A Framework for Human-Web Interaction

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Abstract

Navigation is a critical issue in the World Wide Web and as such there is much interest in developing new navigation techniques and tools. Unfortunately, many of these new developments focus on technological innovation without considering other aspects of human-web interaction and underlying theories. Conceptual frameworks provide structure and guidance for design and research. This paper provides a comparative analysis of a number of conceptual frameworks particularly addressing the role of goals and navigational strategies. A schematic framework for human-web interaction is proposed providing interface designers and researchers with an insight into the various components and concepts in relation to web navigation.

Keywords (Heading – minor)

Navigation, World Wide Web, framework.

INTRODUCTION

One of the central WWW usability problems relates to the vast amount of information that the Web contains and the limited methods by which a user can access this information. As a consequence of these two factors, users are prone to suffer from disorientation whilst navigating through the Web. Disorientation here means that users sometimes feel lost, confused and overwhelmed when attempting to find information (Gershon et al, 1995).

In order to address disorientation problems there has been a significant amount of research into World Wide Web navigation over the past decade. For example, Catledge and Pitkow (1995) report on an investigation into client-side logs providing an understanding of user navigation strategies, Tauscher and Greenberg (1996) examined history mechanisms such as the 'Back' button, Farris et al (2002) examined user's schemata of websites, Danielson (2002) studied the behavioural effects of constantly visible site maps, Chen et al (2000) researched individual differences in virtual environments, Cockburn and Jones(1996) provided an overview of navigational problems in the WWW, and finally a large number of alternative and innovative navigation tools have been developed (e.g. Bederson et al,1998; Pilgrim & Leung, 1996; Pirolli, 2001; Nation et al, 1997)

Despite this research, problems with disorientation and navigation still afflict the World Wide Web. There are a number of potential reasons for the lack of significant improvement in web navigation. First, human-web interaction is a complex issue due to the variety of cognitive, affective, social and situational variables involved (Spink, 2000). Interaction in particular, is a complex, difficult, messy, hard and confusing issue to deal with because humans are involved (Saracevic, 1997). Consequently, research into web navigation, particularly empirical research, is difficult to conduct. A second reason for a lack of improvement in web navigation is that in many cases new navigation tools have been developed with a focus on what is technologically possible without a strong theoretical basis. Design not grounded in theory risks having limited application and is generally not sustainable.

The literature contains a range of frameworks which seek to explain human-system interaction. These models generally decompose the action process into a number of stages or behaviours with connective relationships and feedback loops. Action models range from theoretical models of interaction to specific frameworks that address particular contexts such as information retrieval or navigation. Frameworks or models can be used to guide design, provide connections with existing theories and a structure in which empirical research can be undertaken.

This paper reviews a number of conceptual frameworks and proposes a Human-Web Interaction Framework which provides designers and researchers with an understanding of the role of goals and navigational strategies in the processes of users interacting with web site.

HUMAN-WEB INTERACTION

The processes that take place when humans interact with an information system such as the WWW include the interlaced processes of information retrieval and navigation.

Information retrieval (IR) is the process of extracting information from a system according to some perceived need. This process is essentially a cognitive activity consisting of iterations of steps involving (i) generating a user need based on current goals, (ii) choosing an information source, (iii) carrying out an information search, and (iv) evaluating-judging the relevance and compatibility of retrieved documents with needs (Rasmussen et al, 1994).

Navigation is a sub-process of IR involving movement through a system, generally but not always, towards some target. Navigation involves the concurrent processes of Wayfinding and Motion (Darken & Peterson, 2001). Wayfinding is the cognitive element of navigation including selection of paths, strategy etc, whilst motion is the actual movement (physical or virtual) through a system to the target information.

This description of human-web interaction recognises both the informational and navigational tasks as described by Conklin (1987) who describes the cognitive overhead problems experienced by users of hypertext systems. Conklin attributes cognitive overhead as a major reason that users feel disoriented due to the several tasks that users must perform simultaneously as they interact with a hypertext system (Conklin, 1987; Foss, 1989; Kim & Hirtle, 1995). These tasks include informational tasks involving reading and understanding the contents and relationships between the nodes, and the navigation tasks which involve planning and choosing paths through the system

The two parties who interact in human-web interaction are the user and a World Wide Web interface. The user has a particular information need, a certain level of domain and system experience, and preferred behaviours which are all significant factors in human-web interaction (Benyon & Hook, 1997). Their level of familiarity with the task domain, information seeking experience (Marchionini & Shneiderman, 1988) and experience with the interface are directly linked with the user's ability to formulate an information need and translate it into actions at the interface level.

The World Wide Web interface provides a particular view of the organisation and structure of the information system (Benyon & Hook, 1997). A variety of types of views may be created, some with the goal of minimising lookup time (Hoffman, 1996), others to inform the user about the content and structure of the information space. The type of structure of the information within the system and the access interface techniques both affect the retrieval strategies and thus are critical factors in task performance (Shneiderman, 1988).

The various concepts in relation to human-web interaction, information retrieval and navigation described above require an overall framework in order to understand their particular roles and relationships. The literature contains a number of explanatory theories which are commonly presented as frameworks or models that describe the stages of interactions when humans use systems such as web sites. A framework can be used to structure the research process and guide design.

CONCEPTUAL FRAMEWORKS

A conceptual framework is a way of representing an object, whether it be a system, process, structure or concept, by first identifying all of the essential elements and then representing their relationships in an organised manner. Frameworks may be regarded as a particular view of an object and as such there may exist multiple frameworks for the same object. Saracevic (1997) claims that frameworks and models are not explanatory theories. However, frameworks and models can clarify relationships between components in objects in the context of particular theoretical concepts, principles and philosophical assumptions.

Frameworks and models that have been developed from HCI research usually have a foundation in psychology or information science. These types of frameworks focus on the interaction process particularly the cognitive processes and decision points at different levels of the interaction. These interaction frameworks, sometimes known as action models, deconstruct user behaviour and activity to provide an understanding of the elements and their inter-relationships in the context of existing theories.

The development of frameworks and models are important in the context of research activity. A panel at the CHI'2002 conference addressed the issue of the need to deepen the foundations of HCI as an academic discipline (Schniederman et al, 2002) through the development of predictive, explanatory and generative theories to support the future innovation and development. In this panel, Schniederman stated that "explanatory models such as Norman's seven stages sharpen our understanding of successful products and can guide future designs".

Further, frameworks can provide orientation and direction to research by providing a scaffold in which the various variables, research questions and underlying theories can be organised. This allows a program of research to be approached logically and systematically allowing researchers to decompose research problems into manageable components without losing the overall context.

Finally, frameworks can provide the basis for evaluating the relevance of research outcomes and to facilitate the identification of areas of application and further research.

A COMPARATIVE ANALYSIS OF INTERACTION FRAMEWORKS

Table 1 presents a comparative analysis of a number of significant conceptual frameworks of interaction (Hacker 1985; Neiseer 1976; Norman 1988; Guthrie & Mosenthal 1987; Ellis 1997; Marchionini 1995; Juls & Furnas 1997; Spence 1999). In the table, each stage of analogous action in the various frameworks is identified resulting in eleven discrete categories. A number of the stages in particular frameworks span several of the identified categories and in several cases the sequence of the stages is not purely top-to-bottom. Together these categories of action stages encapsulate the essential activities of general human action and interaction. It is interesting to note that apart from Ellis (1997) who focuses on information seeking behaviours, most of the frameworks are quite similar with stages progressing from identification of goals, planning of strategy, performing actions and then perceiving the results of those actions and finally evaluating the outcomes. Each of these steps will be separately discussed in the following sections.

Goals

In the context of web interaction users' goals will vary widely, for example, a user might have the goal of finding a specific piece of information, browsing for entertainment, purchasing some goods or services, or communicating with another person. The origin of any model of an interaction process is the concept of a goal or information need (Wilson, 1997). Hacker's Action Theory (1985) which commences with the formation of user goals, seeks to explain goal-directed behaviour by distinguishing four stages of action that deconstruct the process of translating an intention into an action. In this model, goals lead to the selection of methods/tools to achieve those goals and conclude with execution and iterative refinement of the methods and actions. Similarly, Norman's "Stages of Action Model" (1988) also commences with a stage of goal formation which expresses the state that is to be achieved.

> *"The basic idea is simple. To get something done, you have to start with some notion of what is wanted – the goal that is to be achieved"* (Norman, 1988, p46).

This initial stage in Norman's model is followed by a stage in which the goal is translated into an intention to do some action. Norman distinguishes these stages by stating that a goal is often a vague statement of something to be achieved, whilst an intention are specific statements of what is to be done. Marchionini (1995) in his eight-stage framework (Table 1) that models the information-seeking processes when using electronic environments also commences with the recognition and acceptance of a problem. This initial stage is described as the "most basic situational factor that causes the user to act" (Marchionini, 1995).

The complexity of goals makes them very difficult to analyse. Goals are formed according to the interests, motivations and prior experiences of the individual and vary in a variety of ways. Armbruster and Armstrong (1993) propose that goals may be categorized according to their source (external or internal), time of formation (before or during) and specificity (very specific to very general). Specificity refers to the fact that some users can express exactly what they want whilst others are vague and unsure of their goal (Canter et al, 1985; McAleese, 1989). Norman (1988) also states that everyday tasks, goals and intentions are often "ill-formed and vague" and many are opportunistic rather than planned. Loeber and Cristea (2003) comment on the complexity of goals in their 'needs model' that describes user goals in terms of functional needs, symbolic needs and hedonistic needs. They state that goals emerge as a the result of various processes relating to cognitive models including perception, knowledge integration, personal interests and prior experiences which commence with a sensory or mental input that triggers the users' attention. Guthrie and Mosenthal (1987) highlight the complexity of goals in their model of how readers search for information in written documents. Their five stage model (Table 1) commences with the formulation of a goal which may arise externally from questions which are provided to readers or internally where a specific information need arises whilst undertaking another activity. Such goals might need to be deconstructed into subgoals if they are vague and the information space is large and complex. Marchionini (1995) also recognises that goals vary in source (internally or externally motivated) and characterisation (a gap, visceral need or a defect in one's mental model).

Action Stages / Model	Hacker (1985)	Neiseer (1976)	Norman (1988)	Guthrie & Mosenthal (1987)	Ellis (1997)	Marchionini (1995)	Juls & Furnas (1997)	Spence (1999)	Stages
Set Goals	Set goals		Goals are stated	Form goals		Recognise and accept info problem	1. Form goal		Goals
Form Intention			Intention to do some action			Define and understand the problem			
Locate Source				Inspect appropriate categories of information	Starting –identify sources	Choose search system			Strategy
Plan Strategy	Plan way to accomplish goals	Schema directs exploration	Action sequence formed	Sequence the inspection	Chaining – following and connecting new leads Extracting – systematically working through sources Monitoring – a particular area for new developments Browsing – scanning contents for subject affinity Differentiating – assessing sources for usefulness	Formulate query	2. Decide strategy	1. Form browsing strategy	
Execute Plan	Physical execution of plan		Execution	Extract details		Execute a search	3. Acquire data 6. Act (then go to 4.)	2. Browse	Action
Examine Results		Exploration samples Object (available information)	Perception			Examine results Extract information	4. Scan		Perception
Interpretation			Interpretation according to expectations					4. Interpret	
Evaluate Results	Evaluation and refinement of methods and actions		Evaluation wrt intentions and goals			Reflect /Iterate /Stop	5. Assess		Evaluation
Refine Methods		Object modifies Schema							Cognitive
Build Schema /Model			(Implicit)				5.5. Form model	3. Form model	
Iterate or Stop		(Iterate)		Recycle to obtain solution	(Iterate)		(Iterate)	(Iterate)	Feedback

Table 1: Comparative Analysis of Action/Navigation Models

The General Framework for Navigation proposed by Juls and Furnas (1997) articulates clearly the role of goals in models of interaction. This framework was composed during a focused workshop on Navigation in Electronic Worlds (Figure 1) where it was stated that "A navigation task begins with the navigator deciding what the object of the task is to be." Examples of the types of tasks were provided as either trying to find a specific item, a group of items or information about the contents of the space.

Several of the models reviewed in Table 1 exclude goals entirely. The models proposed by Neiseer (1976) and Spence (1999) instead highlight the role of the internal schema by attributing it with being the source of direction for exploration without explicitly referring to goals. The role of internal schema will be discussed later in this section.

Strategy

The categories of action stages of 'Locate Source' and 'Plan Strategy' in Table 1 describe a range of cognitive planning processes that must occur before any action can take place. All of the models have some type of planning stage in which a strategy is determined. For example, Norman (1988) proposes a single strategy stage which involves the specification of an action sequence in which the intention to act is translated into a set of internal commands described as a mental representation of an action sequence that can be performed to satisfy the

intention. Similarly Hacker (1985) and Juls and Furnas (1997) also include a stage in which a strategy or plan is devised in order to accomplish a task.

A more detailed approach is taken by both Guthrie and Mosenthal (1987) and Marchionini (1995) who each propose a two part strategy stage in which sources or categories of information are initially identified and then the sequencing or actual formation of the query takes place. This multi-part approach allows the format or type of information source to influence the actual query formation which is particularly relevant when considering the context of World Wide Web navigation. Web navigation involves several different types of strategies for different levels in the navigation process: strategies used to find an appropriate web site, strategies for navigating through a particular web sites and finally strategies for locating desired information on a particular web page. Available strategies may vary at the different levels in the navigation process and may include the use of an index or a table of contents (Guthrie & Mosenthal, 1987) or the use of tools such as search engines or maps (Juls & Furnas, 1997). Spence (1999) in particular highlights the two determinants of the formation of a browsing strategy as being cognitive and perceptual. Cognitively initiated strategies are usually planned strategies that are determined as a result of an interpretation or idea, whilst perceptually initiated strategies are formulated as a result of what is perceived and tend to be more opportunistic. The frameworks presented in Table 1 do not distinguish between different types of strategies and the role of perception prior to choice of strategy.

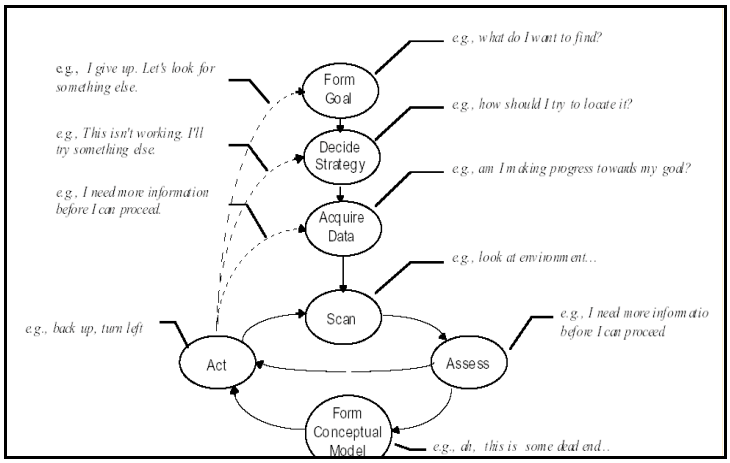


Figure 1: General Framework for the Navigation Process (Juls and Furnas, 1997)

Choice of strategy is also related to the specificity of the information goal and the stage of an investigation, for example, Ellis (1997) in an investigation of the information seeking behaviours of engineers and research scientists in industrial environments identified eight categories of behaviours (surveying, chaining, monitoring, browsing, distinguishing, filtering, extracting and ending). He claims that researchers become more selective about their behaviours as they progress from preliminary to advanced phases of a project, and as they become more knowledgeable and specific about the problem.

The notion of defined strategies has been suggested by Marchionini (1995) who proposed three types of browsing strategies: directed, semidirected and undirected. Similarly, Wilson (1997) identified several categories of information seeking: passive attention, passive search, active search and ongoing search. Neiseer's (1976) proposition that mental schema directs exploration and Hacker's (1985) proposal that methods are evaluated and refined after action both suggest that defined strategies might be developed over time and stored for later use.

Action

All of the models in Table 1 contain a stage in which a plan of action is executed. Norman's model (1988) initially proposed that human action can be divided in stages of execution and evaluation. Execution involves doing something and evaluation is the comparison of what happened in the world with the goal. Norman expanded the stage of execution to provide four levels (Goals, Intention, Actions, Execution) that resemble the first three stages in Hacker's Action Theory and then expanded the evaluation stage to into three levels (Perception, Interpretation and Evaluation).

There is no mention of how actions are managed with respect to previous and current actions. Conklin's (1987) recognition of the cognitive overhead problems experienced by users of hypertext-based systems as they perform both informational and navigational tasks demonstrates how route management is critical in models of navigation. Users who become overwhelmed by the task of monitoring their navigational path to facilitate path decisions and backtracking at the same time as they attempt to comprehend information on each page may become disoriented resulting in suboptimal performance.

Perception

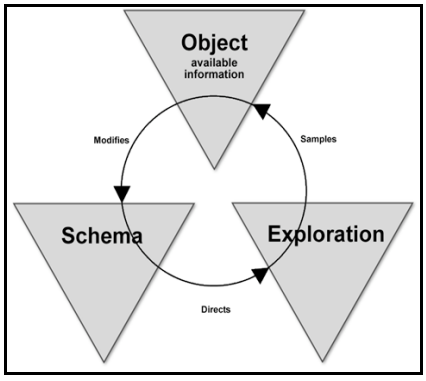
For the purposes of this analysis, perception has been defined to include both the act of viewing an interface and the interpretation of the view. The role of perception in action models needs to be clarified. Some of the models (Spence, 1999; Hacker, 1985; Guthrie & Mosenthal, 1987) do not explicitly contain a stage where the results of the actions are viewed. Most of the other models have a perception stage occurring after execution whilst the Juls and Furnas model (1997) has a 'Scan' stage occurring after strategy formation. Further, although perception was seen as a contributor to strategy selection in a previous section (Juls & Furnas, 1997; Marchionini,1995; Spence, 1999) these models lack an explicit perception stage prior to formation or choice of strategy.

Evaluation

All of the models contained an evaluation stage in which the outcome of the actions is considered relative to the intentions and goals. Norman (1988) states that "evaluation begins with perception". In his model he claims that perceptions are interpreted according to expectations and then compared with respect to intentions and goals. Marchionini (1995) notes that evaluation not only relates to how well the extracted information fulfils the goal but also how it relates to accepting the problem and an assessment of the whole information-seeking process. He highlights that the process of monitoring the information-seeking process is crucial to browsing type strategies which are highly interactive and opportunistic. Evaluation generally results in either concluding the process or following various feedback paths to allow refinement and recycling through other stages.

Cognitive Model

Several of the models reviewed in Table 1 (Neiseer, 1976; Guthrie & Mosenthal, 1987; Juls & Furnas, 1997; Spence, 1999) focused on the cognitive elements of the interaction process by including a reference to a schema or cognitive model. The terms "mental model", "cognitive model" and "schema" have been used in many contexts and for many purposes. The theory of mental models was proposed by Kenneth Craik (1943) to provide a general explanation of human thought based on the contention that humans represent the world they interact with through mental models. Johnson-Laird (1983) developed the concept of mental models claiming that individuals develop and use a working internal model of phenomenon in order to understand it. Mental models are cognitive mechanisms that are dynamically created through experience as people interact with others and their environment (Norman, 1988) allowing predictions to be made about events before carrying out actions. There is evidence to suggest that an appropriate mental model can improve a user's ability to interact with a system (Rumelhart & Norman, 1981). Cognitive models are used specifically in the context of learning (Rumelhart & Norman, 1981). Cognitive models may have new knowledge added to them through reflection, perception or experience, new models may be created by modelling it on an existing schema and then modified based on new experiences, and existing models may be tuned through practice. Similar to cognitive models are schema, which usually refer to organised structures in memory which contain our knowledge of the world.



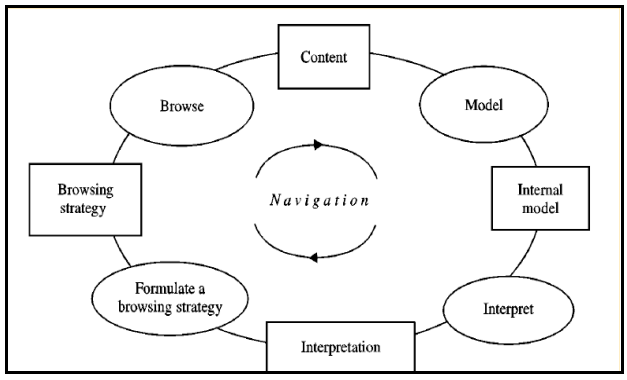


Figure 2: Neisser's Perceptual Cycle (1976) Figure 3: Spence's Extended Framework for Navigation (1999)

The frameworks proposed by Neiseer (1976), Guthrie & Mosenthal (1987), Juls & Furnas (1997) and Spence (1999) include a reference to a schema or cognitive model. Neisser's Perceptual Cycle in particular, emphasises the role of stored mental schema on exploratory behaviour and the perception of external context. Neisser, as one of the first researchers who attempted to integrate learning, perception and activity (Rauterberg, 1995), proposed a cycle (Figure 2) in which perception modifies stored mental schema, the schema directs exploration, and to complete the loop, the exploration samples the available information. This cycle stresses the role of cognitive models in web navigation by proposing that knowledge of particular subject matter through a schema will help readers anticipate, find and organise information (Neisser 1976). Knowledge provided through a schema may include knowledge of the particular subject matter as well as knowledge of the structure of the information space (Winn, 1993) and any navigational features (index, table of contents, etc) and how to use them.

The framework proposed by Juls and Furnas (1997) (Figure 1) includes the development of a cognitive model after an assessment phase. This cycle of Scan, Assess, Form Model and Act parallels Neisser's Perceptual Cycle by relating perception and action through a cognitive model.

Spence (1999), a contributor to the framework described by Juls and Furnas (1997), proposed an extended framework that clarifies the role of the cognitive model (Figure 3). The extended framework included four cognitive activities each with their results: browsing, formation of an internal model, interpretation of internal model and displayed data, and formulation of browsing strategy. Whilst this framework excludes references to goal formation and perceptual processes, it does clarifying the processes by which internal models are created and interpreted.

Feedback

Most of the models contained a variety of feedback paths implying that results would be fed from the last stage back to the first stage. For example, the General Framework for the Navigation Process proposed by Juls and Furnas (1997) contains several feedback loops allowing the results of actions to refine goals, strategies and the decision whether to continue the process. Hacker (1985) also proposed a feedback loop allowing refinement of methods and tuning of strategies after the evaluation stage. The models emphasising the cognitive elements of the interaction process (Neiseer, 1976; Guthrie & Mosenthal, 1987; Juls & Furnas, 1997; Spence, 1999) all contain feedback paths that allow the refined schema to influence subsequent goal formation. Feedback paths between other stages are also proposed in other models which highlights the importance and complexity of feedback routes in information retrieval models (Saracevic, 1997; Spink 2000).

Of course models do not necessarily operate in a one-directional step-by-step manner. Norman (1988) notes that models are 'approximate' since the individual stages are not discrete entities, not all are completed and a continual feedback loop operates. Marchionini (1995) in his eight stage framework comments that whilst there is a sequence of subprocesses, there is a recognition that they develop in parallel and may recursively call each other.

A HUMAN-WEB INTERACTION FRAMEWORK

The comparative analysis of action/navigation models in the previous section has identified six major stages which should be considered in any framework of interaction: formation of goals, strategy, action, perception, evaluation and the development of a cognitive model. These stages should be linked to each other through a variety of sequence and feedback paths.

The roles of, and relationships between, goals, perception and the process of choosing interaction strategies in human-web interaction has some distinctive issues that should be a critical consideration in any explanatory framework.

An initial consideration is that there are two different stages of interaction when using the World Wide Web. The first stage involves locating a particular or relevant web site. The second stage of interaction involves using the chosen web site in order to achieve some goal. A user may swap between stages at any time in a particular session. The range of navigation strategies for each stage will be different and may be defined as either 'intra-site' or 'inter-site' navigation strategies. Inter-site navigation strategies refers to global navigation of the World Wide Web during which the user will use strategies and tools such as those provided by browser tools, global search engines, favourites lists, portal sites, and explicit URLs, in order to locate a particular or relevant web site. These are different from the strategies and tools available when performing intra-site navigation which involves navigating within a particular web site. Intra-site navigation is achieved either by free browsing between pages or by using site navigation tools provided by the site designer such as site-search, sitemaps, indexes and navigation bars. Other site navigation aids such as bread-crumbs, home page buttons, landmark pages and the use of consistent page templates may also aid site navigation by orientating the user in the site. A human-web interaction framework should differentiate between 'intra-site' and 'inter-site' navigation strategies.

A second consideration is clarifying the relationship between viewing the web interface (perception) and the process of choosing an interaction strategy. This link between perception and choice of strategy in a WWW context is not explicitly addressed in any of the reviewed models. Website interfaces vary in the level and type of navigation support they provide. Some sites provide only basic links to areas of content whilst others provide additional navigational support through search tools, navigation bars, breadcrumbs and sitemaps. Strategy of interaction with a web site is influenced by not only the goals of the user and their preferred strategies, but also by the opportunities provided by the interface such as links and navigation tools. The process of information seeking is both systematic and opportunistic (Marchionini, 1995), hence it is only via a scan of the interface that opportunities for alternative strategies will be identified. For example, if the user sees a link to a sitemap then they may use this tool to support an intra-site navigation strategy. A human-web interaction framework should include perception as a specific activity that influences choice of strategy.

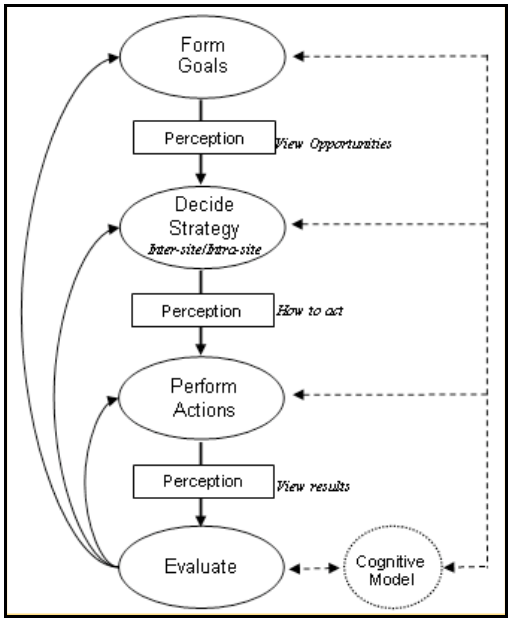


Figure 4: Proposed Human-Web Interaction Framework

A proposed Human-Web Interaction Framework is presented in Figure 4. This framework comprises the six major elements identified in the previous section including a perception stage prior to strategy selection and recognition of the two modes of web interaction.

The proposed framework clarifies the role of perception. Although perception has been listed as a sub-process that occurs between each of the stages, it is recognised that perception is an ongoing activity that parallels the whole interaction process. It occurs before, during and after each of the processes. The role of perception prior to strategy selection is particularly important in relation to the choice of strategy as it allows the identification of opportunities from the interface. Perception is also utilised when considering how to implement actions and evaluate outcomes.

The framework identifies two classes of strategies that exist in human-web interaction. Users will employ inter-site strategies during global web navigation between sites and intra-site strategies when navigating inside a web site. Users may switch between these modes of use as the move between and within web sites.

Each of process in the framework is in a constant state of development over time and in interaction with the others; thus, they are neither static nor discrete. For example, goals are in a continual state of development and may switch at any time. Strategies are continually being evaluated according to their suitability and are influenced by the cognitive model. The cognitive model is built dynamically as a result of on-going evaluation of all of the stages and will influence goal formation, strategy selection and implementation of actions.

CONCLUSION

Problems relating to web navigation will continue to be one of the issue confronting HCI researchers and web designers. We know that web users are impatient, require instant gratification and will leave a site if they cannot immediately figure out how to find what they want (Nielsen, 2000). Conceptual frameworks can provide guidance for both researchers and designers who wish to alleviate such problems. Frameworks can provide orientation and direction to researchers by providing a structure to facilitate the identification of the areas in which there is a lack of research and a scaffold in which to undertake such research. An appropriate framework will enable a program of research to be approached logically and systematically allowing researchers to decompose research problems into manageable components without losing the overall context. Further, frameworks can provide the basis for evaluating the relevance of research outcomes and to facilitate the identification of areas of application and further research. For instance, a researcher who is planning to investigate the relationship between goal types and the selection of navigation strategies may focus their attention on either intra-site or inter-site navigation strategies. In this particular case the researcher will recognise and plan for the influence of perception, the user's cognitive model and other feedback loops in the study. Interface designers may also benefit from frameworks by being provided with an insight into the various components and concepts in relation to navigation.

This paper provides a comparative analysis of a number of conceptual frameworks and proposes a Human-Web Interaction Framework which provides designers and researchers with an understanding of the role of goals and navigational strategies in the processes of users interacting with web site. The proposed framework combines

many of the common elements from existing frameworks but clarifies the role of perception and the process of strategy selection in the context of human-web interaction.

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