

## **METAPHORIC NAVIGATION AIDS FOR CYBER SHOPPING MALLS: AN EMPIRICAL STUDY TOWARD THE CONSTRUCTION OF CUSTOMER INTERFACE\***

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### **ABSTRACT**

Designing effective navigation aids for customer interfaces is critical for the success of cyber shopping malls. Navigation aids can be classified into either basic ones which are based on the structure of the malls or add-ons which are not. Add-on navigation aids provide various short-cuts to promote efficient traversal in the cyber shopping malls, but too many of them would increase the complexity of the customer interface. Metaphors have been used widely for the design of add-on navigation aids, but little research evaluates their impact on the processes and outcomes of customers behavior in cyber shopping malls. This paper presents an empirical study that investigates the navigation process of customers and the subjective evaluation of their shopping experience. This research implemented two versions of a test-bed cyber shopping mall according to different metaphors used; one based on a spatial metaphor, and the other based on a non spatial metaphor. The results of the experiment indicate that navigation aids based on the spatial metaphor were used more frequently, which resulted in better understanding about the entire structure of the cyber shopping malls, which in turn led to an increased ease of finding target items and also a more pleasant shopping experience. The benefits of navigation aids based on the spatial metaphor became more evident when customers were looking for ad-hoc category items rather than common items. This paper presents plausible explanations for the results and implications to the design of navigation aids for cyber shopping malls.

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## 1. INTRODUCTION

Nowadays, one of the most evident changes in the area of information technology is the Internet. The rate of increase in Internet use is second to none compared to any other technological advances in the modern era. The number of users and computers in the Internet is increasing rapidly, with an annual growth rate of 50 % to 100 % [6]. Twenty eight million people are estimated to use the Internet currently, and the number is expected to grow to two hundred million by the year 2000 [16]. As the use of the Internet becomes prevalent, it is expected to have a profound impact on our everyday lives [22]. One important change that can be brought about by the Internet is manifested by electronic commerce. Electronic commerce is defined as the execution of information-laden transactions between two or more parties using inter-connected networks [18]. Because of the rapid diffusion of the Internet, more than one million people have used the Internet to purchase something, and the market for electronic commerce is expected to increase sharply to 600 million dollars by the year 2000 [16].

Electronic commerce can be classified into three distinct categories: inter-organizational electronic commerce, intra-organizational electronic commerce, and consumer-to-business electronic commerce [19]. Of the three, consumer-to-business electronic commerce, mostly implemented as cyber shopping malls, has the greatest potential to influence our everyday life. Through cyber shopping malls, customers can learn about products, buy products with electronic cash, and even have information goods delivered over the network. Customers are spared the drudgery of traffic and long lines of conventional shopping malls. Suppliers can reduce overhead costs through less investment for physical stores and distribution channels. For these reasons, the size of the cyber mall market is expected to grow to 660 million dollars, with twenty percent of total household expenses spent via the Internet [18].

An important precondition to the success of cyber shopping malls is the construction of appropriate customer interfaces. A customer interface is defined as the user interface of the cyber shopping mall system, with which customers interact to search for the target items and to purchase the identified items [21]. The customer interface differs from the conventional user interface of software systems, because conventional user interfaces focus mainly on the task of conveying information in a cognitively efficient way, such as ease of use and ease of learning [29]. Although conveying information efficiently is still important in the design of customer interfaces, it should also provide a pleasant shopping environment. The cyber mall should satisfy or impress the customers

so as to make their shopping experience a pleasurable one, so much that customers are tempted to return. Otherwise, customers would not revisit the shopping mall or would easily switch to an alternative mall. This is because switching costs in cyber space are extremely low compared to conventional shopping malls, since competitors are just a click away in cyber space.

Designing a customer interface involves various activities including content design, structure design, graphic design, and navigation design [26]. Content design determines the type and scope of the products that should be included in the cyber shopping mall. Once the products or services have been identified and the appropriate information collected, the knowledge must be organized to enable customers to understand the domain with minimal effort. Structure design consists of selecting an appropriate structure for the organization of the information such as hierarchical structures, network structure, and grid structures, among others. After the information is properly organized across different pages in cyber shopping malls, a mechanism that enables customers to move from one page to another with minimum effort must be provided [7]. Navigation design determines the types of navigation aids that should be provided to customers for efficient navigation. Finally, the structure of the cyber shopping mall and the navigation aids should be represented on the screen. Graphic design determines how the information is actually presented on the screen.

Among the four kinds of design tasks in the design of customer interfaces, this paper focuses on navigation design. Various kinds of navigation aids are currently available. Some of which are basic aids that are provided by the browser and site structures. Others are non-basic navigation aids that are constructed for specific shopping malls as hard wired page buttons and menus. Metaphors have been used frequently for the bases of the navigation aids, but little research has investigated the impact of metaphoric navigation aids on the subjective evaluation of customer interfaces [34] or on the process of customers navigation in the cyber shopping mall [5]. Most prior studies in electronic commerce have focused on the technological issues related to implementation, such as encryption, security, and electronic cash, just to name a few. These are undoubtedly important issues in electronic commerce, but the human aspects, such as the navigation process of customers and their subjective evaluation, are also essential for a wide acceptance of electronic commerce systems.

The main objective of this research is to investigate the effects of metaphoric navigation aids on the navigation process of customers while shopping in cyber shopping malls. This paper explores the impact of navigation aids with final impressions of the customers through questionnaires, and also investigates the navigation patterns of individual customers by using server log

files [12]. This paper consists of five sections. The next section provides the basic theory of the research focusing on navigation and metaphor. The following section explains the experiment that was conducted to explore the impact of metaphoric navigation aids. The fourth section presents results from the experiment, and finally this paper concludes with the general discussions about the results.

## 2. METAPHORIC NAVIGATION AIDS

### 2.1. Navigation Aids

A cyber shopping mall consists of a myriad of hypertext pages each of which contain valuable information. In hypertext systems such as cyber shopping malls, navigation is the activity of getting from one page to another via a series of small steps that is intermingling of way-finding and locomotion<sup>1</sup>). The most frequently cited problem with navigation is the symptom of “getting lost in cyberspace” [10, 28, 31]. Users in cyber space frequently feel disoriented; not knowing where they currently are, where they came from, nor where to go next [28]. The source of this symptom stems from the users’ cognitive overload, because they need to carry out multiple tasks concurrently while navigating through a hypertext system [20]. For example, the users need to plan and execute routes, read and understand the contents, and also coordinate information and navigational tasks. Various navigation aids have been developed in order to relieve the problem of getting lost. These can be classified into two categories [15].

One is to improve the orientation of users by providing the overall structure and keeping track of their moves through that structure. For example, Rivliln, Botafogo, and Shneiderman [33] developed a visual structure of hypertext systems by using a structure-based toolbox. In another example, Furnas [13] suggested that every node must have good residue at every other node to improve orientation.

The other category, which is the focus of this study, is to assist navigation by providing interaction facilities for navigation in addition to those provided by the browser [7]. There are two types of navigation interaction facilities. Some navigation facilities are directly inferable from the structure of the hypertext system, while others are add-ons to the basic structure. For example,

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1) This definition of navigation is based on the informal exhibit from the Navigation Workshop at CHI97 conference.

if the structure of a cyber shopping mall is organized hierarchically, the “UP” and “DOWN” buttons that moves customers one level higher and lower along the hierarchy should be provided to the customers. For another example, if the mall is organized with a list structure, the “BEFORE” and “AFTER” buttons should be provided to move along the list. Because these buttons are automatically determined based on the structure of the cyber shopping mall, not much room is left for manipulation in the navigation design. Another type of navigation facilities, which is the focus of this study, are those buttons that are added onto the basic structure of the cyber shopping mall. These add-ons are extremely useful because they increase the efficiency of view traversal by fixing the navigation problems resulting from the poor structure of the site [13]. However, too many add-on facilities increase the level of system complexity and supplant users logical mode of locating information [26]. Therefore, devising appropriate add-on navigation aids is an important task in navigation design.

## 2.2. Metaphors and Navigation Aids

When we want to convey an abstract concept in a more familiar and accessible form, we frequently resort to using metaphoric expression. The metaphors we use daily shape our understanding and profoundly influence what we do in the real world. Metaphors are used heavily in our everyday lives to the extent that almost all human thought can be considered as metaphorical [23]. Metaphors have also been heavily used in the design of software. In fact, it is difficult to think of a system that is completely not based on any form of metaphor. The objects on the screen, the types of user interactions we perform, the way the system responds tend to be based on familiar terms. For example, the desktop metaphor has been used widely in most personal computer operating systems [2]. Most user interface guidelines suggest that applications should build on the user’s real-world experience by exploiting concrete metaphors thereby making applications easier to use. Therefore, we need to explore to what extent metaphors help users interact with computer systems. Several design guidelines have been proposed in order to maximize the benefits of using metaphors in system designs [3, 25]. For example, Madsen [25] has suggested to pay special attention to metaphors that are already implicit in the problem description or already used by the users. Building on metaphors that are already familiar to the users increases the chance that the metaphor will be fully exploited by the users. Therefore, metaphors reflecting physical structure, which are usually built on already existing metaphors, are often successful [3].

Metaphors are also widely used in the Internet and cyber-space. Various kinds of metaphors are used, such as the newspaper metaphor [14], the library

metaphor[34], and the community metaphor [27]. In fact, the term “cyber shopping mall” itself is based on the metaphor of “trader” that has been used persistently in the western culture for a long time [35]. The electronic marketplace metaphor carries over many assumptions about how a market works, such as how the price is determined, how the shopping is performed, and how the payment is made. Metaphors have also been used frequently in the design of navigation aids for hypertext systems [30]. Metaphoric navigation aids are those that use familiar terms and concepts in the real world, such as elevators, escalators, store directory, etc. Non-metaphoric navigation aids do not use any real world counterpart. For example, system function names (such as F5) and physical URL (www.xxx.com) are not based on any special metaphor. As Smilowitz [3] points out, most navigation aids provided by the system are non-metaphoric, whereas most add-on navigation aids are metaphoric. This paper focuses on the metaphoric add-on navigation aids.

Of those various metaphors that were already used, spatial metaphors have gotten special attention in previous research [3, 9, 20, 34]. Spatial metaphoric navigation aids are add-on navigation aids that are based on our everyday knowledge of the Euclidean space [9]. Our knowledge on space include place knowledge, route knowledge, and survey knowledge [20]. For example, we know that escalators in the department store move people either one floor up or one floor down. Based on this knowledge, we know how the escalator button in the cyber shopping mall works. Other spatial metaphoric navigation aids includes elevator, next stores, etc. Non-spatial metaphoric aids do not use our everyday knowledge of the Euclidean space and break the assumption imposed by the Euclidean space [9]. For example, if we do not adhere to Euclidean space, it is possible to travel from a location A to a location B without visiting locations between A and B. Examples of non-spatial metaphoric aids include the index metaphor, which list keywords at the end of the book with the page numbers that the key words appear. Navigation aids based on the Index metaphor can move from the index pages to the specific product page instantly.

Navigation aids based on the spatial metaphor are encouraged by many guidelines for interface design and many are currently employed, including such navigation buttons as neighborhood, escalators, and elevators. However, there is little empirical research evaluating the claimed benefits of the spatial metaphor [34].

In order to empirically evaluate the navigation aids based on spatial metaphors, this research conducts an experiment comparing navigation aids based on a spatial metaphor and those based on a non spatial metaphor. This research expects that spatial metaphors will be more effective in helping customers navigate in the cyber shopping mall for two reasons. First, a spatial

metaphor is already implicit in the metaphor of cyber shopping malls which are based on the knowledge of cyber "space". Therefore, navigation aids based on a spatial metaphor could be embedded more naturally into the shopping mall in cyber "space" than a non spatial metaphor. Second, the users' spatial ability has been recognized as an important factor in increasing the efficiency of interacting with hypertext systems [5]. For example, Campagnoni and Ehrlich [4] reported that a greater spatial ability may help one to learn the structure of a subject domain more quickly. Therefore, navigation aids based on a spatial metaphor are expected to enable more efficient navigation than those based on a non spatial metaphor. However, their research could not predict a priori how exactly the features of spatial metaphors influence the navigation process of customers in cyber shopping malls. An experiment was conducted to explore these issues.

This research also expects that the relative usefulness of spatial metaphor will vary depending on the categories of items that customers are looking for. This study focuses on two categories of items: ad-hoc and common [1, 32]. Ad hoc categories are those that are constructed spontaneously to achieve certain goals. For example, constructing the category of "a birthday present for a friend" can be instrumental in achieving the goal of pleasing my friend on a special occasion. These categories are different from the common categories that had already been constructed and applied to a wide variety of contexts (such as fruit, furniture). Compared to the common category, ad hoc categories have three distinctive characteristics [1]. First, ad-hoc categories have a weak concept of category, which results in more difficulty in recalling them from memory. Second, they have weak associations from concept to instances, resulting in a low consistency and slow access to the target items in the cyber shopping malls. Finally, they have weak associations from instances to concepts resulting in category concepts that are not readily available. These characteristics of ad-hoc categories make it more difficult for customers to pinpoint the exact location of the target item, and only allow them to identify its rough location in the cyber shopping mall. In this case, the features of spatial metaphor are extremely helpful to facilitate the navigation process, since spatial metaphors are based on the Euclidean distance. Once a rough location is identified, navigation aids based on the spatial metaphor provide more efficient ways to search for the items that are closely located in the cyber space.

In summary, this research anticipates that spatial metaphors are more helpful for use in the navigation design, and the usefulness will be more profound when customers are looking for ad-hoc category items. In order to test these hypotheses, and to provide more detailed data about the impact of the spatial metaphor on the navigation process, an experiment was conducted with

a test cyber shopping mall.

### 3. METHCD

#### 3.1. Material

A test-bed was constructed based on a cyber shopping mall that had actually been conducting business for several months. An imitation of the actual mall was made, with the consent of the owner, in order to increase the external validity of the study. The experimental cyber mall had a hierarchical structure consisting of five levels. The top level had an introduction page of the mall, the second level had several pages to describe abstract classification of products (e.g., home electronics), the third level had more detailed classification of products (e.g., an audio store), the fourth level had overview information on the individual product (e.g., mini component #342), and finally the fifth level had detailed information on individual products (e.g., technical specifications and evaluation reports). The entire mall had 339 different products and 665 pages in total.

The experimental mall was constructed as two versions. One version was based on the spatial metaphor and the other based on the non spatial metaphor. Examples of a screen for each version are shown in appendix 1. The two versions had exactly the same number of products, same number of layers, and the same basic navigation aids (“UP” and “DOWN” buttons), but differed in terms of the metaphoric navigation aids. The spatial metaphor version had an escalator button that enabled users to move one floor up or down, and neighborhood buttons that enabled users to move to the adjacent shops. The non spatial version was based on an index metaphor such as that usually provided at the end of books, and implemented with a top-index button. The top-index button moved the user from anywhere in the shopping mall to the index page that lists the entire products sold in the cyber shopping mall in the alphabetic order. If a subject selects any of the product, he/she can move directly to the product page. The non spatial version also provides the navigation aid based on the search engine metaphor. The search engine metaphor is based on our everyday question-and-answer help desk in the shopping mall. As any usual search engine, users key in several keywords and then the search engine looks around the shopping mall and provides a list of products that contain the keywords. Clicking any of the product names enables users to move to any individual product page that the users selected to visit.



The navigation aids of the spatial metaphor had two common characteristics. First, they enabled users to move horizontally at the same level of the hierarchy. For example, the escalator button enabled customers to move from the first floor to the second floor without moving up to the top level. Similarly, the neighborhood buttons enabled customers to move to the next store without moving up to the floor level. Second, the navigation aids of the spatial metaphor did not allow the customers to jump. For example, they could not go from the second floor to the fourth floor directly without visiting the third floor. On the other hand, the navigation aids based on the non spatial metaphor allowed users to jump. For example, the users could go directly from the top level index page to the page of individual products without going through all the intermediate pages (floors and stores) in the hierarchy. For another example, they could move to the search engine page anywhere in the shopping mall, and go directly from the result page of the search engine to the page of individual product.

### 3.2. Subjects

A total of 83 subjects participated in the experiment for course credit in an introductory undergraduate marketing class and a management information systems class from an MBA program. Their ages ranged from the early twenties to the late forties, which is a representative sample of ordinary Internet users [16]. Subjects were randomly assigned to one of the four groups: 23 subjects with the spatial metaphor for common category group in which subjects were given the cyber shopping mall that has navigation aids based on the spatial metaphor and asked to shop for target items in the common categories. Similarly, 19 subjects were in the spatial metaphor/ad-hoc category group, 18 subjects in the non spatial metaphor/common category group, and 23 subjects in the non spatial metaphor/ad-hoc category group. The number of subjects in the four groups was not the same because some subjects did not show up or quitted in the middle of the experiment sessions.

### 3.3. Procedures

Subjects were first asked to fill out the pre-questionnaires which probed the amount of prior experience with the Internet, World Wide Web, and cyber shopping malls. The pre-questionnaires also asked the subjects the level of specificity of their shopping goals. For example, the pre-questionnaires determined whether customers sought specific brand names or a specific model before they went shopping, or merely went shopping with rough ideas about

which items to buy.

After the subjects finished the pre-questionnaire, they were introduced to the experimental cyber mall and were asked to purchase five items, one by one, within a given time limit of three minutes per item<sup>2</sup>). There were two sets of five items, one for the common category, and the other for the ad-hoc category. Items in the common category included a sweatshirt, a computer sound card, a popular music CD, a wide screen TV, and an exercise equipment. Items in the ad-hoc category included a present for significant others at the first snow, a present for a sibling's birthday who had interests in technologies, something for a snowy Sunday afternoon, entertainment to enrich the quality of life, and anything they wished to buy with free money. These items were selected to cover a wide variety of products; some products induced high involvement from the users (e.g., a present for significant others) while others produced little involvement (e.g., a music CD). Some products were prone to hedonic purposes (e.g., sweatshirts) while others were more geared toward utilitarian purposes (e.g., a computer sound card). The two sets of five items were selected so that subjects may choose similar items regardless of whether they were in the common category group or in the ad-hoc category groups.

While subjects were searching for the target items, their keystrokes were recorded into the system log files. In order to catch keystroke data as faithfully as possible, the "back" button was disabled, and disk cache was set to zero in the browser. After subjects finished buying the five items, they were asked to fill out the post-questionnaire that probed their subjective opinions on the shopping mall. The questionnaire focused on two dimensions: the ease of navigation and the pleasure of shopping.

Six subjects from each of the four groups were randomly selected (24 subjects in total) to test the reliability of system log files and to measure how much they understood the structure of the shopping mall. They followed exactly the same procedure as other subjects in the same group. However, at the end of the experiment, they were asked to draw the entire structure of the shopping

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2) It may be true in the real world that people would spend more than 3 minutes for shopping one item. However, several informal pretests that we had conducted before the main experiment indicated that three minutes is not too little for the subjects, and our subjects in the main experiment also did not express time shortage either. There may be several reasons for this discrepancy. First, our shopping mall may be too smaller than the real shopping malls (339 different products). Therefore, subjects need less time to search for target items in our shopping mall. Second, our subjects only had to select target items, and they did not have to go through the payment and delivery procedure, which may decrease the time for purchase in our experiment. Finally, the navigation aids provided in our experiment may be so effective that our subjects only need such a short time before purchase decisions. Therefore, subjects in our experiment did not feel unrealistic time limit and this can be shown in section 4.2.1. Especially, subjects looking for common category target items spent only 80 to 120 seconds which is much less than 180 seconds that were given to our subjects.

mall by sketching the elementary digraphs (nodes and arcs) of the cyber shopping mall they had previously navigated to buy the five items [24]. The elementary digraphs were found to faithfully represent subjects understanding about a complex system [17]. Moreover, all of their actions as well as verbal utterances were recorded by two video cameras [11]. The video recorded data were used to test the reliability of the server log files. In the following section, results of the pre questionnaire, navigation process, post questionnaire, and the recall protocol data are provided sequentially.

## 4. RESULTS

### 4.1. Pre-questionnaire Results.

In order to measure the subject's background in computing, two questions in the pre-questionnaire asked how long they had used computers and how frequently they worked with computers. The data were analyzed by using two way ANOVA analysis with two independent variables (target items and metaphors used in the navigation aids). Most subjects responded that they used computers quite often and for a moderately long time without any group difference both in terms of duration ( $F=0.42$ , n.s.) and frequency ( $F=0.31$ , n.s.). Next, three questions asked how long they had used the Internet, the World Wide Web, and the web browser. The results indicated that subjects regularly use the Internet eighty minutes per week, had used the WWW for five months, and 73 percent of the subjects had prior experience with the web browser used in the experiment. The four experimental groups were not different in any of the three aspects (Internet:  $F=0.77$ , n.s.; WWW:  $F=2.02$ , n.s.; Browser:  $F=1.30$ , n.s.). Finally, two questions asked if the subjects had prior experiences with cyber shopping malls, and specifically with the one our test-bed was based on. Only one subject had purchased something from a cyber shopping mall before the experiment, and none of the subjects answered to have visited the cyber shopping mall that our test-bed was based on. In summary, the results from the pre-questionnaire reveal that our subjects in the four experimental groups are homogeneous in terms of their background with the Internet and World Wide Web.

## 4.2. Post-questionnaire results.

The post questionnaire consisted of four questions, with two to measure the ease of navigation (how easy it was to navigate in the shopping mall and how easy it was to locate items that they wanted to buy) and the other two to measure the general satisfaction (how satisfactory and how pleasant was the shopping experience). A 7 point Likert scale was used. Figure 1 shows the results concerning the ease of navigation and figure 2 provides the results on the general satisfaction.

The results in Figure 1 indicate that subjects perceived the cyber mall with the spatial metaphoric aids as being easier to locate items ( $F= 8.78$ ,  $p<.01$ , spatial: 6.12, non-spatial: 5.11) and also easier to navigate ( $F = 7.12$ ,  $p<.01$ , spatial: 6.52, non-spatial: 5.74) than that with the non spatial metaphoric aids. The results in Figure 2 indicate that subjects felt more satisfied ( $F=4.68$ ,  $p<.05$ , spatial: 4.80, non-spatial: 3.93) and the shopping experience more pleasurable

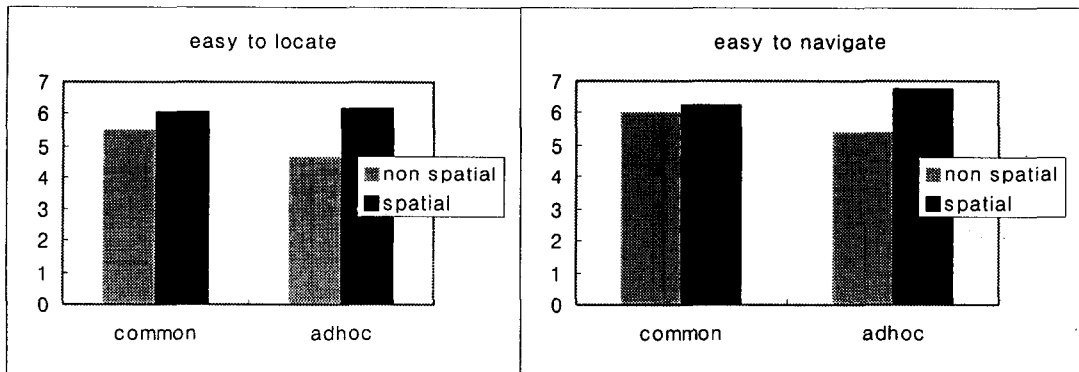


Figure 1 - Ease of Navigation

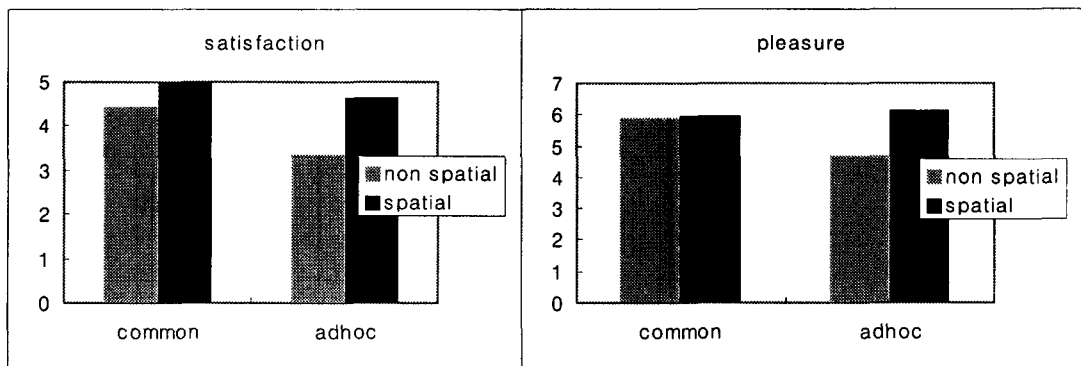


Figure 2 - Level of General Satisfaction and Pleasurableness

( $F=5.19$ ,  $p<.05$ , spatial: 6.05, non-spatial: 5.34) with the spatial metaphor than with the non spatial metaphor. Moreover, there was an interaction effect between metaphor and category in terms of the pleasurable level ( $F=4.72$ ,  $p<.05$ ). The subjects with the spatial metaphor felt more pleasurable than those with the non spatial metaphor to a greater extent with ad hoc category items than with common category items. Detailed analysis on the process log data is followed to explain the group differences in the post questionnaire results.

### 4.3. Process Log Data.

In order to understand the navigation behavior of the subjects, their navigation processes were analyzed in terms of the total number of pages visited and the frequency of pressing the navigational buttons. These analyses were based on the key-stroke data recorded in the server log files. The reliability of the key-stroke data was verified by comparing them with the video-recorded data of the selected subjects.

#### 4.3.1. Total time and total number of visited pages

Figure 3 shows the average number of pages visited as well as time spent for each item while subjects were buying the five items. In terms of the average time spent for each item, subjects spent more time when they were shopping for the ad-hoc category items than for the common category items (ad-hoc category : 170.5 sec vs. common category : 100.4 sec;  $F=35.04$ ,  $p<.01$ , see Table 1 for more details). There was neither a main effect of metaphors nor an interaction effect between metaphors and categories. In terms of the average number of pages visited for each item purchased, there was again a strong

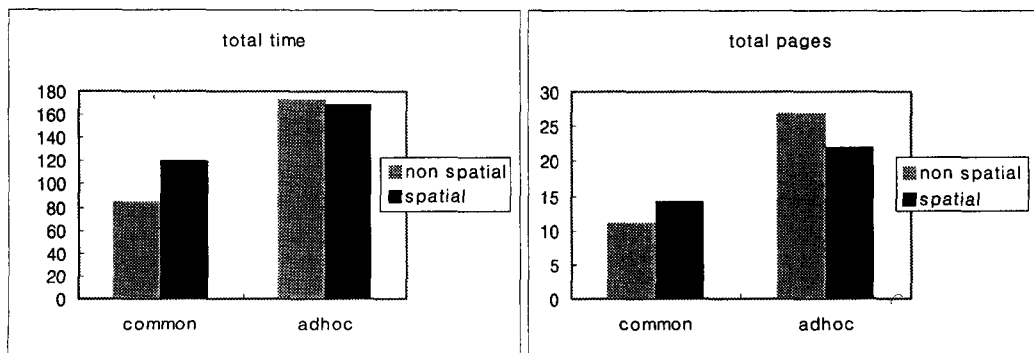


Figure 3 - Average Time Spent and Pages Visited for Each Purchased Item

main effect of categories of the target items ( $F=43.92$ ,  $p<.01$ , see Table 2 for more details). Subjects visited more pages when they were shopping for the ad-hoc category items than for the common category items (ad-hoc category : 24.35 pages vs. common category : 12.47 pages). Moreover, there was an interaction effect between the category of target items and the metaphor of the navigation aids used ( $F=5.23$ ,  $p<.05$ , see Table 2 for more details). When subjects were searching for the common category items they visited more pages with the spatial metaphor than with the non spatial metaphor, whereas they visited pages in the opposite way when they were looking for the ad hoc category items.

In summary, subjects spent more time and visited more pages when they were looking for the ad-hoc category items than for the common category items. Also, when subjects were looking for ad-hoc category items the spatial metaphor group visited less pages than the non spatial metaphor group, whereas the opposite way when they were looking for common category items. In order to move from the current page to a new page, subjects had to use the navigation facilities, either basic or metaphoric. In the next section, we analyzed the usage of the navigation facilities in order to explain the difference in average time and average number of pages visited.

Table 1 - ANOVA Table for "Total time"

Dependent Variable: TOTAL TIME				
Source	DF	Sum of Squares	F Value	Pr > F
Model	3	506827,124485	14.53	0.0001
CATEGORY	1	407268.686142	35.04	0.0001
METAPHOR	1	20948.206236	1.80	0.1803
CATEGORY * METAPHOR	1	36746.302153	3.16	0.0763

Table 2 - ANOVA Table for "Total page"

Dependent Variable: TOTAL PAGE				
Source	DF	Sum of Squares	F Value	Pr > F
Model	3	14275.4316207	14.53	0.0001
CATEGORY	1	12312.0100475	35.04	0.0001
METAPHOR	1	94.9207988	1.80	0.5610
CATEGORY * METAPHOR	1	1467.4490753	3.16	0.0227

**4.3.2. Basic navigation buttons.**

Figure 4 shows the average number of usage for the basic buttons and the proportion among the total page transitions. The basic navigation buttons include the “UP” and “DOWN” buttons. In terms of the number of usage, there was a strong main effect of target item categories ( $F=50.48, p<.01$ ), a main effect of metaphoric aids ( $F=16.85, p<.01$ ), and an interaction effect between categories and metaphoric aids ( $F=7.28, p<.01$ , see Table 3 for more details). Subjects used the basic navigation buttons more often when they were searching for the ad-hoc items than for the common items (ad-hoc category : 21.09 times on average per item vs. common category : 9.97 times on average per item). They also used the basic buttons more often when they were working with the non spatial metaphoric aids than with the spatial metaphoric aids (non spatial metaphoric aids: 17.42 times vs. spatial metaphoric aids : 12.22 times). Finally, the difference in terms of different metaphoric aids were more significant when the subjects were looking for the ad-hoc category items (non spatial : 26.75 times vs. spatial : 15.77 times) than for the common

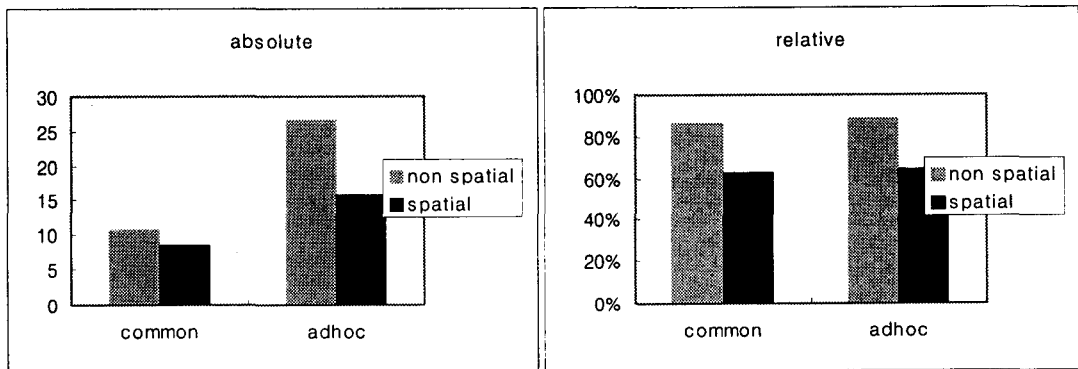


Figure 4 - Absolute and Relative Frequency of Using the Basic Navigation Buttons

Table 3 - ANOVA Table for the usage of Basic Navigation Aids.

Dependent Variable: Basic Navigation				
Source	DF	Sum of Squares	F Value	Pr > F
Model	3	16397.8939355	23.50	0.0001
CATEGORY	1	11742.3536655	50.48	0.0001
METAPHOR	1	3920.6754584	16.85	0.0001
CATEGORY * METAPHOR	1	1694.2804703	7.28	0.0073

Table 4 - ANOVA Table for the proportional usage of basic navigation aids.

Dependent Variable: Basic Navigation				
Source	DF	Sum of Squares	F Value	Pr > F
Model	3	6.77303636	130.73	0.0001
CATEGORY	1	0.04180002	2.42	0.1206
METAPHOR	1	6.65885775	385.57	0.0001
CATEGORY * METAPHOR	1	0.01330367	0.77	0.3807

category items (non spatial : 10.93 times vs. spatial : 8.97 times). In terms of the proportional number of basic button usage, there was only a main effect of metaphoric aids ( $F=385.57$ ,  $p<.01$ , see Table 4 for more details). The groups with non spatial metaphoric aids used the basic navigation buttons more frequently than the groups with spatial metaphoric aids (non spatial : 98% of total page transitions vs. spatial : 71% of the total page transitions).

**4.3.3. Metaphoric Navigation Buttons.**

Figure 5 shows the absolute number of usage for the metaphoric aids and also the proportions in terms of the total number of page transitions. Both figures similarly indicate only a main effect of metaphors (Absolute :  $F=114.32$ ,  $p<0.01$ ; Relative :  $F=385.57$ ,  $p<0.01$ , see Table 5 & 6 for more details). Subjects with the spatial metaphoric aids used the metaphoric navigation buttons more often (5.82 times, 28.7 %) than those with the non spatial aids (0.24 times, 1.5 %). There was neither a main effect of categories nor an interaction effect between the two.

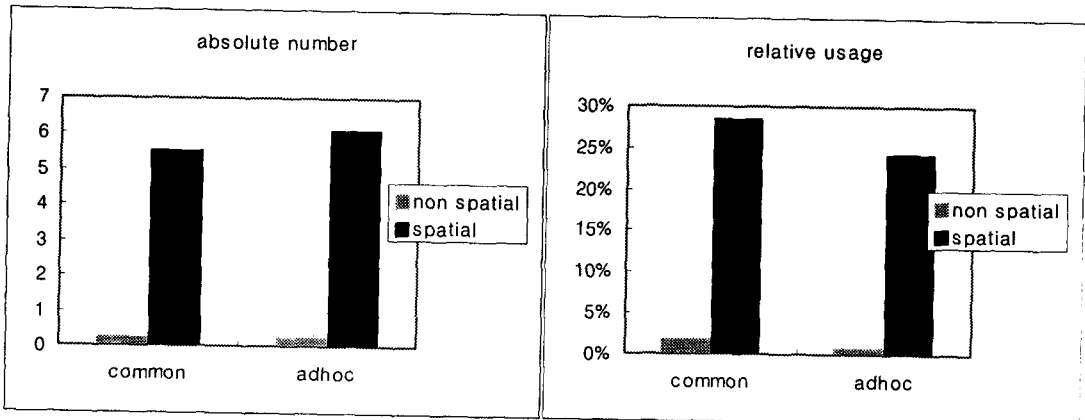


Figure 5 - Absolute and Relative Frequency of Using the Metaphoric Navigation Buttons



Table 5 - ANOVA Table for the usage of Metaphoric Navigation.

Dependent Variable: Basic Navigation				
Source	DF	Sum of Squares	F Value	Pr > F
Model	3	2850.53226185	38.86	0.0001
CATEGORY	1	6.74625838	0.28	0.5997
METAPHOR	1	2795.50831531	114.32	0.0001
CATEGORY * METAPHOR	1	8.14725909	0.33	0.5642

Table 6 - ANOVA Table for the proportional usage of metaphoric Navigation Aids.

Dependent Variable: Basic Navigation				
Source	DF	Sum of Squares	F Value	Pr > F
Model	3	16397.8939355	23.50	0.0001
CATEGORY	1	11742.3536655	50.48	0.0001
METAPHOR	1	3920.6754584	16.85	0.0001
CATEGORY * METAPHOR	1	1694.2804703	7.28	0.0073

#### 4.4. Drawings about Structure.

Selected subjects were asked to draw the entire structure of the cyber shopping mall immediately after they had purchased the five items. Subjects drawings were evaluated in two aspects. The first was how easy it was to remember the structure of the shopping mall in general, and the second was how easy it was to remember the metaphoric navigation aids in particular. The number of correctly remembered nodes and links are shown in Figure 6 to investigate the ease in remembering the entire structure. The results indicate that there was only a main effect of metaphors (Node :  $F=6.80$ ,  $p<.05$ ; Link :  $F=14.51$ ,  $p<.01$ ) with neither main effect of categories nor interaction effect of metaphors and categories. The subjects with the spatial metaphors could remember more numbers of nodes and links than those with the non spatial metaphors (Nodes : 22 for spatial metaphor vs. 15 for non spatial metaphor; Links : 46 for spatial metaphor vs. 16 for non spatial metaphor). In terms of the metaphoric navigation aids in particular, there was again only a main effect of metaphors ( $F=10.85$ ,  $p<.01$ ). Subjects with the non spatial metaphors could recall less navigation buttons and erroneously made up more buttons that had not been provided than those with the spatial metaphor (spatial metaphor : forgot 0.16

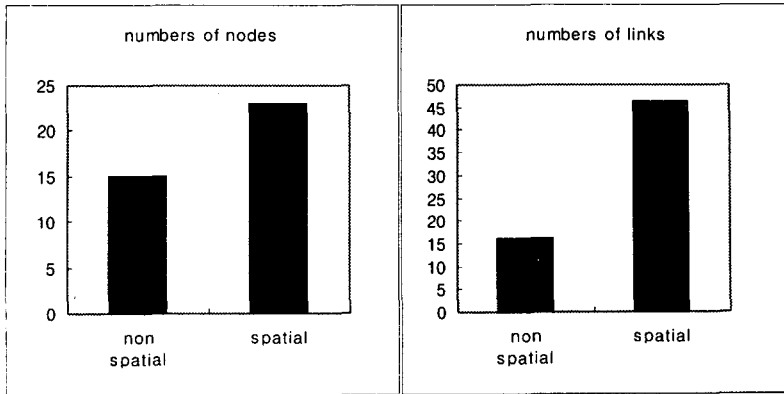


Figure 6 - Number of Nodes and Links Remembered in the Recall Protocols

buttons, made up 0.08 erroneous buttons vs. non spatial metaphor : forgot 1.33 buttons and made up 1.41 buttons). In summary, subjects with the spatial metaphor had better memories both about the entire structure of the shopping mall in general and about the metaphoric navigation aids in particular.

## 5. General Discussion

In summary, subjects perceived the shopping mall with the spatial metaphoric aids as being easier to navigate and easier to find target items than the one with the non spatial metaphoric aids. This ease of navigation may result in an increased level of customer satisfaction and shopping pleasure with the mall providing the spatial metaphoric aids, and this difference became more evident when customers were looking for ad-hoc category items than for common category items.

Then, why did the customers find it easier to navigate and locate items with the spatial metaphoric aids? One plausible explanation stems from the subjects drawings of the structure of the shopping malls. Subjects drawings indicate that the subjects with the spatial metaphor understood the overall structure of the shopping mall better than those with the non spatial metaphor. Subjects who had been provided with the spatial metaphoric navigation aids remembered more number of nodes and links. Moreover, they were able to remember the metaphoric navigational aids more correctly. Therefore, we could infer that subjects with the spatial metaphors were able to navigate and locate target items more easily because they better understood and remembered the entire structure and navigation aids of the shopping mall.

In the next step, how could the subjects with the spatial metaphor un-

derstand the structure of the mall better than those with non spatial metaphor? The difference in the level of understanding does not seem to result from the total number of pages or total time they spent with the mall, since there is no main effect of metaphor on those aspects. In other words, the number of pages visited and the amount of time spent were not different between the subjects with the spatial metaphor and those with the non spatial metaphor. There may be many alternative explanations, but the relative frequency of using the metaphoric navigation aids could present a plausible explanation. Subjects in the spatial metaphor group consistently used the metaphoric navigation aids more frequently than the non spatial metaphor subjects, whereas most non spatial metaphor subjects used the basic navigation aids more heavily than the spatial metaphor subjects. Therefore, we may infer that more frequent use of spatial metaphoric aids results in better understanding of the structure of the shopping mall. This trend became more evident for the ad-hoc category items, where subjects with the non spatial metaphor used the basic navigation aids more often than for the common category items.

This train of thought finally brings us to two questions: (a) why were spatial metaphoric navigation aids used more frequently than the non spatial metaphoric navigation aids? and (b) how did more use of the spatial metaphoric navigation aids lead a to better understanding of the structure? For the first question, one explanation was provided earlier in this study. That is, since the spatial metaphor is already implicit in the metaphor of cyber "space", it should be more familiar to the customers. Thus, people might be more willing to use the navigation aids based on the spatial metaphor because they are already familiar with them in the Internet. In contrast, the index metaphor, which had been implemented as the non spatial metaphor, is not implicit in the cyber shopping mall metaphor, and therefore, those buttons based on the index metaphor may have had less of a chance to be used by the subjects.

The final question is which features of the spatial metaphor induced subjects to better understand the entire structure of the shopping mall. We believe two features of the spatial metaphor may have accounted for the increased level of understanding. First, the navigation aids based on the spatial metaphor enabled subjects to move horizontally in the hierarchical structure of the shopping mall. For example, the neighborhood buttons allowed the users to move to the next shop without going up one level higher in the hierarchy. The ability to move horizontally may have been especially useful when subjects were looking for ad-hoc category items, since they might have felt more of a need to look around at the same level to find closely related items. In the non spatial metaphor, subjects had to move one level up and then one level down to look

around horizontally. In other words, they needed to use twice as many buttons to visit the next items disposed at the same level of the hierarchy. This may have resulted in the increased use of the basic navigation aids and more pages visited for the ad-hoc category by the non spatial groups. Moreover, the repeated up-and-downs may have made it more difficult for the non spatial subjects to understand the structure of cyber shopping malls. Second, the navigation aids based on the spatial metaphor did not allow subjects to jump in the hierarchy. The ability to jump more than one level of hierarchy has been touted as one of the distinguished features of hypertext. However, the jumps may be one of the reason why people get lost in cyber space. As soon as they jump, it becomes more difficult to relate where they were a moment ago and where they are currently. Without the facility to jump, people can always remember that the previous page is just next to the current page. However, if they used the jump buttons, they could no longer know the relative location of the last visited page. For example, if our subjects use the search engine, they can move directly to the specific product pages whereas they are currently. It does not matter where they were previously in the hierarchy or what are the structure of the entire shopping mall. This may be the reason why spatial metaphor subjects better understood the entire structure of the shopping mall. They never lost the relative location of the previously visited pages regardless of the navigation tools they used.

There are several limitations in this study. First, there may be confounding effects of the metaphor, because navigation aids based on the spatial metaphor are different from those based on the non spatial metaphor in several ways. As explained above, spatial metaphoric aids can move horizontally but cannot jump, whereas non spatial metaphoric aids cannot move horizontally but can jump around. Furthermore, the two metaphoric aids are different in terms of the figure of the navigation buttons. For example, because of the metaphoric nature, the spatial metaphoric aids were displayed as graphical icons (e.g., an escalator icon), whereas the non spatial buttons were represented as plain text (e.g., an index). Therefore, the results from this study could not specify which of these metaphoric features had more significant impact on the subjects' navigation behaviors. A series of experiments are currently being conducted to differentiate the effects of horizontal vs. vertical moves and jumps. Second, this study assumes that the basic hierarchy of the shopping mall is hierarchical. However, other structures, such as network or grid, are also possible, even though it is difficult to observe them in actual cyber shopping malls. Also this paper focused on the role of basic navigation aids in terms of horizontal search. However, the fundamental function of the basic aids is to move along the hierarchy vertically step by step. And this function can be used for various

purposes other than horizontal search in the given hierarchical structure of a shopping mall. Moreover, this study assumes a single hierarchy that has one top point and all the other pages are classified under the top page. However, more than one hierarchy can be possible in a cyber shopping mall. For example, one hierarchy may be based on the general classification of the products, whereas another hierarchy on price. Another study is currently under way to explore the impact of multiple hierarchies on the cognitive process of web users. The third limitation stems from our experimental procedure. In our experiment, the back button was disabled in order to catch keystroke data as faithfully as possible. However, lack of back button may affect the non-spatial version more seriously than the spatial version. This is because the add-on navigation aids provided in the non-spatial version (the top level index and search engine) allow the user to jump in the hierarchical structure, whereas the spatial version does not. When we cannot jump, we would always remember that the previous page is just next to the current page in the hierarchical structure. In that case, even without the back button, people can go back to the previous page relatively easily. However, when we can jump, we would no longer remember the relative location of the previous page easily, and back button would play a more important tool to go back to the previous page. This differential effect of back button may have contributed the performance differences between the spatial and the non-spatial groups. Finally, this study does not provide detailed data on the cognitive processes of navigation. We knew that subjects used the spatial metaphoric aids more frequently than the non spatial metaphoric aids, but we did not know what was going through their minds when they selected to use the metaphoric navigation aids.

Even with these limitations in mind, the results of this study provides several interesting implications. For example, the interaction between categories and metaphor suggests that spatial metaphoric navigation aids would be more useful for cyber shopping malls which people usually visit with specific goals determined in their minds but with no specific items selected yet. For example, a gift store would be a candidate to use the spatial metaphoric aids. On the other hand, for example, a shopping mall that specializes in electronic components would be better off with the non spatial metaphor, since visitors would have probably decided the specific brand and model number they wanted to buy. The results from this study indicate that it is possible to construct an adjustable cyber mall that can modify its navigation aids dynamically according to the visitor's specific needs and expectations. These advances in navigation aids would contribute to the construction of a better customer interface for cyber shopping malls.

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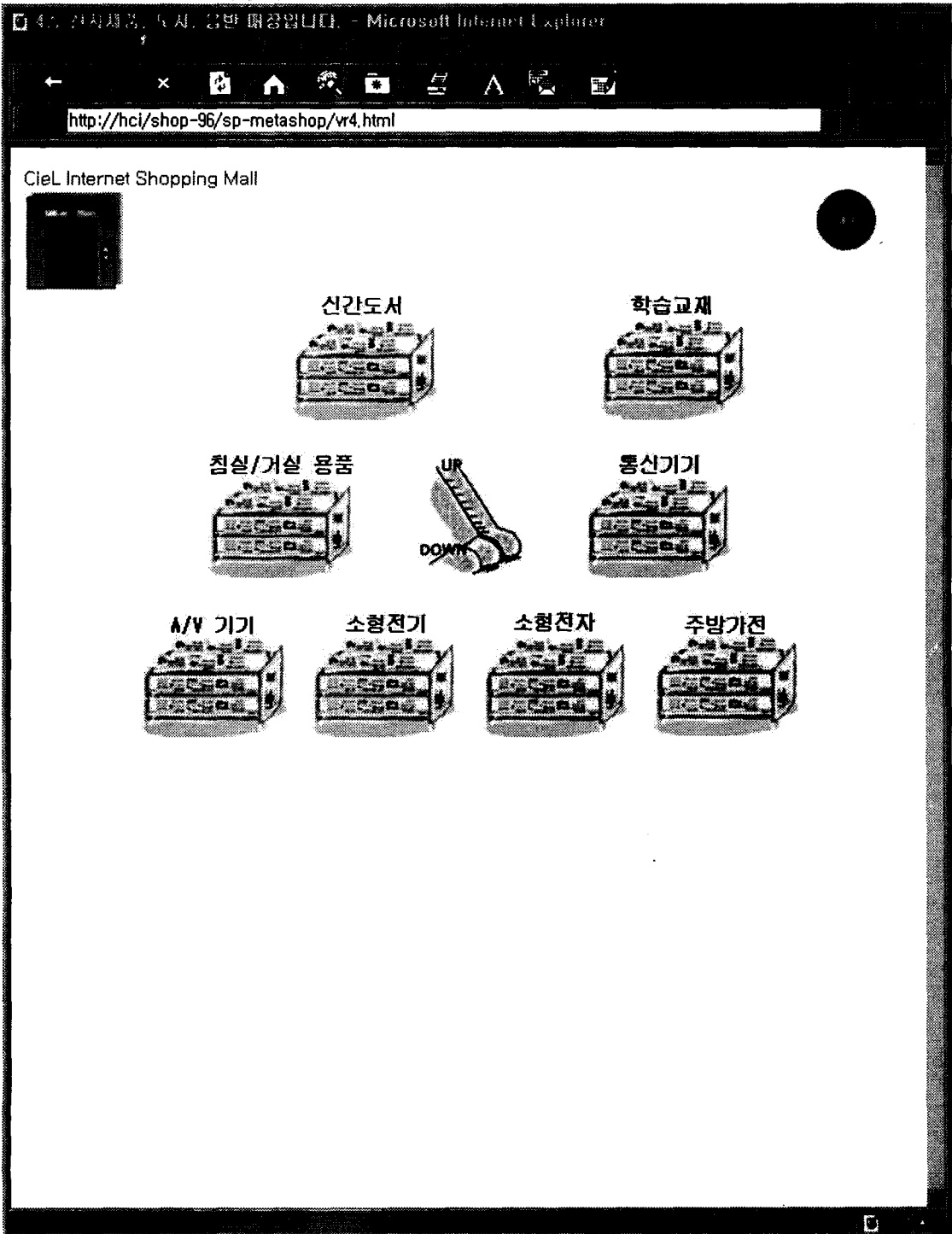
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Appendix 1. Two examples of Screens for the two versions of the test-bed cyber shopping mall.

Spatial Metaphor



## Non-Spatial Metaphor

The image shows a screenshot of a Microsoft Internet Explorer browser window. The address bar displays the URL: <http://hci/shop-96/dir-metashop/list8.html>. The page content is as follows:

상위리스트보기

---

도서/학습교재

- 새로운책

1996년 7대문학상 수상시인 대표작  
 OH, NO!  
 고지 위의 꼬레아노  
 매니저  
 모파상의 괴기소설 광인?  
 붉은 소금  
 사랑이 눈물 때  
 시대를 움직인 인물  
 아버지  
 안개 속의 풍경  
 애비  
 천녀 아미크리나의 사랑  
 토마토  
 프리스트  
 호모 사피엔스의 추억

At the bottom of the page, there is a search engine advertisement with the text: Search Engine      최상위 인덱스로

Appendix 2. Pre and Post Questionnaires.<sup>3)</sup>

**Pre-questionnaires**

1. How long have you used computers for your work?
2. How often have you used computers for your work?
3. How long have you used the Internet?
4. How long have you used the World Wide Web?
5. How long have you used the Web browser?
6. Have you ever visited cyber shopping malls in the Internet?
7. Have you ever visited Dacom Interpark to purchase some products or services?

**Post-questionnaires**

1. Was it easy to locate the target items that you wanted to buy in the cyber shopping mall?
2. Was it easy to navigate around the cyber shopping mall?
3. Are you satisfied with your experience with the cyber shopping mall?
4. Did you enjoy shopping with the cyber shopping mall?

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3) The original questionnaire that had been written in Korean was translated into English.