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Consumer web search behaviour: diagrammatic illustration of wayfinding on the web

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External information search behaviour has long been of interest to consumer researchers. Experimental and *post hoc* survey research methodologies have typically used a large number of variables to record search activity. However, as these are usually considered in aggregate, there is little opportunity for the researcher to overview the search style of a consumer. To date, the diagrammatic illustration of search behaviour has been limited to experimental environments in which the available information was strictly bounded, for example, within databases or when information display boards have been used. This paper, which focuses largely on inter-site world wide web (WWW) search behaviour, discusses web search paradigms and the variables used to capture WWW search. It also provides a conceptual framework for the representation of external information search behaviour in diagrammatic form. The technique offers researchers an opportunity to holistically interpret information search data and search styles. The benefits include the identification of particular search styles, more precise interpretation of web search activity numeric data and the potential application for the training of web users to improve their search effectiveness.

KEYWORDS: consumer behaviour: information search; WWW; wayfinding.

1. Introduction

The advent of the world wide web (WWW) has introduced an exciting new tool to marketing, which is both an information medium and a potential channel of distribution. The implications of this new marketing tool are just beginning to be understood by both marketing practitioners and marketing academics (Hodkinson & Kiel, 1996; Hoffman & Novak 1996*a*,*b*; Burke 1997; Peterson, Balasubramanian & Bronnenburg, 1997; Ghosh 1998). One aspect of WWW use is consumers' use of it to search for information to solve specific problems. The WWW technology offers a unique opportunity for researchers to measure precisely the consumer's web-based information search behaviour as it occurs. By contrast, tracking all components of consumer information search in the conventional shopping environment presents practical problems (for a discussion see Newman & Lockeman, 1975). For this and other reasons researchers have often adopted the *post hoc* self-recall methodology, for example Newman and Staelin (1972), Kiel and Layton (1981) and Furse, Punj and Stewart (1984).

When considering search behaviour in the WWW environment it should be noted that the WWW is a non-broadcast electronic medium. The implication of this is that

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consumer information acquisition is an *active* task. By contrast, in the conventional consumer environment *passive* information acquisition is common due to the presence of broadcast media and promotional activity. Consequently, when a consumer is faced with a problem, significant information acquisition often requires little more than the resetting of the consumer's perceptual filters (Sheth, Mittal & Newman, 1999) to allow relevant information from broadcast media to impinge on their consciousness. In addition to being an active search environment, the WWW places additional burdens on the consumer in terms of information search *technique*. This includes web browser usage, information source location, which typically involves search engine use, inter-site navigation and intra-site hypertext navigation.

Clearly, consumer information search on the WWW involves a number of components. Its overall complexity requires that researchers go beyond simplistic variables such as the "number of sites visited" and the "number of pages read" to include information on search and navigation techniques. Specifically, this paper: (1) discusses the WWW information search task and relevant paradigms; (2) proposes a diagrammatic means of representing WWW search behaviour, (3) suggests some relevant dimensions of web search behaviour, and (4) demonstrates the use of the diagrammatic approach to assist the understanding of the complex processes that comprise WWW consumer external information search.

This paper is structured as follows. First, the phenomenon of WWW consumer information search is discussed within the tradition of the consumer external information search behaviour literature. The wayfinding paradigm from geography is then used to provide a conceptual basis for understanding and mapping WWW search behaviour. This paradigm is then extended to the consumer behaviour context. A schema for the diagrammatic illustration of consumer search within the WWW is then advanced. This methodology is illustrated for two actual WWW searches. The paper concludes with observations about the usefulness and limitations of this diagrammatic approach.

2. Theoretical framework

The question of consumers' information-seeking behaviour on the WWW can be addressed from two key theoretical viewpoints: (1) consumer external information search and (2) the wayfinding paradigm.

2.1. CONSUMER EXTERNAL INFORMATION SEARCH

Understanding consumer information search is vital to an understanding of potential customer's information needs. It is therefore not surprising that there has been a long tradition of research into information search in the consumer behaviour literature including, Katona and Mueller (1955), Newman and Staelin (1972), Kiel and Layton (1981), Punj and Staelin (1983), Beatty and Smith (1987), Urbany, Dickson and Wilkie (1989), Srinivasan and Ratchford (1991), and more recently, Moorthy, Ratchford and Talukdar (1997).

The major approaches involve measurement of the nature and the extent of use of different sources of information such as advertisements, opinion leaders, visits to retail outlets and so forth. The amount of information seeking has then been correlated with

a variety of socio-demographic, past product usage and psychological variables. Alternative taxonomies of information seeking have been suggested, for example by, Claxton, Fry and Portis (1974), Westbrook and Fornell (1979) and Kiel and Layton (1981). However, the emphasis in much of the research has been on information acquisition patterns and information sources.

One aspect that has been rarely discussed in the literature on external information search behaviour is the necessity to *find* information in *consumer-driven* information environments. Examples of consumer-driven information environments include newspapers and physical shopping precincts such as large stores, supermarkets and shopping centres. In such environments, the *location* of appropriate information is a major issue to the consumer and can be problematic. Since the WWW is a consumer-driven information environment, the searcher is required to both *direct and manage* their course through that environment. These acts comprise the two components of *navigation* (Delbridge, Bernard, Blair, Butler, Peters & Tardif, 1991). From a consumer behaviour viewpoint, the execution of a search activity requires the performance of the navigational tasks and the management of the search while assimilating and considering information. The information-seeking consumer's tasks include destination selection (i.e. information source selection), movement to the desired destination (i.e. the information source) and the analysis of the information available there in the light of the previous information available to the consumer. The information gathered there becomes part of the consumer's decision processes and the need for further information search is then reviewed. If the search process is not abandoned or suspended, and if further information search is deemed necessary, another information source is selected and the cycle is repeated. Destination selection and movement to the desired location are tasks that are inherent to active information search by a task-oriented consumer in any environment. Browsing may also be required (Bloch, Sherrell & Ridgway, 1986). However, the distinction between browsing and task-oriented behaviour is necessary because browsing behaviour such as window shopping (Bloch *et al*., 1986) may be a form of entertainment. In the WWW environment, where browsing is often referred to as web surfing, the distinction is particularly important as in browsing the attractiveness of hotlinks may be a factor (Duchastel, 1988). In summary, the need for an information-seeking consumer to navigate, combined with the associated tasks outlined above suggests that the literature on "wayfinding" can provide a starting point for consideration of information search on the web.

2.2. THE WAYFINDING PARADIGM

Downs and Stea (1977) define wayfinding as "the process of solving one class of spatial problems, the movement of a person from one location on the earth's surface to another" (p. 55). Passini (1984) equated wayfinding with the concept of *spatial orientation*, which he defined as "the ability of a person to determine where they are within a physical setting". Spatial knowledge is seen by Stern and Leiser (1988) and Hirtle and Hudson (1991) as consisting of three distinct components namely, place, route and survey knowledge. Place knowledge (Garling & Golledge, 1989; Gopal, Klatzky & Smith, 1989) or landmark knowledge (Dillon, McKnight & Richardson, 1993) includes "...the salient aspects of places encoded in declarative form" (Kim & Hirtle, 1995, p. 242). Thus people know of

the existence of particular places and can recognize them. Route knowledge is the ability to navigate "...from point A to point B, using whatever landmark knowledge we have acquired..." (Dillon *et al.*, 1993, p. 173). Survey knowledge concerns the "...spatial layout of salient places..." (Kim & Hirtle, 1995, p. 242) and represents a "...world frame of reference rather than an egocentric one" (Dillon *et al.*, 1993, p. 174). These three components† are generally accepted as allowing individuals to form "cognitive maps". The concept of cognitive maps is attributed to Tolman (1948) and they are typically seen as "...mental representations of physical spaces used for navigation" (Kim & Hirtle, 1995, p. 242).

In practical terms, place knowledge is acquired by experience and is thus the most easily acquired. For example, one learns to recognize a place, such as one's arrival point in a strange city. Route knowledge is learnt by experimental travel through the environment—for example, one learns the route to a new workplace. Initial exploratory travel in an unknown environment initially relies upon the use of visible landmarks. As the amount of experience increases and more and more landmarks become known, the traveller begins to assemble a plausible mental image of parts of the topography. This level of knowledge is known as survey knowledge. Survey knowledge is the most difficult to acquire, and requires the user to assemble a plausible layout from episodic encounters. In fact where both route and survey knowledge are possessed, people tend to *adhere to familiar routes* rather than deducing a new route from survey knowledge, unless specific motivation is present (Garling & Golledge, 1989). A real-life example of one's natural reticence to develop new routes is the need to visit a new destination in a city with which one is familiar. In many cases the problem is solved by making a *digression* from an *existing* route one knows through the area. The adaptation of existing routes is the norm, even when a *more efficient* new route is available. The perusal of maps, if available, *does* help the acquisition of survey knowledge, for example, if one had a street directory, and more importantly, the motivation, one could design and implement the new direct route to the place one needed to visit. However, the assertion of adherence to familiar routes requires qualification by both trait and situational factors. For example, those individuals with higher optimum stimulation levels (OSL) (Steenkamp & Baumgartner, 1992, 1995) may be tempted to design and learn new routes more easily than others, since the OSL characteristic manifests itself in a number of variety-seeking behaviours including brand switching and exploratory information seeking, of which exploration and route learning could be part. Also other related behavioural characteristics such as a desire for mastery (which could express itself in a desire for efficiency) or high levels of curiosity could lead certain individuals to design and learn new routes. Having established the principle components of wayfinding theory, it is now necessary to consider the case of the consumer information search task within the WWW environment, and the applicability or otherwise of the wayfinding paradigm.

On initial consideration, the wayfinding paradigm appears applicable to WWW search. This is because of the concept's intuitive appeal due to our real-world experience of navigation, and second due to the fact that the WWW is a hypertext-type system and the continued emphasis of recent hypertext research on "navigation problems" (see e.g.

†Dillon *et al.* (1993, p. 172) suggest that a fourth preceding component underlies this process, namely that of schema theory in which "some form of general knowledge of the world aids humans in navigation".

Conklin, 1987; Kerr, 1990; Mohageg, 1992; McDonald & Stevenson 1996). However, before analysing the wayfinding paradigm in relation to the WWW environment it may be helpful to consider a flow diagram of the WWW search task facing consumers. The flow diagram shown as Figure 1 is derived from the earlier consideration of consumer information search tasks placed within the context of the WWW information environment. The search engine output referred to in Figure 1 is the result of consumer inquiry and may be either the result of a web-wide search or a selection from the search engine's internal directory of "recommended" sites.

Two search tasks that face WWW users are: (1) the location of web sites of interest (typically via a search engine) and the movement *between* those sites, i.e. *inter-site search*; and (2) the acquisition of information within sites of interest, that is *intra-site search*. The search for information incorporates both activities, often sequentially. Users often cycle between inter-site and intra-site search, as a search proceeds, just as a consumer may cycle between internal and external information search, as an information search progresses (Bettman, 1979). From this point onwards intra-site search will be excluded from specific discussion. First, because discussion of them is beyond the scope of this paper. Second, because intra-site structures are idiosyncratic and third, because the process of intra-site search is so complex as to warrant dedicated research in its own right.

The applicability of the wayfinding paradigm to consumer information search within the WWW information environment will now be considered by the sequential analysis of its components.

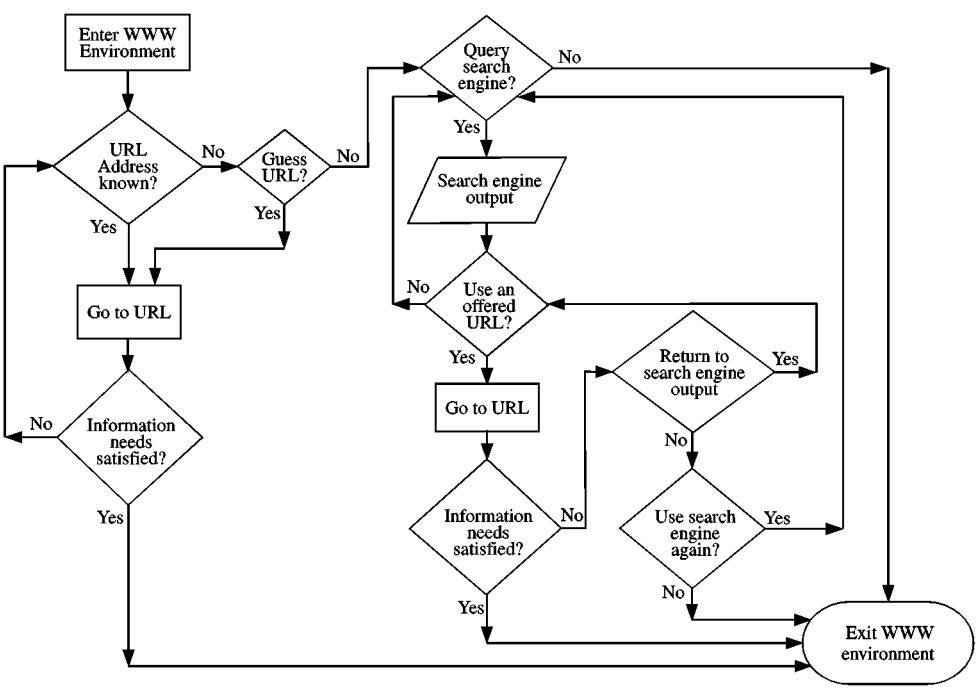

FIGURE 1. Flow diagram of WWW information search activity.

The wayfinding paradigm typically has as its central components landmark, route and survey knowledge. However, the four-component model proposed by Dillon *et al.* (1993, pp. 172–173) seems more suited to the analysis because of its inclusion of schema theory. Dillon *et al.* (1993) propose that through experience individuals develop global schemata (Brewer, 1987) which consist of general or non-specific knowledge. This is followed by the development of more specific "instantiated" schemata relating to a particular environment via the acquisition of landmark, route and survey knowledge. This process may culminate in the development of a cognitive map of a particular environment.

2.2.1. Global schemata

Global schemata consist of some form of "*...general knowledge of the world* that aids humans in navigation tasks" (Dillon *et al.*, 1993, p. 172). In the physical world, such schemata may include the knowledge of the characteristics of large cities for example, large buildings, crowds and the presence of public instrumentalities. In addition, an individual may also possess appropriate schemata for villages and thus be able to distinguish between the two types of habitation when they are encountered. From a consumer behaviour standpoint, the concept of global schemata incorporates aspects of both prior knowledge and expectation/disconfirmation. It is now necessary to consider the extent of global schemata that consumers may possess which may be applicable to the WWW information environment.

Since the WWW is computer based, literacy and a degree of computer literacy is required of the user (Hodkinson & Kiel, 1996). Consequently, the user may have some knowledge of the use of on-line inquiry systems such as library indices or databases. In addition, the user will have had some general real-life experience of searching for information in books, newspapers and timetables. Thus, the *novice* WWW user will bring *some* general experienced-based schemata concerning information search to the WWW environment. Global schemata are the lowest level of schemata or representation and were described by Dillon *et al.* (1993, p. 173) as the "...basic level of knowledge needed to interact with an environment...". However, as the work of Tauscher (1996) and Tauscher and Greenberg (1997) show, the WWW is relatively simple to use at a basic level demanding little more than the use of the "search", "back" and "forward" buttons. Thus it is suggested that novice WWW users will quickly acquire a basic level of non-specific environmental knowledge of the WWW, sufficient to allow them to function (even if only at an inexpert level) within the WWW environment. Thus, the possession or development of basic non-specific schemata even among novice WWW users suggests that the concept of a global schema is applicable to the WWW information environment. However, such non-specific schemata must be replaced by other representations if an individual is to "...plan routes, avoid becoming lost, or identify shortcuts..." Dillon *et al.* (1993, p. 173).

2.2.2. Instantiated schemata

The second level of representation is the development of "instantiated" schemata. This relies upon subsequent episodic encounters within the same environment that will allow the development of more specific schemata. The first step in the instantiation process is the development of landmark knowledge. This knowledge provides the framework on which a cognitive map is built.

2.2.3. Landmark-knowledge

Landmarks are defined as '...any features of the environment which are relatively stable and conspicuous" (Dillon *et al.*, 1993, p. 173). Features that are relatively stable in the user's WWW environment are thus landmarks and may include search engines, and known or frequently visited sites. However, none of these "landmarks" is permanent. Search engines can disappear altogether or be agglomerated. Similarly, commercial sites can disappear. Search engines and known sites may change their URL (i.e. their WWW address) and although temporary redirections are often provided, their life as landmarks may have limited permanence in a manner similar to that of landmark city buildings that are demolished during a brief absence from one's home city. Hence, landmark knowledge alone is not sufficient to accomplish complex navigation, and "...both route and survey knowledge emerge from it as a means of coping with the complexity of the environment" (Dillon *et al.*, 1993).

2.2.4. Route knowledge

Route knowledge is the third component of the Dillon *et al.* wayfinding paradigm, and the second of the instantiation process. Dillon *et al.* (1993) exemplifies this knowledge as "...turn left at the traffic lights and continue on that road..." (p. 173). Thus, route knowledge consists of instructions that *must be followed* to arrive at the desired destination. These instructions enable navigation although the traveller does not really know much about their environment. This is particularly true of the WWW as virtually instantaneous "travel" occurs between the "turns" given in the instructions. However, adherence to such route instructions does not preclude the traveller from getting lost if a wrong turn is taken (Wickens, 1984). In relation to the WWW environment, route knowledge has a direct parallel. For example, "go to the Yahoo search engine, go to its internal directory on 'holidays', look for the portal site for Cyprus tourism and take that link, etc". Subsequent intra-site navigation or the taking of external links from the portal site may result in the user getting lost. Once lost in electronic space, users tend to retrace their steps to a familiar landmark (Lee, Whalen, McEwan & Latremouille, 1984) just as travellers do in physical space when they possess only route knowledge. In the WWW environment where web browsers are used, this recovery strategy is supported by the use of the "back" button. Indeed many WWW users rely on the use of the back button as a basic navigational technique as shown by Tauscher (1996) and Tauscher and Greenberg (1997). Thus, the possession and acquisition of route knowledge within the WWW environment is valid for two reasons. First, in terms of the navigational techniques *actually used by* WWW information searchers, and second, by the navigational features offered by WWW browsers. It is thus clear that even the possession of knowledge of a number of routes is insufficient for navigation in a complex environment, as such knowledge only applies to a limited number of destinations. Survey knowledge is required if widespread travel is to be enabled.

2.2.5. Survey knowledge

Survey knowledge is the fourth component of the Dillon *et al.* (1993) wayfinding paradigm. Survey knowledge is by its nature a more sophisticated representation. In the physical world survey knowledge allows us to know "...the general direction of places for example, westward or over there.... it is based on a world frame of reference rather than

an egocentric one" (Dillon *et al.*, 1993, p. 174). While such compass-based directional knowledge is non-applicable in electronic space, it is possible for experienced WWW users to acquire knowledge components that are more sophisticated than the route knowledge previously outlined. For example, a user may be aware of specific portal sites on a variety of topics, or specific sites. In addition, the user may be aware of a large number of search engines and their strengths and weaknesses, including their method of data acquisition (for example, web crawling or registration) and the effectiveness, syntax and sophistication of their inquiry mechanisms. An accumulation of such knowledge could indeed provide a world frame of reference for the WWW environment which is far removed from even a large collection of route knowledge. Such knowledge could be possessed by expert WWW reference librarians, their very occupation being testimony to and dependent upon the possession of a "world view" of the WWW. Hence, the argument that a survey knowledge component exists for WWW search can be made. It is now appropriate to consider consumer behaviour aspects of WWW use, and the diagrammatic depiction to illustrate this theoretical model.

3. Diagrammatic representation of WWW search behaviour

3.1. PARTICULAR ASPECTS OF CONSUMER BEHAVIOUR IN THE WWW ENVIRONMENT

Although environmental psychologists have long recognized the importance of understanding as to how individuals search through complex environments to locate desired destinations, the issue of navigation in consumer information environments generally has received relatively little consideration from consumer behaviourists and marketers. However, Titus and Everett (1995, 1996) addressed the issue of consumer search in physical environments in a theoretical paper and an exploratory investigation, respectively. With respect to the virtual information environment of the WWW, Hoffman and Novak (1996*b*) have discussed web navigation, but have done so largely in terms of the psychological state of the web user, notably that of the "flow" state (Csikszentmihalyi, 1975). Since the aim of this paper is the improvement of WWW consumer behaviour knowledge, it is appropriate to consider the consumer behaviour of the buyer in typical information search and decision processes and then consider the operationalization of these processes within the WWW environment.

The consumer behaviour literature considers consumers to be involved with problem-solving. Once an individual recognizes that he has a problem, that is he perceives that a less than optimal situation exists, he is then said to enter the problem-solving mode. As such, the consumer consults his first available and most convenient source of information to look for solutions to his problem. The most accessible information source is his own internal memory; thus, he performs an *internal* information search (Bettman, 1979). If sufficient current information is not available within internal memory, and the consumer wishes to proceed with solving the perceived problem, the consumer then commences an *external* information search. Such information search inevitably involves some learning as the original internal memory store is augmented to a certain extent even if external memory aids such as notes are used (Bettman, 1979). The consumers manage their search and the strategy driving it, as further information is accumulated. Many decision processes and strategies have been identified in the consumer behaviour literature

including compensatory and non-compensatory models, elimination by aspects, choice by processing brands and choice by processing attributes. These are typically discussed as discrete processes on the assumption that all information is available to the consumer for consideration at one point in time.

However, in extended problem-solving situations many of these processes occur simultaneously as external information search takes place, indeed they *must* if the consumers are to manage their search strategy. For example, if a particular microwave oven does not possess an attribute that is seen to be essential, then the elimination by aspects decision mechanism will lead the consumers to alter their search strategy to avoid further time expenditure in seeking more information on that model of oven. Thus in complex problem-solving situations the search strategy that results may be *emergent* and is the product of consumer's preferences (including prior knowledge and heuristics) and personal traits interacting with the information acquired from the search activity. In the microwave oven example, having abandoned the further search for information about a particular model, the consumer may find that *none* of the models on the market in fact has the desired feature. The consumers' search strategy may then be modified to include further information search on the model previously discarded from their consideration set of microwaves. The vital point is that *during external information search the perceived value of a piece of information may vary*. If, in the case outlined, the consumer had already thrown away a relevant brochure or notes, then the information would need to be retrieved or reassembled. Having established these points let us now consider information search on the WWW.

3.1.1. Information search on the WWW

When searching the WWW, a graphical WWW browser such as Netscape Navigator is required. Within the browser a number of navigational aids are available in the user interface including forward and back buttons, an address window, book marking and user history facilities. The WWW searcher uses these controls to move around the WWW seeking task-relevant information. As the consumer information search progresses, the consideration of information takes place. As comparisons are made and options are eliminated the perceived value of a particular piece of information may vary as the search progresses. In the conventional shopping environment, the full range of comparison information is not generally available simultaneously to the consumer. This is one reason why decision aids such as brochures are produced, especially in the case of complex products such as automobiles or VCRs. This is also one of the reasons why consumers may make notes as they visit retailers and proceed through the decision process. Similarly, in the WWW shopping environment comparison information is not simultaneously available as one screen full of information, by necessity, *displaces* another. In addition, there is typically no formal provision for the printing of specific data for consumer retention. Accordingly, it is often necessary for WWW shoppers to revisit sites and pages to display information for reconsideration. It is here that the nature of memory stacks, their operation within web browsers and their effect on search behaviour become important, as many browser users are unaware of the mechanism's limitations.

The most basic WWW browser navigation technique is the repeated use of the "forward" and "back" buttons. In this way, navigation is accomplished by taking links forward and by retracing steps via the use of the "back" button. Figure 2 shows the

movement from one site to another. The user subsequently retraces his or her steps to Site 1 by the use of the back button (Figure 3).

The WWW user may then take a new link forward to Site 3 as shown in Figure 4. Having perused Site 3, the searcher may then use the back button to return to Site 1 (Figure 5).

The WWW user may then realize the need to revisit Site 2 to confirm some information and clicks the back button expecting to return to Site 2 because Site 2 was visited earlier in the search (Figure 6). However, because of the nature of the memory stack mechanisms in the web browser it is *impossible* to return to Site 2 by the use of the back button because memory of that destination has been eliminated from the memory system at least as far as the "forward and back" method of navigation is concerned. In that situation, clicking on the forward button will take the WWW user back to Site 3, whereas clicking on the back button will take the WWW user to the site that *preceded* Site 1, if there was one during that session. This occurrence may surprise users when the path presented is different from that which they know they have followed (Tauscher & Greenberg, 1997), or when previously visited pages seem to disappear (Cockburn & Jones, 1996). (It is of course possible for the WWW user to return to Site 2, but *only* if she can identify the original link that took her there in the first instance.)

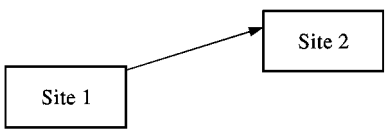

FIGURE 2.

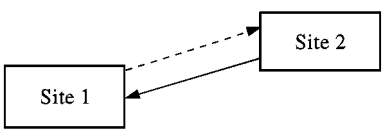

FIGURE 3.

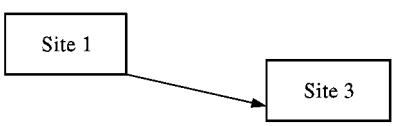

FIGURE 4.

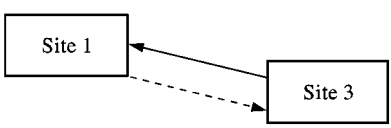

FIGURE 5.

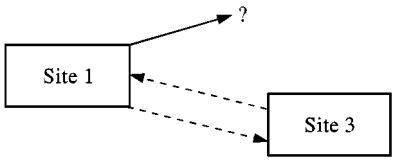

FIGURE 6.

Clearly, the "unsophisticated" forward/back navigation method imposes limitations on the searcher's ability to easily revisit sites to facilitate the typical consumer decision processes previously discussed. Thus, largely, the normal consumer decision processes are inhibited by the employment of "unsophisticated" WWW navigation techniques.

Current research by the authors and extensive analysis of web browser navigation techniques by Tauscher (1996) and Tauscher and Greenberg (1997) confirm the unsophisticated nature of the majority of WWW users' navigation techniques. For example, Tauscher (1996) found that 83% of arrivals at WWW sites were the result of taking a hyperlink forwards. The next most common action comprising 30–40% of all navigation actions was the use of the back button (Tauscher & Greenberg, 1997). These results (and those discussed below) clearly show that many WWW users, if engaged in active information search, would impede their normal consumer decision processes severely unless they printed out information extensively as they find each site.

However, a number of "sophisticated" navigational methods are available for example, URL history, bookmarking (comprising their creation and use), "go" or view (hotlist) history aids (depending on the browser). Despite the fact that the format of WWW browsers has changed slightly since the Tauscher (1996) study and the Tauscher and Greenberg study (1997) the sophisticated navigation features are essentially the same. Notable findings include the fact that only 1% of site arrivals was due to the URL history feature and only 5% was the result of using the hotlist history feature. Similarly, the manual entry of a URL into the URL window accounted for only 7% of site arrivals, with a further 2% of site arrivals due to the entry of a URL into the "Open URL" dialogue box. The findings of Tauscher (1996) and Tauscher and Greenberg (1997) support a similar study by Catledge and Pitkow (1995). In addition, the author's scrutiny of preliminary data from an extensive study currently under way suggests that the majority of users *still* rely on the unsophisticated navigation technique identified in the previous studies. This is despite recent changes to WWW browsers to make some of the sophisticated navigation methods more easily available and more noticeable.‡ Experienced users accustomed to the forward/back navigational technique will need to make a conscious effort to retrain themselves to utilize the more sophisticated features if they are to enhance their WWW search techniques and facilitate their own consumer decision processes.

In summary, the majority of WWW users utilize the unsophisticated forward and back navigational technique. From the consumer behaviour perspective it is thus important

‡For example, many WWW browsers now have history lists available when the right mouse button is clicked on the browser's back button.

for any system of notation of WWW information search behaviour to clearly account for differences in navigational sophistication because of their effect on the ability of the searchers to undertake normal consumer decision processes. From this point on in the discussion of illustration of web search behaviour, distinction will be made between sophisticated and unsophisticated navigational techniques.

3.2. THE DIAGRAMMATIC REPRESENTATION OF WEB SEARCH BEHAVIOUR

Since a great deal of consumer behaviour research has focussed on the recording of information source usage (for example, Kiel & Layton, 1981; Beatty & Smith, 1987) the starting point for the diagrammatic representation of WWW search is the consideration of the various types of information sources. Available WWW consumer information sources include, the home page, search engines, web sites and web pages. For the purposes of this discussion, the home page is the first web page that a web browser displays after being activated. Home pages are typically that of the user's institution or Internet Service Provider, although it can be pre-set to any site at the user's discretion. By contrast, search engines are essentially catalogues of web sites, which can be searched by users to locate likely sites of interest. A web site is a web page or collection of pages, which resides as a set at a specific web address. Web sites may be constructed for a wide range of commercial and non-commercial purposes.

Significant challenges are present when attempting to illustrate information search diagrammatically. Not the least of these is due to the virtually boundless nature of the web information environment. Typically, the study of search behaviour results in a large number of variable counts. This may be comfortingly concrete for the researcher as it permits empirical analysis, but it does little to aid the *understanding* of the search sequence, strategy or style. For example, if an experiment merely notes that a user had made five site visits, the level of understanding of the search process is limited. The actual search behaviour of the web user may have involved the manual entry of five known URLs, the investigation of five links elicited from a search engine, the use of five off-site links from within other commercial sites or combinations of all three navigation methods. Thus, there is a need for the diagrammatic representation of search behaviour to "enrich the picture" the researcher sees beyond mere statistics. Therefore, one of the major objectives of the proposed diagrammatic representation of search behaviour is the illustration of the nature of the individual's information search, and enhancement of the researcher's understanding of an individual search activity, and thus enable the consideration of individual search styles.

Inter-site or web-wide navigation often involves the use of search engines. Search engines are landmarks, and are thus orientation points for WWW searchers. They are also directories of information and are thus information sources. In addition, the use of particular search engines for locating information on the web may be an important characteristic of an individual's search behaviour. There are parallels to this in the conventional shopping environment. First, known landmarks serve as points of reference from which exploratory trips may be launched or by which sophisticated navigation may be aided. Second, consumers often use information directories in physical environments such as shopping centres. In addition, they often have strong preferences for particular business telephone directories for example, blue, pink or yellow page directories.

3.3. DESIRABLE FEATURES OF DIAGRAMS REPRESENTING SEARCH BEHAVIOUR

Given the above, it would seem that any diagrams of information search should be easy to interpret and should include the following information: the chronological nature of the search actions; the method of navigation used to arrive at a web site; the identification of the type of WWW navigation technique used (using the previously outlined taxonomy), the origin and destination of each "journey"; the number and type of search engines used in the search; the number of search engine outputs produced to aid the user's search; the number of search engine outputs used (that is those produced by open search of the WWW); the use of search engine internal listings or directories; the number of sites visited; the number of pages or screens of information viewed in each site and the number of URLs directly entered by the searcher. The distinction between search engine outputs and internal search engine outputs is a valuable one as the internal search engine outputs represent a special selection of "recommended" sites. In addition, it is desirable that the relative depth and breadth of a search be calculated.

In order to proceed with the creation of diagrams to illustrate WWW search behaviour, it is necessary to define and discuss the range of variables required to capture this behaviour. A number of quantitative measures of web search behaviour can be derived within the WWW environment. They are defined largely from mouse clicks or enter key actions. The essential quantitative measures are as follows.

- *Total number of search actions*—an overall measure of search activity—it includes all successful search actions including querying search engines, and taking hot links.
- *Total number of links taken*—a measure of successful information acquisition actions—a link taken from a search engine output is included, but actions such as search engine queries and movement within search engines are excluded.
- *Total number of sites visited*—sites are defined as being separate if they have different initial URL "phrases", for example, www.honda.com and www.honda.com/welcome are the same site whereas www.honda.com and www.honda.com.au are not.
- *The number of pages read within each site*—each new page of data seen within each site, including return visits, is counted.
- *The number of different search engines used.*
- *The number of search engine outputs produced*—the number of separate search engine outputs produced as a result of a web-wide search initiated by a user-entered query term.
- *The number of sites visited by direct URL entry*—either in the URL window or in an "open URL" navigation action.
- *The number of sites visited by site-to-site link*—any arrival at a site that is initiated by taking a link directly from another site (search engines excluded).
- *The number of sites visited by use of the links offered by a search engine output.*
- *The total search time.*

3.3.1. Measures of the depth and breadth of search

The ability to analyse search behaviour in terms of the breadth and depth of search depends on the research methodology and the relevant information environment. Such measurements have traditionally been available only in information display board (IDB) experiments (see e.g., Bettman & Kakkar, 1977; Jacoby, Chestnut & Fisher, 1978), as in that information environment the consumer information has been deliberately unitised

and controlled. In the IDB experiments, the *breadth* of search was generally operationalized as the number of brands for which information was sought. Within the web environment the breadth of search may be conceptualized as *the number of separate sites visited.*

In IDB experiments, the *depth* of information search was generally considered to be the number of product attributes considered. In the web environment, the depth of the information search may be conceptualized as the number of pages or screens of information viewed. This is an especially important measure, because the web is not a minimal-effort information interface like the IDB. With an IDB, the user merely has to *select* the desired information. However, in the web environment the user has to *locate* information and then *access* it. Thus, the number of pages of information viewed is a measure of the acquisition of information and may also reflect a user's success in locating data that may be relevant to the search topic.

The breadth and depth measures are particularly important in relation to the way individuals use hypertext. For example, Beishuizen, Stoutjesdijk and Van Putten (1994) found that hypertext users left to search at their discretion exhibited very different information search behaviours. Some searched very deeply within an area, so deeply in fact that their empirically tested knowledge of the information was severely limited. By contrast, other hypertext users search more widely and less deeply for information. Although the "wide searchers" do not possess some of the very detailed knowledge possessed by the "deep searchers", the "wide searchers" typically perform better than the deep searchers in empirical testing of information acquired. The consideration of these results in relation to search of the hypertext-based WWW would suggest that the natural tendency of individuals to search broadly or narrowly may have an impact on their success and satisfaction in searching for information on the web to solve consumer problems. In summary, the breadth and depth measures would appear to be as relevant to consumer use of the web, as they were to IDB experiments, and that appropriate measures may augment search behaviour analysis by the characterization of searches on two dimensions, namely broad or narrow, and deep or shallow.

The following framework incorporates all of the above features and demonstrates how a search history is built up from a number of simple search components. The major rules for the construction of the diagrams are also demonstrated. Furthermore, to illustrate more fully the "richness" and flexibility of the proposed web search notation system two examples of real-life consumer web search will be discussed.

3.4 THE PROPOSED DIAGRAMMATIC NOTATION FRAMEWORK

This section seeks to construct an appropriate notation that captures the essential elements of web search behaviour using the wayfinding paradigm previously discussed and records information search actions and information sources in a manner similar to that found in relevant *post hoc* survey research (for example, Kiel & Layton, 1981; Punj & Staelin, 1983).

First, web searches begin from a starting point. In this case, the user's opening web browser page noted as their home page (HP) on the web is represented in Figure 7. The HP has no particular significance apart from being the starting point. However, some WWW users have a tendency to return to it frequently as if to re-orient themselves for further bursts of exploratory travel.

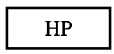

FIGURE 7.

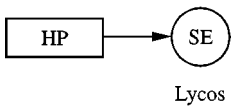

FIGURE 8.

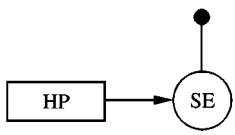

FIGURE 9.

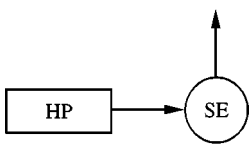

FIGURE 10.

Second, a search that moves from the HP to a search engine (SE) is represented as a circle in Figure 8 with the name of the search engine below the symbol (in this case the "Lycos" search engine). Sequential information search events are shown in chronological order from left to right across the page, and all navigational moves caused by taking a link are represented by an arrowed line.

Third, search engines are the most common method of locating information on the web if the address of the desired site is unknown. Search engines can be used in a number of ways depending upon the range of features available. The most common is the initiation of an inquiry resulting in the production of a *search engine output* which lists sites that match the user-entered criteria. Here, the first search engine output obtained is drawn in the "twelve o'clock position" on the search engine symbol, and is represented by a *transition line terminated by a dot* as shown in Figure 9.

Fourth, search engines may also have a range of internal directories available within them. These directories present lists of sites by pre-determined categories. Sometimes when using a search engine such links appear unsolicited, and are supplied in addition to any web-wide search engine output produced. Despite variations in operation between search engines, the ideological distinction between the two features is that a *search engine output is the result of a specific inquiry entered by the searcher*, whereas the use of other search engine internal directories is not. Here, the generation of a directory-type listing within a search engine is shown by an *arrowed transition line* from the search engine symbol (Figure 10).

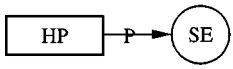

FIGURE 11.

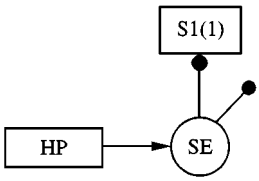

FIGURE 12.

Fifth, the choice of a particular search engine may be an important factor in individual web search style, as search engine features (for example, search refinement), information sources and emphases vary. The repeated use of a particular search engine is essentially a consumer preference for a service, and as with any other service, search engine "brand-switching" may occur. In addition, the *way* in which an individual uses search engines (for example, reliance on internal directories) may be a more fixed personal characteristic although differences between search engine features may have mediating effects. Here, a search engine preference execution is shown by a capital "P" on the relevant transition line. Thus, the execution of a search engine preference when moving from the starting point to a preferred (i.e. deliberately selected) search engine is represented as shown in Figure 11.

Clearly, web navigation is a complex task, and consists of a number of loops if all outward and return trips are shown. *For clarity, the standard return paths such as those produced by the repeated use of the "back button" are implicit (i.e. are not shown) in this diagrammatic scheme.* However, navigational moves made using sophisticated navigation techniques are always shown. Sophisticated navigation techniques include direct URL entry, and the use of the "history" and "bookmark" features of web browser packages. (These specifically allow the searcher to visit sites directly without the use of a search engine or to return to previously visited points in the search, the importance of which was or was not recognized on the first visit.) The knowledge and use of sophisticated web browser navigation techniques is at the least an important contributor to web search flexibility and, as has been shown, may be instrumental in facilitating the normal consumer decision processes. Thus, in Figure 12 the use of a link presented in search engine output 1 led the searcher to the first site they visited—designated "Site 1".

Other notation conventions include: the allocation of site numbers in the order of user visitation and the inclusion of the number of web pages or screens of information viewed within a site (including return visits) shown in brackets inside the relevant web site symbol. In addition, the return to a site or a search engine by conventional bactracking after visiting Site 1 is implicit in the representation if no further link is shown from the site.

The complete description of search actions for Figure 12 is as follows. The researcher used the search engine to produce search engine output 1 and by the selection of one of the links offered visited Site 1 (S1) where they viewed one page of information (S1(1)). They then returned to the same search engine (by a basic navigational method such as

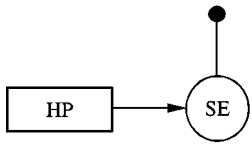

FIGURE 13.

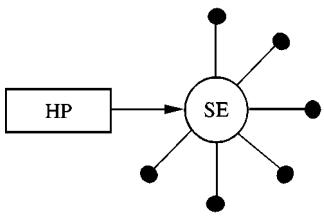

FIGURE 14.

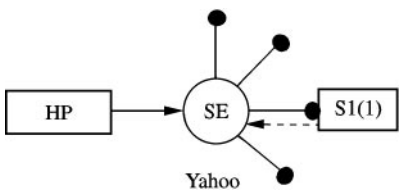

FIGURE 15.

the use of the back button) and undertook another search. None of the sites offered in the second search engine output was visited. As shown, subsequent search engine outputs are drawn radially, sequentially clockwise, around the search engine symbol in the order created by the searcher. Chronological order in the production of search engine outputs is therefore indicated by their clockwise progression around the search engine symbol.

If the search engine output symbols are considered similar to petals on a flower then a brief search utilizing a single search engine output is as shown in Figure 13. By contrast, an intense search using many search engine outputs as shown in Figure 14 appears more like a complete flower.

The distinction between the basic and sophisticated navigational techniques is based upon the use of advanced web browser navigation techniques. The use of sophisticated web navigation techniques is illustrated by a *dotted line* from the commencement of the transition to the destination accessed by the move. For example, in Figure 15, after returning to search engine output 3 from Site 1, the searcher used a sophisticated navigation technique (either the URL history facility or the use of a previously set bookmark, rather than the more basic backtracking technique) to return to the search engine home page, and subsequently produced a fourth search engine output from the same search engine.

Site-to-site transition may also be possible if a site has external destinations available from its internal links (i.e. what is generally referred to as an off-site link). Direct

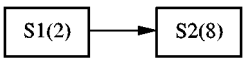

FIGURE 16.

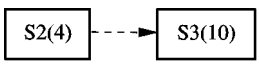

FIGURE 17.

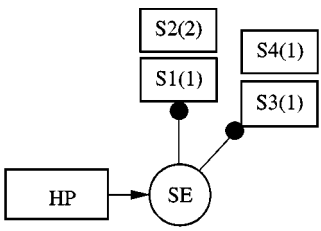

FIGURE 18.

FIGURE 19.

site-to-site transitions are accomplished by taking a site link that leads to another separate site. These are shown by a *full arrowed transition line* in Figure 16.

Sophisticated navigational transitions *between sites* are illustrated by an arrowed dotted line as in Figure 17. These may be accomplished by the use of previously set bookmarks or the URL history list or hotlist.

Visits to multiple sites based on a single search engine output, or a search engine internal link are shown one above the other in the order visited as in Figure 18.

For experienced web searchers, the accessing of sites by the direct entry of the URL is another feature of web search. In some cases, the URLs can be deduced from the name of the company or business once some knowledge of URL structure has been acquired. For example, an experienced web user may look for Honda information at http://www.honda.com as a first try at the correct URL. A dotted line is used to show that a sophisticated navigation technique has been used and the notation "URL" is added to show the manual entry of a URL (Figure 19).

The use of a URL-based transition is also an important navigation technique as it shows user familiarity with a web address, or the user's ability to deduce a likely web address. For example in Figure 20, the web user has directly entered the URL of a search engine.

Similarly, URL-based transitions between sites are shown by a dotted line between the sites, and the notation "URL" as in Figure 21.

In addition to the diagrammatic representations developed above it is possible to augment the diagrams with tabular data of appropriate WWW search measurement variables. In many cases, the tabular data can be derived from counting the components

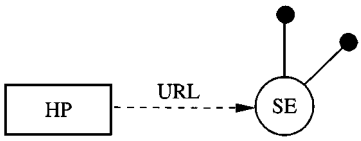

FIGURE 20.

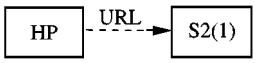

FIGURE 21.

in the diagram (for example, the number of search engine outputs, the number of sites visited or the number of pages of data viewed within sites). The "richest" picture of the search activity may be gained by appreciation of the search style exhibited in the diagram followed by consideration of the detailed search variables tabulated below in coordination with further referral to the diagram. The data table can also be extended further, if necessary, to include search engine query terms and options, and the subsequent numbers of results found. In this way search refinement actions could also be illustrated. Certainly, the diagrammatic and tabular data have the ability to improve a researcher's understanding of the complex behaviour that comprises WWW information search.

4. The notation framework: two real-life examples

As part of a larger study of consumer web search behaviour, two information search topics were presented to each WWW user via standardized scenarios. One required a search for information on a modest personal vacation, the other a search for information on a replacement PC hard drive. They were selected because one involved goods and the other services and thus they presented contrasting tasks. For example, the vacation information search task was more open-ended than the very specific PC hard drive replacement task. In summary, the information search tasks were designed to engender the test subjects' personal interest, and to stimulate a wide range of search behaviours. They were also consumer problems that were unlikely to be solved from previous experience.

The diagrammatic analysis of the recorded WWW search behaviour was developed to provide an adjunct qualitative analysis for the study, in addition to the empirical analysis of the search action data. The diagrammatic notation is demonstrated for two information searches. A number of variable scores are displayed in tables below the relevant search diagram. The variable categories include general data (the search task details, the search outcome and the search duration), and measures of search effort (the number of search actions and the total number of links taken). In addition, a number of derived measurements are presented including measures of search style and "efficiency". Search style measures include the number of sites visited (as a measure of search breadth), the number of pages of data viewed (a measure of search depth) and the average number of pages of data viewed per site (a search depth to breadth ratio). Search engine use is also recorded as a search behaviour style characteristic, via the following variables: the number of times search engines are used, the number of *different* search engines used, the number of search engine preferences executed and the number of search engine outputs

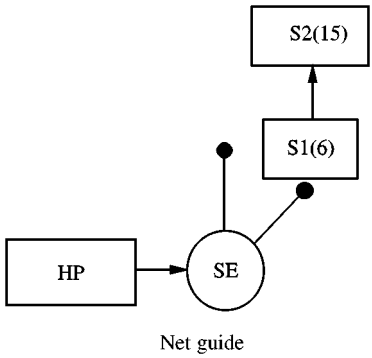

FIGURE 22. A consumer search for a replacement PC hard drive.

produced. Search "efficiency" (solely in terms of information retrieval efficiency) is also calculated as the *percentage of search actions that results in the display of data.*

Site arrival methods are also tabulated, as they may be a valuable characteristic of individual search behaviour. Only three methods of site arrival are possible and they are accomplished by, manual URL entry, site-to-site transition or a search engine link. (No distinction is drawn here between the use of search engine outputs and search engine internal links.) In the diagrams a "P" on the relevant transition line indicates the execution of a search engine preference (the initial selection of a search engine by the entry of a URL is also deemed to be an executed search engine preference).

It should be noted that in this recorded real-life web search, the web browser used the Microsoft web search screen as the default web search page. The Microsoft site allocated search engines on an apparently random basis unless the user specifically executed a search engine preference. A complete description of each search is provided together with a brief commentary. Summary tables (Tables 1 and 2) of some of the relevant search variables are included below each diagram (Figures 22 and 23).

TABLE 1
Search characteristics summary—hard drive (Figure 22)

Search 6B characteristics summary		Search task: Hard drive	
Search outcome: Purchase decision made			
Search time	20 min		
Effort		*Breadth/depth*	
Links taken	23	Depth (no. of pages of data)	21
Total search actions	40	Breadth (no. of sites visited)	2
Percentage of search actions that yielded data	58%	Depth/breadth ratio	10.50
Site-arrival method		*Search engines*	
Link from search engine	1	No. of search engines used	1
Site-to-site link	1	No. of times preference executed	0
URL	0	No. of search engine outputs produced	2

Commentary (*Figure* 22): This medium effort search was extremely brief. Two search engine outputs were generated and no search engine preferences executed. No sophisticated navigation techniques were used, and only two sites visited. Site-to-site transition was used, and a considerable depth of search was evident within Site 2. The search was thus categorized as very narrow and very deep.

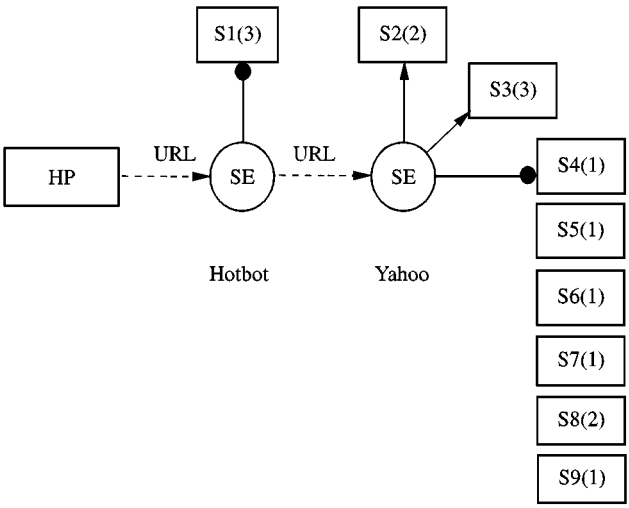

FIGURE 23. A consumer search for vacation information.

TABLE 2
Search characteristics summary—vacation (*Figure 23*)

Search 14A characteristics summary		Search task: Vacation	
Search outcome: No purchase decision—"Hard to find information—too many sites"			
Search time	23 min		
Effort		*Breadth/depth*	
Links taken	30	Depth (no. of pages of data)	15
Total search actions	59	Breadth (no. of sites visited)	9
Percentage of search actions that yielded data	51%	Depth/breadth ratio	1.66
Site arrival method		*Search engines*	
Link from search engine	9	No. of search engines used	2
Site-to-site link	0	No. of times preference executed	2
URL	0	No. of search engine outputs produced	2

Commentary (*Figure* 23): This high-effort search utilized two search engines that were visited by URL entry. Their selection by URL is akin to a search engine preference. Search engine internal directories were used on two occasions. Only two search engine outputs were generated, the remainder of search engine navigation being achieved by the

use of internal search engine directories. A large number of sites were visited; however, information acquisition within the sites was modest. No site-to-site transitions or sophisticated navigation techniques were used. The investigation of one search engine output was particularly thorough. The search was thus classified as broad and shallow.

5. Discussion

5.1. THE WAYFINDING PARADIGM

In view of the preceding analyses, what conclusions can be drawn as to the applicability of the wayfinding paradigm to the WWW environment? The first component of the Dillon *et al.* (1993) wayfinding model is the possession of global schemata which "...provide the basic knowledge needed to interact with an environment..." (Dillon *et al.*, 1993, p. 173). Since millions of individuals *do* manage to interact with the WWW environment it must be concluded that such users either possess or develop appropriate global schemata. However, it is unlikely that all such consumers would possess such schemata before their first interaction with the WWW. Thus, it can be concluded that appropriate non-specific global schemata can be developed by novice WWW users. Second, the three types of knowledge required for instantiation (landmark, route and survey knowledge) are also available in the WWW environment. Thus the four components of the wayfinding paradigm (Dillon *et al.*, 1993), that facilitate the development of a cognitive map, are present. On this basis, some form of cognitive map may be achievable for *highly experienced* WWW users.§ A cognitive map or mental model is formed *only* when instantiated schemata are increased in detail to the point of ceasing to be schematic in nature. Thus, infrequent and intermittent WWW users will be unlikely to achieve the level of detail required to develop such a map. In addition, the difficulty of developing an effective cognitive map in the WWW environment should not be underestimated since their construction is challenging in environments that possess "low legibility" (Titus & Everett, 1995), or which "have confusing layouts" (Moeser, 1988) or which are "confusing" (Kim & Hirtle, 1995). This raises the question as to the likely characteristics of a WWW cognitive map. Such a cognitive map would inevitably be non-directional in nature and would consist of locational components including landmarks, portals and specific sites together with specific navigational and inquiry strategies.

The inclusion of the latter strategic elements in the description of a cognitive map may be unexpected. However, their inclusion is caused by the partially obscured topography of the WWW itself, and it does have some parallels in real-life physical navigation. Take the case of an individual who possesses a sound cognitive map of a city that he or she is traversing *by night*. It should be remembered that the cognitive map he or she holds is *not* an encyclopedic street directory. Thus, given a *general* location description such as "its in a street off to the right soon after the high street traffic lights" the journey may then be commenced. However, the street may not be located immediately and it may take limited trial and error exploration in the *close vicinity* to locate finally the street or the house. In

§Cognitive maps may not always be developed even by experienced travellers. Their development may depend on the tasks at hand (Wetherell, 1979; Thorndyke & Hayes-Roth, 1982), abilities (Dillon *et al.*, 1993) and age differences (Francescato & Mebane, 1973).

the darkness, it may be necessary to retreat to a known nearby landmark for reorientation, or even to refresh the detail in memory by reference to a street directory.

Exactly the same situation exists in the WWW environment when a WWW user is told that the required information resides on "a Honda site" in which case the experimental direct entry of likely URLs containing the word "Honda" may be attempted. If unsuccessful, then retreat to a landmark Honda site or Honda portal site may be required, or perhaps even reference to a search engine or its directory. However, in the WWW environment the possession of a *specific* site address enables the user's direct and almost instantaneous transfer to it in a manner similar to the "beaming" concept used in Star Trek. Due to the limited visibility of general topographic detail, the WWW could be characterized as a "terrain in darkness". In view of these real-life examples of physical city navigation and WWW use the reader may now find the concept of a WWW cognitive map may be less challenging. Indeed there is some support for the development of cognitive maps in a number of non-geographic environments including documents (Dillon, 1991), document spaces (Zechmeister, McKillip, Pasko & Bespalec, 1975), electronic document space (Simpson, 1990), and limited support for the concept in hypertext documents (Edwards & Hardman, 1989; Simpson & McKnight 1990).

5.2. THE ADVANTAGES AND LIMITATIONS OF THE DIAGRAMMATIC METHOD OF REPRESENTATION

The diagrammatic representation of search behaviour demonstrated in this paper has been developed from a synthesis of aspects of the wayfinding paradigm and consumer behaviour studies of search behaviour. For example, the search engines shown in the diagrams are landmarks in the WWW topography, as are known sites and the user's home page or starting point. The diagrams also illustrate the *navigational* methods used by the WWW searchers. By contrast, from the consumer behaviour perspective, the diagrams allow the identification of the sophisticated techniques that enable on-line consumer decision-making rather than mere WWW browsing or window-shopping. The diagrammatic method thus incorporates aspects of wayfinding theory and consumer information search strategy, while supplying details such as the breadth and depth analysis that has typically only been available in laboratory experiments.

The diagrammatic representation of search behaviour demonstrated in this paper clearly has a number of advantages. First, it is highly compact as shown by the fact that the complex 23 min search illustrated in Figure 22 was detailed in a half post-card-sized diagram. Second, the actual search actions and the volume and sources of information are evident. Third, the sequences of actions may offer some insights to the individuals' search logic and style. Fourth, the representation is readily interpreted and preliminary indications are that individuals can quickly be trained to interpret the diagrams. Fifth, the system of representation may lend itself to being fully automated.

In addition, our proposed notation system allows the tracking of search behaviour in a completely uncontrolled and almost unlimited information environment. Consumer researchers for the first time may thus obtain a holistic overview of individual consumer searchers, which to date have been presented by a mass of statistics and variable counts. The idiosyncratic search styles of individuals or groups may be identified by their reliance upon particular navigational techniques or information sources and the thoroughness (or disordered nature) of their search behaviour. As considerable research of

WWW buyer behaviour is likely to occur in the next few years, we recommend that researchers utilize diagrammatic representations of search behaviour as an additional resource in order to better understand its characteristics rather than relying on numerical measures alone. In addition, the methodology allows the scrutiny of individual search styles and ready comparison between those of expert searchers and novices. For example, the search of an expert WWW reference librarian shown in Figure 22 and that of a relative WWW novice shown in Figure 21. Such diagrams may assist the identification of areas that require training and correction in order to improve the effectiveness of the novice's search behaviour.

Current limitations of the methodology include the labour-intensive nature of the observations necessary to generate the diagrams and attached tables. The diagrams also do not incorporate the use of within-site search engines. However, the availability and use of within-site search engines may be more a function of each web site's size and design rather than the idiosyncrasies of web-wide search which are the focus of this paper. Another limitation is that more complex searches can make the diagrams quite crowded and they can appear challenging to interpret. In addition, when sophisticated navigational techniques are used a number of times to return to previously visited sites, the order of search actions may appear ambiguous. In such cases, it may be necessary to include additional notations. However, despite such limitations the diagrams readily illustrate the style, order or chaos of an individual information search.

5.3. FUTURE RESEARCH DIRECTIONS

Further research should be directed at developing a taxonomy of WWW search styles. Automation of the diagram construction process will be required to produce large numbers of diagrams. Refinement of the notation will be an inevitable by-product of this process. Complaints are often made regarding the effectiveness of the WWW as an information source. However, marketers understand that a service user's participation affects the service outcome. The WWW is obviously a service and hence effective WWW use depends in part on the development of the user's own search skills. Thus, the investigation of the use of the diagrams for WWW user training may also be a fruitful area of research, with the outcome being of benefit to both consumers and WWW site proprietors generally.

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