

# **Design Considerations for Optimal Web Page Usability**

By  
Eric Neimy

Graphic Communication Department  
College of Liberal Arts  
California Polytechnic State University  
2008

## Approval Page

Title: Design Considerations for Optimal Web Page Usability

Author: Eric Neimy

Date Submitted: December, 2008

Xiaoying Rong

---

Senior Project Advisor

Signature

Harvey Levenson

---

Department Head

Signature

## **Design Considerations for Optimal Web Page Usability**

Eric Neimy

Graphic Communication Department, December 2008

Advisor: Xiaoying Rong

The Internet has evolved into a significant element of our lives; whether we use it for shopping, reading, playing games, sharing ideas, or communicating with family and friends, it has changed the dynamics of our culture and the way we interact with knowledge. A web site's success relies heavily on an understanding of human psychology and the way people navigate. This study asked the question: What design considerations must web developers understand in order to create successful user-centered designs for web sites?

Research for this study consisted of a literature review and five elite and specialized interviews. Four industry professionals were interviewed, along with one visually-impaired user. They found that visual elements like heading hierarchy, typography, color schemes, images, and borders guide the navigation of sighted users. Correct use of semantic elements like alternative text tags, tables, and descriptive links guides the navigation of non-sighted users. In either case, interviewees indicated that a thorough understanding of a web site's target audience is essential for optimal usability. Web developers must understand various usability considerations to ensure the success of web sites they design.

The purpose of this study is to improve the experience of users interacting with web pages and to provide designers with a set of guidelines or considerations to remember as they implement their design choices. As digital media becomes a larger part of the global economy and people spend more time online, the importance of these considerations will become ever-apparent. From a business perspective, this study will ensure optimal

navigation of digital storefronts and address certain aspects of marketing and promoting websites. It will examine scientific evidence to justify different elements of design and search for cutting-edge solutions to the challenges of ensuring user success and satisfaction.

## Table of Contents

I.	Introduction and Purpose of Study.....	6
II.	Literature Review.....	8
III.	Research Methods .....	16
IV.	Results.....	19
V.	Conclusions .....	35
	Appendix.....	37
	References.....	39

## Chapter I: Introduction and Purpose of Study

The Internet has evolved into a significant element of our lives; whether we use it for shopping, reading, playing games, sharing ideas, or communicating with family and friends, it has changed the dynamics of our culture and the way we interact with knowledge. The printing industry represents an important outlet for communication; however, printed materials such as newspapers, magazines, and books cannot offer the level of interaction provided by digital alternatives such as those found on the Internet. While similar guidelines apply to the design of digital media and printed media, digital media faces a unique set of considerations for effective communication. The same way book designers must anticipate readers' preferences, web designers must pay special attention to the various needs of the anticipated users. The success of a web site relies heavily on an understanding of human psychology and the way people navigate.

This study asks the question: What design considerations must web developers understand in order to create successful user-centered designs for web sites? By applying different aspects of psychology and human-computer interaction, developers create web sites that are both engaging and accessible. The answer can be found in the methods and procedures of usability engineers (UEs), graphic designers, content developers, technologists, and software engineers. Web developers need a respect for the implications of their decisions and an awareness of their influence on their sites stakeholders. Developers are responsible for the experiences of those interacting with their creations and, therefore, must understand how users think and act. Studying these considerations provides an

understanding of the needs of the target audiences and allows designers to support their choices with scientific evidence.

The purpose of this study is to improve the experience of users interacting with web pages and to provide designers with a set of guidelines or considerations to remember as they implement their design choices. As digital media becomes a larger part of the global economy and people spend more time online, the importance of these considerations will become ever-apparent. From a business perspective, this study will ensure optimal navigation of digital storefronts and address certain aspects of marketing and promoting websites. It will examine scientific evidence to justify different elements of design and search for cutting-edge solutions to the challenges of ensuring user success and satisfaction.

## Chapter II: Literature Review

As web standards change and more users rely on web sites for everyday functions, researchers have been busy incorporating science into the way content is presented on the Internet. Effective web design achieves a balance between the needs of the site provider and the needs of the site's users. This balance plays a crucial role in the development of effective web sites, which means usability engineers (UEs) must have multi-disciplinary experience, including an understanding of topics such as software engineering, biology, cognitive psychology, human-computer interaction (HCI), and graphic communication. Careful examination of users, the web development process, and the disciplines that connect them will bring focus to the responsibilities of web developers and establish which considerations are essential to user success and satisfaction, before conducting new research.

To better anticipate users' preferences, web developers need to understand how users accept information technology in general before honing in on the elements specific to web design. The Technology Acceptance Model (TAM) illustrates this broader understanding of users' interaction with technology, since it speculates that an individual's acceptance of information technology is based on their attitudes, beliefs, intentions, and behaviors.<sup>1</sup> Specifically, the TAM examines users' emotional response to technological innovation. An individual's attitude toward technology adoption is based on the perceived usefulness and ease of use. The individual's unique viewpoints and experiences lead to subjective judgments that assess the amount of cognitive effort required to accept a new

---

<sup>1</sup> Davis, Fred D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* 13, no. 3 (1989)

technology or apply it to a certain work context.<sup>2</sup> The TAM stresses the importance of understanding users' characteristics as a means of predicting their acceptance of modern innovations such as the Internet.

Similar to the TAM, the theoretical construction called "Personal Innovativeness for Information Technology Adoption" examines users' domain-specific innovativeness.<sup>3</sup> This theory strives to make generalizations about an individual's innovativeness based on their characteristics and behaviors within a common domain. In the case of information technologies, these are users who have high exposure to mass-media, are less influenced by subjective evaluations of information technologies by their peers, are comfortable with uncertainty and risk-taking, and rely less on positive perceptions of information technology for adoption.<sup>4</sup> By anticipating these characteristics within the general population of information technology users, studies in psychology can provide web developers with frameworks that will enhance usability.

The TAM and personal innovativeness constructs give designers a basis for designing to accommodate the general characteristics of information technology users. To apply these ideas to web development, designers must understand that users' view of the Internet is based on the "using space", "using literacies", and "Internet space."<sup>5</sup> Using space describes a user's sphere of understanding—their method of anchoring their perceptions of the Internet with meaningful personal realities. Users who experience a high degree of confidence and security while browsing a particular web site are likely to perceive a greater amount of

---

<sup>2</sup> Bruce, Harry. (2002) *The User's View of the Internet*. Maryland: Scarecrow. (p. 24)

<sup>3</sup> Agarwal and Prasad, "A Conceptual and Operational Definition of Innovativeness."

<sup>4</sup> Agarwal and Prasad, "A Conceptual and Operational Definition of Innovativeness."

<sup>5</sup> Bruce, Harry. (2002) *The User's View of the Internet*. Maryland: Scarecrow. (p. 163)

control. Users who perceive a lack of control are operating outside their using space. Using literacies include the skills required for effective use of the Internet. These proficiencies allow users to face the unknowns of the Internet with a comfortable understanding that intuitive interfaces will provide them with contexts for learning.<sup>6</sup> Users' perception of Internet space differs from the others because it is their concept of the Internet as a whole. For the most part, Internet space is regarded as optimistic and positive, but can also be a source of fears and negative perceptions based on a user's personal experiences and the opinions of others.<sup>7</sup> Users' personal using space, using literacies, and Internet space help predict their experiences of the Internet, and provide web developers with general guidelines for design; namely, users prefer web sites with good security, intuitive patterns, and interfaces that align with their understanding of the Internet as a whole.

A general understanding of users' perceptions gives web developers some basic design considerations, but a more focused understanding will provide them with specific models that will ensure success and satisfaction. The central problem when studying Internet users is the variability of knowledge formations—designers face the challenge of developing systems that will incorporate the multiple viewpoints of the people who will use them.<sup>8</sup> Many variables are inherent to users. Some variables are intrinsic, such as age, gender, intellect, aesthetic preferences, experience with technology, interaction styles, and the presence or absence of cognitive disabilities. Other variables are extrinsic, such as users' working

---

<sup>6</sup> Bruce, Harry. (2002) *The User's View of the Internet*. Maryland: Scarecrow. (p. 167)

<sup>7</sup> Bruce, Harry. (2002) *The User's View of the Internet*. Maryland: Scarecrow. (p. 170)

<sup>8</sup> Bruce, Harry. (2002) *The User's View of the Internet*. Maryland: Scarecrow. (p. 52)

environment or the goals of their employers.<sup>9</sup> Together, intrinsic and extrinsic variables define a user's capabilities and limitations. It is the UE's responsibility to correctly apply research findings in order to satisfy the broadest range of users.<sup>10</sup>

Usability engineers must make connections between user variables and the specific elements of web sites so that they can begin to plan and develop interfaces that will address the needs of targeted users. Pete Faraday at Microsoft (2000) outlined a number of salient visual elements (SVEs) of web sites that guide users' attention as they browse web sites. He lists motion, size, color, text-style, images, and positioning as the key visual elements of design that influence users' absorption in the content and aid in their retention of details.<sup>11</sup> Translated into specific web design terms, these SVEs encompass key elements of web sites such as Flash animations, animated GIFs, color schemes, typography of text and links, graphics, and page layout. While Faraday's (2000) studies failed to draw strong conclusions about the SVEs hierarchy of significance, these visual elements make up the building blocks that designers must work with to achieve their goal of user success and satisfaction.<sup>12</sup>

Knowledge of the crucial elements of web sites helps web developers create interfaces that will engage users and facilitate optimal usability. With the physical essentials laid out, it is important to understand the various disciplines that influence the implementation of designs. Donald Norman, a cognitive scientist at Northwestern

---

<sup>9</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 4)

<sup>10</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 4)

<sup>11</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 23)

<sup>12</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 23)

University studies the relationship between technology and people. Norman's Theory of Action defines the design process as a bridging of the gap between the goals of the people and the physical system.<sup>13</sup> Human factors professionals apply knowledge in cognitive science, psychology, systems theory, sociology, and organizational theory. In addition to the disciplines above, UEs need relevant experience in human-computer interaction (HCI), testing protocols, software engineering, linguistics, biology, and graphic design, and must be well-versed in technology, standards, and laws.<sup>14</sup> While Norman's Theory of Action explores the importance of psychological considerations, it is important to understand that successful design relies on other fields as well. Each of these disciplines plays an important role in the design process, and together they ensure a diversified approach to the challenges of usability.

To better grasp the dynamics of the web development process, it is important to understand that usability engineering (UE) must be fully integrated into web development. Since web engineering is not inherently user-centered, it takes forethought and dedication to combine the psychological considerations presented by UEs with the technical software-writing expertise of the code writers.<sup>15</sup> While some software engineers favor a common sense "I know it when I see it" approach to usability, UEs present an established process for usability design that reflects an understanding of users' attributes and needs.<sup>16</sup> Collaborating with a design team of content developers, software engineers, web administrators,

---

<sup>13</sup> Norman, Donald A. "Cognitive Engineering." (p. 32)

<sup>14</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 7)

<sup>15</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 2)

<sup>16</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 3)

accessibility consultants, legal experts, and graphic designers, UEs play an important part throughout the lifecycle of a project.

While there are many models for the lifecycle of web development projects, most projects begin with conceptualization of goals and project planning.<sup>17</sup> During the conceptualization stage, it is the UE's responsibility to collect and analyze users' feedback from legacy web sites.<sup>18</sup> The psychological considerations presented by UEs in this stage serve as precursors for decisions made in subsequent stages. Project planning establishes a blueprint for the development process based on a strong understanding of the site providers' vision and the needs of the site's users.<sup>19</sup>

Following project planning, UEs collaborate on a definition of the requirements specific to each project. UEs must deal with three types of requirements—functional requirements, system performance requirements, and usability requirements. Functional requirements ensure that a web site serves its intended purpose; for instance, peer to peer networking sites are likely to require a search feature to help connect users with their acquaintances. System performance requirements specify the technical expectations for web site design, such as bandwidth and resolution. Usability requirements measure users' success and satisfaction, and ensure repeat visits. Usability requirements bring the UE face to face with a site's users in the form of focus groups, interviews, workplace observations, analysis, and the

---

<sup>17</sup> Bruce, Harry. (2002) *The User's View of the Internet*. Maryland: Scarecrow. (p. 46)

<sup>18</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 10)

<sup>19</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 10)

development of user personas.<sup>20</sup> Because of the UE's intensive interaction with target users, usability requirements define the look and feel of the web site.

In some cases, UEs enact a system of participatory design to learn users' design preferences. Users are encouraged to comment on design prototypes and generate their own sketches of preferred interfaces.<sup>21</sup> Close collaboration with target users helps to ensure the information architecture facilitates navigation and makes information discovery natural. Once UEs are confident in the usability of the interface the project can progress through the design stage and on to version production.<sup>22</sup>

In the final stage before the launch of the web site, the design undergoes evaluation testing to analyze the effectiveness of various psychological considerations. In this stage, UEs implement a series of user-centered tests that reflect the tasks from requirements definition. Tests include click-capture software, "think aloud" methods, satisfaction surveys, environment-specific observations, and automated accessibility tools. Click-capture software records a user's click patterns as they browse the web site. UEs pay special attention to the number of errors and periods of latency, which might indicate faults in the design of the interface. Think aloud methods encourage users to navigate through the site and vocalize their reactions to the design of the site. Satisfaction surveys provide evidence of successful navigation. Environment-specific observations take into account the varying contexts of use, and verify a universal experience despite differences in location, bandwidth, and resolution.

---

<sup>20</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 112)

<sup>21</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 15)

<sup>22</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 10)

Finally, the site is processed by a series of automated accessibility tools that check the code for compliance with strict web accessibility standards. Once the accessibility checks confirm the integrity of the code, usability considerations are complete and the site is ready for launch.<sup>23</sup>

By observing the web development process from start to end it is clear that consideration of human psychology plays a vital part in the goal of user success and satisfaction. From conceptualization to launch, web site usability is vastly improved by an understanding of users' preferences and the way people interact with information technology. With proper application of planning, requirements definition, analysis, and design, usability engineers connect the needs of web site providers and web site users.

---

<sup>23</sup> Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing. (p. 17)

### Chapter III: Research Methods

Web development is an interactive process of human collaboration to connect people with their goals. While previous definitions of the Internet considered it to be an interconnected web of machines, increasingly it is being perceived as an interconnected web of humans. The nature of usability engineering and its reliance on human thought makes this topic an excellent target for elite and specialized interviewing. This research technique empowers industry professionals to voice their opinions on critical issues and clarify the details outlined in my literature review. Unlike casual interviewing, which may rely on pre-phrased questions, elite and specialized interviewing serves as a professional dialogue between a knowledgeable interviewer and a qualified professional.<sup>24</sup> The interview process functions as a search for comprehensibility, plausibility, and consistency, with both individuals teaming up to refine research and clarify the interviewee's definition of the situation.

I enacted a series of elite and specialized interviews by contacting four industry professionals who are involved with web development and usability engineering. In addition to the opinions of these professionals, I interviewed one visually-impaired user in order to get a first-hand look at usability from the perspective of a user who faces exceptional navigational challenges. Since the web development process involves many disciplines, I was able to choose from content developers, software engineers, web administrators, accessibility consultants, legal experts, graphic designers, and most importantly, usability engineers. I sent

---

<sup>24</sup> Levenson, Harvey R. *Some Ideas About Doing Research in Graphic Communication*. Atascadero: The Good Neighbor Press & Services. (p. 22)

each person an interview request outlining the purpose of my project, and the importance of their opinion for my research (see Appendix, page 37, for an example interview request), and made arrangements that suited the needs of their schedules. Face-to-face interviews were preferable, but distance and scheduling were limiting factors, so I had to complete two of the interviews over the phone. By contacting a diverse mix of professionals, this study helped me gain a stronger understanding of the importance of usability engineering and the various design considerations that web developers deal with on a day to day basis.

The path of the interview depended on the discipline of the interviewee, but I opened each dialogue by asking the general question: How does human psychology relate to the design and usability of web sites? This question was general enough to generate thought and inspire a conversation that portrayed the interviewee's expertise and helped me better understand the world of usability engineering. While the literature review lead me to expect a strong relationship between human psychology and web site interface design, it was interesting to hear how this psychology manifested in each unique situation. Each interview pursued the individual perceptions of the interviewees and I strived to elicit their unique opinions as specialists.

Content analysis was conducted throughout the interviews and afterwards. During the interviews, I asked questions to clarify points based on my understanding of the process, and the resources I have covered in the literature review. By asking open-ended follow-up questions, I demonstrated my level of understanding, and allowed the interviewees to expand my concept of their professions and its reliance on psychological considerations. I emphasized their specialization as a means of eliciting answers that might otherwise have been withheld. I asked questions to ensure that my understanding of their answers was

consistent with their meanings. Once the interviews were complete, I took quick notes on my impressions and any details to help refine my study. I documented the results of my interviews and analyzed these results in relation to my expectations and the research in the literature review. The resulting analysis of all five interviews supplemented the study and introduced specific elements that support the general ideas from the literature review, and portray the wide variety of professions that rely on an understanding of human psychology to ensure optimal web page usability.

## Chapter IV: Results

To explore the importance of design considerations in the success of web page usability, I interviewed four web professionals, and one visually-impaired user. The information gained from my professional dialogue with these individuals supplements the research in my literature review, and introduces specific concepts and issues that highlight important aspects of design for usability. I interviewed Wyatt Renew, Art Director at iiiDesign, Chi Hang, the Design Director for Shop.com, Steve Rutland, an Information Technology Consultant at the Cal Poly Information Technology Services (ITS) department Sally Anderson, an Accessibility Specialist in the Cal Poly ITS department, and Jennifer Allen Barker, a legally blind user and Access Specialist in the Cal Poly Disability Resource Center. Their opinions, based on years of experience, have provided me with tangible evidence of the importance of design considerations for web usability.

With a major in Art and Design, and a minor in Graphic Communication, Wyatt Renew now serves as the Art Director for iiiDesign, a creative group operating in San Luis Obispo, California. Wyatt has been involved with a plethora of design challenges, supervising the visual aspects of usability throughout the design process. His job as the Art Director requires him to interact extensively with iiiDesign's clients and explore their needs, before developing a proposal and working to build a site that will accommodate the client's needs, and the needs of its users.

For Wyatt, anticipating the usability requirements of web sites is different from site to site, and begins with an exploration session to speak face-to-face with clients and gauge their needs, and formulate a plan for execution. During these exploration sessions, he asks

simple questions to test clients' understanding of web site design, and better grasp their unique set of design requirements. Once he has established their needs, he works with two primary designers, a project manager, and two part-time designers to develop a unique solution. The interface for every site is created based on the target audience, with some sites using common navigational schemes, and others using more unusual freeform layouts. Some clients prefer pages based on familiar grid-based layouts, while others opt for organic exploration-based navigation. Regardless of the layout, the designs are carefully constructed with target users in mind.

Instead of following a strict set of usability requirements, Wyatt said that iiiDesign is guided by a list of best practices, as defined by a compilation of web resources that is constantly changing as the web evolves. These best practices are not a checklist, but rather guidelines for successful design. These guidelines include proper use of white space, visual hierarchy, color schemes, and typography. Successful implementation of these elements creates focal points, and drives the user's attention. In this way, the designers use a basic understanding of human psychology to anticipate the direction of eye movement, and guide users throughout the site.

Occasionally, iiiDesign is faced with the challenge of creating sites for multiple similar clients. Wyatt cited this similarity as a potential impediment to creativity, because of the attractiveness of repeating one design for multiple web sites. Instead of using a premade template, like some design firms, iiiDesign prefers to start from scratch for each project, thereby forcing the design team to come up with unique solutions to each of its projects.

While each web page is built from scratch, there are several design elements that make it into many of the pages that iiiDesign creates. These include utility navigation and

“boilerplates.” Utility navigation, commonly located in the top-right of a web site, offers a familiar set of links, such as Login, About Us, View Cart, Help, and others. Since utility navigation appears on many web pages, users are familiar with their placement and function, and can quickly navigate without much thought. “Boilerplates,” another feature of many web sites, are located at the bottom of the page, and feature a horizontal list of critical links, such as About Us, Feedback, Contact, Privacy Policy, and others. By using design elements that are standard for the majority of web sites, the designers can have confidence that their designs will be easy to understand and navigate, regardless of the content.

Driven by the unique needs of each individual client, Wyatt and the rest of the Design team work to create web sites that are attractive and easy to navigate. The designs they build are based on extensive knowledge of their clients’ needs, and a well-rounded understanding of common web navigation schemes, and best practices. Their anticipation of users’ behavior allows them to design a great variety of web sites, with a high degree of confidence in each site’s usability.

Chi Hang is the Design Director for Shop.com, an e-commerce site based in Monterey, California. Through his job managing various web design and marketing projects, he has developed an understanding of critical considerations for the creation of successful user interfaces. Since Shop.com is a commercial web site looking to attract as many users as possible, optimal usability is imperative for the success of the entire company. With a detailed understanding of Shop.com’s target demographic, guidance from focus groups and visual surveys, and common navigational schemes, Chi works to create an effective interface that is attractive and easy to use.

Consistent with my research, Chi said that usability is determined in the conceptualization stage of the development process. Before the designers begin work, they must understand what kind of audience they are trying to attract. Using statistics about visitors to the site, analysts have determined that Shop.com's target market is women ranging in age from thirty-two to fifty. Because of this, their primary focus is on merchandising and beauty products. Designers are faced with the challenge of stepping into the mindset of the demographic, as they try to guess what kinds of layouts, graphics, and colors will be the most attractive. While some of this may be intuition, Chi said that their design choices are backed up with two usability surveys per year—a focus group and a general visual survey. These studies gauge the ease of navigation and reactions to the site's aesthetics. All decisions about interface design are carefully weighed to ensure the site is suitable to this demographic. Working closely with potential users, the design team can test the usability of new pages before they are posted live on the Internet.

The focus group tests the usability of the web site, observing users' reactions as they navigate. Participants, specially picked to match Shop.com's target demographic, are videotaped as they complete a series of tasks by navigating around the site. The design team watches the recordings, paying special attention to apparent difficulties in navigation, or other negative feedback to the site's interface. After watching the recordings, the designers may decide to make changes, like moving things around or changing colors. By constantly testing the preferences of potential customers, the designers can maintain optimal usability while evolving the look and feel of the site to compete with other businesses online.

With intense competition, the look and feel of the site is a critical consideration. As an e-commerce site, Shop.com must gain the interest and trust of new visitors to the page in

a matter of seconds. Because of this, the designers rely on a yearly general visual survey to provide feedback about the site's layout. Instead of recording users' reactions as they navigate, designers rely on comments from a "screenshot session." During a screenshot session, potential users are presented with a series of screenshots of new pages on the site, and asked to voice their reactions. By listening to the opinions of these users, the design team can justify its decisions, or work to make changes that will benefit the site's attractiveness.

Combining the results of the focus groups and the general visual surveys, the design team has determined some key design considerations for optimal usability. The readability of navigational elements and content is imperative. Not only must type be large enough to read, but it must be well-phrased and brief. In the past, focus groups have complained about small type, and suggested that the designers make all type larger or add buttons so that users can increase the size according to their preferences. Complaints from screenshot sessions indicated that the homepage was too text-heavy. After modifying the layout and the content, users responded positively to a design that used more imagery.

While usability studies help Shop.com's designers decide on the positions of some elements, most key navigational elements are positioned based on standard layouts found throughout the Internet. By positioning navigation similar to other sites on the Internet, users can quickly scan for familiar patterns and locate common links, such as those found in utility navigation or boilerplates, as Wyatt mentioned. These links can be found on the majority of e-commerce web sites, and the designers at Shop.com position them according to their traditional locations. By following these predictable layouts, the designers make it easy for users to find what they are looking for.

The design team does everything it can to make the web site usable, up to a point. Consistent with my research about environmental variables, Chi said that sometimes the degree of usability is determined by the system performance requirements of computer displaying the web site. For instance, the loading time of individual pages will be different for users connected via 56k modem or broadband like cable or digital subscriber line (DSL). Shop.com is designed with broadband users in mind, but follows design guidelines that aim for download times of less than two seconds per page, even at lower bandwidth. Screen resolution is another factor determined by the user's computer. In the past, web sites were optimized for a resolution of 800x600 pixels, but analysts at Shop.com have determined that the majority of their users larger monitors. Because of this, the designers have optimized the site's layout to fit on screens at a resolution of 1024x768 pixels. When viewing the web site at a resolution lower than 1024x768 pixels, users will have to scroll horizontally to see the entire page. This is an inconvenience that Shop.com is willing to risk, since its target demographic is made up of users who typically view the site at higher resolutions.

From Chi Hang's experiences as the Design Director for a successful e-commerce web site, it is apparent that web usability is a major factor that must be considered even during the earliest phases of development. Design for optimal usability is an ongoing process that incorporates many different factors, including target demographics, usability studies, and familiarity with common navigation schemes. As an e-commerce site, it is in Shop.com's best interest to provide users with an interface that is attractive and easy to use. The company values the opinions of these users, and counts on them for feedback. By constantly improving its navigation, Shop.com ensures successful usability.

As an Information Technology Consultant at Cal Poly's Information Technology Services (ITS) department, Steve Rutland has helped design several Cal Poly web sites. With more than 12 years of experience as a web developer, he has faced many challenges, and understands the importance of design for effective navigation. By taking advantage of usability studies and by staying well-informed about industry standards, Steve helps design interfaces that incorporate users' needs and are easy to navigate.

As Steve works to help other designers improve the usability of their web sites, he encounters the challenges of evaluating web sites and looking for elements to improve upon. Since every web site that he deals with is different, he said that it is tough to pinpoint usability issues. He must apply his knowledge of web design and his understanding of the web site's target audience in order to judge the site's usability. Many of the projects that Steve works on are in the advanced stages of development, a difficult time to make major usability changes. Some designers will create interfaces that cannot be retrofitted for usability, or designs that they are not willing to change. In these cases, Steve must present the flaws in the design and work to re-educate designers about critical issues. Sometimes it is hard for him to convince designers to make compromises in order for their web sites to be accessible, but by citing usability studies and contemporary research, he helps them improve.

One usability study that Steve conducted was a test of the effects of colors and symbols on perceived meaning. He surveyed seventy-five people, asking them to associate meanings with several symbols in various colors. Based on the results of the survey, he designed several alert icons for the Cal Poly Web Authoring Resource Center (WARC) site that help guide users' navigation. The icons have been implemented on several Cal Poly websites, and their consistent use as condition indicators for campus web applications

contributes to their effectiveness as symbols that are instantly recognized by users. In this case, Steve successfully applied the perceptions of target users to improve the usability of different web sites.

Since Steve can't perform usability studies for all graphical elements of the web sites he works on, he stays up to date on usability considerations by reading various research articles and literature related to web development. Web sites such as the World Wide Web Consortium (W3C) maintain up to date resources related to different usability considerations. One such resource is the Web Content Accessibility Guidelines (WCAG) 2.0. These guiding principles cover special considerations for making websites accessible to people with disabilities—ranging from blindness and low vision to deafness, learning disabilities, cognitive limitations, limited movement, and photosensitivity. Another resource on the W3C's site is the Accessible Rich Internet Applications Suite (ARIA), which defines methods for making dynamic content accessible to people with disabilities. An offline resource that Steve refers to for usability challenges is Steve Krug's book titled *Don't Make Me Think*. The book encompasses many usability topics, with the theme of simplifying interfaces for intuitive, easy to use navigation. By combining the knowledge gained from a thorough understanding of these resources, Steve knows how to build usable interfaces and convince skeptical designers of the importance of optimal usability.

Steve's experiences consulting on usability issues have emphasized the importance of building usability into a website during the earliest stages of creation. It is beneficial for designers to lay out the navigation and information architecture before becoming attached to their graphic designs. Sometimes it is necessary to compromise certain design elements for the sake of making the site more accessible to different users. Steve can back up his

assertions with knowledge gained from case studies, and literature online and offline.

Combining these resources, he can stay up to date on ever-changing standards and practices relating to optimal usability.

Sally Anderson, an Accessibility Specialist at Cal Poly's Information Technology Services (ITS) department, is in charge of accessibility reviews of all Cal Poly web sites. She evaluates new Cal Poly associate sites one-by-one, and makes sure that they are up-to-speed with Section 508 compliance, a federal standard for the design of information technology interfaces, that requires certain elements for successful interpretation by assistive technologies. With such a diverse user-base, the California State University (CSU) system has defined a set of requirements for usability of CSU-affiliated web sites. These requirements, which must be implemented by 2012, ensure that new web sites provide an equivalent experience for the greatest variety of users, even those who rely on assistive technologies. In addition to usability enhancement, compliance with accessibility requirements benefits the CSU system by preventing lawsuits from disabled users who cannot properly access a web site's content. By anticipating the needs of visually-impaired users, and understanding the challenges of navigating with assistive technologies, Sally helps guide interface design, and protects the integrity of Cal Poly's associate web sites.

While Section 508 standards cover a broad range of technologies, the most relevant standards for web site design are those dealing with web-based intranet, and Internet information and applications. These provisions ensure compatibility with assistive technologies, such as screen-reading software for visually-impaired users, software to magnify everything on a users' screen, and Braille readers. Software applications, such as Freedom Scientific's "JAWS," make it possible for visually-impaired users to navigate web

sites based on a computerized voice that reads aloud the textual content of web sites. Since navigation on the Internet without vision is a significant challenge, adherence to Section 508 standards in web design guarantees successful usability, even for the blind.

For Sally, Section 508 compliance means that she must navigate through each new website following a checklist of requirements. The process requires a special mindset, as she looks at websites based on what a screen-reader would see, not what a typical sighted user would see. Rather than navigating based on visual cues from graphic design, Sally must make sure that users can navigate using only the semantic elements of each page. Some of the most important elements of semantic markup include proper heading hierarchy, alternative (alt) text-tags on images, and tables with proper metadata. While this isn't a comprehensive list of requirements, Sally cites these as having the most profound effect on a web site's usability.

Semantic markup means that the content of a web page is built using a structural coding language like HyperText Markup Language (HTML), and is separate from the visual design of the page. In the past, it was attractive for web designers to lay out web sites by improperly using elements such as tables and block-quotes to make the page appear the way they wanted it, rather than using these elements for their original purposes. Unfortunately, this style of design makes it difficult for assistive technologies to interpret the content of a page. Tables were meant to display data, not position elements for graphic design. Block-quotes were meant to indicate text from quotations, not as a contrived method for indenting text. With the advent of Cascading Style Sheets (CSS), designers were given the opportunity to control the look and feel of a web site without compromising the semantic meaning of its elements.

One of Sally's jobs is to make sure that web sites are coded using valid HTML and CSS, with the content of the site independent from its graphic design. Semantic markup provides a bare-bones structure to a document that defines each type of content as a specific element, and CSS defines the look and feel of these elements on the page. For instance, page content can be broken down into headings, paragraphs, block-quotes, ordered lists, unordered lists, and more. Screen-reading software is coded to interpret each of these different elements in a specific way. Headings, which are numbered according to their level in the hierarchy, allow screen-readers to quickly and effectively skip from section to section. The hierarchy helps visually-impaired users understand their position on the page, relative to other content. CSS can be used to create a visual hierarchy for sighted users, but this information is invisible to screen readers. This does not mean that the look and feel of a page is irrelevant for usability—Sally cites CSS as an important part of making web sites usable for sighted users. Her accessibility checks ensure that designers combine semantic HTML markup and proper use of CSS for successful usability for both types of users.

As part of semantic validation, Sally must verify that tables are only implemented to portray sets of data, rather than to position content for graphic design. Since many designers are used to the old tables-based method of layout, this can be a challenge; however, the extra effort to use CSS for layout pays off big time for usability. Instead of trying to interpret a website as one giant data table, screen-readers can read sites in an order that makes sense. Sally checks the accessibility of tables by looking for proper metadata, which gives screen-readers extra information about how to read the contents of the table. Special hidden tags on each of the column headings helps screen-readers present the data naturally—indicating which column each entry is in, rather than reading the contents as one long list without

context. The result is a more effective interpretation of tabular data that is more user-friendly to navigate and understand.

Similar to semantic markup, alternative text tags provide images with textual equivalents that screen-readers can interpret. Each image on the site that portrays content is given a short description so that visually-impaired users can perceive content in a fashion similar to sighted users. Images that are meant solely for graphic design are coded with empty alt tags, so that screen-readers skip over them. This way, alt tags are read aloud by screen-readers to help visually-impaired users grasp the subject of relevant images, and provide a context for nearby text. By checking for proper use of alt tags, Sally helps visually-impaired users interpret web sites and visualize content that would otherwise be lost.

Sally Anderson's work with accessibility ensures optimal usability for all users—sighted or not. By applying Section 508 standards, she works to review and refine new websites so that they are easy to navigate with or without vision. Her understanding of the needs of the visually-impaired and the tools that they rely on gives her a unique perspective that contributes to the usability of the sites that she reviews, and provides an equivalent experience that would otherwise be impossible.

Jennifer Allen-Barker is an Access Specialist for Cal Poly's Disability Resource Center (DRC). While her job at the DRC means she is an expert at making course materials accessible to students with special needs, she is knowledgeable on the topic of web usability because of her first-hand experiences navigating the web as a legally-blind user. Jennifer, who has a condition called macular degeneration, has learned to cope with a loss of vision in the center of her visual field, and partial blue-green and yellow-blue color blindness. Because of her macular degeneration, which is caused by damage to the retina, Jennifer must rely on

her peripheral vision for sight. Since more than twenty percent of Internet users suffer from visual impairments, her experiences with web navigation highlight many of the challenges of interface design for optimal usability.

With only peripheral vision to navigate the web, Jennifer relies on assistive technologies that she can configure to suit her individual needs. ZoomText, a software application developed by Ai Squared, lets her define a screen magnification level and invert colors for high contrast. This combination of settings is specially suited to take advantage of her peripheral vision and minimize fatigue on her eyes. She typically uses a magnification level of three to four times, but knows some users who require six or seven times magnification. At this level of magnification, text and graphics are large enough for her to distinguish and make sense of. Magnification, in combination with high-contrast colors, makes the most of her limited vision. With white text on black backgrounds, her color scheme makes use of the component of vision that is specially adapted for seeing in the dark. Under these conditions, Jennifer's navigation experience is different than that of sighted users, requiring different design considerations for full usability.

Viewing web sites at high magnification allows Jennifer to read their content, but makes navigation a much slower process. She must constantly scroll pages left and right to read whole lines, since many text blocks become too large to fit on one screen width. With all of the horizontal scrolling, it is easy for Jennifer to become disoriented. She makes mental maps of familiar web sites to help memorize the location of its left and right margins. On unfamiliar web sites, it is easy to miss right-aligned elements like figures or menus. Large areas of white space make it seem like there is nothing left to see, while there may be

important content just off-screen. Because of this, Jennifer said visual cues and the proximity of content elements are an important part of her navigational experience.

Some of the more effective visual cues include headings and boxes around content sections. Headings can be styled to set them apart from the rest of the content and quickly convey the position on the page. Boxes break the site into chunks, which are easier to process when only a portion of the screen can be seen at any given time. These design elements makes it easier to navigate bit-by-bit.

One visual cue that Jennifer cannot rely on is color. With her blue-green and yellow-blue color blindness, she has difficulty reading red text. Since red is often used to catch peoples' attention or indicate important information, this is a serious problem. If the text is too small, she may miss it entirely. Only at six or seven times magnification can she read such text, a major hassle for navigation as she must slow down, zoom in further, read the text, then zoom back out before continuing. Because of this, she prefers visual cues that function regardless of color.

Users who rely on screen-readers must navigate not only without color, but without any form of visual cues whatsoever. Although Jennifer relies primarily on ZoomText for navigation on the web, her experience with JAWS highlights some important usability issues for users with complete blindness. Since users cannot rely on visual cues to indicate meaning, they must navigate solely by what is read aloud.

Jennifer has experienced limited success with screen-readers, citing unnatural reading style as a major drawback. JAWS, for instance, reads rapidly, without pauses between links. It reads special characters as their names—pronouncing the phrase “cats & dogs” as “cats ampersand dogs.” While blind users can probably grasp what is really going on, the

unnatural reading style slows down navigation and makes it harder to understand. To enhance the usability of web sites for blind users, it is important to pay special attention to the way content and links are written. A successful alternative to the previous phrase is “cats and dogs,” which JAWS pronounces correctly. By taking the extra time to think about how screen-readers will interpret various phrases, content developers can provide disabled users with a more natural experience of the Internet.

The naming of links is another important consideration for screen-reader usability. Link names need to be descriptive and easy to understand, independent from the context of surrounding text. To speed up navigation, JAWS users can skip, or “tab,” from link to link. Instead of a link like “Click here for more information,” which limits the link to one word, a more accessible link would be “Click here for more information.” By making the entire phrase part of the link, blind users tabbing through links get the whole picture, rather than a small chunk of it. In this case, usability can be enhanced simply by anticipating the quirks of screen-reading software, and writing the site’s content in a way that makes it easy to understand.

Jennifer’s experiences as a visually impaired user have given her an intimate understanding of different design considerations for optimal usability. Her familiarity with accessibility challenges have drawn attention to the importance of visual cues for those users who can still see, and well-planned content for those users who cannot. Of the visual cues she mentioned, heading styles and borders were the most effective for guiding navigation, since they do not rely on color to convey meaning. Of the content considerations she covered, substitution of special characters, and intuitive link names were the most effective considerations for screen-readers, since they provide users with a more natural experience,

and eliminate unnecessary confusion. While they were mentioned in the context of visual-impaired users, these design considerations are important elements of usability for sighted and non-sighted users alike.

## Chapter V: Conclusions

Usability is of vast significance for the success of web sites. By understanding how users interact with technology, web developers can anticipate their needs and work to design interfaces that are easy to use. Literature reviews and specialized interviews have proven the importance of design for usability in all stages of the development process. Detailed dialogues with industry professionals consistently highlight specific design considerations that enhance users' ease of navigation. Discussions with accessibility specialists and disabled users emphasize the importance of designing web sites tailored to the needs of an important minority of users. By combining these factors, web developers can work to create web sites that are attractive and easy to use.

As an interconnected web of humans, the success of the Internet relies on users' ability to access information. Starting with general concepts of users' behavior, such as the Technology Acceptance Model (TAM), usability engineers (UEs) can predict users' general perceptions of technology. Other theoretical constructs like Personal Innovativeness for Information Technology Adoption attempt to explain users' needs within specific domains of experience. Even more specific is the concept of using space, using literacies, and Internet space, as they relate to users' knowledge formations, and the importance of anticipating multiple viewpoints. What this really means is that a strong understanding of the target audience is critical for the success of web usability. Only once this demographic has been researched and articulated can the true usability engineering begin.

Starting with conceptualization, usability engineering is part of every step in the production process. Once the target demographic has been established alongside the goals

of the web site, developers can move on to project planning and the creation of an effective navigation. Regardless of the audience, usability considerations are vital for design decisions that effect a web sites' navigation. As developers work on the navigation, they must consider the needs of typical sighted users, and a minority of non-sighted users. Once an effective navigation has been created, developers can define the look and feel of a site without worrying about future problems. Visual elements like heading hierarchy, typography, color schemes, images, and borders guide the navigation of sighted users. Correct use of semantic elements like alternative text tags, tables, and descriptive links guides the navigation of non-sighted users. Either way, a site's content and its design go hand-in-hand to ensure optimal usability.

Usability engineering continues even after the site has completed the production process and gone live. Usability studies work to test a sites' effectiveness and make sure that it appeals to its target audience. By systematically investigating users' perceptions of a web site, developers can refine their designs based on real-life testimonials. These testimonials can be an invaluable part of the success of websites in an online environment that is increasingly competitive.

The results of literature reviews and professional interviews are clear—it is critical for web developers to have a diverse understanding of usability so that they are prepared to design successful interfaces for any kind of user. They must know how to relate to different users, and what this means for the content and layout of a web site. By taking the time to better grasp the concept of web usability, web developers can build sites that are accessible to the widest variety of users and facilitate an experience that is satisfying for anyone.

## Appendix

### Sample Interview Request

Dear Sir or Madam,

My name is Eric Neimy, and I'm a senior at Cal Poly State University in San Luis Obispo. I am contacting you to ask about the possibility of conducting an elite and specialized interview with a member of your business as part of my senior project. The project, a research paper, explores design considerations for optimal web page usability. Specifically, it asks the question: What psychological considerations must web developers understand in order to create successful user-centered designs for virtual environments?

Since creating a usability-optimized web sites involves any number of individuals (such as content developers, software engineers, web administrators, accessibility consultants, legal experts, graphic designers, and usability engineers), their input would be a valuable addition to my research project.

The interviewee's perspective as a usability specialist will be a very useful addition to my research. Specifically, I'm interested in the different challenges web developers face as they work to design with different subject matter for different audiences. How does usability factor into the production process? How do developers anticipate users' needs and apply some of this psychology to successful design? Are there any universals, or is usability defined on a case-by-case basis? I'm interested in the reasoning behind different design choices, as they related to human-computer interaction.

This interview, along with four other interviews, will comprise the research segment of my project. The information I gather will be invaluable to my understanding of web

usability and human-computer interaction, and personally rewarding because of my interest in web design.

I am willing to work around the schedule of your employees. Mondays, Wednesdays, and Fridays work best for me, but I should be able to re-arrange my schedule if it works better for you.

Please get back to me, and let me know if you would be willing and available to participate in the final step of my education at Cal Poly. Thank you for your time, and I look forward to learning more about usability design from the perspective of a successful industry professional.

Regards,

Eric Neimy

(805) 234-5236

## References

- Agarwal, R. and Prasad, J. (1998) "A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology". *Info. Sys. Research* 9.
- Bruce, Harry. (2002) *The User's View of the Internet*. Maryland: Scarecrow.
- Davis, Fred D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* 13.
- Levenson, Harvey R. *Some Ideas About Doing Research in Graphic Communication*. Atascadero: The Good Neighbor Press & Services.
- Norman, Donald A. (1986) "Cognitive engineering." *User Centered System Design: New Perspectives on Human-Computer Interaction*. Hillsdale: Lawrence Erlbaum Associates.
- Zaphiris, Panayiotis, and Sri Kurniawan. (2007) *Human Computer Interaction Research in Web Design and Evaluation*. Hershey: Idea Group Publishing.