

World Wide Web Interfaces and Design for the Emergence of Knowledge

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Introduction

We have entered into a new era in which our lives increasingly are being mediated by the computer. This mediation exists from advanced computational scenarios, such as intelligent software agents and immerses virtual reality environments, to more simple scenes, such as browsing for books or purchasing insurance online. Within these moments of computational mediation, our interaction, and subsequently our experience, is powered by the processor and viewed through the screen. Disturbingly, these computationally mediated experiences all too often are completely unsatisfying. Interactivity often is reduced to clicking a button on the screen. Perhaps the greatest amount of control we are given over the content and experience of our computational environment is the ability to turn the computer off.

There already is a history and an established bibliography addressing the use of computational media for learning. The literature on interface and interaction design is overwhelming. However, investigations of the interface design of museums as sites of applied innovation have been limited to dialog within and among cultural institutions. Museums are an intriguing place to seek out innovations in design and technology. As institutions, they tend to attract sophisticated designers, have a wealth of content, limited technological resources, and a drive to create compelling educational experiences. They do not represent the mainstream, but can be looked at as places where investigation that trickles into the mainstream occurs. This effect is apparent in the interface projects that they have undertaken.

Over the past twenty years, museums have actively engaged information technologies. For the most part, this effort has centered on the field of museum informatics, specifically the creation of libraries and the documentation of collections. With the advent of the World Wide Web and its capability for the relatively easy and low cost mass distribution of information, museums began to explore the use of the www as a site for exhibitions and related projects. Many of these exhibitions and projects did, and continue to, present the information in an online gallery format. In this

format, the works are displayed as static images on a wall, except the wall was replaced by the screen and, rather than walking through the gallery, users clicked their way from image to image.

Some museums have begun to investigate the www as a locale, as well as a medium for the experience of art and related cultural activities such as education. In these scenarios, the museums used the nature of the network environment coupled with opportunities for sophisticated interactivity to create compelling experiences for the audience. In these scenarios, the designers of these interfaces for online exhibitions and projects have used the wealth of information present in an exhibition. Historical facts, images, and multimedia have been coupled with interactivity to create interfaces that allow us to experience information in a meaningful way. In order to understand and appreciate the design of these, we must begin with an understanding of the www as a medium of information distribution, as well as the difference between information and knowledge.

Information, Knowing, and Knowledge

The www is not just a funky tourist stop along the “information superhighway.” It is a new lane along that highway, requiring a new way of driving. In this paper, we are not interested in joy riding, we are interested in traveling. We have a destination, a goal which gives us a purpose. That purpose is different from the acquisition of information, as might seem to be implicit in the phrase “information superhighway” that has been attached to the www. In fact, the assignation of this term to the www is misdirected. Herbert Simon in *The Science of the Artificial* insightfully points out that our construction of the www into an “information superhighway” is conceptually flawed. It is flawed in that it rests upon the notion of a desperate need for vast and rapid information flow. However, such a need does not exist. A need does exist for a vast and rapid system that allows for meaningful interpretation of information.¹ In short, what is needed is a system that supports the cultivation of knowledge.

Information is not knowledge. This is something that, after our much-heralded launch into the “Information Age,” we are beginning to acutely realize. Information is a record and presentation of data. Information can be organized in a germane form to be sure. It can express intricacies to such an extent that information management and study, quite with reason, constitute a science. But it is not knowledge.

John Slatin, in his chapter “Is There a Class in This Text” in *Sociomedia*, discusses the use of hypermedia for educational purposes, examining the relationship between information and knowledge. He proposes that, in the use of that “If information is the news of difference,² then knowledge has to do with recognizing the implications of the new, with creating patterns that connect the differ-

1 Herbert Simon, *The Sciences of The Artificial* (Cambridge: MIT Press, 1996), 144.

2 Gregory Bateson, *Mind and Nature: A Necessary Unity* (New York: Bantam, 1980).

ences but do not resolve or dissolve them.”³ While the potential for knowledge to emerge is dependent upon the information, to create knowledge it is necessary to design opportunities that act upon differences within that information, constructing a context in which that difference is of meaning.

Stating that there is a difference between information and knowledge is not enough; we must be able to say something about what knowledge is. The positioning and nature of knowledge I will present is founded upon American social pragmatism, particularly the writings of John Dewey. According to this paradigm, knowledge is the result of an act, an action, it requires efforts and activity. Knowing is not passive, and thus the possession of knowledge cannot come about in the absence of interaction. Dewey writes, “There is no such thing as genuine knowledge and fruitful understanding, except as the offspring of doing.”⁴ This interaction, in the context of the WWW interfaces, is based on information and experiences with information. These experiences are ones of doing, that is, of acting upon that information and its representation in the interface. “Only by wrestling with the conditions of the problem at first hand, seeking and finding his own way out, does he think,” that is, possess knowledge, or know. Thus, experience creates the opportunity for knowledge: the meaningfully designed, sensing of information. The nature or source of this information is not essential for the construction of a meaningful experience; it may be read from a database or gleaned from years spent in the wilds of Alaska. It is the meaningful interaction with and action upon this information, the doing, that transubstantiates it in to what we will call knowledge.

Dewey suggests that knowledge is not one specific moment or activity, but rather a scenario of engagements. “For Dewey, a moment of engagement is an ‘experience,’ but experiences do not exist as discreet entities...Experiences have a ‘pervasive’ quality. They are immediate and also aesthetic.”⁵ Knowledge thus is an emergent process, and not a static happenstance. Knowledge is actualized by the organization and interaction of individual instances and information into a product, the meaning of which extends beyond its individual parts. While the emergence of knowledge is a phenomenon, which may not be completely deconstructed, it may be cultivated through the design of engagements, and of experiences. It is this conception of knowledge founded in Dewey; knowledge as the emergent result of an activity of awareness committed upon some bit of information, that we will use in order to analyze and achieve advanced visual interfaces.

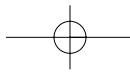
Revealing Things

The interface is something that has to be experienced in order to fully understand it and to enact its potentialities. Since this discourse is taking place on a piece of paper, a description will have to do. Describing and examining the design and experience of two

3 John M. Slatin, “Is There a Classroom in This Text? Creating Knowledge in the Electronic Classroom” in E. Barrett, ed., *Sociomedia: Multimedia, Hypermedia, and the Social Construction of Knowledge* (Cambridge: MIT Press, 1992), 34.

4 John Dewey, *Democracy and Education: An Introduction to the Philosophy of Education* (New York: Simon & Schuster, 1997), 275.

5 Richard Coyne, *Designing Information Technology in the Postmodern Age* (Cambridge: MIT Press, 1995), 41.



interfaces constructed for museums (one as an exhibition and the other as a cultural project) on the www will provide us with material to further investigate the transformation of information into knowledge through the interface.

Plumb Design, a New York interactive design studio, created a captivating interface for the Smithsonian, supported by a proprietary tool entitled Thinkmap™. Thinkmap is a Java applet, which serves as an engine to enable the visual enactment of an advanced interaction paradigm.

Although Thinkmap generates graphical representations of data, it does not produce static graphs, but rather Java Maplets™, which are kinetic displays of multidimensional information that link directly to complex data sets. Thinkmap gives users the ability to understand interdependent information through interacting with data in real time.⁶

While the Thinkmap tool has been used in many applications to date, two stand out as germane examples. One of these examples is *The Visual Thesaurus*⁷ a “way of exploring language through creating a visual interface to a thesaurus”⁸ in which a user can manipulate textual information objects (words) in either two- or three-dimensional space to explore their interrelationships of meaning. The other example is the online exhibition *Revealing Things* for the Smithsonian Institution.⁹ In this example, the interface for the exhibition is not merely a tool for the presentation and navigation of the exhibition. Instead, the interface itself is the very space of the exhibition. The challenge in creating this interface-based exhibition, as stated by Plumb Design on their Website, was:

Develop an online exhibition devoted to material culture that combines objects from the Smithsonian collection with everyday objects contributed by visitors. The Smithsonian Institution approached Razorfish and Plumb Design to develop a prototype for an exhibition that demonstrates the meaning behind everyday objects. The challenge was to show a group of objects connected in a myriad of ways, and encourage people to explore.¹⁰

When a user comes to the *Revealing Things* exhibition, she is presented with a Maplet, a dimensional representation of the exhibition contents within a colorful framework of images and informative text headers. The Maplet used in *Revealing Things* functions in the same manner as the one used in *The Visual Thesaurus*. By interacting with the Maplet, the user activates the process of culling forth through space information about the selected topic. A user selecting a topic on the Maplet tree with a “mouse” and moving the object, which is text, in different directions accomplishes this interaction. As this occurs, in addition to the presentation of information of the

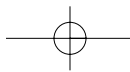
6 Plumb Design Website, <http://www.plumbdesign.com/projects/thinkmap.html> (accessed January 2001).

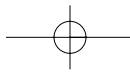
7 Plumb Design Website, <http://www.plumbdesign.com/thesaurus> (accessed January 2001).

8 Plumb Design Website, <http://www.plumbdesign.com/thesaurus> (accessed January 2001).

9 Smithsonian Revealing Things Website, <http://www.si.edu/revealingthings/> (accessed January 2001).

10 Plumb Design Website, http://www.plumbdesign.com/projects/smithsonian_institution.html (accessed January 2001).





selected topic, relational information in the form of texts and images is brought forth, and the relationship between the different kinds of information is represented visually through dimensional relationships on the Maplet tree. Thus, as the user interacts with the interface of *Revealing Things*, the representations of information changes and is experienced, and as the title expresses, connections between the chosen objects are revealed.

“I-Life”

Another example of an innovative interface on the www is a component of Guggenheim CyberAtlas Project entitled “I-Life”¹¹ designed by Laura Trippi.

CyberAtlas, a project of the Guggenheim Website and Guggenheim magazine, is a concerted effort to chart this terra incognita [cyberspace]. The aim of CyberAtlas is to commission and collect a series of maps of cyberspace, with a particular focus on sites related to visual art and culture. Unlike the typical navigational chart, the maps in CyberAtlas can take you where you want to go, as well as tell you how to get there: clicking on a Website in any of the maps will transport you immediately to the corresponding Web page.¹²

The Guggenheim CyberAtlas is a collection of commissioned interfaces that act as maps to cyberspace. “I-Life” is one of these interfaces/mapping projects designed by Laura Trippi. The maps of “I-Life” are integrated and designed into a visual interface that permits exploring intricacies of relationships between intersecting data (specifically Websites) in the realm of the arts, humanities, and technology on the Internet. The visual design of this interface does not appear to be a map, or at least one that we are accustomed to. Rather, it is a highly stylized and color-coded organization of material based theoretically and visually on neural nets.¹³ The basis of the organization of information on neural nets is a challenge to conventional information architecture, and the visual interface reflects this.

As in neural-net diagrams, along the top are the “input nodes”—here disciplines in the hard and social sciences generating models of life and thought.

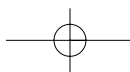
Along the bottom are the “output nodes”—in this case art, theory, and popular culture, categories of cultural production that (among other things) filter, redirect, and disseminate material from the sciences. The middle nodes do the grittiest work, and it is here that the Websites themselves appear, arranged in the four main thematic groupings mentioned above.¹⁴

11 Guggenheim CyberAtlas, I-Life Website, <http://www.guggenheim.org/cyberatlas/home/index.html> (accessed January 2001).

12 Guggenheim CyberAtlas Website, <http://www.guggenheim.org/cyberatlas/home/index.html> (accessed January 2001).

13 A neural net is an aggregation of interconnected nerve cells. It is a mathematical construct that has been used extensively in the development of artificial intelligence. Neural nets often are represented by complex diagrams that represent the neurons as nodes within a network.

14 Guggenheim CyberAtlas, I-Life Website, <http://www.guggenheim.org/cyberatlas/home/index.html> (accessed January 2001).



A user interacts within the “I-Life” interface by selecting graphical objects—“nodes,” on the interface map with their mouse. This selection then reveals a detailed level of the selected node, presenting its content and the interrelations among the items within that “node.” These intermediate “nodes” are represented by the same formal visual interface elements as the higher level view of the map. At these intermediate map views, the items represented as individual “nodes” are hyperlinks, taking a user to a specific site other than “I-Life.” When a user chooses to examine a “node” that links to a site outside of “I-Life,” that chosen site appears in the frame that the “I-Life” map previously occupied. A floating window exists next to the main browser window. In this window is a smaller representation of the interface/map, which continues to provide a relational context and opportunities for interaction between the site now being viewed and the “I-Life” project. Through the elegant complexity of this interface, the “I-Life” project implements an advanced visual interface, based upon a novel interface paradigm and its visual interface and interaction is expressed accordingly.

Designing the Emergence of Knowledge by Association:

The emergence of knowledge through interaction with the *Revealing Things* and “I-Life” interfaces is not happenstance. This experience is a designed function of the product, expressed through the interface: a purposeful outcome of the visual representation and interaction models. It must be designed in a manner in which the actions that a user takes from one point to another mean something.

Revealing Things and “I-Life” both use conceptual strategies within their design to allow for the emergence of knowledge through the interface. These strategies take two primary forms. The first is through visual representation. The visual representation is the immediate impression that a user gets from an interface: it is the impression which users are most familiar with. The second is the interaction model. The interaction model is the formal structuring of the experience with the interface through direct manipulation. These two conceptual strategies are inextricably tied together in interface to create its whole.

The primary strategy for visual representation enacted by both the *Revealing Things* and “I-Life” interfaces is that of the spatial representation of information. In the case of the *Revealing Things* interface, the spatial representation is based upon the three-dimensional representation of information. When the user encounters the *Revealing Things* interface, the first impression received is the presentation of three dimensional information consisting of text objects on a tree-like structure. The organization, and thus visual representation, of the information upon this three-dimensional tree is one of association. Within *Revealing Things*, the information is presented to make the visual locality of information meaningful. For the user to interact with that information, he or she must make cognitive sense

of its three-dimensional visual representation. In the process of navigating the three-dimensional representation of information, the user is continually presented with visual reinforcements of the meaning of this dimensionality. As one text object is chosen and brought forth, the text objects are affected. The associated text objects visually present themselves in perspective, either growing larger or smaller in relation to the chosen text object. This three-dimensional representation of information does not exist alone, but is reinforced by a standard, flat, presentation of corollary information alongside it.

In the “I-Life” interface, the spatial representation is based upon the mapping of information in a two-dimensional structure of neural net diagrams. The first impression received of “I-Life” is the representation of information upon a colorful diagram organized into nodes and connections between those nodes. The core topics of information are visually represented along the top and bottom of the interface as primary. These primary nodes are then visually linked with other nodes; some are primary nodes of their own, while others are relational nodes of information existing in-between the groupings of the primary nodes. In the process of navigating “I-Life,” the user travels along the lines of linkage and activates responses in the form of culling from the nodes more detailed representations of the information. Each click brings another level of visual detail, not unlike zooming in on a map for increased levels of detail. Within this representation, the information is granted space by its placement upon a map, a neural net diagram which communicates the association and interrelationship of ideas via a conceptual space model. The space model is conceptual because it does not refer to actual space, but rather references the notion of the cognitive association of like ideas by proximity of thought or purpose. The association by proximity is reinforced with the presence of linkages—lines drawn from node to node visually expressing the relationship between any two or more items within the interface.

The design challenge of the visual representation for both *Revealing Things* and “I-Life” is not the two- or even three-dimensional representation of information. The design challenge is the construction of such a visual representation of information whose spatial construct is meaningful. In designing the three-dimensional space for *Revealing Things* and the cognitive representation of space for “I-Life,” the space was not just required to exist, but was required to visually produce relations between information in a cogent and intuitive manner that informed the content itself.

The visual representation strategies developed for *Revealing Things* and “I-Life” work together with their interaction models to create the totality of the interface. However, it is the interaction model itself that drives the activity that takes place within these interfaces. With *Revealing Things*, the interaction paradigm is based upon the navigation of a three-dimensional information space. In

navigating a three-dimensional space, the information is not presented all at once, but rather culled forth from space through interactions which leverage the relationship of items based upon their position on an x, y, and z axes. Within this model, to reveal a certain object, another object must first be revealed and, in doing, additional associative objects are brought into view. This occurs in *Revealing Things* when a user selects a text object upon the three-dimensional tree. Once the object is selected, the user pulls it forward or pushes it to the back or chooses another object and brings it into view; thus the movement of one chosen object moves the entire tree in a kinematic relation. This kinematic relationship, driven by the user interaction, defines the relational nature of the interaction with the visual representation.

Though the technology that powers “I-Life” does not have the sophistication of *Revealing Things*, its interaction model is so strong as to make the issue of technological prowess irrelevant. While *Revealing Things* utilizes a three-dimensional spatial construct, “I-Life” utilizes a spatial construct based upon the concept of cognitive space for its interaction paradigm. This idea of cognitive space is based upon neural nets. The adoption of the neural network model by Trippi in “I-Life” engages the user in a manner of interaction that is fundamentally an interior phenomena referring to the associative linking of information within a brain in order to create a sense of knowing. In order for a user to interact with the “I-Life,” he or she must activate the interrelated nodes of information. Additionally, the user must follow and reveal linkages between the nodes of information in order for the scope of their interconnectedness to become apparent and meaningful. This is accomplished by the activation of nodes upon lines of linkages, and the feedback of subsequent associated nodes and linkages being brought into view. In order to discover bits of information, the user must travel through the nodes of information in increasing depth. The extent of the information available, and even more important its context and meaning, is only made present by an active involvement with the spatial construct of “I-Life.”

The “Doing” Being Done in These Interfaces

The design strategy of associative visual representation and associative interaction within *Revealing Things* and “I-Life” is what makes possible an experience of meaning. These experiences of meaning, which the user enacts within these interfaces, are the “doing” which Dewey requires for knowledge to emerge. In both of the interfaces, the “doing” is designed and subsequently enacted through meaningful movement through space, which triggers an expression and subsequent understanding of the visual representations of information.

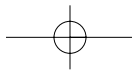
Within both *Revealing Things* and “I-Life,” the knowledge experience is a complex but elegant series of interactions with and interrelations among the information. We cannot define any one point in the experience with the interface in which knowledge emerges. There is no one moment of “Ah ha!” but rather a continuous and evolving experience with the interface. With *Revealing Things*, the physical manipulation of “doing” occurs as a user selects an object in a three-dimensional space. The conceptual “doing” that leads to knowledge occurs as the user reconciles the difference of information views with one another into a whole of meaning. Within the “I-Life,” the physical manipulation “doing” is a bit less obvious by the fact that it does not employ a spatial three-dimension construct which provides corresponding feedback, but it still is as involved and effective. “I-Life” uses the strategy of physically activating representational spaces of information by user choice along a map of cognitive space. The conceptual “doing” leads to understanding as the user places importance and meaning along the path of activity and interconnections with the information within the interface. Through these two examples, we are given a glimpse of the possibilities for the design of enhanced opportunities of computational mediation in our lives.

The Promise of Interfaces Designed for Knowledge

As with all discourse, we have come to a point where we must assign some sort of relevance to our discussion. We examined the visual interface through the two examples of *Revealing Things* and the “I-Life.” We illustrated how these interfaces are designed to engage the user with an experience through which knowledge can emerge. But we have yet to state why these advanced visual interfaces, which allow for the emergence of knowledge, are important.

With our headlong leap into the information age, we have entered into a crisis of meaning in which increasingly questions our purpose and grasps for meaning in superficiality. The obscene proliferation of information in our daily lives may, in fact, be the very cause of our crisis in meaning. We have placed the mere creation and dissemination of information as the cultural imperative of the late twentieth century and we have ignored the consequences of that tide of information. We also have ignored the opportunities that meaningful interaction with information may provide. We have ignored knowledge. Compounding the situation is the fact that the sea of information in which we now find ourselves pathetically dog paddling in has transformed its essential nature as well. The essential nature of many of the experiences which form our knowledge have rapidly been transformed away from what we have known as the natural into the artificial. We seek experiences not directly with nature, but artificially with information. Margolin, again, has stated “We first need to question what meaning is in a world where reality is no longer the ground on which values are formed. Meaning then

15 Victor Margolin, “The Politics of the Artificial,” *Leonardo Electronic Almanac* (MIT Press, 1995).
<http://mitpress.mit.edu/e-journals/LEA/home.html> (subscription required) (accessed January 2001).



becomes a strategic concept that exists pragmatically at the interface of design and use.”¹⁵ This statement places the value of meaning within the realm of design as an imperative. While we have realized that the seas have changes, we have only begun attempting to develop new ways of, quite literally, navigating them.

Design can approach interfaces as spaces to transform information into knowledge. These interfaces can provide meaningful experiences with information, and save us from its potentially numbing crush upon our lives. To do so, we must begin to approach interfaces not as tools, but rather as a medium in and of themselves. A medium differentiates itself from a tool in that the product of a medium reveals the essence of medium in its execution. The interface designed for the emergence of knowledge must be reflective of both its content as of itself. As a place of interaction, the interface becomes a place where the potential for the creation of knowledge exists. As a place of knowledge, this is where we find meaning and create experiences which are memorable.

