bates referred to Ingarden and Trosborg when she proposed that "a given genre can be seen to be an expression of, and a vehicle for, a particular kind of communication" (2006, p. 1043). With a broadened understanding of information and metadata required for more powerful and more flexible systems, the idea of information types and genres provides a way of dealing with complexity. The distinction information—meta-information, data—metadata is a step in that direction. Further differentiation between forms of metadata such as formal—interpretive, analytical—poetic may be the next step.

On a Lemon Trail
The personal development of understanding and meanings of the whole information system can grow together through different configurations of information. An example of a relatively simple research path may serve as an illustration of how the system could work for a researcher in the humanities.

The scholar would be able to identify large bundles and small morsels of information and meta-information, and then select them for further research and manipulation. The sources would be integrated to allow the scholar to establish her/his own path. Information would be retrieved by word, shape, color, sound, and, some way down the track, by smell and touch. While searching, the scholar would apply different filtering systems to target particular types of information and follow well-established or previously rarely used paths.

If the researcher wants to study the history of the use of lemons, they can decide to start from academic digital libraries to look at digitized manuscripts of diaries, which describe past travels by ship when scurvy occurred; find references to lemons in medical treatises from the Mediterranean area and China through history with parallel translations; retrieve medical information about scurvy today; browse discussions of young people about the use of lemons during self-imposed diets; combine all different information about the taste and appearance of lemons, including images, songs, and descriptions in the literature; exchange opinions with various people on the way and leave comments online. A perspective for each combination of information could be reconfigured so the researcher could look at information from a particular disciplinary point, consider a period in time or focus on one of the senses. The researcher would be able to select or exclude filters to browse information about lemons "in the wild." While doing the search, the researcher would establish some connections for the first time and strengthen others. Comments, evaluations, discussions, and collaboration, as well as new products created by

the scholar, would all contribute to the constantly developing information environment.

Allowing the system to trace someone's path, even anonymously, can be potentially problematic, so a number of issues have to be addressed for that to happen. One of them is that the system has to document its representation of strong and weak links between information. The researcher will not want to leave any visible trace of an innovative information path if individual originality is the most important measure of scholarly achievement, but scholarship may be measured by its contribution to the information environment. In this case, scholars would want to keep records of their own information passage to learn from it and select parts that they would include in an electronic portfolio to demonstrate their own contributions to the information environment. The potential of an open dynamic system of this kind is in the user-directed growth and a degree of self-maintenance balanced by a professional involvement in ensuring some regulation and goal-oriented development of the system.

Root or Rhizome

The need for associative ability and flexibility of the network, as well as the need for some control and structure suggest that both root-like and rhizomatic structures have their advantages. Very importantly, they are not mutually exclusive. As the originators of the idea of rhizomatic structure suggested, a rhizome can be entered through the root-tree: "A new rhizome may form in the heart of a tree, the hollow of a root, the crook of a branch. Or else it is a microscopic element of the root-tree, a radicle, that gets rhizome production going" (Deleuze & Guattari, 1987, p. 16).

An information system can follow the arborescent structure of the natural lemon tree as well as the rhizomatic structure of an imaginary red-leaved plant on which blue lemons grow. These two structures can complement each other or be exchanged as required. Like some computer applications, which allow the user to select different representation models to view data, it is possible to consider the design of a system that will allow hierarchical or rhizomatic approach on demand. A user-directed selection of structure in addition to various options for filtering information would be part of the system's flexibility. A selection of hierarchical and nonhierarchical approaches in addition to the morselization of information, the removal of artificial boundaries between information and metadata and availability of different levels of filtering would give a great deal of control to the user.

RESEARCH SUPPORT

Significant assistance is required to ensure that scholars are able to take full advantage of electronic environments. This article cannot address the complexity of issues involved in providing recognition and support for

digital scholarship, nor can it consider research education, but it points toward some aspects of support required of academic organizations and the information profession.

Organizational Support
In order to find novel approaches, the researcher needs time and space to experiment. However, time is a scarce resource for most scholars. Participants in the study into the roles of e-texts often commented that younger generations of researchers were better suited for work with electronic media. The observation may be correct, but the reality of building an academic career makes early and mid-career researchers the least likely to spend time on exploration. Job demands and criteria for evaluating scholarship influence research approaches, particularly when researchers are at earlier stages of their careers.

Organizational culture may also encourage some types of research by providing conditions for certain choices. Considering that feelings are part of cognition, not just an accidental part of academics' lives that they carry with them to information processes, it is possible that the way academics feel at work has had some impact on their research. As investigations of affect indicated (Chartrand, van Baaren, & Bargh, 2006; Damasio, 2000, p. 164), negative emotions may not impede researchers' ability to analyze and observe, but they are likely to have a negative effect on creative and exploratory approaches. Working conditions and managerial styles promote organizational cultures in which employees share similar feelings. Relatively recent studies have confirmed what many managers of knowledge organizations already know—the way researchers feel at work is likely to have some impact on their creativity and, consequently, on the way they use information systems.

Support by Information Professionals
Information professionals in general and librarians in research libraries in particular can provide support by being involved in information provision, which includes dealing with a variety of information of different granularity, and by developing information services suitable for research in electronic environments.

Information Provision A wide range of materials is of critical importance for humanities research, but the proliferation of information sources has made the task of comprehensive information provision increasingly difficult for any single collection or institution. A variety of materials has been traditionally used in scholarly research, but researchers increasingly find valuable information in nonacademic online sources, which usually do not satisfy library criteria for preservation and description. While research libraries cannot work with all online sources, they need to find novel ways in which they can aid integration of sources, and reconsider divisions on which they base their collection development and information provision.

Enabling access to information with different levels of granularity requires significant professional involvement. Some research projects in the humanities provided valuable sources by working with one particular text or with a thematic collection in which they identified and interpreted information of fine granularity. However, projects of this sort cannot provide access to large bundles and small morsels of information on a large scale. This is work that has to be done systematically by information professionals from the moment of conceptual design of information systems to decisions about treatment of the document content. The involvement of research libraries in providing information in different media and formats is critically important to ensure the transfer and application of valuable library knowledge and skills to developing electronic environments.

Information Services Scholars require individual and highly specialized services to provide consultation about issues, resources, and tools in a particular project. These services require time and librarians' specialization that is beyond the means of most individual research libraries. However, large cooperative initiatives in provision of online services would be able to respond to researchers' needs for specialized individual assistance.

Verbal communication from help files to reference services that require reference interviews have been the norm in the information field. Although verbal communication will continue to have its role in service provision, new forms of support for information discovery and insight will be required. Work in interactive environments with multimedia encourages nonlinguistic ways of knowing and expression, which have to be supported in similar ways. The current knowledge about information processes beyond conscious rational processing that allows verbalization is very limited. Research in this area will provide the basis for much-needed innovation in information services.

CONCLUSION

The growing recognition that different types of information do not exist in separate divisions is part of a broader interest in connections and mutual influences, characteristic of contemporary thinking. Dynamic, open, and often unpredictable research in the humanities emphasizes the importance of connectedness. At the same time, these research practices put high demands on electronic information systems, but they also highlight the nature of information processes and set goals for the development of information systems.

In order to provide integrated electronic environments with desirable aspects of ecological connectedness and growth, information professionals, academic institutions, and other actors who/that shape information systems have to clarify the meaning and relevance of the existing divisions as well as ways of satisfying different interests without imposing obstacles on the user. Integration is necessary to allow information discovery, which

is essential in academic research as well as in many other areas. An electronic environment that is rich enough to provide a sufficient variety and amount of information, flexible enough to enable individual discovery, but managed and ordered in a way that prevents chaos and accommodates changeable requirements for quality will be suitable for scholars as well as for everyone else.

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