

Examining Users' Perspectives of Domain-Specific and Standardized Web Site

Navigation Systems

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by

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Navigation Systems

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ABSTRACT

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Northcentral University, January 2009

With the current heterogeneous design of Web site navigation systems in use today, many users must relearn how to navigate these Web sites with every new Web site they visit, even when navigating within the same domain. The purpose of this quantitative comparative study was to identify users' preference frequencies for characteristics of Web sites' navigation features, and to examine if the preference frequencies differed with users' demographic characteristics. The study was designed to address these issues through user responses to a Web-based survey. The study's population consisted of users of selected Internet forums/search engines that were expected to be frequented by Web developers, designers, and Web site managers. In addition, Northcentral University learners and faculty were asked to participate. Using a priori power analysis, the desired total sample size was 156 respondents. A total of 160 surveys were returned. A statistical significance level of .05 was used. Findings indicated users do prefer domain-specific, standardized Web site navigation systems to a standalone, non-standardized Web site navigation system; common/standardized menu navigation system to different/non-standardized menu navigation; and, users prefer menu systems with sub-menus to no sub-

menu navigation system. However, with the exception of gender there were no significant preference differences among users' demographic characteristics. The conclusions from the study could be used to provide Web site developers, designers, and managers, with design guidelines for more intuitive Web site navigation systems, thereby enabling more meaningful and efficient searches.

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I have learned many things throughout this journey, which are best summed up by a quote from Rene' Descartes.

"Each problem that I solved became a rule which served afterwards to solve other problems." (Rene Descartes (1596-1650), "Discours de la Methode")

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CHAPTER 1: INTRODUCTION

According to a 2008 survey conducted by its developers at the Internet services company Netcraft (2008), more than 185,167,897 sites were identified on the Internet. It has been estimated that users are spending twice as much time surfing the Web as they do watching television. According to an International Data Group study on consumer online behavior, users spend 32.7 hours/week surfing the Internet. This accounts for almost half of the total time spent each week using all media or 70.6 hours (Weide, 2008).

Many Web site navigation systems have evolved through trial and error, through advances in Web programming languages, and through collaboration among Web site owners, developers, and, most importantly, users. However, Meadhra (2005) stated, “even the most standards-compliant modern browsers suffer from annoying inconsistencies in the way they render pages” (p. 1). As would be expected, many of these navigation systems are built on a variation of a few common types and formats, such as tabular navigation systems, left-side and right-side navigation systems, or any combination. Tabular and side menus are just a few of the many variations and combinations of navigation systems that are common. Regardless of type or format, each of these navigation systems has the intended purpose of helping the user navigate the Web site to find information as quickly as possible.

To facilitate users' Web navigation experiences, developers must understand and utilize a few simple conventions when designing Web site navigation systems. For example, a domain-specific Web site (e.g., a .gov Web

site) navigation system may be employed to provide common user experiences. That is, if users are interested in Web sites that contain information regarding alternative fuel sources, all Web sites within this domain (alternative fuel sources) would have a common navigation system with which the user would be familiar, thereby enabling the user to more quickly find the desired information.

Standardizing the user's experience through knowledge gained from previous Web sites could ultimately reduce the time required to locate needed information.

Danielson (2003) posited that using a standardized domain navigation menu would allow users to visit any e-commerce Web site and easily find and understand how to navigate all e-commerce Web sites. Taken further, this could result in research sites with a navigation menu that would be familiar to users across all sites, including education sites, with a similar navigation system for all education domains.

Developers have implemented industry standards, allowing more consistent cross-browser functionality (Web Standards Project [WaSP], 2002). Some Web sites reflect very intuitive navigation and yet others provide few clues to finding desired information. Many companies' managers spend hundreds of man hours and thousands of dollars just in maintenance of their sites (Robinson, 2004). To redesign a Web site to reflect the latest technological advances may be seen as too costly (Figuroa, 2001). Although no Web site function is guaranteed to produce a strong return on investment, some are worth the effort and expense. Yet other functions can have a negative return on investment if users do not want or need them (Pratt, 2007). Generally, however, unless

analysis reveals a Web site would lose business, it is extremely difficult to convince one's corporate information technology (IT) oversight committee that these changes are necessary (Nonnenmacher, 2004). The cost of doing online business increases rapidly when these factors are not considered (Golja, 2006).

Achieving compatibility with user needs is an important part of designing and maintaining Web sites. As will be shown in the following sections, users' preferences in designing and maintaining Web sites has not been adequately studied. A quantitative methodology study was used to identify and analyze users' perceptions and preferences, and to investigate how they differ with various types of users.

Statement of Problem and Purpose

Web users must adjust to unpredictable Web site designs, which can result in nearly one-third to one-half of the time spent in front of the computer as lost time due to frustrating experiences while searching for their intended objective (Lazar, Bessiere, Ceaparu, Robinson, & Shneiderman, 2003).

The purpose of this dissertation was to determine whether users' prefer a standards-based Web site navigation system that would allow them to easily find and navigate any Web site, thereby reducing the need to *re-learn* how to find and navigate other Web sites.

A quantitative methodology was used to compare particular Web site features with users' preference frequencies, and more specifically, the degree to which users prefer domain-specific, standardized Web site navigation systems versus standalone, non-standardized Web site navigation systems. A domain-

specific navigation system could provide a user with the confidence to navigate common domain Web sites and the ability to more easily locate information he or she is seeking in a domain-specific navigation system. Users could then find a navigation system common to every Web site within a given domain that would appear and function identically, regardless of the Web site's purpose. For example, within the federal government, all .gov Web sites could have the same type and functioning navigation bar at the top of the department's or agency's main page that would provide links to data that are specific to that Web site. Domain-specific Web sites might also have vertical menus located on either side of their main page to direct users to related information located on other sites, links to specific databases, archival areas, or additional supporting information. Such domain-based Web sites could increase productivity through association with similar Web sites, providing greater usability benefits and lower costs. Nielsen (2003) wrote, "Web site usability is dominated by users' ability to avoid errors in navigation and interpret new information. In a well-managed intranet, users deal only with a single design, and thus eventually achieve a degree of skilled performance" (p. 1).

Research Questions

The research questions for this study were:

1. To what extent do Web users perceive differences in the usability of standardized versus standalone Web site navigation systems?
2. To what extent do Web users perceive differences in the usability of navigation systems that employ a Web site navigation layout featuring a

menu that looks the same on every page versus different navigation menus throughout the Web site?

3. To what extent do users perceive differences in the usability of navigation systems employing flyout menus (sub-menus) versus navigation systems with single-level menus (no sub-menus)?
4. To what extent do users' preference scores differ among their occupations, experiences, gender, or ages?

The importance of determining potential drivers of user preference frequencies/satisfaction with Web site navigation systems was highlighted to show that user satisfaction and feedback serve as measures of business performance and general usability and applicability of the navigation system used in the Web site (Hummerston, 2002). Further research in this area is needed to determine both the potential key correlates of user Web site satisfaction (navigation layout, consistency of menu type, menu functionality) and the extent to which user expectations and priorities are currently satisfied. The quantitative, comparative study was designed to identify users' Web site design characteristic preference frequencies, the potential key correlates of Web site users' satisfaction (navigation layout, consistency of menu type, menu functionality), and if the application of a standardized, domain-specific Web site navigation system could provide increased Web site user satisfaction. Davulcu, Vadrevu, Nagarajan, and Ramakrishnan (2003) found that by using a calculation algorithm, experimental evaluation for news and hotel domains indicated that a population-specific ontology provided high

precision and recall. The population from which responses for addressing the research questions were solicited consisted of participants in Internet forums/search engines for Web site designers, developers, users, and Northcentral University students and faculty.

Definition of Key Terms

The Internet, and more specifically the World Wide Web use a variety of terms and acronyms. The most relevant terms used in this study are defined here.

Domain. A group of networked computers that share a common communications address (American Heritage Dictionary of the English Language, 2000).

Domain-specific Web sites. Same topic Web sites, similar in content structures and textual contents (Dong, Qi, & Gu, 2005).

Navigation system. A Web site navigation system is the science and skill that is applied to a Web site that helps visitors move from one page to another (Tambralyn HTML/CSS Designer, 2008).

Navigational freedom. A term used to describe how a user moves within a specific Web site structured to reduce orientation problems (Wu, 2002).

Organization for the Advancement of Structured Information Standards (OASIS). A nonprofit consortium that promotes the adoption and direction of e-business through its development of global standards in the public sector and for application-specific markets (OASIS Open, 2007).

Standalone Web sites. Self-contained and usually independently operating (American Heritage Dictionary of the English Language, 2000).

Standards-based Web sites. Web sites that have been developed using the World Wide Web Consortium specifications. They provide a standard reference point for Web browser developers and Web site developers. If both browser developers and Web site developers refer to the same set of specifications, then a Web page should appear and function consistently, across all browsers (Motive Glossary, 2006).

Think-aloud protocols. A technique employed in user testing where users are asked to speak their thoughts as they perform a task (U.S. Department of Health & Human Services, 2007).

Upgradation. Act or process of upgrading a computer network, hardware, software, etc.; upgrade. (Word Web Online, 2007).

Usability. The efficiency with which a user can perform required tasks with a product, for example, a Web site. Usability can be measured objectively via performance errors and productivity, and subjectively via user preference frequencies and interface characteristics. Web design features that effect usability include navigation design and content layout (Nielsen, 2003).

User-centered. Is a structured development methodology that involves users throughout all stages of Web site development in order to create a Web site that meets users' needs (U.S. Department of Health & Human Services, 2007).

User compatibility. In the context of Web site design, a design feature is user-compatible when the design is acceptable to most users, not only a few of them (Mayhew, 2002).

Webring. A group of related Web pages linked to each other in a sequence that forms a ring. When someone searching the Web finds one of the webring's pages, they can click through to other sites that have related content. Web content providers can add their pages to the ring by *linking in* to the ring so that Web surfers are more likely to encounter their site (Huggins, 2001).

Web portal. A Web portal is a Web site that provides a starting point, a gateway, or portal to other resources on the Internet or an intranet (Arizona State University, 2008).

Brief Review of Related Literature

The founder of the World Wide Web Consortium (W3C), Berners-Lee (2004), is the leading proponent for the development of open standards for the Web. One of the primary roles of the W3C is the creation of standards that can be used to help establish consistency among Web technologies and specifications. To attain this objective, the W3C's mission includes developing the foundation for the next generation of the Web. This development involves making the Web a robust and adaptive infrastructure, including accessibility for disabled, as well as able-bodied, users. Similar to W3C, the members of the Web Standards Project organization (WaSP) (2002) sought to contribute to a standards-based Web through a program called the Web Standards Project. The members of the WaSP strive to make the Web available to the greatest number

of users through standards directed at Web designers and developers, and by ensuring simple, affordable access to Web technologies for all users and designers.

The need for Web site standardization is illustrated by Nielsen (2004a), who posited that standards can ensure users will know what features to expect from site to site and readily recognize, locate, and use standardized features across the Web. Nielsen (2004a) concluded that standards would help to eliminate confusion and lead to greater user confidence regardless of the users' current Web experiences. Standards would range from creating cross-browser compliant coding systems that would render the same appearance and functionality from one browser to the next, to usability standards that allow users with varying degrees of physical ability to navigate Web sites by using shortcut keys, screen readers, and enlarged fonts.

In addressing user preferences with respect to ease of use, Vredenburg (2003) discussed how guidelines for achieving ease of use are essential for any site competing for business on the Web. "User analysis is the first step in producing an effective Web site" (p. 594). Vredenburg also asserted that user analysis planning should be conducted to gain input from potential users on the content of a Web site:

Input from users on your content will help you create a site that is relevant and engaging. Ask users for feedback on the quality of your ideas, and ask them to contribute ideas. The Web provides a unique opportunity to quickly gather specific information from users from distant locations. (p. 517)

The addition of surveys, interviews, task analysis, and focus groups also need to be considered as part of this planning phase. Vredenburg (2003) also discussed the design aspect of creating the framework for the site, specifically how navigation elements should be used consistently. "Once users see a link, they expect when they see it again it will look the same, be in the same location, and function the same. If it has changed, users may be forced to relearn the button, which will delay their completion of tasks" (p. 517).

Vredenburg (2003) discussed the importance of testing the navigation design as well:

To determine whether users can find information easily, test your navigation design as soon as possible. You do not necessarily need all the links to be active or all the pictures to be in place, but you will need the significant navigation mechanisms to be working and some of the content to be placed. Ask representative users to find particular information. (p. 517)

Katz-Haas (1998) discussed how users report feeling lost or disorientated when navigating some Web sites, and concluded that links should be descriptive enough so that users can easily predict what they will find when they click a particular link. Katz-Haas also suggested that testing for usability is an iterative process, and that it is important to conduct usability testing throughout the development cycle.

Hilhorst (2004) discussed ease of use from the designer's perspective, with emphasis on aesthetics as being the key to making Web site navigation systems more usable:

Design, and more specifically, aesthetics are key to this process, yet graphically-enhanced versions provide the effect of perceived ease-of-use, usefulness and enjoyment – the basic, text-based versions do not

achieve this, which, in my opinion, results in a less-favorable user experience. Professionals in the industry should not, de facto, favor usability above design, but rather recognize their coalescence and reciprocal significance in achieving an optimal outcome. (p. 1)

It was apparent from the literature that it is imperative users not only be included in the beginning but throughout the entire process of Web site navigation design and development. The review of the literature has further indicated that user-based surveys can provide a wealth of information regarding factors that influence users' perceptions of *ease of use*.

In summary, this brief literature review has illustrated the need to have users actively involved in all aspects of the Web site navigation development process. In the following chapter, further research is detailed that has indicated the value of a survey instrument as a very simple and cost-effective method for developers in understanding what users expect in a Web site navigation system, and what values users attribute to ease of use.

Highlights and Limitations of Methodology

This quantitative study was designed to identify what users perceive as ease of use features associated with Web site navigation systems, and the degree to which users prefer domain-specific, standardized Web site navigation systems versus standalone, non-standardized Web site navigation systems. A comparative design was used to determine the extent to which there may be statistically significant differences in users' preference frequencies, and the design features of Web site navigation systems. By comparing these perception data, it was expected that any significant differences could be detected, and the nature of the differences could be analyzed. The study was also used to identify

and analyze other key differences in preference frequencies (navigation layout, consistency of menu type, menu functionality) that may have been attributable to the users' demographics.

A domain-specific navigation system could provide a user with the confidence to navigate common domain Web sites and the ability to easily find sought-after information. In a domain-specific navigation system, users would find a navigation system common to every Web site within a given domain that would appear and function identically, regardless of the Web site's purpose. Such domain-based Web sites could increase productivity through association with similar Web sites, providing greater usability. Zhang and von Dran (2002) found in their study that across domain-specific Web sites (financial, education, and government), domain-specific features *Easy to Navigate* and *Navigation* ranked among the most important features across all domains investigated.

The population for this study consisted of participants in selected Internet forums/search engines for Web site designers, developers, users, and Northcentral students and faculty. One disadvantage that must be considered among all groups is the differing levels of experience. Although this researcher addressed these questions to *users* specifically, it must be realized that Web site designers and developers are also users. Another recognized limitation is that participants' ages could affect the outcome. Older users may not be as comfortable navigating the Web as younger, more technology-oriented users would be, thereby possibly influencing overall outcomes. Nielsen (2002) posited that Web sites are twice as hard to use for seniors as they are for younger users.

Another age-associated limitation to this study could apply to the differing levels of experience, as older users most likely use the Internet to communicate with family by using Web-based e-mail programs and do not actually spend time surfing the Web. However, the potential effects of such extraneous variables were addressed by including them in a analysis of variance (ANOVA).

Another assumption is related to use of a questionnaire. It must be assumed that all of the participants would interpret the items of the questionnaire in the same way, and as the researcher meant them to be interpreted. Assurance of the validity of this assumption was addressed by including a glossary of terms as well as examples of different Web site navigation systems (Appendix B).

Research Expectations

It was and is expected that the study's findings could be used to provide additional insights into what factors users employ when determining ease of use with Web site navigation systems, and specifically, whether users prefer a standardized navigation system or a non-standardized navigation system, including a logical grouping of menu items. It was also expected that survey respondents would favor a domain-specific navigation system where they can use the knowledge they have learned navigating one site within the domain to any other site within the same domain.

CHAPTER 2: REVIEW OF RELATED LITERATURE

The purpose of this study was to identify and analyze what users perceive as key ease of use features related to Web site navigation systems, and to examine the degree to which users might prefer a domain-specific, standardized Web site navigation system versus a standalone non-standardized Web site navigation system. This chapter contains reviews of related research on the usability, navigation problems, consumer Web use, and logical Web site groupings associated with ease of use.

Ease of Use

Ease of use is one of the more critical aspects related to how users determine whether a Web site is usable or not. Germonprez (2003) indicated that the more complex a Web site is, the less likely that relevant information can be obtained from the site or that the site can be used efficiently, if at all. Likewise, Hurteau (2006) posited that usability is the measure of how effectively something can be used by its target audience.

From the researcher's experience as a Web developer, designer, and user, navigation problems can be directly related to a lack of a common understanding among developers or site owners and users. Consumer Web use provides an insight into how users perceive Web site navigation with regard to user-centered philosophies versus developer- or site owner-driven philosophies. Logical Web site groups address the common understanding that ties all of these areas together, and ultimately determines the overall user satisfaction as related to Web site navigation.

Standards

The need for Web site standardization was illustrated by Nielsen (2004a), who posited standards can ensure that users will know what features to expect from site to site and readily recognize, locate, and use standardized features across the Web. Nielsen (2004a) concluded that standards would help to eliminate confusion and lead to greater user confidence regardless of the users' current Web experiences. Standards could range from creating a cross-browser compliant code, which renders the same appearance and functionality from one browser to the next, to usability standards that allow users with varying degrees of physical ability to navigate Web sites by using shortcut keys, screen readers, and enlarged fonts.

Berners-Lee (2004), founder of the World Wide Web Consortium (W3C), is the leading proponent for the development of open standards for the Web. One of the primary roles of the W3C is the creation of standards that help facilitate the establishment of common Web technologies and specifications. To attain this objective, the W3C's members' mission includes developing the foundation for the next generation of the Web. This development involves making the Web a robust and adaptive infrastructure, including accessibility for disabled, as well as able-bodied, users. Similar to W3C, members of the Web Standards Project (WaSP) (2002) sought to contribute to a standards-based Web through a program called the Web Standards Project. The Web Standards Project strives to make the Web available to the greatest number of users through standards

directed at Web designers and developers, and by ensuring simple, affordable access to Web technologies for all users and designers.

Other standards bodies are generally comprised of working groups primarily representing major software and hardware manufacturers and developers. Representatives from manufacturers such as Microsoft, Sun Microsystems, Hewlett Packard, Adobe, and others totaling more than 400 members of the World Wide Web Consortium (Jacobs, 2006) met to discuss and agree on proposed standards. They also proposed their own ideas of what the standards should be and which ones should be approved. Microsoft's representatives, for example, have argued in favor of its proprietary technologies as standards and have regularly implemented, without soliciting recommendations from the other members, its own standards within its Internet Explorer™ browser, further complicating the realization of an industry standard (Biglione, 2004). Often, these proprietary technologies do not work with other browsers. For example, the differences between Netscape's JavaScript™ and Microsoft's Jscript™ render them incompatible. As evidenced by the box model (Gallant & Bergevin, 2003), the difference between how Microsoft and the rest of the community handle total space associated with borders and padding regarding Web page layout clearly shows how varied and confusing the features used on the Web can be. Although users have the option to purchase other products, the fact that this difference in standards even exists indicates a lack of willingness by some software developers to consider users' concerns about issues as fundamental as Web page layout (Biglione, 2004).

Usability

The developers of the International Standards Organization's (ISO) publication ISO 9241-11 (ISO, 1998) defined usability as, "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (p. 6). The ISO 9241-11 standard also contains information on how user performance and satisfaction can be used to measure how any and all components of a system affect the quality of the entire system. Unless a Web site meets the needs of the intended users, it will not meet the needs of the organization providing the Web site (Bevan, 2001). Bevan's research has been used to support the position that a user-centered design approach is needed to solve the problem of usability.

The U.S. Department of Health and Human Services' Web Design & Usability Guidelines (2006) were developed to address the issue of usability and to provide current evidence-based guidelines on Web design and usability issues. Usability should be the ultimate concern (Hurteau, 2006) of a standards-based World Wide Web, and usability guidelines need to address many different aspects of Web site quality: functionality, consistency, visual clarity, language and content, online help and user guides, user control, navigation, and many more aspects.

The Usability Professionals' Organization (2004) has defined user-centered design as an approach to design that grounds the process in information about the people who will use the product. The four main cycles required for this process involve (a) the specific context of use (who will use it,

how will they use it, and under what conditions), (b) specific requirements (user requirements and goals), (c) design solutions (storyboards, prototypes, and models), and (d) design evaluation (testing using actual users).

Lazar, Bessiere, Ceaparu, Robinson, and Shneiderman (2003), Nielsen (2004b), and others have questioned if users and usability are considered in Web design. The most frequent user complaints are centered on a lack of consistency from one Web site to another, which represents a potential standards issue. The methodology for this quantitative study consisted of data collection using a modified time diary, and surveys. The descriptive research design consisted of users spending approximately 1 hour using the computer, with no assigned tasks. Users were then asked to perform normal tasks and report any experiences that were frustrating. Researchers expected this type of activity would provide data that was representative of actual tasks that users would perform. Variations include such examples as Web sites displaying their site navigation as a series of tabs across the top of the page, while other Web sites display a vertical menu either on the left or right side of the page and others use a combination of both (Bernard, 2003).

Burrell and Sodan (2006) examined several navigation systems focusing on placement and type of menus. This examination determined that users do have a preference for tabbed style navigation systems when compared to left- or right-side vertical listings. Findings from this study further indicated respondents' preference for tabbed style was because it was more easily understood and learned.

In a related quantitative comparative study, Kalbach and Bosenick (2003) found regarding their hypothesis:

Left-hand navigation would perform significantly faster and the right-hand navigation was not supported. Instead, there was no significant difference in completion times between the two test conditions. This research questions the current leading Web design thought that the main navigation menu should be left justified. (p. 1)

The authors also indicated users were ambidextrous or seemed comfortable using left- or right-hand navigation.

Ojakaar (2001) indicated that designers use flyouts, rollovers, and dropdown type menu navigation to conserve space and enhance the users' experiences. However, the findings revealed that users experienced confusion and disorientation when using flyout menus for the first time. The learning process was quick, but initially confusing.

The U.S. Department of Health and Human Services' Web Design & Usability Guidelines (2006) regarding internal and external links showed:

Users tend to assume that links will take them to another page within the same Web site. When this assumption is not true, users can become confused. Designers should try to notify users when they are simply moving down a page, or leaving the site altogether. (p. 97)

Navigation Problems

Nielsen (2004b) illustrated some of the problems that result from a lack of standardized Web site navigation systems. For instance, many Web sites simply use hyperlinked graphics or text to indicate where other information or locations dealing with a topic may be found. This graphic choice requires the user to search or scan an entire page to find the desired link. Nielsen found that users

left such Web sites after 1 minute and 49 seconds on average, concluding that the Web site did not fulfill the users' needs.

Danielson (2003) indicated it may not be practical to expect all Web sites to use either a tab or vertical navigation menu, proposing instead that a standard within a given domain could provide overall navigation. The quantitative methodology for this correlational study consisted of two questionnaires, and tasks and procedures to collect variables. The domain for this study consisted of hierarchically organized sites that allowed investigators to monitor participants with directed search tasks. Reinforcing what researchers such as Danielson (2003) have proposed as a key design criterion for Web sites, the ISO (1999) 13407 standard on human-centered design process contained guidance on achieving quality in use by incorporating user-centered design activities throughout the life cycle of interactive, computer-based systems.

The potential benefits of designing specific Web sites using a standards-based approach include the ability to reach a larger audience, ease in managing Web content, faster page download times, search engine optimization, and overall improved site maintenance (Janis, 2005). Through the use of common principles of a usable interface design, consistency may be achieved by an effective and common style (Oppedisano, 2002). Oppedisano explained how such commonality could result in users maximizing task completion and minimizing interfering factors related to interface complexity or performance. The user, thus, becomes comfortable with the interface, thereby requiring a shorter learning curve when using other sites within a common domain. By creating a

logical grouping of menu items, developers could help to create a clearer understanding of Web site navigation.

Larson and Czerwinski (1998) indicated that previous non-cross-cultural analyses provided evidence that adapting Web sites to users' cognitive styles and abilities may lead to better navigational performance and easier information access. The quantitative study included visual search tasks, dual tasks, reaction time and accuracy, deadline procedures, and memory methods. The research design consisted of an experimental method using a wide range of observational techniques including field studies, contextual inquiry, and usage log collection. The actual benefits from this study have been questioned by Olsen (2005), who found that users tend to ignore navigation and do not care where they are in a site structure. He concluded that users are highly goal-driven and follow a very simple *click-link-or-hit-back-button* strategy when navigating Web sites. Olsen stated that organizing a site into sections and subsections does not by itself create a good user experience, and posited that it is of more importance to enable users to quickly and easily advance to the next step in the pursuit of a goal. Nielsen (2000) stated that, "users are extremely goal-driven and look only for the one thing they have in mind" (p. 2), reinforcing what Olsen believed. Olsen further posited that users come to a site with specific objectives in mind, and ignore everything that does not appear relevant to their current task.

However, navigation bars have been found to help users browse and search for information more efficiently (Bowler, Ng, & Schwartz, 2001). Bowler, et al. surveyed 18 participants to determine user actions when confronted with

different navigation options. The researchers found that, after a short amount of use, participants could significantly reduce the number of page loads necessary to find specific information. The results also indicated that some level of knowledge transfer enabled participants to more easily navigate other Web sites. The methodology utilized consisted of 10 different multiple choice questions. The research design consisted of test Web sites where subjects were asked to find information within each Web site. Researchers then measured and compared completion times and number of page loads.

According to Nielsen (2006), 80% of findings regarding Web site usability from the 1990s continue to hold true today. Nielsen found that results based on testing 831 Web sites with 2,744 users in 16 countries provided proof that even with the technology improvements, the biggest design issues revolve around communicating clearly to users, providing information users want, and offering simple, consistent page design and clear navigation, with an architecture that puts things where users expect to find them.

Cockburn and McKenzie (2001) endeavored to characterize users' navigation patterns as they tracked how and why users visited and revisited pages. Their primary objective was to provide information that could aid future Web site designs to provide better support for common navigation activities. First, they used a query technique (interviews and questionnaires) to gather background demographics on users and their surfing habits. Secondly, they conducted dynamic observation techniques, such as controlled experiments and think-aloud studies to actively record users as they performed specific actions.

Thirdly, they used static observation techniques where they reviewed the client and server logs to reveal the history of the users' actions.

In their study, Tullis, Connor, LeDoux, Chadwick-Dias, True, and Catani (2005) elected to research a large number of participants via the Web to determine which navigation system they preferred. Each of the 706 participants were randomly given one of six navigation styles and then given a set of 12 tasks. Each participant was required to navigate a prototype Web site and find the answer to a specific question. The correct answer could be found if the participant successfully navigated the Web site. Each participant was measured based on:

1. How long it took the user to answer the question,
2. A user-provided rating of the ease/difficulty of each task,
3. The accuracy of the participant's answer,
4. An overall rating of effectiveness of the navigation technique that the participant used, and
5. Comments about the navigation technique.

Zviran, Glezer, and Avni (2005) concluded, that user satisfaction was linked to different types of Web sites as a function of usability and user-based design. The quantitative methodology included a questionnaire to collect data on user satisfaction developed by Doll, et al. (1988), consisting of a 12-item measure of users' reactions to a specific interface. Usability data was collected using an instrument developed by Digital Equipment Corporation, and user-

based design data was collected using a combination of three different questionnaires.

Consumer Web Use

To provide an empirical characterization of user actions on a Web browser, Cockburn and McKenzie (2001) used a quantitative descriptive study to examine the activity of Web users. Cockburn and McKenzie analyzed four months of log file data and compiled a description of user actions using then current versions of Netscape Navigator. The compilation and analysis of logged data allowed for determining the title, URL, and time of each page visit. The log file data were also used to determine the length of time that users spent on each visit for each page and the number of bookmarks collected and other aspects of user interaction with the Web and specific Web sites.

Cockburn and McKenzie's (2001) study has major implications for Web-based interface features, such as Web browsers, the design of caching proxy servers, and the design of efficient Web sites. The study results updated and provided advanced information on the nature and empirical characterizations of Web use. Web page revisitation (frequent visits to the same page) seemed to be one of the more common user activities, with approximately 81% of pages having been previously visited by the same users. The researchers found that most Web pages were seen for a very short period of time and users maintained a large selection of bookmarks. The authors also concluded that the users visited a wide variety of Web site page types.

The role and effectiveness of context-based navigation have been examined by Lemahieu (2002), who posited that the advantage of hypermedia systems like the Web is that users can navigate through the information space in a nonlinear manner. This means that links could be explored and opened randomly according to the likes and preferences of the user, giving the user greater freedom in terms of navigation when compared with pages of a book that are available only in systematic linear fashion. However, navigational freedom involves risks of disorientation in the hypertext characterizations of the Web.

Lemahieu (2002) presented a context-based navigation paradigm for the Web and reconciled navigational freedom with measures of linear guidance to prevent user disorientation. With such a paradigm, optimum navigational advantages could be expected through freedom of navigation with some form of linear guidance. In the case of conventional navigation along static links, Web browsing and navigation could be complemented by guided tours derived from the context of the user's information requirements. The guided tours of the nonlinear navigational system and linear guidance applications seemed to be equally important in providing full navigational freedom as well as coherent directions to Web users.

George (2005) provided a case study of the redesign and updating of the Web site for the libraries of Carnegie Mellon University. For purposes of upgradation, the libraries used a Web-based survey to determine the needs of students and faculty and used a prototype design before completing the process of final design and user testing. The strengths and weaknesses of the final

design were determined by using techniques and opinions of participants who were asked to verbalize their thoughts while completing a series of tasks. The participants' responses and opinions indicated several weaknesses in the library information system in navigation, screen design, and labeling. This information led to further design revisions and the release of an upgraded version.

In a similar study, Turnbow, Kasianovitz, Snyder, Gilbert, and Yamamoto (2005) used a case study methodology to study the UCLA Library Web site redesign. The objective of the redesign study was to develop a new library Web site that would be responsive to the needs of the varied UCLA library users. The library Web site redesign team used structural analyses of previous library Web sites, user surveys, and card-sort and think-aloud protocols to collect information on redesign goals. Following the collection of required data and user information, the Web site was organized with a manageable navigation system. Utilization of user-centered nomenclature, establishing clear site organization and navigation, and ensuring easy access from the library's homepage for relevant information and development of unified institutional visual identity enabled the developers to produce a broad content management system. The findings indicated that the standard usability analysis methods of surveys and card-sort and think-aloud protocols are essential for evaluating and redesigning Web sites.

Logical Web Site Grouping

While admitting there are differences between the early portals and the portals of today, Gore (2004) discussed how portals are not a new concept. The current portals center on the design concept of Web service delivery software.

Gore used the example of Google's search engine, which can be subscribed to as a Web service and added to a portal based on a user interface being consistent with the subscribing organization's Web site. The benefit to a company in adding a Google search engine service is in the cost savings associated with having to develop its own search engine. The subscribing company may simply download scripts and add them to their company's Web site.

Huggins (2005) studied hosting his own Web site. He discussed every aspect of a webring as part of this process. One of the benefits of a webring is that it allows users to quickly find what they are looking for and continue to explore other sites within this ring of common interests. Such personalized Web site navigation seems to be one of the major aspects of Web site upgradation and redesigning. Flesca, Greco, Tagarelli, and Zumpano (2005) reported on data from usage similarities and content of Web pages as well as exploitation of user browsing interests, and concluded that webrings are useful in emphasizing new approaches to personalization of Web sites.

Flesca, Greco, Tagarelli, and Zumpano (2005) concluded that the manageability of information available on the Web presents a challenge in Web site design and improvement. They stated that the challenge stems from the need to address variations in users' interests and preferences, and it is questionable whether Web-based information systems can be tailored to such a wide variety of different users' requirements. The delivery of page recommendations was found to be related to the navigational purposes of visitors

and their spatial location within the Web site. Flesca et al. recommended the use of a non-invasive system allowing Web users to navigate through pages of personal preferences and interests without having prior knowledge of the structure of the Web site. This conclusion supported the importance of the ease of usability of Web sites and navigational systems.

In a similar study, Zviran, Glezer, and Avni (2005) used a correlational study employing a Web-based questionnaire rather than the more traditional person-to-person interview for usability testing. Processing the questionnaire resulted in easier control and quicker processing of data, indicating that a Web site's success was directly related to usability measures.

Tullis, et al. (2005) used an online study to evaluate six different navigation methods. Similar to this researcher's proposed study, this case study required participants to view different Web site navigation systems to determine the best system. The final conclusion, again, supported the importance of ease of use as a primary factor in determining Web site navigation systems.

Summary

The literature review was focused on user-centered design aspects of Web site navigation from the context of the construct ease of use, a usability perspective emphasizing the need for standards-based development. According to Hurteau (2006), usability should be the ultimate concern of a standards-based World Wide Web. The literature review was also used to identify and characterize the issue of navigation problems as described by Nielsen (2004b), illustrating the problems that can result from a lack of standardized Web site navigation

systems, and by Danielson (2003), further indicating that a standardized domain navigation menu could allow users the ability to easily find and understand how to navigate Web sites. Consumer Web use and logical Web site groupings were also reviewed and provided insights into how consumers actually use Web site navigation and how Web site groupings play a key part in minimizing confusion and help to expedite the user to the information they are seeking.

Web site navigation problems are relevant as navigation problems will result in poor usability. The methodological approach was chosen to build on existing research by Danielson (2003), from the standpoint of asking users questions regarding their preferences related to domain-specific navigation systems versus standalone Web site navigation systems. Additional facets of the methodological approach were also built on previous research from Lazar, Bessiere, Ceaparu, Robinson, and Shneiderman (2003), Nielsen (2004b), and others that have questioned whether users and usability have been considered in Web design – for example, via Web site navigation layout, common grouping of related menu items, and menu functionality.

This literature review identified the need for continued research by showing how easily users can become frustrated with the current Web site navigation standard or lack of standardized Web site navigation. This literature review has also provided evidence that user expectations for the type of menu, location of menu, and menu functionality may not have been considered prior to actual Web site development. These findings identify many concerns of usability, and user-centered Web site development that required further investigation to

determine what ease of use factors make a Web site navigation system user friendly.

CHAPTER 3: METHODOLOGY

Overview

This chapter contains a description of the research design, operational definition of constructs with key variables, description of materials and instruments, selection of subjects, procedures, discussion of data processing, methodological assumptions and limitations, and ethical assurances. This chapter also contains a description of the comparative design that was used to identify and analyze Web site users' navigation preference frequencies.

Restatement of the Problem and Purpose

Web users must adjust to unpredictable Web site designs, which can result in lost time while searching for their intended objective and increased frustration in not being able to quickly or easily find what they are looking for. (Lazar, Bessiere, Ceaparu, Robinson, & Shneiderman, 2003). The focus of this research was the identification of Web site user preference frequencies, and the specific characteristics of a Web site that could provide increased user satisfaction through perceived ease of Web site navigation. The research goal was to identify and determine the key design features' which may effect significant differences in users' preference frequencies. Higher preference frequencies could be expected to increase their satisfaction with Web sites' ease of use. Specifically, the extent to which users prefer a domain-specific Web site navigation system to a traditional, standalone navigational system was analyzed. Therefore, the problem addressed by the dissertation is characterized by the time wasted and associated levels of user frustration that prevent users from successfully accomplishing their intended goal. User-centered Web site

navigation systems development could help to reduce unpredictable user expectations and allow users to easily find and navigate any Web site, thereby reducing the need to *re-learn* how to find and navigate other Web sites.

The research questions were focused on identifying and examining particular Web sites' features (navigation layout, consistency of menu type, menu functionality) and the extent to which user expectations and priorities are currently satisfied. For example, the extent to which Web users prefer domain-specific, standardized Web site navigation systems or standalone Web site navigation systems were estimated. In addition, users' preference frequencies were studied and measured on the basis of their preferences compared with their demographic features.

Statement of Research Questions and Hypotheses

Research question 1: To what extent do Web users perceive differences in the usability of standardized versus standalone Web site navigation systems?

H1₀: On the average, users have no greater preference frequency for web navigation features for standalone Web site navigation systems than they do for domain-specific Web site navigation systems.

H1_a: On the average, users prefer domain-specific Web site navigation systems to standalone Web site navigation systems.

Research question 2: To what extent do Web users perceive differences in the usability of navigation systems that employ a Web site navigation layout

featuring a menu that looks the same on every page versus different navigation menus throughout the Web site?

H2₀: On the average, users have no greater preference frequency for web navigation features for a common/standardized navigation system than they do for a different/non-standardized navigation system.

H2_a: On the average, users prefer a common/standardized navigation system to a different/non-standardized navigation system.

Research question 3: To what extent do users perceive differences in the usability of navigation systems employing flyout menus (sub-menus) versus navigation systems with single-level menus (no sub-menus)?

H3₀: On the average, users have no greater preference frequency for web navigation features for Web site navigation systems employing flyout menus (sub-menus) versus Web site navigation systems employing single-level menus (no sub-menus).

H3_a: On the average, users prefer flyout menus (sub-menus) versus Web site navigation systems with single-level menus (no sub-menus).

Research question 4: To what extent do users' preference scores differ among their occupations, experiences, gender, or ages?

H4₀: Users' preference frequencies do not differ among their occupations, experiences, gender, or ages.

H4_A: Users' preference frequencies do differ among their occupations, experiences, gender, or ages.

Note: For testing, the composite alternative hypothesis H_{4A} was subdivided into four parts.

H_{4a} : Users' preference frequencies are related to their occupations.

H_{4b} : Users' preference frequencies are related to their experiences.

H_{4c} : Users' preference frequencies are related to their gender.

H_{4d} : Users' preference frequencies are related to their ages.

The first three null hypotheses are defined as uni-directional, for one-tailed testing. It is expected that Web site characteristic preference frequencies perceived as producing greater efficiency/ease of use would be assigned *higher* average preference ratings. The null hypotheses imply that users would not have a higher average preference frequency for web navigation features for standalone Web site navigation systems, uncommon Web site menu navigation, or single-level menus (no sub-menus). The alternative hypotheses imply that users would have a higher average preference frequency for web navigation features for standardized, domain-specific Web site navigation systems, common Web site navigation, or flyout menus (sub-menus).

Description of Research Design

A non-experimental comparative research design was implemented to identify and examine the key Web site design characteristics associated with users' preference frequencies among Web site navigation systems. The design was used to compare users' preference frequencies among Web site navigation systems, Web site navigation layout, and menu functionality. The design was used to examine relationships among users' demographics and their stated

preference frequencies among the stated Web sites' design features. To address the research questions and test the hypotheses, the study required the design and use of a survey instrument. Data were collected from users' responses to a series of Likert-type survey questions. The initial survey instrument (Appendix B) was designed to collect data on users' characteristics and preference frequency for web navigation features levels. The Web site navigation systems' examples used within the instrument consisted of sample Web site navigation systems chosen to reflect the design characteristics addressed within the survey.

Dependent and independent variables. The users' survey response data were used to develop and analyze both the average level of preference response via one-sample t tests, and a 2-way main effect analysis of variance, (ANOVA) models. The average preference frequency for web navigation features response statistics were used to test the first three hypotheses. A suitably coded ANOVA was used to test hypotheses four. The response variable user preference frequency for web navigation features was operationally measured by using preference scores for the independent variables' level of (a) Web site navigation systems type (e.g., domain-specific Web site navigation and standalone Web site navigation), (b) Web site navigation layout, reflecting whether the navigation system features a common/standardized navigation layout or a different/non-standardized navigation layout, and (c) menu functionality, reflecting either flyout (sub-menus) navigation menus or a single level (no sub-menus) navigation menu. An appropriately coded ANOVA model was used to analyze the statistical

significance of users' characteristics, such as age, gender, years of Web navigation experience, and occupation with the preference scores' averages.

Power analysis. As previously stated, the dependent variables are the preference scores for each of the Web site design characteristics. There were three one-sided t tests, and one 2-way main effect ANOVA model conducted for analyzing the average preference scores. Table 1 contains the a priori power analysis for mean and the t test to detect differences from a constant for average preference scores, with an individual preference score of three indicating no preference. An effect size of .20 was selected for the effect size, with desired alpha and power levels of .05 and .80, respectively. The specified parameters resulted in a minimum required sample size of 156.

Table 1

t Tests - Means: Difference From Constant (One Sample Case)

Analysis: A priori: Compute required sample size

Input: Tail(s)	One
Effect size d	0.2
α err prob	0.05
Power (1- β err prob)	0.8
Output: Noncentrality parameter δ	2.497999
Critical t	1.654744
Df	155
Total sample size	156
Actual power	0.800167

Note. G*Power 3.0.4 (2006), Power Analysis Software, program written by Franz Faul, Kiel University, Germany.

Because it was deemed unlikely that the survey would provide a sufficient number of responses for a full ANOVA model, a power analysis for a reduced 2-way main effect ANOVA model was used. Table 2 provides the a priori power analysis for four independent demographic factors and their six potential two-factor combinations for a desired alpha = .05, Power = .8, and an effect size of .15 yielding a required sample size of 118.

Table 2

*A Priori Power Analysis Required Sample Size With Ten Predictors
Given Alpha Level, Desired Statistical Power, and Anticipated Effect Size*

Alpha Level: 0.05

Number of Predictors: 10

Anticipated Effect Size: 0.15

Desired Statistical Power Level: 0.8

Minimum Required Sample Size: 118

Note. Soper, D. S. (2007) "A-priori Sample Size Calculator", Free Statistics Calculators (Online Software), <http://www.danielsoper.com/statcalc>

Utilizing the results from both Tables 1 and 2 indicates that a minimum sample size of 156 responses was required.

Operational Definitions of Constructs and Key Variables

The independent and dependent variables used to represent the constructs in this research are operationally defined as:

Navigation system type: Independent variable (X_1). A two-level nominal independent variable reflecting whether the navigation system for a Web site is either a standardized, domain-specific Web site or a standalone Web site.

Layout format: Independent variable (X_2). A two-level nominal independent variable reflecting whether the navigation system features a common/standardized navigation layout or a different/non-standardized navigation layout.

Menu functionality: Independent variable (X_3). A two-level nominal independent variable reflecting either flyout (sub-menus) navigation menus or a single level (no sub-menus) navigation menu.

User type: Independent variable (X_4). A four-level nominal demographic variable (developer, designer, owner, none of the above).

Level of Web Navigation Experience: A four-level nominal demographic variable (X_5). (less than 1 year, 1 to 5 years, 6 to 10 years, more than 10 years).

User age: Independent variable (X_6). A 5-level nominal demographic variable (18 to 28 years old, 29 to 39 years old, 40 to 50 years old, 51 to 60 years old, over 60 years old).

User gender: Independent variable (X_7). A two-level nominal demographic variable (female, male).

The dependent variables' preference score values were measured using Likert-type scale responses to survey questions, where an assigned score of 1

through 5 represented the degree to which a user preferred one design alternative to another. The values used to estimate users' preference scores are the individual response values from the survey item questions related to user-selected preference frequency for web navigation features levels from *never* (1) to *always* (5). For example, an individual score of 4 or 5 for research survey question 6 indicates a preference frequency for web navigation features for a domain-specific navigation system. An individual score of 1 or 2 for research question 6 would indicate a preference frequency for web navigation features for a different menu navigation system, while an individual score of 3 would indicate *no preference*.

Y₁: Domain Preference Scores: A dependent ordinal variable representing the degree to which the respondent prefers domain-specific versus standalone Web site navigation systems.

Y₂: Layout Format Preference Scores: A dependent ordinal variable representing the degree to which the respondent prefers a common/standardized menu navigation layout format versus a different/non-standardized menu navigation layout format.

Y₃: Menu Functionality Preference Scores: A dependent variable ordinal representing the degree to which the respondent prefers flyout menu functionality versus static menu functionality.

Y₄: User Characteristics Preference Scores: A dependent variable used for examining the relationship between users' preferences and the demographic of user type (1 = developer, 2 = designer, 3 = owner, 4 = none of the above).

Y₅: User Characteristics Preference Scores: A dependent variable used for examining the relationship between users' preferences and the demographic of Web navigation experience (1 year, 1 to 5 years, 6 to 10 years, more than 10 years).

Y₆: User Characteristics Preference Scores: A dependent variable used for examining the relationship between users' preferences and the demographic of gender (female, male).

Y₇: User Characteristics Preference Scores: A dependent variable used for examining the relationship between users' preferences and the demographic of age (18 to 28 years old, 29 to 39 years old, 40 to 50 years old, 51 to 60 years old, over 60 years old).

Description of Materials and Instruments

A self-created survey was used for this study. Several published surveys were reviewed and determined not suitable for this research as they did not address the specific issues associated with users' preferences for domain-based Web site navigation systems. Therefore, these instruments would not provide a valid measure for the group under study.

The survey instrument's set of items contained a variety of Likert-type, multiple-option answers and open-comment questions. An online version of the survey was available at

<http://www.kayladog.com/questionnaires/questionnaire.php?webnavuser>.

Appendix B contains a copy of the instrument. Table 3 is a summary of the relationship between each research questions, hypotheses numbers, and the

corresponding survey questions.

Table 3

Summary of Relationship Between Research Questions, Hypotheses, and Survey Questions

Research question	Null Hypotheses Numbers	Survey Question Number
1 Users' preferences for domain-specific versus standalone navigation systems	H1 ₀	6
2 Users' preferences for layout format, common menu navigation versus different menu navigation systems	H2 ₀	7
3 Users' preferences for flyout menus (sub-menus) versus single-level menus (no sub-menus)	H3 ₀	8
4 Preference relationship with user characteristics (user type, age, gender, or experience)	H4 ₀	2, 3, 4, 5

After receiving Institutional Review Board approval, a pilot test for establishing face value validity and identifying survey instrument design and analyses improvement opportunities was conducted prior to distributing the instrument for the actual study. Participants of this pilot test consisted of approximately 10 users. These users possessed a general understanding of the Internet and Web site navigation. The results were reviewed and used to address any improvement opportunities for modifying the instrument. Additional discussion of the pilot study's results and use in modifying the instrument are presented in Chapter 4.

Selection of Subjects

The study's targeted population consisted of a convenience sample consisting of users of Internet forums/search engines that are frequented by Web developers, designers, and Web site managers who discuss navigation and usability aspects related to standards and general Web site upgrades. The actual forums/search engines selected were: Sitepoint

(<http://www.sitepoint.com/forums>); Usernomics – The Usability Company

(<http://www.usernomics.com/online-forums.html>); Webmaster World

(http://www.webmasterworld.com/accessibility_usability/); and Google Groups - Web Design and Development (<http://groups.google.com/group/SiteDesign>).

Additional respondents were solicited from Northcentral University learners and faculty.

Procedures

The following procedures were used to implement the survey portion of this proposed research:

1. Northcentral University learners and mentors were requested to participate, and advised of this survey via approved university communications – for example, posting on the university's learners' and mentors' Web sites.
2. Web site designers, developers, and users of related forums were invited to participate by a posting on associated Web forums.
3. All respondents were asked to comply with the instructions contained on the survey.

4. Within the survey, respondents were shown samples of several different Web site navigation systems available on the Web.
5. Each respondent was asked a series of Likert-type questions regarding their preferences for navigating Web sites.
6. Each respondent was given the option to provide comments on their preferences for navigating Web sites.
7. Respondents' data were obtained by the participant clicking a button to submit their data via the Internet. All data were stored in a database. Once all data were received, respondents' answers were charted/graphed and analyzed.

The Web-based survey was accessed via the researcher's personal Web site with a specific link pointing directly to the survey. All respondents were directed to this link via the notification e-mail that was sent to the Northcentral University learners and mentors through the University's Web site, and to each of the developer, designer, and user forums. The current version of the survey was developed using the commercial software product CJ Questionnaire Builder. This PHP script language program was used to create the customized survey for use in collecting and storing data in a Structured Query Language (SQL) database, which is also maintained on the researcher's personal Web site. This CJ Questionnaire software and survey were tested with three popular Web browsers – Internet Explorer, Firefox, and Opera – all with successful results. The survey procedure was tested using a combination of self-generated verification, and further verified by reviewing data collected during the pilot test. Both methods

helped to ensure all links were working and that all data collected could be accurately stored and recalled as necessary. Test data were collected after IRB approval using this survey and all data were accurately retrieved from the database and displayed in tabular or graphical representations as provided by this software. All testers successfully completed the survey with no reported or identifiable problems. Upon completion of the survey, each tester used their computer mouse to click the submit button to submit their survey answers to the database. A *thank you page* was then displayed thanking them for their participation and also indicating that their survey had been received.

Discussion of Data Processing

The survey response data were collected and analyzed to address the principal and each of the derivative research questions. Three single sample t tests were used to determine whether there was a statistically significant difference among user preference frequencies and navigation system layout, specifically between flyout (sub-menus) and single-level (no sub-menus) navigation systems. The effect of users' demographics (occupation, experience, gender, age) and preference frequency for web navigation features levels was analyzed using an appropriately coded 2-way main effect ANOVA model. Table 4 is a summary of the hypotheses, and statistical methods used.

Table 4

Summary of Hypotheses, and Statistical Methods

Hypothesis Number	Statistical Test
H ₁	Single t-test for average preference value = 3
H ₂	Single t-test for average preference value = 3
H ₃	Single t-test for average preference value = 3
H ₄	2-way main effect ANOVA model for testing significance of the demographic variables

Methodological Assumptions and Limitations

The selected sampling frame's potential relationship with the study's external validity is recognized. Since other universities' learners and mentors are not included in the recruitment for participants, generalizing the results to university students outside of Northcentral University may be problematic. At best, a generalization might be made to students of similar online universities. It was also assumed that participants visiting any of the selected Web sites would have a specific interest in Web site navigation issues. Example, Webmaster World forum has a forum topic devoted specifically to accessibility and usability, where visitors with differing levels of experiences can find information regarding many different aspects of Web site navigation. Google Groups also provides a Web Design and Development forum addressing all aspects of Web site design, including usability. Additionally, the target audience, regardless of user type, was assumed to have at least a basic level of experience in using Web-based search

engines. The potential bias associated with using a convenience sample is recognized in that it may not represent the entire population.

Another recognized limitation is that participants' ages could affect the outcome. Older users may not be as comfortable surfing the Web as younger, more technology-oriented users would be, thereby possibly influencing overall outcomes. Nielsen (2002) posited that Web sites are twice as hard to use for seniors as they are for younger users. Another age-associated limitation to this study applies to the differing levels of experience, as older users most likely use the Internet to communicate with family by using Web-based e-mail programs, and do not actually spend time surfing the Web. To address this potential issue, participants were asked to provide their ages and number of years of experience using the Internet. These factors were used in the analysis of the ANOVA model to address their potential effects of age that may have been associated with differences in the preference level responses .

It was assumed that all of the participants would interpret the items of the questionnaire as the researcher meant them to be interpreted. To address this issue, participants were provided with a glossary of terms (Appendix B) to help ensure a more uniform understanding. It was also assumed that the participants would answer questions objectively.

Ethical Assurances

The study was designed to comply with the standards for conducting research with human subjects. Personal identification information was not collected. The survey instrument contained an informed consent to participate

section, whereby the participant, by selecting the *I agree* option, indicated that they were at least 18 years of age and consented to participate in this study. A copy of the consent for participation is provided in Appendix B.

No attempt was made to determine the users' computer addresses. All findings will be made available on the Internet for participants to review at the completion of the research. The study includes a set of written instructions and an online survey. These instructions included the purpose of this research and the required information for addressing Informed Consent Guidelines developed by Northcentral University's Institutional Review Board (IRB). No data were collected prior to receiving IRB approval.

CHAPTER 4: FINDINGS

Overview

The purpose of this dissertation was to determine whether users' prefer a standards-based Web site navigation system that would allow them to easily find and navigate any Web site, thereby reducing the need to *re-learn* how to find and navigate other Web sites. To accomplish this purpose, a quantitative comparative design was used to examine the statistical significance of differences in users' frequency of expressed degree of preference for key Web site features. More specifically, the design was used to estimate the degree to which users prefer domain-specific, standardized Web site navigation systems versus standalone, non-standardized Web site navigation systems.

The following research questions and hypotheses were used in determining possible differences in respondents' preferences for Web domain/site design characteristics and any correlations with their reported demographic factors:

Research question 1: To what extent do Web users perceive differences in the usability of standardized versus standalone Web site navigation systems?

H1₀: On the average, users have no greater preference frequency for web navigation features for standalone Web site navigation systems than they do for domain-specific Web site navigation systems.

H1_a: On the average, users prefer domain-specific Web site navigation systems to standalone Web site navigation systems.

Research question 2: To what extent do Web users perceive differences in the usability of navigation systems that employ a Web site navigation layout

featuring a menu that looks the same on every page versus different navigation menus throughout the Web site?

H2₀: On the average, users have no greater preference frequency for web navigation features for a common/standardized navigation system than they do for a different/non-standardized navigation system.

H2_a: On the average, users prefer a common/standardized navigation system to a different/non-standardized navigation system.

Research question 3: To what extent do users perceive differences in the usability of navigation systems employing flyout menus (sub-menus) versus navigation systems with single-level menus (no sub-menus)?

H3₀: On the average, users have no greater preference frequency for web navigation features for Web site navigation systems employing flyout menus (sub-menus) versus Web site navigation systems employing single-level menus (no sub-menus).

H3_a: On the average, users prefer flyout menus (sub-menus) versus Web site navigation systems with single-level menus (no sub-menus).

Research question 4: To what extent do users' preference scores differ among their occupations, experiences, gender, or ages?

H4₀: Users' preference frequencies do not differ among their occupations, experiences, gender, or ages.

H4_A: Users' preference frequencies do differ among their occupations, experiences, gender, or ages.

Note: The alternative hypothesis *H4_a* was sub-divided into four parts.

H4_a: Users' preference frequencies are related to their occupations.

H4_b: Users' preference frequencies are related to their experiences.

H4_c: Users' preference frequencies are related to their gender.

H4_d: Users' preference frequencies are related to their ages.

The research questions were focused on identifying and examining the key Web sites' features that may be correlated with perceived ease of use – for example, the extent to which Web users prefer domain-specific standardized Web site navigation systems or standalone Web site navigation systems. In addition, users' preference frequencies were analyzed for possible differences associated with their demographic features.

To verify the efficacy of procedures proposed for the main study, a pilot study was conducted to help assure the instrument's reliability. This pilot study's results were based on 10 pilot respondents and were conducted with the Web-based survey proposed for full scale study. To more appropriately represent actual field subjects, pilot subjects represented a microcosm of typical visitors to Web sites. For example, respondents were comprised of university faculty, university students, Web designers/developers, and users.

Based on the data received from this pilot study, it was obvious that specific words and/or phrases needed to be changed to eliminate *industry-specific* terms. Respondents in *none of the above* or user category indicated that they did not understand the terminology *application domain*, or the difference between domain Web sites and individual Web sites. There was also concern expressed regarding the meaning of the word *common*, as it referred to a

standardized application. The primary research instrument for this study was modified utilizing findings of the pilot study to facilitate the respondent's interpretation of the items, and to thereby improve the expected quality of the response data.

Findings

Using descriptive analysis and one sample t tests, users' survey response data were analyzed to estimate the mean and standard deviation for each user preference frequency for web navigation features response associated with the first three hypotheses. A 2-way main effect ANOVA model was used to test null hypotheses four. H_{4_0} : Users' preference frequencies do not differ among their occupations, experiences, gender, or ages.

Each of the values for the *users' preference frequencies* dependent variables was operationally measured by comparing the preference scores assigned to the variables' of (a) Web site navigation systems type (e.g., domain-specific Web site navigation and standalone Web site navigation), (b) Web site navigation layout, reflecting whether the navigation systems feature a menu that looks the same on every page or different navigation menus throughout the Web site, and (c) menu functionality, reflecting either flyout (sub-menus) navigation menus or a single level (no sub-menus) navigation menu. The ANOVA models contained the users' responses on levels of preference and the coded values for the demographic characteristics, which represented the respondents' age, gender, years of Web navigation experience, and occupation. The actual study consisted of 160 respondents to the online survey.

The descriptive analysis of survey question 2, (How long have you been using the Internet?), indicated that more than 75% or 121 of the 160 respondents had more than 10 years experience (Table 5).

Table 5

Survey Question 2 Descriptive Analysis of Respondents' Years of Experience

Question 2: How long have you been using the Internet

Experience	n	%
Less than 1 year	1	.6
1 to 5 years	5	3
6 to 10 years	33	20.6
More than 10 years	121	75.6
Total	160	100

Descriptive analysis of survey question 3, (What is your age?) indicated that more than 33% or 54 of the 160 respondents were between 40 and 50 years of age (Table 6).

Table 6

Survey Question 3 Descriptive Analysis of Respondents' Ages

Question 3: What is your age?

Age	n	%
18 to 28 years old	13	8.1
29 to 39 years old	24	15
40 to 50 years old	54	33.7
51 to 60 years old	50	31.2
Over 60 years old	19	11.8
Total	160	100

Descriptive analysis of survey question 4, (What is your gender?), indicated an almost equal split between female and male respondents, with 51% female and 48% male or 82 of 160 female respondents compared to 78 of 160 male respondents (Table 7).

Table 7

Survey Question 4 Descriptive Analysis of Respondents' Gender

Question 4: What is your gender?		
Gender	n	%
Female	82	51.2
Male	78	48.7
Total	160	100

Descriptive analysis of survey question 5, (I consider myself a: Web Developer, Web Designer, Web Owner, None of the above), indicated that more than 68% or 109 of 160 respondents considered themselves as *none of the above*, followed by 13% considered themselves *Web Owners*, 10% considered themselves *Web Developers*, and 7.5% considered themselves *Web Designers* (Table 8).

Table 8

Survey Question 5 Descriptive Analysis of Respondents' Occupations

Question 5: I consider myself a:		
Occupation	n	%
Web Developer	17	10.6
Web Designer	12	7.5
Web Owner	22	13.7

None of the above	109	68.1
Total	160	100

Descriptive analysis for survey question 6, (Based on my experience when visiting Web sites in a particular application/institutional domain (e.g., financial, government or educational), I prefer a standard menu throughout the entire domain, rather than a different menu for each.), indicated that 17.5% had no preference for a standard menu throughout the entire domain, rather than a different menu for each. Also, more than 9% did not prefer a standard menu, however, 73% favored a standard menu throughout the entire domain (Table 9).

Table 9

Survey Question 6 Descriptive Analysis of Respondents' Preferences for Domain Menus

Question 6: Based on my experience when visiting Web sites in a particular application/institutional domain (e.g., financial, government or educational), I prefer a standard menu throughout the entire domain, rather than a different menu for each.

Question 6	Scale	n	%
Never	1	6	3.7
	2	9	5.6
No Preference	3	28	17.5
	4	43	26.8
Always	5	74	46.2
Total		160	100

Table 10 provides the associated t test statistics for the frequency preference data associated with the responses for Question 6.

Table 10

t test Question 6

n = 160
 $\sum X = 650$
 $\sum X^2 = 2832$
SS = 191.375
Variance = 1.2036
SD = 1.0971
Standard Err = 0.0867
Sample mean = 4.0625
Hypothetical population mean = 3
Difference = 1.0625
t = 12.2549
df = 159
P one-tailed = <.0001
P two-tailed = <.0001

Descriptive analysis for survey question 7, (Based on my experience when visiting a Web site I prefer to find a menu system that looks the same and can be found on every page of the Web site instead of different menu systems throughout the Web site), indicated that slightly more than 4% had no preference, while 4% also indicated they did not prefer to find the same menu on every page of the Web site. However, more than 90% indicated that they did prefer to find a menu system that looks the same and can be found on every page of the Web site (Table 11).

Table 11

Survey Question 7 Descriptive Analysis of Respondents' Preferences for Standardized Web site Menu

Question 7: Based on my experience when visiting a Web site I prefer to find a menu system that looks the same and can be found on every page of the Web site instead of different menu systems throughout the Web site.

Question 7	Scale	n	%
Never	1	0	0
	2	7	4.3
Neutral	3	7	4.3
	4	42	26.2
Always	5	104	65
Total		160	100

Table 12 contains the associated t test statistics for Question 7.

Table 12
t test Question 7

n = 160
$\sum X = 723$
$\sum X^2 = 3363$
SS = 95.9437
Variance = 0.6034
SD = 0.7768
Standard Err = 0.0614
Sample mean = 4.5188
Hypothetical population mean = 3
Difference = 1.5188
t = 24.7362
df = 159
P one-tailed = <.0001
P two-tailed = <.0001

Descriptive analysis for survey question 8, (Based on my experience when visiting a Web site I prefer menu systems with sub-menus (e.g., flyout, dropdown,

or slide menus), instead of single-level menus (no sub-menus)), indicated that 13% of respondents had no preference to Web sites with sub-menus instead of single-level menus. Also, slightly more than 17% of respondents indicated a preference for single-level (no sub-menus), whereas slightly more than 69% indicated they did prefer Web sites with sub-menus (Table 13).

Table 13

Survey Question 8 Descriptive Analysis of Respondents' Preferences for Menu Systems with Sub-menus

Question 8: Based on my experience when visiting a Web site I prefer menu systems with sub-menus (e.g., flyout, dropdown, or slide menus), instead of single-level menus (no sub-menus).

Question 8	Scale	n	%
Never	1	14	8.7
	2	14	8.7
Neutral	3	21	13.1
	4	42	26.2
Always	5	69	43.1
Total		160	100

Table 14 contains the associated t test statistics for Question 8.

Table 14

t test Question 8

n = 160
 $\Sigma X = 618$
 $\Sigma X^2 = 2656$
SS = 268.975
Variance = 1.6917
SD = 1.3006
Standard Err = 0.1028
Sample mean = 3.8625
Hypothetical population mean = 3
Difference = 0.8625

t = 8.3901
df = 159
P one-tailed = <.0001
P two-tailed = <.0001

The analysis of variance (ANOVA) for research question 4, (To what extent do users' preference scores differ among their occupations, experiences, gender, or ages?), tested the null hypothesis

H4₀: Users' preference frequencies do not differ among their occupations, experiences, gender, or ages.

H4_A: Users' preference frequencies do differ among their occupations, experiences, gender, or ages.

Note: The alternative hypothesis *H4_A* was sub-divided into four parts.

H4_a: Users' preference frequencies are related to their occupations.

H4_b: Users' preference frequencies are related to their experiences.

H4_c: Users' preference frequencies are related to their gender.

H4_d: Users' preference frequencies are related to their ages.

by analyzing the responses from survey questions 6, 7 and 8.

A 2-way main effect ANOVA model was used to identify which, if any, of the Web site design variables and users' demographic variables were statistically significantly related to users' preference frequencies. Although the overall models for questions 6 and 7 were not significant at the 0.05 level, the analysis of the individual factors revealed that for survey question 6, (Based on my experience when visiting Web sites in a particular application/institutional domain (e.g., financial, government or educational), I prefer a standard menu throughout the

entire domain, rather than a different menu for each.), *experience* had a mean preference response for standard menu throughout the entire domain of 4.1 on the average, with a difference for *experience level 1 to 5 year group* of 2.5 on average, *experience level 6 to 10 year group* of 4.1 on average, and *experience level more than 10 year group* of 4.0 on average (Table 15).

Table 15

Analysis of Variance (ANOVA) – General Linear Model – Main Effect Model

Dependent Variable: Survey Question 6 (Preferred Domain Menu Type)

Source	DF	SS	Mean Sq	F Value	Pr>F
Model	10	20.8000514	2.0800051	1.82	0.0622
Error	149	170.5749486	1.1447983		
Correct Total	159	191.3750000			

R-Square	Coeff Var	Root MSE	Q6 Mean
0.108687	26.33729	1.069952	4.062500

Source	DF	Type III SS	Mean Sq	F Value	Pr>F
gender	1	0.36874456	0.36874456	0.32	0.5712
exp2	2	11.62786919	5.81393459	5.08	0.0074
agecat2	4	5.39024569	1.34756142	1.18	0.3233
occup2	3	5.27131312	1.75710437	1.53	0.2079

Analysis for survey question 7, (Based on my experience when visiting a Web site I prefer to find a menu system that looks the same and can be found on

every page of the Web site instead of different menu systems throughout the Web site.) revealed *occupation* had a mean preference response for the same menu system throughout the Web site of 4.6 on the average, with a difference for *occupation type web developer* of 4.6 on average, *occupation type web designer* of 4.0 on average, *occupation type web owner* of 4.2 on average, and *occupation type none of the above* of 4.7 on average (Table 16).

Table 16

Analysis of Variance (ANOVA) – General Linear Model – Main Effect Model

Dependent Variable: Question 7: (Preferred Web Site Menu Layout Type)

Source	DF	SS	Mean Sq	F Value	Pr>F
Model	10	9.09713252	0.90971325	1.56	0.1237
Error	149	86.84661748	0.58286320		
Correct Total	159	95.94375000			

R-Square	Coeff Var	Root MSE	Q7 Mean
0.094817	16.89526	0.763455	4.518750

Source	DF	Type III SS	Mean Sq	F Value	Pr>F
gender	1	1.34543993	1.34543993	2.31	0.1308
exp2	2	0.17170475	0.08585237	0.15	0.8632
agecat2	4	2.77986743	0.69496686	1.19	0.3166
occup2	3	5.65368562	1.88456187	3.23	0.0241

Finally, analysis for survey question 8, (Based on my experience when visiting a Web site I prefer menu systems with sub-menus (e.g., flyout, dropdown, or slide menus), instead of single-level menus (no sub-menus)) revealed the overall model was significant at the 0.05 level, indicating the mean preference response for (fly out menus) is higher for men (4.19 on the average) than for women (3.40 on the average) (Table 17).

Table 17

Analysis of Variance (ANOVA) – General Linear Model – Main Effect Model

Dependent Variable: Question 8: (Preference for Web site Menu Functionality System Type)

Source	DF	SS	Mean Sq	F Value	Pr>F
Model	10	30.6406976	3.0640698	1.92	0.0471
Error	149	238.334302	1.5995591		
Correct Total	159	268.9750000			

R-Square	Coeff Var	Root MSE	Q8 Mean
0.113917	32.74399	1.264737	3.862500

Source	DF	Type III SS	Mean Sq	F Value	Pr>F
gender	1	12.98150131	12.98150131	8.12	0.0050
exp2	2	5.19152730	2.59576365	1.62	0.2008
agecat2	4	5.01137747	1.25284437	0.78	0.5378
occup2	3	3.89983912	1.29994637	0.81	0.4887

Analysis and Evaluation of Findings

Research question 1: To what extent do Web users perceive differences in the usability of standardized versus standalone Web site navigation systems?

H1₀: On the average, users have no greater preference frequency for web navigation features for standalone Web site navigation systems than they do for domain-specific Web site navigation systems.

H1_a: On the average, users prefer domain-specific Web site navigation systems to standalone Web site navigation systems.

Analysis and evaluation of the results: Descriptive analysis of this question revealed that 73% of all respondents preferred domain-specific Web site navigation systems to a standalone system (Table 10). A t test further supported the alternative hypothesis whereby the hypothesis population mean of 3, representing no preference, was compared to the sample mean of 4.0625, resulting in a 1.0625 difference (or 12.25 standard errors) in favor of the alternative hypothesis. Given that a 1-sample t test is a comparison of an observed mean against a fixed constant (a mean of 3 in this case), a t-statistic of $t = 12.25$ would indicate the measure of the precision of the sample mean, with a difference between the observed mean and the absolute standard of 3 being 12.25 times as large as the standard, or in other words, 12.25 times as large as would have been expected this difference to have been on the average, by chance alone. The null hypothesis was rejected with a p-value of $p < 0.0001$ (Table 11) in favor of the alternative hypothesis, (*H1_a*: On the average, users

prefer domain-specific Web site navigation systems to standalone Web site navigation systems.). Based on the data analysis for this hypothesis, the rejection of the null hypothesis indicates a 73% user preference for Web sites utilizing domain-specific Web site navigation systems versus Web sites utilizing a stand-alone Web site navigation system.

Research question 2: To what extent do Web users perceive differences in the usability of navigation systems that employ a Web site navigation layout featuring a menu that looks the same on every page versus different navigation menus throughout the Web site?

H2₀: On the average, users have no greater preference frequency for web navigation features for a common/standardized navigation system than they do for a different/non-standardized navigation system.

H2_a: On the average, users prefer a common/standardized navigation system to a different/non-standardized navigation system.

Analysis and evaluation of the results: Descriptive analysis of this question revealed that 91% of all respondents preferred a navigation system that looks the same throughout the entire Web site (Table 12). A t test further supported the alternative hypothesis whereby the hypothesis population mean of 3, representing no preference, was compared to the sample mean of 4.5188, resulting in a 1.5188 difference (or 24.74 standard errors) in favor of the alternative hypothesis. Given that a 1-sample t test is a comparison of an observed mean against a fixed constant (a mean of 3 in this case), a t-statistic of $t = 24.74$ would indicate the measure of the precision of the sample mean, with a

difference between the observed mean and the absolute standard of 3 being 24.74 times as large as the standard, or in other words, 24.74 times as large as would have expected this difference to have been on the average by chance alone. The null hypothesis was rejected with a p-value of $p < 0.0001$ (Table 13). Based on the data analysis for this hypothesis, the rejection of the null hypothesis indicates a 91% user preference for Web sites utilizing a standard menu layout on every page of the Web site versus Web sites utilizing a different menu layout throughout the Web site.

As with survey question six, the findings from analyzing the data for survey question seven could be attributable to the preference for a common/standard menu throughout the entire Web site, instead of different menus throughout the Web site. Also, previous life experiences may provide the same logical thought process to this situation, resulting in *occupation* not being the key variable in determining user preference for menu layout selection. For example, a subway system provides a logical means for riders to get from one place to another by means of routes. Designers use color to help riders find their way. There is a red line with red colored cars going in one direction, and a green line with green colored cars going in another direction, and a map showing the various routes and their colors displayed in each station (Fleming, 1998, p.134). Another possible reason for the 91% user preference for Web sites utilizing a standard menu layout could be the fact that each different occupation type tends to overlap. That is, it is common to find Web site developers that are also designers and owners, or any combination, and all are potential users. Therefore,

there may be any number of life experiences that could provide a logical condition for this finding.

Table 18 provides the individual occupation means for question seven.

Table 18

Individual Preference Means by Occupation Type for Survey Question 7

Occupation Type	
Scale	Mean
Web Developer	4.57026000
Web Designer	3.99439180
Web Owner	4.16952533
None of the Above	4.66279671

Research question 3: To what extent do users perceive differences in navigation systems employing flyout menus (sub-menus) versus navigation systems with single-level menus (no sub-menus)?

H3₀: On the average, users have no greater preference frequency for web navigation features for Web site navigation systems employing flyout menus (sub-menus) versus Web site navigation systems employing single-level menus (no sub-menus).

H3_a: On the average, users prefer flyout menus (sub-menus) versus Web site navigation systems with single-level menus (no sub-menus).

Analysis and evaluation of the results: Descriptive analysis of this question revealed that 69% of all respondents preferred flyout menus (sub-menus) versus single level menus (no sub-menus). A t test further supported the alternative hypothesis whereby the hypothesis population mean of 3, representing no

preference, was compared to the sample mean of 3.8625, resulting in a 0.8625 difference (or 8.4 standard errors) in favor of the alternative hypothesis. Given that a 1-sample t test is a comparison of an observed mean against a fixed constant (a mean of 3 in this case), a t-statistic of $t = 8.4$ would indicate the measure of the precision of the sample mean, with a difference between the observed mean and the absolute standard of 3 being 8.4 times as large as the standard, or in other words, 8.4 times as large as you would have expected this difference to have been on the average, by chance alone. The null hypothesis was rejected with a p-value of $p < 0.0001$ (Table 15). Based on the data analysis for this hypothesis, the rejection of the null hypothesis indicates a 69% user preference for Web sites utilizing a menu system with sub-menus versus Web sites utilizing a single-level (no sub-menu) menu system.

Research question 4: To what extent do users' preference scores differ among their occupations, experiences, gender, or ages?

H_{4_0} : Users' preference frequencies do not differ among their occupations, experiences, gender, or ages.

H_{4_A} : Users' preference frequencies do differ among their occupations, experiences, gender, or ages.

Note: The alternative hypothesis H_{4_A} was sub-divided into four parts.

H_{4_a} : Users' preference frequencies are related to their occupations.

H_{4_b} : Users' preference frequencies are related to their experiences.

H_{4_c} : Users' preference frequencies are related to their gender.

H_{4_d} : Users' preference frequencies are related to their ages.

Analysis and evaluation of the results: Research question four consists of four parts that were addressed individually to determine if any relationships existed between any one of the classifying variables and the users' preference frequencies for survey questions 6, 7, and 8.

The ANOVA models consisted of the dependent variable users' preference counts for survey questions 6, 7, 8 and the classifying variables of occupation, experience, gender, and age.

The coding used for the independent classifying variables is as follows:

Gender – Female = 1, and Male = 2.

Experience – Less than 1 year = 1, 1 to 5 years = 2, 6 to 10 years = 3, and more than 10 years = 4.

Age – 18 to 28 years old = 1, 29 to 39 years old = 2, 40 to 50 years old = 3, 51 to 60 years old = 4, and over 60 years old = 5.

Occupation – web developer = 1, web designer = 2, web owner = 3, and none of the above = 4.

Initially a 4-way ANOVA was performed starting with a full factorial model that included some higher order interactions with the initial objective of creating a *big picture* effect model. However, after reviewing the data it was determined that it would not be feasible to analyze the full ANOVA model because the ability to include all such interactions was limited by the profile of subjects who responded to the survey. This macro level of analysis resulted in too many combinations of categorical predictors for which there were no data (Appendix C). Further analysis was accomplished by *pruning* this model by eliminating insignificant

interaction terms from the ANOVA model. None of the 3- and 4-way interactions were statistically significant. This led ultimately to a 2-way main effect ANOVA which resulted in the best overall analysis. Although the main effect model did not include any interactions, it did take more than one demographic factor into account at a time.

Although the overall models for analyzing the responses to survey questions 6 and 7 were not significant at the 0.05 level, the data analysis for the individual factors of this hypothesis revealed for question 6 (Based on my experience when visiting Web sites in a particular application/institutional domain (e.g., financial, government or educational), I prefer a standard menu throughout the entire domain, rather than a different menu for each.), *experience* had a mean preference response for a standard menu throughout the entire domain of 4.1 on the average, with a difference for *experience level 1 to 5 year group* of 2.5 on average, *experience level 6 to 10 year group* of 4.1 on average, and *experience level more than 10 year group* of 4.0 on average.

Data analysis for the individual factors of this null hypothesis revealed that on the average, users have no greater preference frequency for web navigation features for a common/standardized navigation system than they do for a different/non-standardized navigation system. The failure to reject the null hypothesis revealed for survey question 7 (Based on my experience when visiting a Web site I prefer to find a menu system that looks the same and can be found on every page of the Web site instead of different menu systems throughout the Web site.) *occupation* had a mean preference response for the

same menu system throughout the Web site of 4.6 on the average, with a difference for *occupation type web developer* of 4.6 on average, *occupation type web designer* of 4.0 on average, *occupation type web owner* of 4.2 on average, and *occupation type none of the above* of 4.7 on average.

To address the findings of questions six and seven (of why for question six the respondents preferred domain-wide navigation versus different menus within the same domain, and for question seven, why the respondents preferred a common/standard menu layout versus different menu systems throughout the entire Web site), it may be useful to further understand the users' Web navigation habits or experience. One possible reason for these findings would be that domain-wide navigation preference as related to a user's Internet surfing experience may not be a key variable in determining whether someone prefers the same menu/navigation system throughout the entire domain. It is possible that this preference is developed from some other life experience that enabled the user to transfer that logic to this event. One such example could be seen when a person knows that in filling out an electronic form that they can move faster through the different fields or input boxes if they tab through them rather than use the mouse to click into each field. This knowledge could then be applied to any situation where the user filled out electronic forms, regardless of whether the form is on a web page or any other electronic medium (Kobulnicky, 2008).

Simultaneously testing via the ANOVA model for the alternative hypotheses for survey question 8, (H4a: Users' preference frequencies are related to their occupations, H4b: Users' preference frequencies are related to

their experiences, H4c: Users' preference frequencies are related to their gender, H4d: Users' preference frequencies are related to their ages.) for the individual factors of this hypothesis, resulted in the rejection of the principal null hypothesis (Users' preference frequencies are not related to their occupations, experiences, gender, or ages) at the .05 level. Based on the data analysis of the individual factors for this hypothesis, the rejection of the null hypothesis revealed the mean preference response for (fly out menus) is higher for men (4.19 on the average) than for women (3.40 on the average) (Table 18).

Summary

The purpose of this study was to determine if Web site users, developers, designers and owners had preferences for standardized Web site navigation systems when (1) applied to domain-specific application/institutional Web sites, (2) applied throughout entire Web sites versus standalone Web sites, and, (3) whether users', developers', designers' and owners' preferences were affected by any of the demographic classifying variables gender, experience, age, and occupation.

For research questions one, two, and three, the null hypotheses were rejected. There was an overwhelming preference ($p < 0.001$) for standardized Web site navigation systems for domain-specific application/institutional Web sites, standardized Web site navigation throughout individual Web sites, and a standardized layout of Web site navigation systems. However, for research question four, the results from the analysis of the derivative sub questions six and seven indicated that, for the overall ANOVA model, the null hypothesis that the

mean preference scores were independent of the demographic variables could not be rejected at the 0.05 level. Although the overall models (for questions six and seven) were not significant at the 0.05 level, the analysis of the individual effects indicated that there were differences among the response to question six by years of experience, and for question seven by occupation type. For derivative sub question eight (menu type), it was determined that men had a higher mean preference score (4.19 on the average) for Web sites featuring sub menus than did women (3.40 on the average).

Survey question nine, (Open Comments:) allowed respondents the opportunity to comment on any aspect of Web site navigation relevant to this survey. Of the 160 respondents to this survey 39 respondents, or approximately 24% provided comments. Although many comments addressed likes and dislikes for flyout menus, as evidenced by the 69% of users in favor of flyout menus, several comments specifically addressed the need for a standard menu/navigation system throughout the entire Web site (91% preferred standard menu/navigation system) as being vital to not only finding the intended information, but also in being able to backtrack without having to use the back button. Although this researcher does not believe the comments influence the interpretation of the results, it would seem apparent however, that the comments further confirm the interpretation of the statistical analysis. (Appendix D).

The results of this study indicate user preferences are consistent with existing guidelines to provide consistent navigation within and between web sites, (e.g. "Create a common, Web site-wide navigational scheme to help users

learn and understand the structure of your Web site”), (U.S. Department of Health and Human Services, 2006).

The results of this study also indicate users prefer “menu systems with sub-menus (e.g., flyout, dropdown, or slide menus), instead of single-level menus (no-sub-menus)”. The related guidance in U.S. Department of Health and Human Services (2006, p.67) is “Use *sequential* menus for simple forward-moving tasks, and use *simultaneous* menus for tasks that would otherwise require numerous uses of the Back button”.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine and analyze user preferences for various features of Web site navigation systems and to identify potential design guidelines for Web developers that could improve search efficiency and usability. These design features were sub-divided into domain-specific Web site navigation and standalone Web site navigation systems as applied to domain applications/institutional Web sites (e.g., financial, educational, government). A second sub-division addressed possible user preferences between Web site menu functionality, (e.g., menu systems with flyout menus and menu systems with no flyouts), and Web site menu navigation layout addressing common/standardized and different/non-standardized menu navigation layouts. Additionally, user preferences were analyzed to determine if any differences in preferences could be explained by the demographic variables of occupation, experience, gender, and age.

The literature review was focused on user-centered design aspects of Web site navigation from the context of the construct ease of use, and a usability perspective emphasizing the need for standards-based development. This review identified the need for continued research by showing how easily users can become frustrated with the current Web site navigation standard or lack of standardized Web site navigation. The literature review also identified many concerns of usability, and user-centered Web site development that should be further investigated in determining what ease of use factors make a Web site

navigation system user friendly. According to Hurteau (2006), usability should be the ultimate concern of a standards-based World Wide Web. Nielsen (2004b) identified problems that can result from a lack of standardized Web site navigation systems, and Danielson (2003) further indicated that a standardized domain navigation menu could allow users the ability to easily find and understand how to navigate Web sites. The findings from this research support Hurteau, Nielsen, and Danielson's previous research as indicated by users' preferences for standards-based Web site navigation systems over non-standards-based Web site navigation systems. Seventy-three percent of respondents to research question 1 (Research question 1: To what extent do users prefer standardized, domain-specific Web site menu/navigation systems versus standalone Web site menu/navigation systems?) indicated a preference for standards-based Web site navigation. Ninety-one percent of all respondents to research question 2 (To what extent do users prefer navigation systems that employ Web site navigation layout, reflecting whether the navigation systems feature a menu that looks the same on every page versus different navigation menus throughout the Web site?) indicated a preference for a standardized navigation system or menu on every page instead of different menus. These findings demonstrate that a Web site navigation system based on a specific standard would be preferred to a non-standard Web site navigation system. Furthermore, the findings demonstrate that a standards-based Web site navigation system would provide a greater ease of use, whereby reducing the negative usability aspects found in non-standard Web site navigation systems. A

standards-based navigation system could also help to minimize possible Web site navigation confusion by allowing the user to become familiar with the navigation system through a common menu interface.

Web site navigation problems are directly related to this research as they are directly affected by usability issues. Based on the findings stemming from this research, generally accepted theories (e.g., navigation that appears on every page, navigation in the same location throughout the Web site, and consistent look and feel of menu functionality) would indicate that when usability is high, users' encounter less Web site navigation problems, and when usability is low, users' encounter more Web site navigation problems. A quantitative methodology was used to examine and compare the differences in preference scores of Web site design features. This approach was chosen primarily to evaluate how users prefer to interact with Web sites, and to analyze their types and degree of preferences. Whether a person is new to navigating Web sites or has many years experience navigating Web sites, all users' have expectations of how things should work, some based on previous life experiences, and some on intuition, all of which culminate as individual preference. Asking users' for their preference by using a web-based survey provided the most immediate and efficient instrument for identifying and measuring these preferences. To verify the efficacy of procedures proposed in the main study, a pilot study was conducted to help assure reliability. By using a quantitative methodology to examine user preferences, this research provides the findings to extend existing research by Danielson (2003) from the standpoint of asking users questions regarding their

preferences as related to domain-specific navigation systems versus standalone Web site navigation systems. Thereby adding to the overall knowledge of how users' perceive Web site navigation. This quantitative methodology was also built on previous research from Lazar, Bessiere, Ceaparu, Robinson, and Shneiderman (2003), Nielsen (2004b), and others that have questioned whether users and usability have been considered in Web design – for example, via Web site navigation layout, common groupings of related menu items, and menu functionality.

The statistical models used for this study were centered on the survey response data used to develop and analyze the averages via one-sample t tests, and a main effect analysis of variance, (ANOVA) model. The t tests of the average preference frequency for web navigation features response statistics were used to test the first three hypotheses. The main effects ANOVA model was used to test hypothesis four by determining the statistical significance of the variation in preference scores for the demographic variables (occupations, Web experience level, gender, and age).

The following hypotheses were used to test the four research questions:

Research question 1: To what extent do Web users perceive differences in the usability of standardized versus standalone Web site navigation systems?

H1₀: On the average, users have no greater preference frequency for web navigation features for standalone Web site navigation systems than they do for domain-specific Web site navigation systems.

H1_a: On the average, users prefer domain-specific Web site navigation systems to standalone Web site navigation systems.

Research question 2: To what extent do Web users perceive differences in the usability of navigation systems that employ a Web site navigation layout featuring a menu that looks the same on every page versus different navigation menus throughout the Web site?

H2₀: On the average, users have no greater preference frequency for web navigation features for a common/standardized navigation system than they do for a different/non-standardized navigation system.

H2_a: On the average, users prefer a common/standardized navigation system to a different/non-standardized navigation system.

Research question 3: To what extent do users perceive differences in navigation systems employing flyout menus (sub-menus) versus navigation systems with single-level menus (no sub-menus)?

H3₀: On the average, users have no greater preference frequency for web navigation features for Web site navigation systems employing flyout menus (sub-menus) versus Web site navigation systems employing single-level menus (no sub-menus).

H3_a: On the average, users prefer flyout menus (sub-menus) versus Web site navigation systems with single-level menus (no sub-menus).

Research question 4: To what extent do users' preference scores differ among their occupations, experiences, gender, or ages?

H4_o: Users' preference frequencies do not differ among their occupations, experiences, gender, or ages.

H4_A: Users' preference frequencies do differ among their occupations, experiences, gender, or ages.

Note: The alternative hypothesis *H4_A* was sub-divided into four parts.

H4_a: Users' preference frequencies are related to their occupations.

H4_b: Users' preference frequencies are related to their experiences.

H4_c: Users' preference frequencies are related to their gender.

H4_d: Users' preference frequencies are related to their ages.

The following results were obtained:

Analyses of the response data revealed that 73% of all respondents do prefer domain-specific Web site navigation systems to a standalone system. A t test further supported the alternative hypothesis whereby the hypothesis population mean of 3, representing no preference, was compared to the sample mean of 4.0625, resulting in a 1.0625 difference (or 12.25 standard errors) in favor of the alternative hypothesis. Given that a 1-sample t test is a comparison of an observed mean against a fixed constant (a mean of 3 in this case), a t-statistic of $t = 12.25$ would indicate the measure of the precision of the sample mean, with a difference between the observed mean and the absolute standard of 3 being 12.25 times as large as the standard, or in other words, 12.25 times as large as you would have expected this difference to have been on the average, by chance alone. The null hypothesis was rejected with a p-value of $p < 0.0001$, see Table 11.

Analyses associated with the second hypothesis revealed that 91% of all respondents do prefer a navigation system that appears the same throughout the entire Web site. A t test further supported the alternative hypothesis whereby the hypothesis population mean of 3, representing no preference, was compared to the sample mean of 4.5188, resulting in a 1.5188 difference (or 24.74 standard errors) in favor of the alternative hypothesis. Given that a 1-sample t test is a comparison of an observed mean against a fixed constant (a mean of 3 in this case), a t-statistic of $t = 24.74$ would indicate the measure of the precision of the sample mean, with a difference between the observed mean and the absolute standard of 3 being 24.74 times as large as the standard, or in other words, 24.74 times as large as you would have expected this difference to have been on the average, by chance alone. The null hypothesis was rejected with a p-value of $p < 0.0001$, see Table 13.

Analyses associated with the third hypothesis revealed that 69% of all respondents do prefer flyout menus (sub-menus) versus single level menus (no sub-menus). A t test further supported the alternative hypothesis whereby the hypothesis population mean of 3, representing no preference, was compared to the sample mean of 3.8625, resulting in a 0.8625 difference (or 8.4 standard errors) in favor of the alternative hypothesis. Given that a 1-sample t test is a comparison of an observed mean against a fixed constant (a mean of 3 in this case), a t-statistic of $t = 8.4$ would indicate the measure of the precision of the sample mean, with a difference between the observed mean and the absolute standard of 3 being 8.4 times as large as the standard, or in other words, 8.4

times as large as you would have expected this difference to have been on the average, by chance alone. The null hypothesis was rejected with a p-value of $p < 0.0001$, see Table 15.

The fourth and final hypothesis was sub-divided into four parts to allow for a more specific analysis of each classifying variable (occupation, experience, gender, and age). Initially a 4-way ANOVA was performed starting with a full factorial model that included some higher order interactions with the initial objective of creating a *big picture* effect model. However, after reviewing the data it was determined that it would not be feasible to analyze the full ANOVA model because the ability to include all such interactions was limited by the profile of subjects who responded to the survey. This macro level of analysis resulted in too many combinations of categorical predictors for which there were no data (Appendix C). Further analysis was accomplished by *pruning* this model by eliminating insignificant interaction terms from the ANOVA model. None of the 3- and 4-way interactions were statistically significant. This led ultimately to a main effect ANOVA which resulted in the best overall analysis. Although the main effect model did not include any interactions, it did take more than one demographic factor into account at a time (Tables 16, 17 & 18). The analysis of the model provided p-values for each of the four demographic factors. The analyses indicated that while the four classifying variables did not provide any significant contribution to the overall study, these findings would seem to indicate the potential presence of a yet unknown factor being responsible for the observed user preference selections.

Conclusions

Web users must adjust to unpredictable Web site designs, which can result in lost time while searching for their intended objective, and increased frustration in not being able to transfer the knowledge learned from previous Web sites to other Web sites within the same domain (Lazar, Bessiere, Ceaparu, Robinson, & Shneiderman, 2003). The purpose of this research was the identification of Web site user preferences, and the specific characteristics of a Web site that could provide increased user satisfaction through perceived ease of Web site navigation. The research goal was to identify and determine the key design features' that may be used to satisfy users' preferences, and thereby that could be expected to increase their satisfaction with Web sites' ease of use. Specifically, the extent to which users prefer a domain-specific Web site navigation system to a traditional, standalone navigational system was analyzed.

The study's participants represented a microcosm of typical users that might be found anywhere in the United States. These respondents were comprised of Northcentral University students and faculty, Web site developers, Web site designers, Web site owners, and users in general. They ranged from 18 years old to over 60 years old, male and female, with experience ranging from less than 1 year to more than 10 years.

The research questions for this study were: Question 1: *To what extent do Web users perceive differences in the usability of standardized versus standalone Web site navigation systems?*

According to the results of the t test analysis, users overwhelmingly prefer a standardized Web site navigation system to a non-standardized Web site navigation system. More than 73% of respondents indicated a preference for a standardized navigation system throughout the entire domain. Domain-specific Web site navigation systems allow application/institutional domain Web sites to provide a consistent look and feel across all domain Web sites, thereby implying when users have a familiar navigation system, they can feel more confident in knowing how to navigate inside a given Web site, or domain. This can also help to reduce any user frustration associated with navigating various domain-related Web sites, resulting in faster retrieval of information. Nielsen (2004b) identified problems that can result from a lack of standardized Web site navigation systems, and Danielson (2003) further indicated that a standardized domain navigation menu could allow users the ability to easily find and understand how to navigate Web sites.

Question 2: *To what extent do Web users perceive differences in the usability of navigation systems that employ a Web site navigation layout featuring a menu that looks the same on every page versus different navigation menus throughout the Web site?* Data analysis revealed that 91% of all respondents preferred a Web site navigation system that looks the same and can be found on every page of the Web site. As identified in research question one, users preferred a standardized Web site navigation system throughout the entire Web site. This consistent *look and feel* provides the user with a familiar navigation system to quickly and accurately find what they are looking for

without having to relearn how to use the navigation system. Previous findings by Nielsen (2006) indicated that results based on testing 831 Web sites with 2,744 users in 16 countries provided proof that even with the technology improvements, the biggest design issues revolve around communicating clearly to users, providing information users want, and offering simple, consistent page design and clear navigation, with an architecture that puts things where users expect to find them.

Question 3: *To what extent do users perceive differences in the usability of navigation systems employing flyout menus (sub-menus) versus navigation systems with single-level menus (no sub-menus)?* Overall, 69% of respondents preferred a Web site navigation system with sub-menus. This researcher found this response interesting based on personal Web site development experience which indicated a dislike for flyout menus because of the possibility of accidentally closing the sub-menu when the mouse moves off of the sub-menu list, requiring the user to re-open the list to the desired sub-menu, thereby increasing frustration and wasting time. It was expected that users would prefer a more direct menu link, such as that which a tabular layout could provide. A study by Ojakaar (2001) indicated that designers use flyouts, rollovers, and dropdown type menu navigation to conserve space and enhance the users' experiences. However, Ojakarr discovered that users experienced confusion and disorientation when using flyout menus for the first time. The learning process was quick, but initially confusing.

Question 4: *To what extent do users' preference scores differ among their occupations, experiences, gender, or ages?*

Collectively, findings from the Analysis of Variance (ANOVA) demonstrated that, with the exception of gender, these classifying variables have no statistically significant correlation with user preferences. This hypothesis was sub-divided into four parts to allow for a more specific analysis of each classifying variable (occupation, experience, gender, and age) when compared to survey questions 6, 7, and 8; leading to a main effect ANOVA which provided the best overall analysis. Although the main effect model did not include any interactions, it did take more than one demographic factor into account at a time, (see Tables 16, 17 and 18). The main effect analysis of the model provided p-values for each of the four demographic factors.

Although the overall models for survey questions 6 and 7 were not significant at the .05 level, the analysis of the individual factors revealed that for question 6 (Based on my experience when visiting Web sites in a particular application/institutional domain (e.g., financial, government or educational), I prefer a standard menu throughout the entire domain, rather than a different menu for each.), *experience* had a mean preference response for standard menu throughout the entire domain of 4.1 on the average, with a difference for *experience level 1 to 5 year group* of 2.5 on average, *experience level 6 to 10 year group* of 4.1 on average, and *experience level more than 10 year group* of 4.0 on average. For question 7 (Based on my experience when visiting a Web site I prefer to find a menu system that looks the same and can be found on

every page of the Web site instead of different menu systems throughout the Web site.) *occupation* had a mean preference response for the same menu system throughout the Web site of 4.6 on the average, with a difference for *occupation type web developer* of 4.6 on average, *occupation type web designer* of 4.0 on average, *occupation type web owner* of 4.2 on average, and *occupation type none of the above* of 4.7 on average.

For question 8 (Based on my experience when visiting a Web site I prefer menu systems with sub-menus (e.g., flyout, dropdown, or slide menus), instead of single-level menus, no-sub-menus.), the overall model was significant at the .05 level. Analysis of the individual factors for question 8 revealed the mean preference response for (fly out menus) is higher for men (4.19 on the average) than for women (3.40 on the average).

This researcher noted that female to male respondents were nearly equally represented with 51% to 48% respectively. Also, female respondents preferred flyout menus (with sub-menus) three times more often than single-level (no sub-menus) menus. Male respondents followed approximately the same pattern with three times as many males preferring flyout menus to single-level menus. This researcher expected that at least among the Web site designers there would be a trend toward single-level (one-click-to-target link), list format menus, or multiple tab rows that would expedite the user to the desired location, as opposed to flyout menus that could require numerous nested flyouts before finding the desired location. However, vertical expanding menus could also provide a more efficient means of presenting one-click-to-target link Web site

navigation and also provide a clean layout. The finding that there was at best a minimal effect of the classified variables of occupation, experience, gender, and age associated with users' preferences was also surprising to the researcher.

Recommendations

The purpose of this study was to determine if Web site users, developers, designers and owners had preferences for standardized Web site navigation systems when (1) applied to domain-specific application/institutional Web sites, (2) applied throughout entire Web sites versus standalone Web sites, and, (3) whether users, developers, designers and owners preferences were affected by classifying variables gender, experience, age, and occupation. Based on the results of this study, web designers and developers can use the available data to develop more user-centered features by applying specific techniques to improve usability. For example, navigation systems can function with minimally invasive menus that logically display either dropdown, flyout, or any combination. The results of this study indicate a strong user preference for flyout style menus as a preferred method for navigating a web site. More specifically, findings from this study also indicated a preference for a navigation system that is standardized across the entire web site or domain as being easier and more effective in finding the desired information. The scope of Web site domains could be identified as any group of Web site's that meet the definition of a class, category, or genre, (education Web sites, financial Web sites and government Web sites) which collectively represent an application domain. This researcher posits that in reality it would be unrealistic to expect Web site designers and developers of personal

Web sites to adopt a standardized navigation system as personal Web sites are just that, and therefore reflect the developer or designers ideas, and or desires. However, even personal Web sites can be part of a larger collection of like-minded Web sites (web rings) and in that respect a common/standardized navigation system would help users better understand how to navigate the collection. As for corporation or enterprise level Web sites, domain-based navigation could provide much easier web surfing by helping to eliminate frustration and lost time in moving from one site to the next. For example, the United States Department of Defense has adopted the portal concept within each of its military services (AF Portal, Navy Knowledge Online, MarineNet, Army Knowledge Online). Every organizational Web site within these domains display the same type of Web site navigation system, specific to that service, including functionality, layout, and design. With the objective being that if a user can navigate one site, that user can navigate all sites within the domain. Danielson (2003) posited that site domain expertise may allow users to make predictions based upon knowledge of how a particular class or genre of sites are typically organized and designed.

The results of this study provide impetus for the study of other research questions that might be of importance to Web site developers, designers, owners, and users, such as:

1. If the classifying variables of gender, experience, age, and occupation offer only minimal insight into users' preferences, what other possible demographic variables could influence a user's Web site design preferences?

2. From this research and previous research conducted by Nielsen (2003) and Danielson (2003) questions of usability-based standards could be further studied to determine if there is a statistically significant correlation between perceived ease-of-use navigation of Web sites and Web site navigation based on a series of questions that could lead users to the information they are seeking.

For example, a user might visit a Web site and instead of a menu listing to pick from, the user is presented with a question that is specific to that Web site, such as, *What type of food are you looking for?* The following questions would ask more detailed information until the user finds the information they seek.

3. Another potential derivative research study could be used to investigate users' perceptions of a navigation system that is out-of-sight either along the left or right side of the Web site and only viewable when the user places the mouse pointer over or clicks on the prescribed area to display the complete menu. This particular style of Web site navigation allows for a very clean, unobtrusive menu navigation system that is always in the same place on each page, but also not interfering with visual or other functional aspects of page content until activated. This concept could also be extended by adding a scrolling feature where as the users scrolls down or up the page the mechanism for launching the menu would also follow along.

4. Based on the overall findings of this research, Web-design practices as related to Web site navigation should be viewed from the user perspective with a focus on consistent site-wide or global navigation standards.

In summary, further research in the area of user preferences as applied to ease-of-use navigation for Web site usability is necessary for continuing advances in user-centered Web site navigation systems design. Continued research in this area should help to ensure that as advances are made in Web site navigation that usability based on user-centered, standards-based requirements are the main focus for new methods of Web site navigation. As users continue to find the Internet as a source for infinitely more information, they will also need to find that information in a much simpler and intuitively logical way. Enhancing user interaction through standardized Web site navigation systems can provide the user with a system that does not have to be relearned from one Web site to the next. As new Web-related navigation technologies become available, additional research should be directed to further the understanding of how users' perceive ease of use for Web site navigation.

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Appendixes

Appendix A:

Informed Consent for Participation

Consent For Participation

My name is James W. “Jake” Leggett and I am a Ph.D. Candidate at Northcentral University. As partial fulfillment of the requirements for this degree, I am required to conduct a research study as part of my doctoral dissertation. I have decided to investigate how users perceive their experiences with different Web site navigation systems. I will accomplish this research using an online survey. This survey is directed at Web site users, developers, and designers. After completing this survey, you can elect to receive more information about this study once it is completed. This survey will take approximately 10 minutes.

There are no risks or direct benefits associated with participation in this study. Data collected will be confidential and used only for research purposes. Your participation in this survey is anonymous and no attempt will be made to identify any participant. If you wish to be contacted regarding the results of this survey, you may provide an e-mail address at the completion of this survey. You are free to withdraw at any time.

By selecting the *I agree* option you affirm that you are at least 18 years of age and consent to participate in this study.

Consent to participate in this study.

I agree

I decline

Appendix B:

Questionnaire for Examining Users' Perspectives of Domain-Specific and Standardized Web Site Navigation Systems

Definition of terms related to use of the questionnaire

Glossary of Terms

Dropdown Menu

a menu of options that appears below the item when the computer user clicks on it

Expanding Menu

When a user clicks or moves the mouse over the menu item, it expands to reveal sub-menus, can be horizontal or vertical.

External Links

hyperlinks to documents or images that are located on other Web sites

Flyout Menu

When users need direct access to sub-navigation menu items, mostly used when space is limited or for organizational layout, users can click or mouse over menu items to display sub-menu items.

Horizontal Menu

is a set of menu options presented across the Web site layout, normally found at the top of the Web page or at the bottom of the Web page.

Hyperlink

Text or graphics that are hyperlinked will transport a user to another location of content either on the same page or another page.

Internal Links

links to other text or graphics located within the page or Web site the user is presently at

Menu

is a set of options presented to the user to help find information

Non-standardized Web Site Navigation System

a Web site navigation system that is different throughout the Web site – for example, a vertical menu on the main or homepage with horizontal, tabular, or individual links throughout the rest of the Web site

Standardized Web Site Navigation System

a Web site navigation system that is standard throughout the entire Web site, such as the same vertical menu on every page of the Web site

Sub-menu

A menu that is attached to another menu, which can be brought to the screen by clicking or mouse-over of another menu item, can be referred to as a cascading menu or hierarchical menu.

Tab Menu

can be horizontal or vertical tab layout arranged in a tabular design similar to a filing cabinet with tabbed folders, can have sub-menus and other combinations

Vertical Menu

is a set of menu options presented vertically or down the Web site layout, normally found at the left or right of the Web page

Web site Navigation System

is a collection of links that form a Web site navigation system; This navigation system can be placed either vertically or horizontally and is usually found on every page of the Web site, although you can find various themes depending on requirements.

User Web Site Navigation Survey

This survey contains questions related to Web site navigation and user preferences for Web site design characteristics. This survey will be used to gather data in support of the completion of James W. "Jake" Leggett's doctoral dissertation at Northcentral University.

Consent For Participation

My name is James W. "Jake" Leggett and I am a Ph.D. candidate at Northcentral University. As partial fulfillment of the requirements for this degree, I am required to conduct a research study as part of my doctoral dissertation. I have decided to investigate how users perceive their experiences with different Web site

navigation systems. I will accomplish this research using an online survey. This survey is directed at Web site users, developers, and designers. After completing this survey, you can elect to receive more information about this study once it is completed. This survey will take approximately 10 minutes.

There are no risks or direct benefits associated with participation in this study. Data collected will be confidential and used only for research purposes. Your participation in this survey is anonymous and no attempt will be made to identify any participant. If you wish to be contacted regarding the results of this survey, you may provide an e-mail address at the completion of this survey. You are free to withdraw at any time.

By selecting the *I agree* option below, you affirm that you are at least 18 years of age and consent to participate in this study.

1) Consent to participate in this study.

I agree

I decline

Participant's Demographic Data

Questions in this section pertain to general demographics. No personal identification questions will be asked.

2) How long have you been using the Internet?

Less than 1 year

1 to 5 years

6 to 10 years

More than 10 years

3) What is your age?

18 to 28 years old

29 to 39 years old

40 to 50 years old

51 to 60 years old

Over 60 years old

4) What is your gender?

Female

Male

5) I consider myself a:

Web Developer

Web Designer

Web Owner

None of the Above

Web site Navigation – Survey Questions

Following are several questions that pertain to users' perceived preferences or satisfaction regarding Web site navigation systems, also referred to as Web site menus.

6) Based on my experience when visiting Web sites in a particular application domain (such as financial, government, or educational), I would prefer a common menu/navigation system throughout the entire application domain rather than specific menu/navigation systems for each Web site.

Never

Always

1 2 3 4 5

7) Based on my experience when visiting a Web site, I prefer to find a menu/navigation system that looks the same and can be found on every page of the Web site instead of different menus/navigation systems throughout the Web site. (Example: All menus within a given Web site look and function identically.)

Never Always

1 2 3 4 5

8) Based on my experience when visiting a Web site, I prefer navigation systems with flyout menus (sub-menus), instead of single-level menus (no sub-menus).

Never Always

1 2 3 4 5

9) Open Comments.

This space for respondents' comments related to this survey.

Your E-mail Address (Optional)

If you would like to be notified of the results of this research, please provide your e-mail address below.

10) Please notify me when this research is complete.

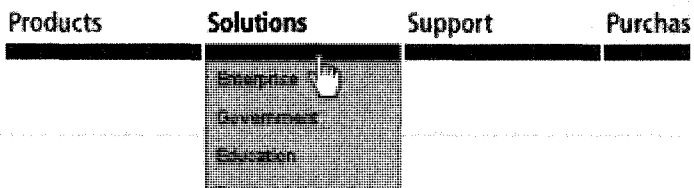

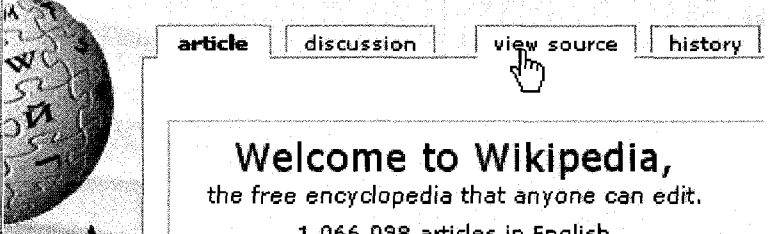

E-mail Address (Optional): _____ (Optional)

Thank you for participating.

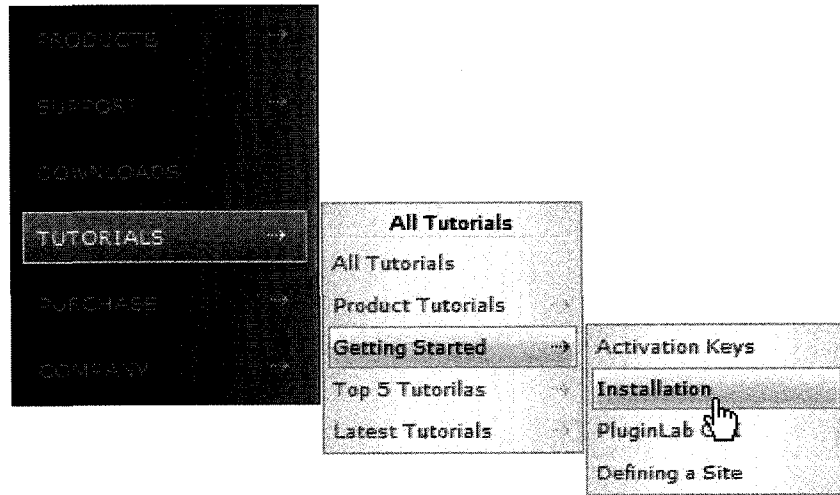
If you have any questions, you may contact the researcher at:

jake@kayladog.com

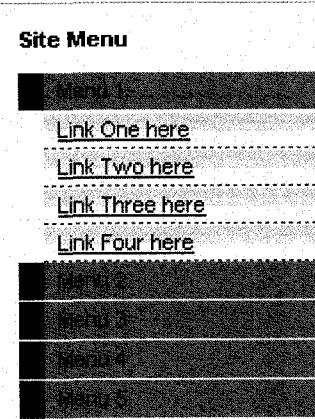
Sample Web site Navigation Systems Graphics

<p>Horizontal Menu Bar with Dropdown</p>	 <p>A horizontal navigation bar with four items: Products, Solutions, Support, and Purchas. The 'Solutions' item is highlighted, and a dropdown menu is open below it, containing three sub-items: Enterprise, Government, and Education. A mouse cursor is positioned over the 'Enterprise' sub-item.</p>
<p>Horizontal Menu Bar with Dropdown & Flyout</p>	 <p>A horizontal navigation bar with four items: Support, Where to Buy, About Us, and Partne. The 'Where to Buy' item is highlighted, and a dropdown menu is open below it. This dropdown menu has a flyout sub-menu. The main dropdown contains: Shop, Retailers, Resellers, Distributors, Online, Worldwide Sales Offices, and Promotions / Rebates. The flyout sub-menu contains: North America, Africa, Asia, Europe, Latin America, Middle East, and Oceania. A mouse cursor is positioned over the 'Latin America' sub-item.</p>
<p>Horizontal Tab Menu</p>	 <p>A horizontal tab menu with four tabs: article, discussion, view source, and history. The 'view source' tab is highlighted, and a mouse cursor is positioned over it. Below the tabs is a large text area that reads: 'Welcome to Wikipedia, the free encyclopedia that anyone can edit. 1,066,098 articles in English'.</p>
<p>Horizontal Tab Menu with Slide Menu</p>	 <p>A horizontal navigation bar with six items: Sports, Politics, Tech, Entertainment, Science, and Business. The 'Entertainment' item is highlighted, and a mouse cursor is positioned over it. Below this bar is a secondary navigation bar with several items: ET, TECH, MICROSOFT, NEWSVINE, MAC, WINDOWS, and WEB. A mouse cursor is positioned over the 'WINDOWS' item.</p>

Vertical Menu with Flyouts



Vertical Expanding Menu



Appendix C:

Statistical Analysis for this Study

11:19 Tuesday, September 9, 2008

Gender	Frequency	Cumulative Frequency	Percent	Cumulative Percent
Female	82	82	51.25	51.25
Male	78	160	48.75	100.00

exp2	Frequency	Cumulative Frequency	Percent	Cumulative Percent
2	6	6	3.75	3.75
3	33	39	20.63	24.38
4	121	160	75.63	100.00

agecat2	Frequency	Cumulative Frequency	Percent	Cumulative Percent
1	13	13	8.13	8.13
2	24	37	15.00	23.13
3	54	91	33.75	56.88
4	49	140	30.63	87.50
5	20	160	12.50	100.00

occup2	Frequency	Cumulative Frequency	Percent	Cumulative Percent
1	17	17	10.63	10.63
2	12	29	7.50	18.13
3	22	51	13.75	31.88
4	109	160	68.13	100.00

main effect ANOVA on questions 6-8

The GLM Procedure

Class Level Information

Class	Levels	Values
gender	2	Female Male
exp2	4	1 2 3 4
agecat2	5	1 2 3 4 5
occup2	4	1 2 3 4

Number of Observations Read	160
Number of Observations Used	160

Dependent Variable: q6

Source	DF	SS	MS	F Value	Pr > F
Model	10	20.8000514	2.0800051	1.82	0.0622
Error	149	170.5749486	1.1447983		
Corrected Total	159	191.3750000			

R-Square	Coeff Var	Root MSE	q6 Mean
0.108687	26.33729	1.069952	4.062500

Source	DF	Type III SS	MS	F Value	Pr > F
gender	1	0.36874456	0.36874456	0.32	0.5712

exp2	2	11.62786919	5.81393459	5.08	0.0074
agecat2	4	5.39024569	1.34756142	1.18	0.3233
occup2	3	5.27131312	1.75710437	1.53	0.2079

Dependent Variable: q7

Source	DF	SS	MS	F Value	Pr > F
Model	10	9.09713252	0.90971325	1.56	0.1237
Error	149	86.84661748	0.58286320		
Corrected Total	159	95.94375000			

R-Square	Coeff Var	Root MSE	q7 Mean
0.094817	16.89526	0.763455	4.518750

Source	DF	Type III SS	MS	F Value	Pr > F
gender	1	1.34543993	1.34543993	2.31	0.1308
exp2	2	0.17170475	0.08585237	0.15	0.8632
agecat2	4	2.77986743	0.69496686	1.19	0.3166
occup2	3	5.65368562	1.88456187	3.23	0.0241

Dependent Variable: q8

Source	DF	SS	MS	F Value	Pr > F
Model	10	30.6406976	3.0640698	1.92	0.0471
Error	149	238.3343024	1.5995591		
Corrected Total	159	268.9750000			

R-Square	Coeff Var	Root MSE	q8 Mean
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0.113917 32.74399 1.264737 3.862500

Source	DF	Type III SS	MS	F Value	Pr > F
gender	1	12.98150131	12.98150131	8.12	0.0050
exp2	2	5.19152730	2.59576365	1.62	0.2008
agecat2	4	5.01137747	1.25284437	0.78	0.5378
occup2	3	3.89983912	1.29994637	0.81	0.4887

Appendix D:

Survey Question Nine (Open Comments)

1. I have been teaching over 40 yrs. Consistency, regardless of medium will always make our lives simpler. Good luck!
2. 1. The easier your web is to navigate the more people will return.\$\$\$\$\$\$
3. no computer, only handheld devices. eliminate txt or graphic menus, go to voice.
4. each website should be unique to fit its purpose, however, menus can and should be consistent throughout.
5. I am a user, but like to visit dev sites, good survey.
6. I like your example of the vertical expanding menu. It conserves space and also provides sub menus. Good idea
7. I work for the state and sure wish they would make a standard menu.
8. I am a developer and owner. I get many comments regarding flyout menus that disappear to fast. You have slide menus, if you are referring to tabbed horizontal sliders, these are the best.
9. Sub menus add a dynamic most users like to see, but they also make surfing more time consuming, you have to filter more information.
10. I want to click a link and find what I'm looking for. submenus slow me down.
11. I do not like computers, I use them at work and anything that will make my life simpler is good for me. thank you
12. As a student, I need to find what I am looking for quickly. First I look for a menu somewhere on the page or a search box. I don't spend to much time. If I cannot find what I want, I leave. good luck.
13. It is nice to have access to the entire website from anywhere on the site. So give me everything.
14. I look for search engine on website

15. My biggest problem is with web sites that are designed by people that do not have sufficient knowledge about the requirements of the user. Thus they make it very difficult for the user to locate the information they need.
16. I don't mind that different entities have different navigation systems, but I hate all the web page clutter that companies put up because it makes it hard to figure out on some sites what their navigation system is.
17. Personally, I hate flyouts. I find it hard to navigate those since I'm not really coordinated using a mouse.
18. I generally prefer "Flyout" menus when a single drop down is not sufficient to display all options.
19. Flyouts are very irritating. It's too easy for the mouse to slip off of the menu from which the flyout springs, requiring starting over. Grrr... Also, I don't believe flyouts work consistently amidst various browsers and OS's.
20. There is a difference in what navigation scheme is desired between sites that are known to the user vs. a new site. On those sites that are known, I would prefer to use a shorthand navigational menu to speed up traveling through the site (you know where you want to go). On the other hand, when traversing a new site, a step by step means of navigating is more apt to get you to the desired location without mistakes or backtracking.
21. Intelligent search would be the best! I am a consultant -- implement Web Content Management systems for a living. We wrestle a lot with alternate methods of menu-based navigation. Most clients want 3-4 click access to everything. Sophisticated search engines with learning capability, lots of metadata, and sophisticated relevancy algorithms solve a lot of issues that can't be solved through menu-based navigation.
22. It had better work - reasonably - with any browser I choose - including "Off By One" and with graphics turned off. Anything which depends on "flash" gets binned. Anything which makes a noise without warning gets binned and a special prayer said for the spawn of Satan responsible.
23. Menus should always be horizontal and a good site will have them at both top and bottom. Drop-downs from menus (or flyouts) should never be more than one deep. Slide menus are very hard to some users and should be avoided where possible.
24. Having to fly the mouse all over is distracting
25. I prefer tabs to flyouts, static submenus depending on the page. I find anything that forces a redraw (layout change) incredibly annoying, and

even flyout menus with z-order properties to float them over the page content are mildly annoying.

26. Uniformity = simplicity = improved efficiency and functionality for the user
27. Use of contrasting colors, large type, and menu placed for high-visibility preferred! I hate having to search for the tools to move around a site.
28. Re (8) PROVIDED the main menu is sufficiently detailed to enable me to find the necessary sub-menu. Sometimes the labeling is NOT intuitive.
29. On (8): It really depends, some sites are better with submenus, some better with a single level. The number of items and how those items are related are really the drivers for that. On (5): While I am not a web developer, I do develop client-side software (non-browser), so my thoughts really come down more on the web-developer side.
30. I do not like menus that change content, position, or geometry when hovered over or clicked.
31. Slide and drop-downs are okay. Flyout and expanding menus can be too busy and hard to click on correctly. For a given website, providing a consistent UI obviously helps with navigation, but if the navigation is poorly designed, then what you have is consistently bad navigation. So ideally you need a reasonable design that is consistently implemented.
32. I hate vertical menu with flyout because a lot of times, it doesn't stay open and tend to click on the choice that I don't want.
33. I think there are cases where sub-menus are more helpful, and cases where they are less helpful... in the case of a more complex, hierarchical content structure, sub-menus are probably beneficial. In this case, I tend to prefer a left-to-right navigation style. My own company uses a horizontal tab menu with slide menu *and* flyout, and I find it very irritating in that the flyout often covers up other options from the slide menu. Add to that the delay in flyouts appearing/disappearing, and it can be very frustrating to make sure you get the mousing JUST right to get the right item on the slide menu and not the flyout from the next item over. I'm a technical writer so I have some familiarity with web usability (Jacob Nielsen, etc) but I'm by no means an expert - hope the thesis comes out well! Good luck!
34. I would like to see a "picture" or icon to let the user know that the menu has scroll down sub-menus. It would alert the user to navigate the options.

35. I appreciate menu styles/navigation systems that always offer you a way to get back to where you previously came from. Some web sites just leave you stranded where ever you last navigated to.
36. Don't like inconsistency on a website or in a menu. Not too keen on flyouts as sometimes too many levels of flyouts make it hard to get the correct selection at first attempt
37. I believe that most users would prefer to go directly to the target, however, users also like to see all of the options available by using sub-menus to display other related areas. Great survey.
38. Menu systems should be wide, not deep. I don't mind reading a list of twenty options to find the one I want, but don't ask me to click through four levels of menus! If multiple menu levels are required, they should refine the top-level choice, not simply "fold" unrelated items in order to keep the number of choices within an arbitrary limit.
39. Most of the time sub-menus are necessary to go into deeper level. I prefer the main menu to be consistent and the same on every major category pages. So that I can find the page I would like to go back later easily. I dislike the web site that is hard to navigate, have too many layers of the sub-menus.