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A model of the role of conceptual metaphors in hypermedia comprehension

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Abstract

This paper presents a model of metaphorical processes at play in hypermedia comprehension based on conceptual metaphor theory and blending theory. Hypermedia are metaphorically understood through a process which involves three "layers" of metaphors structured hierarchically: primary metaphors, generic metaphors and specific metaphors. Higher-level projections inherit the structure of lower-level ones. A major hypothesis supported by our model is that this metaphorical comprehension of hypermedia and navigation activity influences the way users interact with the system and understand its informational contents. The proposed model relies on behavioral and discursive data about user interaction with a hyperdocument.

Keywords: comprehension, conceptual integration, conceptual metaphors, hypermedia, navigation behavior

1. Introduction

Electronic resources and documents have become ubiquitous in our lives with the development of the World Wide Web, which has made hypermedia a pervasive presentation format for information in the digital world. Hypermedia documents, or hyperdocuments, are organized collections of "nodes" of information connected by "hyperlinks" that the user can activate to access information. How individuals interact with hypermedia is partly conditioned by how they understand this interaction. In this paper, we argue that this understanding relies heavily on conceptual metaphors.

The very notion of *navigation*, used to describe interaction with hypermedia, implies an underlying spatial metaphor (Dieberger 1994; Dillon, McKnight & Richardson 1990, 1993; Edwards et Hardman 1989). Furthermore, numerous hypermedia interfaces (in websites, virtual campuses, etc.) reproduce familiar objects or locations, assuming this will facilitate their use (Benest 1990; Elm & Woods 1985; Gentner & Nielsen 1996; Madsen 2000; Saffer 2005).

This paper introduces a theoretical framework based on conceptual metaphor theory (Lakoff 1993; Lakoff & Johnson 1980, 1999) and conceptual integration theory (Fauconnier & Turner 1998, 2002) to explain the role metaphor plays, as a cognitive tool, in hypermedia comprehension.

2. Metaphor and blending

Our work relies on conceptual metaphor theory and conceptual integration theory, two theories that belong to the wider field of cognitive semantics, and view comprehension and meaning production as processes of mental representation construction involving projections of conceptual structure between mental spaces or conceptual domains.

Conceptual metaphor theory, or CMT (Lakoff 1993; Lakoff & Johnson 1980, 1999), introduced the idea that metaphors are not merely literary figures, but rather cognitive tools that are essential to the way human beings understand their experiences. According to CMT, metaphors map the conceptual structure of entire experience domains onto one another, and constitute means of understanding abstract concepts in terms of more concrete ones. For example, we tend to think and speak of arguments in terms of war, so that we use expressions like "your claims are *indefensible*", or "he *attacked every weak point* in my argument" (Lakoff & Johnson 1980: 4). The same source to target conceptual mapping (from the domain of war to the domain of arguments) underlies all of these expressions. We will argue that interaction with hypermedia as an experience domain is understood by hypermedia users through a series of conceptual metaphors.

Conceptual integration theory (Fauconnier & Turner 1998, 2002), or blending theory (BT), holds the view that discourse comprehension is a process through which individuals use linguistic structures as cues to construct, manipulate and connect different mental spaces. Mental spaces are "small conceptual packets constructed as we think and talk, for purposes of local understanding and action" (Fauconnier & Turner 2002: 40). Conceptual blending involves the construction and manipulation of a conceptual integration network composed of a minimum of four mental spaces: two (or more) input spaces that contain conceptual (image-schematic) structure from different cognitive domains, a generic space that contains structure common to the input spaces, and a blended space, or blend, that integrates some of the structure from the input spaces into a coherent whole, exhibiting emergent structure of its own.

3. A three-layer model of hypermedia comprehension

Our model of conceptual metaphors underlying hypermedia comprehension was elaborated on the basis of empirical evidence from two experiments related to knowledge construction through hypermedia use. The first experiment (Fastrez 2002, 2005) focused on the influence of hypermedia structure on acquired knowledge organization. The second experiment (Collard 2009) concentrated on the effects of metaphors used to structure and shape hypermedia interfaces on user behavior and content comprehension.

The focus element of our model is the construction of a mental model of a given hypermedia by its user. This model integrates different items from distinct mental spaces, through multiple metaphorical projections. These projections are organized in a hierarchical structure, in such a way that the higher-level mappings inherit the structure of lower-level projections (Lakoff 1993). This hierarchical structure includes three levels, or "layers" of successive metaphors, which we will present in the three next paragraphs. The overall structure of our model, integrating all three layers, will be presented in the fourth paragraph as a conceptual integration network involving successive metaphorical blends (Grady, Oakley & Coulson 1999), in which the initial blends serve as inputs to more elaborated blends that further specify them.

3.1. *Primary metaphors*

The first layer of our model consists of a series of fundamental orientation and ontological metaphors (Lakoff & Johnson 1980) that structure our understanding of the basic elements of hypermedia systems (such as nodes and links) and the basic actions that can be undertaken on them (such as clicking on a link or accessing a node) in terms of simple image-schemas. We identified such metaphorical mappings in the analysis of a corpus of 41 interview transcripts in which hypermedia users described their interaction with the hyperdocument they browsed (Fastrez 2002). A dual conceptual metaphor underlies the different expressions we analyzed, the source domain of which is our experience of space: HYPERMEDIA IS SPACE.

The first version of this dual metaphor is the INTERACTION WITH A HYPERDOCUMENT IS MOTION THROUGH SPACE metaphor, which was also documented by Maglio and Matlock (1998, 2003). In this metaphor, nodes and groups of nodes (sections) are SURFACES-CONTAINERS, and the links connecting these nodes are PATHS. The user's activity of clicking on links to access nodes corresponds to the motion of a traveler along a PATH, where each step on the path is a SURFACE-CONTAINER that contains the traveler. Expressions like "I *went to* this page" or "I found myself *in* another

folder"[1] are common in our users' discourse, and illustrate this first metaphor. In this context, the user's inability to access a specific node or to manage their browsing strategy effectively is described in terms of *disorientation*, a state described by one of our users as when "one doesn't know *where they are* in the document".

The second version of the HYPERMEDIA IS SPACE metaphor is the INTERACTION WITH A HYPERDOCUMENT IS MANIPULATION OF AN OBJECT metaphor. In this metaphor, nodes and sections, and the hyperdocument itself are nested CONTAINERS. The hyperdocument contains sections, which contain specific nodes. The user is positioned in front of (and not in) the document, and their activity is conceptualized in terms of opening and closing CONTAINERS within CONTAINERS (opening the document, a section, a node, etc.). Expressions like "I started systematically *opening* all the pages" or "I first started to *open it* from the homepage" are examples of such metaphors. Table 1 presents the respective frequencies of these different categories of metaphors in our corpus.

Target of expression: Action of User (U) on Document (D)		
Source	*Percentage*	*N*
Motion of U in D	90.21 %	1521
Manipulation of D by U	9.23 %	159
Other	0.36 %	6
Target of expression: State of User (U) with respect to Document (D)		
Source	*Percentage*	*N*
Position of S in D	70.38 %	202
Disorientation	23.69 %	68
Possession of D by S	5.92 %	17

Table 1. Number of metaphorical expressions form the interview corpus

3.2. *Generic metaphors*

The second layer of our model corresponds to generic metaphors. They are conventional structural metaphors, i.e. generic representations of hypermedia as a typical media format. The source concept is more complex in generic metaphors than in primary metaphors. 65 students majoring in Information and Communication

1. All expressions cited are translated from French.

(Collard 2009) were asked to provide a general description of a website by completing the sentence "To me, a website is like a...". 58% their answers involved a metaphor. Among these metaphorical expressions (see Table 2), the source concepts referred to paper documents (a book, a brochure, an encyclopedia, a magazine, etc.), structured objects (a spider web, a labyrinth, a puzzle, etc.), informational places (a library, an exhibition, etc.), containers (a house, a box, etc.) and structured routes (a guided tour, a marked trail, etc.).

Metaphorical expressions		
Source	*Percentage*	*N*
Paper documents	50,0 %	19
Structured objects	21,0 %	8
Informational places	10,5 %	4
Containers	10,5 %	4
Structured routes	8,0 %	3

Table 2. Types of metaphorical expressions form the questionnaire corpus

In generic metaphors, the source concept is mapped on the product of the "first layer" primary metaphor, which acts as a target mental space. For example, the library concept, which is an "informational place", is mapped onto the MOTION THROUGH HYPERSPACE mental space.[2] The result of this mapping is a new generic metaphor: INTERACTING WITH A HYPERMEDIA IS NAVIGATING IN A LIBRARY.

Generic and primary metaphors are fundamental "layers" in our model, as they represent the way users usually think of hypermedia, regardless of the specific hypermedia they browse.

3.3. *Specific metaphors*

If a particular hypermedia is organized by a specific source concept, an additional metaphorical projection can add a third "layer" to the two previous ones. These specific metaphors are structural, but not limited to the fundamental "layers" described above. They correspond to the way some hypermedia are specifically built and represented. Specific metaphors provide additional structure to generic metaphors. For example, in

2. Described in the previous paragraph as the INTERACTION WITH A HYPERDOCUMENT IS MOTION THROUGH SPACE metaphor.

a hypermedia structured by the library concept, users can find nodes corresponding to floors, aisles, books, chapters in books, etc. The library mental space is mapped onto the navigation mental space described earlier, and the result is a new specific metaphor: INTERACTING WITH *THIS* HYPERMEDIA IS NAVIGATING *THIS* LIBRARY.

The condition to activate this third process is that the source concept must be identifiable, and users have to be aware that the system is metaphorically organized (Blackwell 1998). To make the source concept explicit is indeed not sufficient: after browsing a hypermedia explicitly organized and presented as a library, only 61% of our users mentioned the library when asked to describe it (Collard 2009). If the metaphor is not recognized and activated by the user, they may not be able to project elements from the source space onto the hypermedia space and infer its structure. Then the hypermedia is not processed as a whole metaphorized system, but metaphoric elements are interpreted literally and separately from one another (Toms & Kinnucan 1996).

At this third "layer", we distinguish between *physical* metaphors and *semantic* metaphors. This distinction is not based on the type of source concepts, on the type of manipulation they induce, or on the effects they produce (Neale & Carroll 1997; Saffer 2005). Rather, it focuses on the way the source concept is implemented in the system, and how this implementation influences the users' mental representations and navigation behavior.

The first category of specific metaphors is that of *physical* metaphors, in which the source concept maps either onto the system's hypertextual structure, or onto its multimedia interface, or onto both. We define an *interfacial* metaphor as a metaphor in which the target is the multimedia interface. Audio-visual aspects of the source concept appear through the techno-semiotic properties of the interface. The source concept can also structure the spatial organization of interface elements. For example,

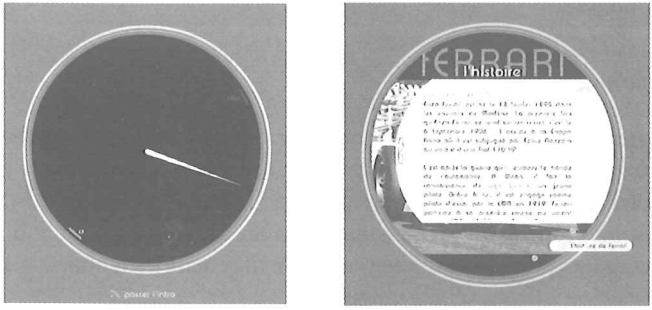

Figure 1. The introduction and the homepage of a Ferrari non official website (http://ferrari.fr.free.fr, accessed 25.02.2008)

Figure 1 shows the interface of a non official website for Ferrari, which is presented and organized according to the car dashboard metaphor. Graphic design and link locations are metaphorized, but the website structure, which includes two main topics (the history and the collections of the famous carmaker), is not structured by the source concept.

Conversely, the source concept can map onto the hypertext structure without being made explicit through the multimedia interface. We call this type of implicit metaphor a *hypertextual* metaphor. The network of nodes and links is built according to the structure pattern of the source concept. An example is the website of the Isabelle Durant's Cabinet, Belgian Minister for Mobility and Transports and Vice-Prime Minister from 1999 to 2003. The website was divided into sections and sub-sections according to the Cabinet staff organization chart: one section for each main department (the Minister's staff, the Vice-Prime Minister's staff and the Mobility and Transports department), with one subsection for each of the groups included in the third department (Rail, Road Safety, Aviation & Shipping, and International). The hypertext structure of this website was therefore metaphorically structured by the Cabinet's internal organization, although the interface did not make the metaphor explicit.

Another example of hypertextual metaphor is the website built for Collard (2009)'s research, called Texto (Figure 2), which is structured like a virtual scientific library. The topic of the library is the Internet, and it deals with both technical and social issues. Its informational contents are grouped in sections that correspond to books, with subsections that correspond to chapters when necessary. Books are grouped together in topical sections that correspond to aisles, which are organized in two main topics that correspond to two floors – Exact Sciences and Human Sciences – plus one floor for general encyclopedias. Texto's graphic design is neutral, and does

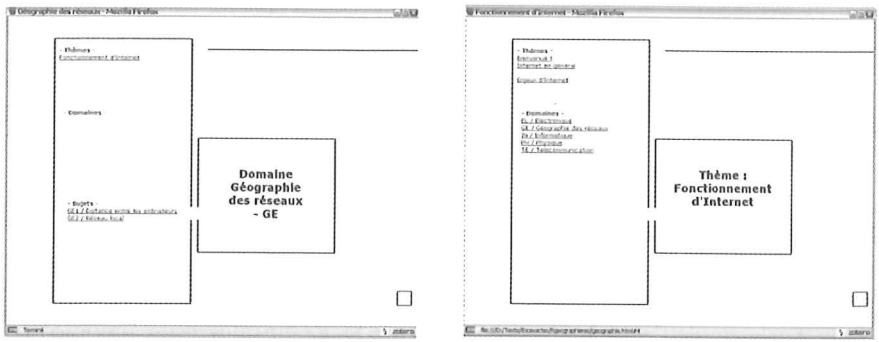

Figure 2. Homepages of a main topic section (as a floor, left) and a topic section (as an aisle, right) of Texto

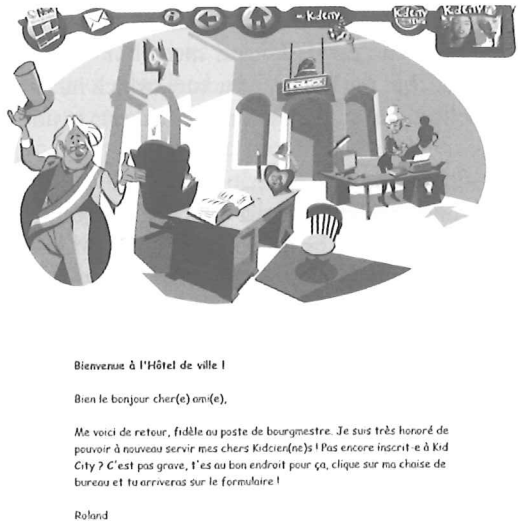

Figure 3. The homepage of the Town Hall section in KidCity website (http://www.kidcity.be, accessed 25.02.2008)

not refer to a library in any way. Accordingly, all terms related to the source concept are banished from the interface. Links appear as simple underlined text.

We call metaphors where both the multimedia interface *and* the hypertext structure are organized by the same source concept *hypermediatic* metaphors. The fact that the interfacial metaphor reflects the way the hypertext structure is organized and makes it explicit allows users to process and understand this structure accordingly (Barr, Biddle & Noble 2002). For example, the graphic design and the spatial organization of the KidCity website's interface follow a town metaphor, and so does the website's hypertext structure. In this example, KidCity's Town Hall (Figure 3) is a metaphor of the steps required to register to the website (*i.e.* to become a KidCity citizen).

A second example of a hypermediatic metaphor is another website built for Collard (2009)'s research, called Biblio (Figure 4). Biblio's hypertext structure is identical to that of Texto. But in this case, the library appears visually through the interface. Links are displayed on objects as floors signs, aisles signs, book covers or book pages.

The second category of specific metaphors is that of *semantic* metaphors. In this case, the source concept organizes the informational contents of the system and therefore augments the users' understanding of the presented knowledge domain (Meyer 2001). For example, "War Académie" (see Figure 5), a satirical website, proposed an original way to present information on the war in Iraq. The source concept was the

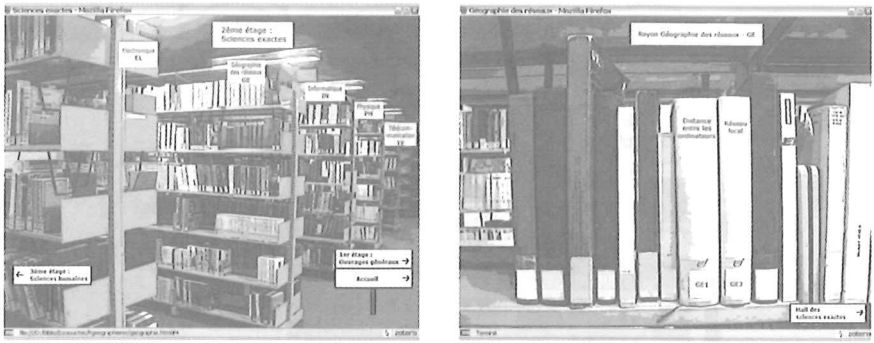

Figure 4. Homepages of a main topic section (as a floor, left) and a topic section (as an aisle, right) of Biblio

Figure 5. Homepage of the "War Académie" website
(http://www.waracademie.com, accessed 05.11.2003)

French television talent show Star Academy and its website (Figure 6). This source concept gave a particular meaning to information related to war. In "War Académie", the metaphor highlights the excesses of the war. War becomes a media campaign lead by competing political personalities, which eludes the complexity of its issues.

Of course, physical metaphors and semantic metaphors are not mutually exclusive categories. The source domain of a specific metaphor can structure a hyperdocument at the physical and at the semantic level.

Figure 6. The homepage of the "Star Academy" program as it was online during the war in Iraq (http://staracademy.tf1.fr/, accessed 05.11.2003)

3.4. *The whole picture: integrated metaphorical blends*

The three metaphorical processes described in the previous paragraphs are connected through a conceptual integration network, in which each "layer" of the network inherits structure from the previous layer. The result of this network is a metaphorical blend that encompasses the hypermedia itself as well as the user's interaction with it. This interaction can be structured and understood metaphorically in terms of specific types of spatial navigation or object manipulation, based on the dual primary spatial metaphor described earlier. The example of the library metaphor highlights these processes (see Figure 7).

In the case of the navigation metaphor, the structure and the elements of the "bodily experience of space" mental space are blended at the first layer with the structure and the elements of the "hypermedia" mental space. The hypermedia is then understood like a space in which users can move. At the second layer, the conventional metaphor of a "building" leads the user to specify the general MOTION THROUGH HYPERSPACE activity as NAVIGATION IN A BUILDING. Finally, when users browse the Biblio website (*cf.* supra), the venue through which they move is a library, a specific building. Then users experience their navigation activity as VISITING *THIS* LIBRARY.

In the case of the manipulation metaphor, the primary spatial metaphor of OBJECT MANIPULATION is organized by the "document" source concept at the second layer. Users do not manipulate any given object, they browse a document. In Biblio, users find books as a hypermediatic metaphor, and the specific objects they read are then the books proposed by the library.

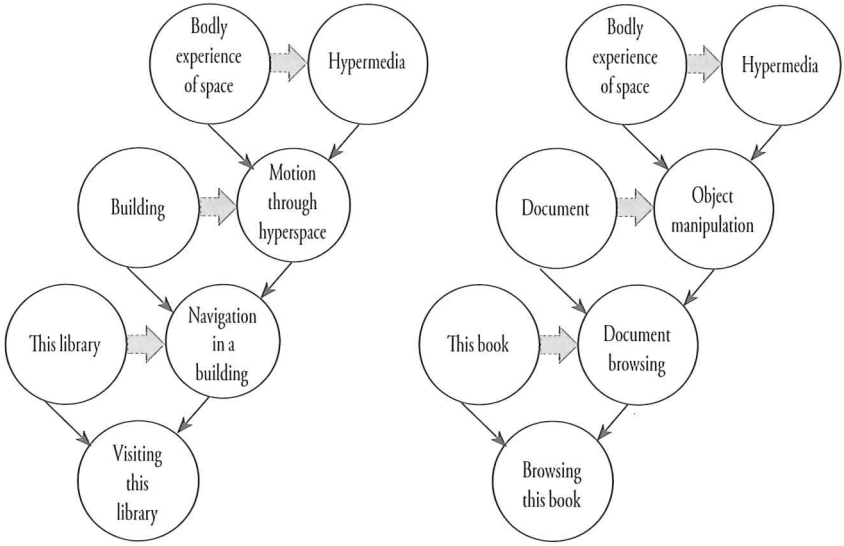

Figure 7. The library integrated blend (left) and the book integrated blend (right)

The conceptual integration network described above is seldom as unified and coherent as our presentation may make it seem. Rather, it is a patchwork of blends constructed opportunistically within context. For example, both primary metaphors (navigation and manipulation) are often used interchangeably by the same users. Furthermore, the same source input spaces can be mapped onto different target spaces depending on context. This is the case for physical metaphors that are also semantic metaphors: in such cases, a hyperdocument is organized by a hypermediatic metaphor which leads to a specific understanding of its informational contents. It is also the case for sources that are mapped onto targets at different layers in the network. For example, for Biblio users, the concept of a page can be projected onto a hypermedia node as a generic metaphor (leading them to talk about "webpages") or as a specific metaphor (where the node is a "library book page"). This process is illustrated by the following excerpts from an interview transcript of a user who browsed Biblio (Collard 2009). In the first excerpt, the same node is both a *page* (generic webpage metaphor) and the *library reception* (specific library metaphor), involving both versions of the primary dual metaphor described earlier:

> There was the *entrance door*, I *went in*, I came onto… uh, yes, the *page* where there was, I think it was the *reception*. And there were the three, the different *floors* where I could go. Then I went to the first *floor*.

In this second excerpt, the nodes referred to as pages are book pages (specific book metaphor), which are different from other nodes described as locations (specific library metaphor):

> I don't know if it was in *that floor* where there was "physics", "telecommunication", anyway in any case I went int', I clicked on a, on one of the options and... uh well... in function of this again I had *books*, I clicked on a book, and again I had a *page* that opened, the properties "*next page*", etc. [...] In any case, there was a *shelf* with several *books* and there was the "Firewall" *book* and I clicked on it. And then, it was the book where there was the shortest explanation, that's why I remembered. And uh... then, I think it's *one or two pages* and then one could simply *close the book*.

4. Running the hypermedia blend

An interesting property of conceptual blends is that they can guide action (Coulson & Oakley 1999). This is the case when the process of elaboration in the blend is coupled with the individual's activity. In this section, we will explore how the metaphorical blend of a given hyperdocument, created by its user, partly determines (and is determined by) the user's navigational behavior. Indeed, the conceptual integration networks we described so far are not static representations that stay unchanged throughout the user's activity. Rather, they are built dynamically as navigation unfolds, and can be modified in the course of navigation, can modify the course of navigation, and can be modified by the course of navigation. We will briefly review these three claims in order.

First, the hypermedia blend can be modified in the course of navigation. For example, in the interview excerpts mentioned above, the user switches between the two versions of the HYPERMEDIA IS SPACE metaphor (i.e. MOTION THROUGH SPACE and OBJECT MANIPULATION) when they describe their interaction with the system, depending on the specific aspect of their activity they are referring to (navigating the library or browsing a book).

Second, the hypermedia blend can modify the course of navigation. A comparison of the navigation behavior of users of the Texto and Biblio hyperdocuments we presented earlier will illustrate this point. Both Texto and Biblio include sections that correspond to books in the library, although these sections are not presented explicitly as books in Texto. "Books" include two specific navigation tools: a table of contents on their first "page", and "previous page" and "next page" links on each page. The analysis of the users' activity records shows that subjects using Texto tend to use the table of contents more than subjects using Biblio, as an alternative to the "previous/next" links ($\pi_{Texto} = 0.39$; $\pi_{Biblio} = 0.09$; $p < 0.001$). The explanation of this difference lies in the

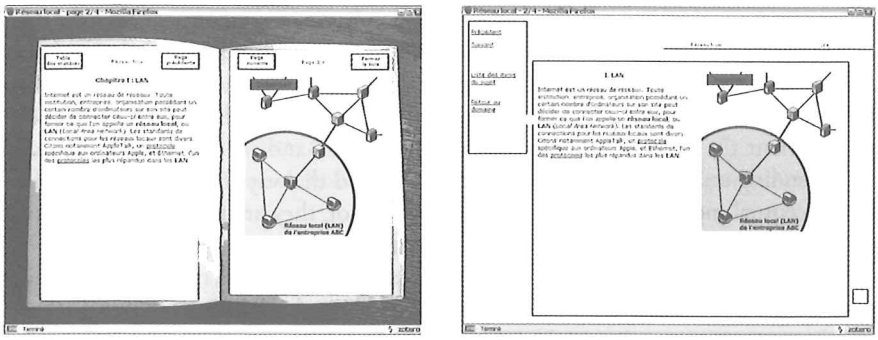

Figure 8. An open book in Biblio (left) and Texto (right)

fact that Texto users do not identify the book metaphor (as it is only implicit in the system). Hence, they interpret the "previous/next" links as being "back" and "forward" browser buttons, not links connecting the nodes of the section in their logical order (as pages in a book). When Texto users activate these links, they are confused about how they work. By comparison, most Biblio users easily identify the book metaphor, and are able to interpret how these links work within the context of this metaphor, and adapt their navigation strategies accordingly.

Third, the hypermedia blend can be modified by the course of navigation, as navigational choices may provide information that challenges the way users understand the system, and lead them to modify their representation of it accordingly. This is apparent in the way some Biblio users browse "books in the library". When they first see the "previous page / next page" links described earlier, these subjects interpret the function of these links outside of the book metaphor, i.e. as acting as "back" and "forward" browser buttons. However, when they activate these links, and realize (for example) that clicking "previous" takes them to the previous page in the book, not to the previous node in the chronological order of their navigation, these subjects (unlike Texto subjects) are able to correct their interpretation. In short, their usage of these links prompts them to construct the appropriate metaphorical mapping.

5. Conclusions and future work

In this paper, we presented a theoretical model accounting for the role of conceptual metaphors in hypermedia comprehension. This model highlights the hierarchical structure in which primary metaphors set the bases for more elaborate generic metaphors, which in turn may be expanded by specific metaphors. It also supports the

following theoretical hypotheses. On the one hand, our very concepts of hypermedia and hypermedia navigation are structured by metaphorical projections, whether or not specific hyperdocuments rely on explicit metaphors to organize their structure, their interfaces or their informational contents. On the other hand, different specific metaphors orient the user's comprehension of hypermedia and of their interaction with it, depending on the way they are implemented and the way they are made explicit. As conceptual metaphors impact navigation behavior, they are likely to influence the way users construct knowledge through browsing.

Future empirical work will explore the specific effects of metaphors on navigation behavior, as well as the extent to which these effects impact contents understanding.

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