Travel Information Search on the Internet and the Implications for Designing Travel Recommendation Systems

Abstract
Travelers plan a trip using a variety of information sources including the Internet. Since travel recommendation systems are a part of the information environment a trip planner will encounter online, the understanding of trip planning behavior on the Internet is essential to provide guidance to the designing of useful systems. When travelers plan trips on the Internet, their interaction with the Internet can be viewed in different levels: as the interaction between a user and a computer, a user and an information retrieval system, and a navigator and a hypertext system. This chapter reviews relevant research in Human Computer Interaction, cognitive information retrieval, hypertext navigation, and trip planning on the Internet. This chapter shows that in order to design better travel information recommendation systems, we need to understand how the user’s mental models change along time and their influence on users’ satisfactory information search, both in terms of semantic mental models and procedural mental models. The hedonic and experiential aspect of travel planning on the Internet indicates that the recommendation systems should not only provide relevant result but also provide exciting and novel choices which are beyond the planners’ expectations.

Keywords
Trip planning, Internet, mental models, information search, information retrieval, Human-Computer Interaction.
Travelers are adopting the Internet as a travel information source at a fast pace (TIA, 2002; Lake, 2001; Weber & Roehl, 1999). However, travelers are often overwhelmed by the huge amount of information online and not able to locate the information they intend to find (Pan & Fesenmaier, 2000). Trip planning on the Web can be a frustrating experience (Radosevich, 1997; Stoltz, 1999). Using artificial intelligence and expert system techniques, travel recommendation systems have been promoted as a proactive way to facilitate travel information search and trip planning (Ricci & Werthner, 2001; Hwang & Fesenmaier, 2001; Klicek, 2001). However, the usefulness of these systems is still unclear.

The way potential travelers process travel related information determines their information search behavior. Thus it is essential to understand how users process information online in order to inform the design of a useful system; the understanding is also crucial in determining the applicability of behavioral models of trip planning in the context of the Internet. Researchers have conflicting opinions on whether the travelers’ information processing is different depending on different medium or channels used. Flanagan and Metzger (2001) argued that the Internet is multi-dimensional and is used similar to other traditional media, like newspaper or television. On the other hand, Hoffman and Novak (1996) demonstrated that the Internet is a new type of media which induces different implications for marketing.

In this volume, Hwang and Fesenmaier (2004) have reviewed relevant behavioral research in consumer studies and tourism research which inform the designing of travel recommendation systems; Hwang, Gretzel and Fesenmaier (2004) reviewed travel information search through information processing perspective. This chapter focuses on understanding trip planners’ information processing in Computer Mediated Environments (CME). Different from information processing on printed media or television, when planning a trip online a traveler needs to work with a computer and a web browser. The interaction between a travel information searcher and the Internet can be viewed in different levels: (1) the interaction between a user and a computer; (2) the interaction between an information searcher and an information system; (3) the interaction between a navigator and a hypertext system. There are many research pieces in these areas which may deeper our understanding of trip planning online. This chapter starts with a review of the literature in these areas; different views on usability issues were then discussed followed by the results and the implications from an online trip planning study. The designing implications for travel recommendation systems were detailed at last.

1. Human-Computer Interaction Models

Travelers search information on the Internet through the use of a computer. Thus, behavioral models in Human-Computer Interaction (HCI) can deeper our understanding of this process. Traditional Human-Computer Interaction literature is based on information processing theory which views human beings as information processors (Preece, et al., 1994; Card, Moran & Newell, 1983). Human information processor is composed of the perceptual system, the motor system, and the cognitive system, along
with their own memories and processors. The perceptual system includes every sense of human being and their relevant buffer memories. The cognitive system consists of a mechanism which receives information from perceptual system and memory to generate appropriate responses whereas the motor system is responsible for carrying out actions according to responses from the cognitive system. Based on the results of empirical research, Card, Moran and Newell (1983) proposed GOMS model (Goals, Operators, Methods, and Selection rules) which describes the process of interaction between a user and a computer. It is proposed that a user sets up goals to determine what he or she wants to achieve. The operators are the elementary efforts needed to achieve the goal, such as keystrokes. The user determines the procedures for achieving the goal, which consists of operators and other relevant goals. The user then follows selection rules to determine which method to apply if several methods exist.

Norman’s execution-evaluation cycle (Norman, 1990) is another influential model which guides the design of information systems. According to this model, the stages of interaction include establishing the goal, forming the intention, specifying the action sequence, executing the action, perceiving the system state, interpreting the system state and evaluating system state respecting the goals and intentions. Norman argued that problems always arise when there is an evaluation gulf whenever the physical representation of the system cannot match the expectation of the users. Furthermore, the user and the system each describes the task in different languages: a user uses “task language” while a system uses “core language”, which is the computerized representation of the task (Dix, Finlay, Abowd & Beale, 1998, p.105). The two languages are not identical and the discrepancies often cause communication problems between a user and a system.

2. Cognitive Information Retrieval Models

Travel information search on the Internet can also be viewed as an information retrieval process. According to Jacob and Shaw (1998) there are two paradigms dominating most information retrieval research. The physical paradigm is based on an analogy to mechanical systems which does not take users’ cognitive mode into account. On the other hand, the cognitive perspective of information retrieval argues that “any processing of information, whether perceptual or symbolic, is mediated by a system of categories or concepts which, for the information-processing device, are a model of his world.” (de Mey, 1977, pp. xvi-xvii). Cognitive information retrieval views information as subjective instead of objective in that information only makes sense when it is assimilated into the mental model and knowledge structure of the information receiver. Accordingly, effective information retrieval depends on the congruence between the cognitive structure of an individual user and the knowledge representation of the information system (Shera, 1965). Since each individual’s idiosyncratic mental model is influenced by many socio-cognitive variables and is hard to capture and analyze, it is easier to explore the shared mental model and knowledge representation of a user group or knowledge domain (Allen, 1996).
Similarly, Ingwersen (1992) argued that in information retrieval process, data in the information system has been transformed into information in relation to the mental model of the user and subsequently, the knowledge state of the user is changed. The concept of “polyrepresentation” of information can be applied to both a user’s mental model and the system’s information space. The linkage between different representations of knowledge states of the user’s and the system’s can reduce the uncertainty by eliminating lexical ambiguity and providing contextual information. Furthermore, the interaction between a user and an information system is mediated by the user interface. Users always need to generate queries to match the system’s language (Beaulieu, 2000), which represents compromises between his or her information needs and the need to adapt to the information system itself. Mental models can be represented either as the different metaphors or affordance of a computer system (Norman, 1988), or as the inter-relationship between different concepts in information user’s mind and information space (Carley & Palmquist, 1992).

3. Research on Navigation on the Internet

Travelers search a variety of web sites on the Internet for a trip planning task (Pan, 2003). The Internet is an interactive hypertext system where information nodes are “hyperlinked” according to their semantic relevance (Boechler, 2001). Different from traditional information retrieval, travel information search process is a navigation process in the hypertext space, both among different web sites and inside a specific one. For information searchers, traversing through the Web space involves information processing and learning, and judgments of semantic relevance according to information searchers’ knowledge states and search goals. Accordingly, the success of finding travel related information on the Internet is determined by the ease of navigation and understanding of information content on web pages.

Research in hypertext systems showed that there are three ways to carry out information search tasks in a hypertext system: (1) the user can traverse through a set of links to reach relevant nodes; (2) the user can navigate through the documents using a representation interface (such as using a graphic bookshelf to represent the organization of online books); and, (3) the user can query all documents through keyword search to locate relevant documents (Conklin, 1987). The main advantage of hypertext is that a large amount of information can be accessed rather quickly and the organization of the information is relatively flexible. However, hypertext does not have a conventional structure that leads the user through documents and the user is completely unrestricted in terms of where to go and which hyperlink to click; thus the hypertext systems require more cognitive effort.

Two different theories have emerged which provide explanations for hypertext navigation: (1) information foraging theory (Pirolli & Card, 1999) and, (2) a cognitive model of web design and navigation (Bollen, 2001). In an analogy to food foraging behavior of living organisms, information foraging theory is a general model describing how people use different strategies and technologies to search for information in response to the changing informational environment. Information searchers organize information in clusters in
order to minimize information search cost and use filtering method to single out documents which are more relevant (Figure 1). Furthermore, they use proximal cues to identify important information for further exploration or consumption. The concept of information scent is a construct that describes how information searchers identify valuable information from “snippets” of proximal cues (represented by link anchors on the Web). In an empirical study, the value of information scent was measured by vectors of words in the documents in relation to the information searcher’s intention. The decision of which link to click on a web page depends on the value of information scent of each link (Chi, Pirolli, Chen & Pitkow, 2001). In contrast, Bollen (2001) proposed a cognitive model of web design and navigation whereby he argued that shared knowledge is necessary for hypertext navigation (Figure 2). In addition, he argued that a user’s expertise, navigation strategies, domain knowledge and mental models, along with hypertext network structure, all contribute to hypertext navigation. The mental models of the users are represented in their navigational path and the model of the system is represented by the hyperlink structure of the web sites. In explaining the navigation process, Kim and Hirtle (1995) argued that the users of a hypertext system need to perform several tasks at the same time. Informational tasks, which is reading and understanding the contents presented in the linked nodes; navigational tasks, which is planning and searching through links; and also management and negotiation of the previous two tasks. Failing the second task may lead to disorientation in a hypertext system.

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---------------- Insert Figure 2 Here ----------------------

4. Usability Issues in Searching Information on the Internet

Various models in HCI literature view different mental models, languages, and understanding of tasks between a user and a computer system contribute to usability problems in the interaction process (Dix, Finlay, Abowd & Beale, 1998). For example, Abowd and Beale (1991) proposed an interaction model which is comprised of four major parts (the user, the system, the input and the output) (Figure 3). When a user’s mental model is congruent with the conceptual model of the designer which is embodied in a computer, the interaction between a user and a computer will be smooth and successful (Norman, 1990). Similarly, the cognitive information retrieval literature, similar to the constructivist view of learning, views the degree of congruence between the mental model of information users and the semantic model of the information systems as determining the usefulness and efficiency of the system (Beaulieu, 2000).

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Hypertext is a special type of information retrieval system. The complexity of hypertext navigation may induce additional usability problems. According to Nielsen (1995) hypertext usability includes five aspects: easy to learn, efficient to use, easy to remember,
few errors, and pleasant to use. However, Smith (1996) argued that since hypertext is designed to encourage exploration and browsing, traditional measures of computer system usability, such as the time it takes to complete a task and the number of mistakes made in the process, are not appropriate. Instead, he proposed a measurement of “lostness” as the number of information items inspected compared with the number of items which nominally needed to make a decision. To explore the nature of usability problems, Wang and Pouchard (1997) showed that users had problems understanding the syntax and semantics of search engines. More than 30 percent of the subjects did not click any links of the results returned from the search engine on a university homepage. They suggested that providing context-sensitive help and automation of query terms would reduce this type of errors. Another study conducted by Bilal (2000) with middle-school students showed that the students always used natural language to perform information search which is not supported by the search engine. Many times they were searching information on the concepts which were either too broad or too narrow. These results suggest that the semantic meanings of concepts are a major factor contributing to usability problems when users are searching information on the Internet.

From the previous discussed literature, either in Human-Computer Interaction, information retrieval, or hypertext research area, mental models are a central concept in explaining the difficulties and usability problems during the interaction process. However, different researchers define mental models through different perspectives. According to Norman, a mental model is “the model people have of themselves, others, the environment, and the things with which they interact. People form mental models through experience, training and instruction” (Norman, 1988, p. 17). Furthermore, Johnson-Laird (1983) suggested that mental models are the basic structure of cognition: “… mental models play a central and unifying role in representing objects, states of affairs, sequences of events, the way the world is, and the social and psychological actions of daily life.” (p. 397). However, mental models are incomplete and constantly evolving and usually are not accurate representations of a phenomenon (Kearsley, 2001). They are parsimonious, typically contain errors and contradictions and provide simplified explanations of complex phenomena. In information retrieval literature, Jacob and Shaw (1998) define a mental model as an “internal cognitive structure that the individual constructs, explicitly or implicitly, to represent a particular target domain, be it an event, an activity, an object, or a subject area.” (pp. 158). They further argued that the concept of mental models subsumes several related constructs such as scripts (Schank & Abelson, 1977), schemata (Rumelhart, 1980), and frames (Minsky, 1986).

According to cognitive scientist Anderson (2000), knowledge can be divided into declarative knowledge and procedural knowledge. Declarative knowledge represents our understanding of concepts/ideas and the relationships between them; procedural knowledge stands for the knowledge of accomplishing a task. In other words, declarative knowledge is about “what” and procedural knowledge is about “how”. The concept of mental models in Human-Computer Interaction literature (Norman, 1988) mostly refers to procedural knowledge while mental models in communication research typically refer to declarative knowledge (Carley & Palmquist, 1992). According to Sasse (1997), most empirical research on mental models in procedural knowledge sense is separated from
theoretical frameworks. Most of these pieces of research tried to direct users through metaphors and analogies in the instructions before the experiments, which are actually secondary mental models based on the researchers’ understanding of the system (Borgman, 1986; Frese et al., 1988). On the other hand, Semantic mental models in communication literature are closely related to human memory. According to Collins and Quillian (1972), human beings have a networked semantic memory, in which networked nodes and links among these nodes represent concepts and their relations. Since the Web is mainly text-based, and Internet browsers have relatively fewer functions (bookmarks, printing, history list, and Back and Forward buttons) which are easier to learn compared with frequent use of Internet browsers, the mental model regarding declarative knowledge is much more important in information search on the Internet. Semantics deal with different concepts or different keywords regarding one concept. Therefore, the concept of semantic mental model can be used to differentiate the concept of mental models in the declarative knowledge sense (following Carley & Palmquist, 1992) from traditional view of mental models in HCI (Norman, 1990). According to Carley and Palmquist (1992), there are three major ways to elicit mental models: content analysis, procedural mapping, and task analysis. The second and third methods are used to elicit users’ mental models in procedural knowledge sense. Content analysis is used to extract mental models in declarative knowledge sense and has a long history in communication research and more recently has been used in research on the Internet (Bauer & Scharl, 2000; Haas & Grams, 2000).

Additionally, satisfaction is another major indicator of success of information technology and information systems and is determined by many elements (Mahmood, Burn, Gemets & Jacquez, 2000). A user’s background knowledge and experience with computers, the Internet, and other information retrieval systems can influence their web search behavior (Hsieh-Yee, 2001). Since a mental model is an important construct in explaining information searcher’s navigation behavior, it is argued that the congruence between the mental models of information searchers and the semantic model of information space contributes to the overall effectiveness of travel information search on the Internet. Research showed that product knowledge and information search experience can influence their information search efficiency (Hsieh-Yee, 2001).

5. Travel Information Search on the Internet

Following the HCI and cognitive information retrieval literature, travel information search on the Internet is the interaction between information searchers and the information space (the part of the Internet related to tourism and travel destinations) in the context of trip planning. This section describes a conceptual model for travel information search and trip planning on the Internet and further details the results of a trip planning study and its design implications.

----------------Insert Figure 4 Here-------------------
The travel information space contains different types of information provided by various parties in tourism industry who are marketing their tourism products and communicate with travelers. Three components constitute the interaction: a travel information searcher, the interface, and the travel information space (Figure 4). Traveler’s situational factors, knowledge and skills regarding traveling and the travel information space, contribute to effective travel information search; the travel information space refers to all the travel related web pages on the Internet which potential travelers can access; the interface consists of search engines, the information structure of web sites, and various metatags and link structures which are used to facilitate the information search.

Jeng (1999) argued that the goal of travel planning can be seen as a hierarchical structure of sub-goals. Following the concept of semantic mental model, the goals can be represented as a network of sub-problems which need to be solved (Network A in Figure 5). In Network A, different nodes represent different sub-goals in which different darkness of the nodes represents different rigidity and centrality levels (the darker nodes represent more central and rigid sub-decisions). For example, “Travel Partners” is generally rigid and central to the overall travel plan, and is difficult to change. On the other hand, one’s choice of “Rest Stops” usually changes according to other aspects of the trip. These sub-goals are interrelated and are constraints to each other. This is the most general level of a travel information searcher’s semantic mental model prior to their information search and consists of various sub-goals in different domains. However, this level of semantic mental model is too general and not sufficient for exploring one’s semantic structure which can be compared with the language and vocabularies in the travel information space. Therefore, if we “zoom in” to see the details of each node, one can see that each sub-goal has a cluster of related concepts and ideas and may include nouns, adjectives, and verbs. The Network B of Figure 5 is an illustration of two clusters, destinations and activities. When searching for travel information on the Internet, one’s choices of links are determined by the value of relevance of the link anchors; in other words, the value of information scent, which is perceived cost and value of information source from proximal cues (Card, Pirolli, Van Der Wege et al., 2001). For example, “Theme Parks” is the most significant concept in this semantic network. If “Theme Parks”, “Tropical”, “South”, and “Florida” appear on the same page and they are equally visually prominent, most likely the information searcher will click on the link of “Theme Parks”. However, not every click is equally important. Some clicks are intended to reach certain destination web pages on which the travel information searcher stays for a longer period of time. According to Kim and Hirtle (1995), information seeking on the Web involves reading/understanding and navigating, and the two processes happen simultaneously. Since attribute information regarding alternatives are needed in the decision making process, the destination page is usually a content page describing attributes of different alternatives (Nakayama, Kato, & Yamane, 2000), whereas click-through web pages are index pages and the content is limited. For example, a travel information searcher with a mental model as in Figure 3, will likely click through “South”, “Florida”, “Theme Parks” rather quickly in order to reach the “Disneyland” page and then spend a much longer time reading its content. In this example, the former
pages constitute navigational pages and the latter are reading or navigational pages. Accordingly, the travel information search can be represented as “episodes” whereby each episode contains one destination or content page. The rest of pages in the “episode” are index pages in which the travel information searcher clicks through quickly in order to reach the destination or content page.

Importantly, during the navigation process the mental model of the travel information searcher and the representative semantic network is continuing changing. For example, after the destination choice has been made (e.g. the travel information searcher decides to go to Disneyland in Florida), her/his semantic network will change accordingly. Some destination concepts/ideas (Disneyland and Theme Parks) will disappear and some related concepts will emerge and become more central (for example Hotels and Motels). Travelers’ mental models are dynamic and contingent upon traveler’s decision making process. After a certain period of searching and travel planning on the Internet, the information searcher will stop when all the goals are satisfied or the travel information searcher encounters obstacles (fatigue, no relevant information, or time constraint). The result of the planning effort is a “sub-space” of the overall travel information space, which represents the results of the interaction between the mental model of the travel information searcher and the travel information space. Clearly, the semantic model of the travel information searcher plays an essential role in this process. If the traveler’s mental model and the concepts/keywords in the travel information space do not match, the information searchers will not find the information s/he is looking for. In conclusion, the travel information searchers’ mental models represent their background knowledge, information search tasks, and their understanding of the Internet as a travel information source. The travel information searchers search through the travel information space according to their idiosyncratic mental models. Their mental models continue changing during travel information search on the Internet based on upon the information they encounter and sub-decisions they make.

In a trip planning exercise in which 15 subjects were asked to plan a weekend trip to San Diego, California, Pan (2003) shows that the travel information search follows a hierarchical structure, in which the process can be divided into different chapters (Figure 6 denotes a semantic graph of a trip planning process and Figure 7 is a translated hierarchical map). One chapter denotes one aspect of travel planning, for example, selecting a hotel, an attraction, or a transportation method. Furthermore, one chapter can be divided into different episodes. For example, to make an accommodation choice, the planner may consider several alternatives by visiting different hotel web sites. Each alternative considered is one episode of the accommodation chapter. Their mental foci at each chapter and episode are different. However, there are commonalities in the chapter level since results show that more than half of the subjects make their accommodation choice first.

---------Insert Figure 6 Here---------

---------Insert Figure 7 Here---------
On average the travel information searchers were generally satisfied with their online trip planning process. The information searchers were also highly adaptive; when they encountered navigation problems, for example, broken links, they simply ignored them and took them as granted. However, the mismatch of semantic mental models is evident. The travelers used more subjective and experiential keywords to describe their background knowledge and their information needs; alternatively, online travel information is dominated by a marketing and promotion language, which focuses on profitable attractions and price information. The points of interests shown on web sites are also different from travelers’ interests. In general, there are still great discrepancies between these two types of mental models.

Surprisingly, research results show that wider mismatch of mental models can actually leads to more satisfactory information search process. It demonstrated that different from other types of information search, travel information search is not totally functional; encountering novel and exciting information can boost planners’ current emotional states. A more congruent match of semantic model actually means the users are more likely to encounter routine information and confirm their expectations and thus make the trip planning process less fun. Mandler (1975) indicated that novel and incongruent information leads to arousal. When the arousal happens in a positive and pleasant context, positive feeling will occur. Travel planning happens in a positive context since traveling is a leisure activity. When novel and incongruent information encountered, the subjects will achieve a more positive feeling.

The research results indicate that the satisfaction of travel information search may be determined by two factors, hygiene factor and motivator (Zhang & von Dran, 2000). Satisfying the functional needs of travelers is the hygiene factor, without which the information searcher will feel frustrated and unsatisfied; on the other hand, novel and exciting information they encountered which is beyond the travel information searcher’s semantic models is the motivator, which satisfies the information searcher’s hedonic needs. Only when both the functional and hedonic information need is satisfied, can the travel information searcher achieve higher level of satisfaction.

In general travel information search and travel planning are more experiential and hedonic. Travel planning on the Internet is one integral part of traveling experience. The previous discussions indicate that the users’ satisfaction with information systems surpass traditional view of functional needs in terms of finding relevant information but is moving toward fulfillment of hedonic needs. These findings indicated that navigation is not usually a major usability problem which may lead to unsatisfactory information search. The actual alternative evaluation on a certain web page influences their satisfaction to a greater degree. In other words, the content of the web sites is more important than their structure. It poses important implications for the research and design of information technology since the focus should be switched more on providing exciting and novel content besides fitting the users’ mental models to satisfy their functional needs.
6. Implications for Designing Travel Recommendation Systems

The reviewed literature and the results from the recent study show that in order to design better travel information recommendation systems, we need to understand how the user’s mental models change along time and their influence on users’ satisfactory information search, both in terms of semantic mental models and procedural mental models. We need to understand what types of information they are looking for and how they understand the travel information search system. Various methods could be used to assess different mental models. Interviews, verbal protocol, and semantic network analysis on the transcriptions of interviews can be used to abstract the users’ semantic mental models. In terms of procedural mental models, we need to make sure the users understand the functions of different part of the recommendation system, and the way to achieve different functions. Stages of information seeking need to be taken into consideration when designing a recommendation system. Different stages of information seeking have different mental models. It is essential to understand in what stage the travelers are at in order to design a dynamic and useful system.

The hedonic and experiential aspect of travel planning on the Internet indicates that the recommendation system does not only provide relevant results, for example, information about Yellowstone National Park for nature lovers, but also provide exciting and novel choices which are beyond the planners’ expectations. It makes up the limitations of functional view of travel recommendation system and thus boosts the satisfaction of trip planning experience. Customization and personalization is widely promoted in recent years as a way to design better interface of information systems. The underlying assumption is that when we can get a better knowledge of the individual characteristics of each user, we can customize the interface according to their preference and mental models. However, this research showed that the total match of two models is not necessarily leading to higher level of satisfaction. Pleasant surprise which is beyond the user’s mental model is necessary. Hence, it is important to provide enjoyable “surprises” which the travel information searchers did not anticipated. Beyond finding the perfect mental model of information users, more focus can be put on producing novel and exciting information which represents the characteristics of the destination.

The research results demonstrated that the travel information searchers used a variety of web sites in their travel information search, which greatly influence the decisions the travel information searchers may make. They are not selective in terms of which web sites to visit. In designing a new travel recommendation system, we need to consider how to position the new travel recommendation system in the mental models of trip planners. Since they may have alternative information sources and web sites to visit, a marketing oriented approach in designing the new system may be followed (Ernst, 2002). Users’ mental models regarding different information sources need to be considered so as to position the new travel information recommendation system accordingly.

The keywords in the travel information searchers’ semantic mental model represent their connections with designated destination. They are also the concepts/keywords associated with the destination as a brand. In tourism marketers’ effort to promote their destinations,
using the concepts in the travelers’ semantic mental model will be destined to achieve better results. From the results of this study, narrative design appears to be a good alternative besides design principles of web sites (Nielsen, 1999). By using a storytelling style, travel information providers can incorporate travelers’ language and concepts to provide a more powerful persuasive marketing language. Furthermore, since every click in the navigation process is a decision-making regarding the relevance of information, each individual’s semantic mental model can be inferred through their click streams on a single session of information search. The web interface can be improved using the language and vocabulary of the information searchers instead of the designer’s language (Furnas, Landauer, Gomez & Dumais, 1987). The link anchors can be improved according to the information searcher’s semantic mental model to provide more meaningful proximal cues.
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Figures

Figure 1. Information in Clusters: The Physical Layout of a Business Office
(Pirolli & Card, 1999)

Figure 2. Hypertext Design and Use is Shaped by Users’ and Designer’s Mental Models (Bollen, 2001)
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