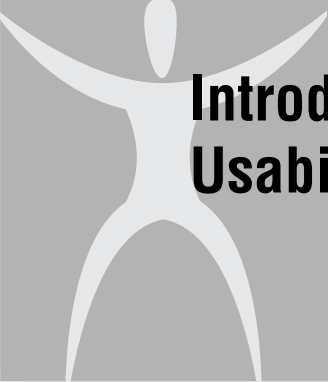




Introduction to Universal Usability

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The phrase ‘universal usability’ was first coined by Shneiderman in his landmark article in 2000, which appeared in the *Communications of the ACM* (Shneiderman, 2000). Universal usability is focused on three areas – user diversity, technology diversity, and bridging the gap between what users know and what they need to know. User diversity includes novice and expert users, younger and older users, users with perceptual, cognitive, and motor impairments, users with learning disabilities, low-income users, and illiterate users. Technology diversity includes desktop computers, laptop computers, portable devices and PDAs, mobile phones, and various screen sizes and connection speeds. There is often a gap between what users know and what they need to know, and there are many ways to bridge this gap. Some ‘gap fillers’ include help menus, tutorials, and natural-language assistance systems (e.g. ‘clippy’). This is a very large area of study, and realistically, it is too broad a topic to be covered in one book. So this book focuses on the user diversity area of universal usability. Other books in the future will need to address technology diversity and bridging gaps in user knowledge.

Conceptually, universal access means something different from universal usability. Universal access means ensuring that all people have access to technology. For instance, many individuals in the United States pay a fee on their telecommunications bill, and that fee goes to a central fund which helps connect schools, libraries, and rural health care facilities to the Internet. Access means simply having the equipment, the technology, and the opportunity to access a system. User diversity does not come into play, and ease of use is not an issue. In reality, the term ‘universal access’ is often used to mean the exact definition of universal usability, and many of the conferences in this area are called universal access while featuring work on usability (see Shneiderman’s Preface for more information on the history of universal usability).

Some say that universal usability is an elusive, impossible goal. Others say that while it is theoretically possible, the amount of work required to make interfaces universally usable makes it impractical. I disagree with both statements. First of all, there is no problem in interface design that cannot be solved, or at least improved. To deal with these challenges, we may need to choose different design strategies, we may need an increased amount of user involvement in development, or we may need to design adaptive interfaces. I'm not saying that this goal is easy. But in life, the most important goals, the ones that you care about in your gut, generally are not easy. They are challenging, and are indeed the ones most worth working toward.

1.1 How Does It Happen?

There are really two types of universal interface design strategies, and it depends on the usage of the software application being designed. There are some types of applications that potentially will be used by all users. For instance, government and news web sites, digital libraries, and online communities can benefit all users, regardless of disability or age. Everyone can benefit from these resources, and therefore, they should work properly for all users, regardless of age, experience, or disability. On the other hand, there will be some applications that will be designed for a specific population. In this book, the chapters on Alzheimer's, autism, and dementia, showcase applications that were built for a specific population. The applications built for children with autism may not be usable by other populations, regardless of how good the interfaces are. Those applications designed for children with autism will not serve a useful goal for blind users, regardless of how good the interface is. The goals of these types of applications were not universal, they were only meant to meet the needs of a specific user population. These applications can then be maximized to meet the needs of that user population. So some application interfaces will be designed for all, while others will be designed for a specific population, because other populations do not need to use the application at all.

For applications or web sites that are built to serve multiple user populations, we like to minimize the use of a different interface for each population. Realistically, multiple interfaces can add to development time and costs. And if there are multiple different interfaces, not all of them are supported or updated as frequently as they should be. For instance, the Web Content Accessibility Guidelines (<http://www.w3.org/wai>) state that if a web page cannot be made accessible, then an alternate web page should be set up with equivalent content that is fully accessible. However, this is not encouraged, as it is likely that a second interface which is accessible would have more out-of-date content than the main web site, because it might

not be properly maintained. There are some circumstances where it actually might be appropriate to have multiple separate interfaces and content, but those situations are limited. For instance, most people would agree that it is acceptable to have two separate web sites for NASA (the National Aeronautics and Space Agency), one primary web site and a second web site focused on children. The goal of the children's NASA web site is to get children interested in space and astronomy. Sounds good, right? However, what about the National Cancer Institute's web site, where information was presented separately for doctors, researchers, patients, and family members? Many users felt that they wanted to get the same information as their physicians, and felt very uncomfortable having separate web information for the different groups. Their feelings were really strong, despite the reality that the terminology used will probably need to be different for medical personnel and patients (Lazar, 2006).

Despite all of this, a well-designed interface can appeal to multiple populations, even when it wasn't originally designed for multiple populations. For instance, while the chapter from Matthew Meyers highlights the development of training modules for users with Down Syndrome, their 'Web Fun Central' is actually used by many librarians to teach web skills to patrons without any disabilities. While this was unexpected, it demonstrates that good design generally benefits not only those it is designed for, but also many others.

1.2 Universal Usability in the Real World

Universal usability is simply good design. And there are precedents in the physical world around us. For years, the argument has been made that 'curb cuts' in streets are the equivalent of universal usability. These curb cuts were designed for people in wheelchairs, to get from the sidewalk level to the street level. These curb cuts not only help individuals in wheelchairs but also bikers, parents with strollers, and people with wheeled luggage. I want to extend this argument to other examples of universal usability in noncomputer design. A curb cut is something that is necessary, but also expensive, and most people couldn't create a curb cut themselves. However, there are many other things that can be done to improve universal usability of physical spaces, which are inexpensive and easy to do. Similarly, there are many things to improve the universal usability of computer interfaces, which are quick and easy, and simply aren't being done due to the perceived large cost in time required. Some examples follow that help illustrate the point.

For instance, EMCO Windows and Doors offer a feature on their screen doors that greatly increases the ease of use for many populations. Most screen doors have one arm, up high, where a small metal hinge can be pushed into place to help the door stay open



Figure 1.1 A traditional screen door hinge, too high for most people to reach.

for an extended period of time (see Figure 1.1). The hinge is hard to reach, and stretching up high to reach the hinge could possibly make someone lose their balance and fall. The EMCO screen door has two arms, one high and one low. The low arm has a small button that can be pressed with the foot (see Figure 1.2). This makes it much easier to reach, and therefore increases the number of people who can use the feature.

There are numerous people who benefit from the ability to more easily keep a screen door open, similarly to the curb cut: individuals carrying groceries, pushing strollers, or using luggage. But at least two other populations benefit. For individuals who are shorter, they could not normally reach the hinge on the high arm, and now they can. In addition, there are many individuals (especially those with mobility impairments) who need more time going through the door, and the door needs to stay open for longer, rather than closing automatically. This button on the door arm, in a convenient place, benefits multiple user populations!

Another example can be seen by examining thermostats in a home or office setting. These thermostats control temperature (both heating and air conditioning) in a room, office, or house. Certain thermostats can be too simplistic. For instance, consider the thermostat in Figure 1.3. It doesn't provide enough information, and it is unclear which side of the dial the user should point in the direction that they want. It simply doesn't provide the functionality that users need.



Figure 1.2 An EMCO screen door hinge, lower, where more people can reach it.

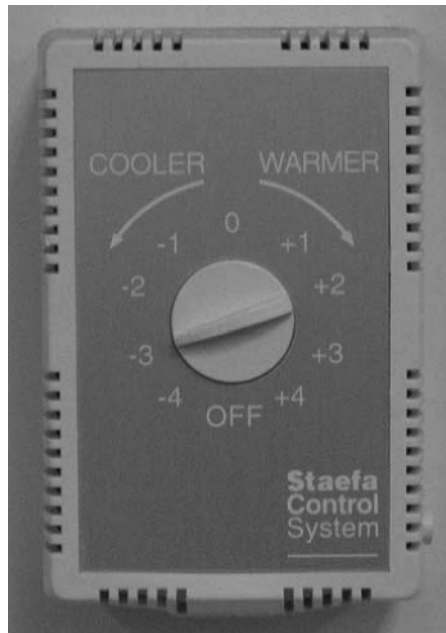


Figure 1.3 An inadequate thermostat (picture courtesy of Evan Golub).



Figure 1.4 A thermostat that offers the needed functionality, but is too small to read and accurately control.

Now, if you consider a second thermostat (Figure 1.4), it seems to provide all of the control that the users need: you can program it for certain days or hours, you can make it the exact temperature that you want – it offers all of the functionality that users want. It seems like the ideal thermostat. However, it has problems related to usability. The buttons are too small, and the readout is so small that individuals with limited finger dexterity, or with minor visual impairments, or individuals who are older, and may have both limited finger dexterity and minor visual impairment, will find this readout hard to use. Now, consider a third thermostat. It has the same functionality as thermostat number 2, except that it has a bigger temperature readout, the buttons are larger, and it is less likely that the users will hit one button when they mean to hit another (see Figure 1.5). This thermostat is more usable. And while it might not offer voice output (for blind users) or speech recognition (for users with full motor impairment), it is a great improvement for older users with either limited finger dexterity or minor visual impairment.

1.3 Making Small Strides

It has sometimes been said that ‘Perfection is the enemy of the good’ (attributed to the French writer Flaubert). Sometimes, designers, web masters, project managers, or others worry about making their interface 100% accessible and perfect. And since



Figure 1.5 This thermostat offers larger controls and display, making it easier for older individuals.

they can't make it perfectly accessible, they feel that it is not worth the effort. But the goal shouldn't be perfection. Over time, our standards related to universal usability may change. Over time, we may learn more. However, we should implement as much knowledge as we currently have that we can use in a practical way. By making small improvements, it might make an interface usable for certain user populations, even if it is not fully usable for other populations.

Two related research projects examined accessibility levels of web sites, and web master perceptions of web accessibility. In the first study, accessibility levels were examined on 50 web sites, and only 1 out of 50 web sites were determined to be fully accessible (Lazar *et al.*, 2003). However, there was great diversity among the levels of inaccessibility. Many of the web sites were actually close to full accessibility. For instance, nearly 70% of the web sites had only violated one to three accessibility guidelines. And these tended to be the guidelines that, from a technical point of view, were easiest to fix. The most frequent violations were that (1) there was no alternative text for graphics and (2) there was no device-independent alternative text for scripting. Both of these are technically easy to solve. These web sites were not that far from being accessible. In another study, web masters were surveyed to determine their perceptions of web accessibility (Lazar *et al.*, 2004). Among the misperceptions cited by web masters was that an accessible site is text-only, with no graphics. At the time of the study, 20% of web masters did not even know that software tools existed that could help with accessibility. While web accessibility is just one aspect of universal usability, it shows how part of the challenge is 'selling the topic' as something that is do-able, that improves the user experience for all. Again, the perception of the work

involved, and the misperception that only perfection is acceptable, can be stumbling blocks to moving toward improvements in usability for all.

In other words, don't worry about making the whole house or office 100% accessible yet. Start with the small things, like the screen door and the thermostat. Don't worry about making the computer interface 100% accessible yet. Start with the small things, like alternative text, better labels for tables and frames, adding appropriate labels for forms, and then go on from there. To paraphrase Flaubert, perfect accessibility is the enemy of good accessibility. Don't worry about making an interface 100% accessible. It may cause some people to avoid doing it, to be intimidated with the process, to say 'why bother?' Let's shoot for 95% accessible. And then once we're there, we'll see what new guidelines or tools exist at that time. And what we can do to take another step forward.

1.4 Connection between Universal Usability and Public Policy

Universal usability is not only good design, it's also good policy. In many countries (Australia, Canada, Portugal, Taiwan, USA, UK, and others), there are laws that require government technology (including web sites) to be accessible for individuals with disabilities (see Paris, 2006 or Lazar *et al.*, 2003 or Chen *et al.*, 2005 or <http://www.w3.org/WAI/Policy/> for more information). Many countries also address language diversity as a universal usability issue, for instance, in Canada, government web sites must be available in both French and English. Even though laws generally don't address design for older or younger users, many government agencies have separate and appropriate information for different age groups. And while these laws cover only government computers and web sites, policy is increasing in scope: many private companies and organizations are now also required to make their web sites accessible. The rights of individuals with disabilities are well established in legal systems around the world. The rights of diverse users to access computers and online information are now starting to be recognized. The US Public Policy Group of ACM SIGCHI (which, in all openness, I currently chair) recently approved a policy statement, encouraging the passage of laws that clearly state the rights of individuals with disabilities to have fully accessible web sites, both for governmental information and nongovernmental information on company or organizational web sites (see www.sigchi.org/uspolicy for more information). By the time you read this book, it is certain that the policy situation for universal usability in a number of countries will have changed.

1.5 About this Book

The goal of this book is to highlight some of the current research projects that focus on practical outcomes in moving toward a goal of universal usability. These are not theoretical readings about what might happen in the future. These are hands-on readings about what we are capable of doing today.

Since Ben Shneiderman created the concept and coined the term ‘universal usability,’ he seemed like the natural choice to write the Preface. His historical overview provides useful information on where these concepts were created, who created them, and how they have grown over time. In addition, Shneiderman provides a comprehensive list of web sites and references related to the topic.

You are currently reading Chapter 1, so no summary is needed!

In Chapter 2, Hutchinson *et al.* describe design issues related to the development of an International Children’s Digital Library (ICDL). Specifically, this chapter focuses on searching and browsing behaviors. A review of the literature provides information on how children look for information, and specifically, what has been done in the area of digital libraries. After describing the ICDL, the authors of this chapter describe the challenges of designing search tools for children, and how they were addressed in the ICDL.

In Chapter 3, O’Connell discusses web usability issues for older users. This is one of the great usability challenges of our time. As current users get older, they will want to continue using computers, and our interface design strategies need to improve to meet this great challenge. O’Connell provides guidelines and examples from a number of different web sites, in how to improve web usability for older users.

In Chapter 4, Evers and Hillen provide a description of their new approach for providing web navigation to blind users. They attempted to separate out the structural information on a web site from the content, to assist in navigation of a web site for blind users. Their application, called ‘NavAccess,’ allows users to listen to a high-level overview of the architecture of the web site, without having to listen concurrently to the content. The results of their evaluation are presented in the chapter.

In Chapter 5, Zhao *et al.* describe the interface they built called *iSonic*. The goal of *iSonic* was to allow users with low or no vision to listen to a map. *iSonic* adapts information visualization approaches to sonification, so that users can hear a high-level view of the data that is presented on a map, through the use of different non-textual sounds. Since tactile maps are prohibitively expensive, *iSonic* can provide a map experience for blind users utilizing only standard computer hardware.

In Chapter 6, Lazar and Allen present their project which investigated how to improve screen reading for blind users on the web. The frustrations of blind users

browsing the web were investigated, and suggestions for both improved web site design and improved screen reader design are presented. In addition, the impact of the frustrations on user mood is discussed.

In Chapter 7, Kirijian *et al.* describe the web site that was built to help teenagers with Down Syndrome learn how to use the web. This web site, built in partnership with the National Down Syndrome Society, was the first known effort to include users with Down Syndrome into systems development. The learning modules have not only been used extensively in the Down Syndrome community, but they have also been used throughout public libraries in the United States to help teach web skills.

In Chapters 8 and 9, two sets of authors present different approaches for improving skills among children with autism. Autism is an epidemic, and there is no clear evidence as to the causes of autism or the most effective approaches for intervention. Tartaro and Cassell use animated virtual peers to interact with children and tell them stories. Whalen *et al.* use the scenario of a town to teach both social and learning skills.

In Chapter 10, Alm *et al.* present an application that they built for users with dementia. This system, which is touch screen based, assists the users with dementia in accessing long-term memories, through the use of pictures and music. This, in turn, helps spur communication between the users who have lost use of much of their short-term memory, and family members and/or caregivers.

In Chapter 11, Wu *et al.* address the needs of users with amnesia. The tool they developed, the OrientingTool, helps provide information about current activities and schedules, which can reduce confusion and disorientation for users with amnesia. As caregivers cannot be present at every moment, the OrientingTool can help those with amnesia to better manage their own daily schedules and events.

In Chapter 12, Cohene *et al.* address the topic of users with Alzheimer's disease (which is more specific than dementia, although related). They created computing applications that help users build a personal life history. This is not only a good activity for users and family members, but in the chapter, it was reported that the histories were repeatedly watched by the individuals with Alzheimer's disease. Compared with Chapter 10, these users took a more passive role and were more limited in their abilities.

In Chapter 13, Feng *et al.* examine speech recognition for users with spinal cord injuries (SCI). Although speech recognition is a natural choice for users with SCI, error rates are high, which discourages users from using speech. Feng *et al.* present and investigate new approaches for target-based and direction-based navigation using speech recognition.

In Chapter 14, Wobbrock and Myers discuss issues related to text input for users who have spinal cord injuries and are often limited to wheelchairs. Their work looks

at turning pointing devices (such as joysticks and trackballs) into devices that can easily be used for text entry. Their chapter discusses EdgeWrite, which they created to allow joystick users to perform text entry faster and more successfully.

In Chapter 15, Pinkett discusses the Community Connections project, in which community-based software was built for the residents of the Camfield Estates community, in partnership with MIT. The goal of the system was to help with economic self-sufficiency for the residents of the community, who were economically disadvantaged. The chapter discusses the development and evaluation of the community networking project.

In Chapter 16, Maloney-Krischmar *et al.* investigate how to improve access to online health care information for economically disadvantaged African-American women. This population is often overlooked in the research community as it relates to interface design. Suggestions for improving access and interfaces are provided.

In Chapter 17, Murphy *et al.* discuss accessibility issues in US Census Bureau forms. Every 10 years, the US government takes a census of data, involving all individuals and residences. In 2000, there was a small test of an online option for filling out a census form. In 2010, it is expected that online census forms will be filled out by a large percentage of Americans. Ensuring the accessibility of these forms for all users is therefore paramount, and this chapter presents the multiyear effort that took place!

In Chapter 18, Nichols *et al.* discuss the creation of Greenstone, a tool for creating digital libraries. These digital libraries must address not only different user populations (such as librarians, readers, and anthologists), but also searches in one language for documents in another language. And the content can come in multiple forms – for instance, text, images, audio, and video. The chapter discusses the challenges and solutions in meeting the needs of so many.

In Chapter 19, Preece lays out the future for universal usability, talking about where we need to be going. She discusses universal usability in the context of social computing, which is a major trend right now in the online world. In this context, Preece presents her vision for how universally usable communities can help bring people together.

1.6 The Challenge!

I hope that you will find this book inspiring in your work. I often hear that ‘we can’t develop an interface for population X. It simply can’t be done.’ Even with very challenging user populations (e.g. users with autism, Alzheimer’s, or dementia), appropriate interfaces and applications CAN be developed. In reality, developing interfaces

for diverse and specialized user populations may be more challenging, it may take more time, and in all honesty, it may take more resources. However, it CAN be done. We are capable of making this happen. The skeptics who say it can't be done are wrong. Period. Don't listen to them. Prove the skeptics wrong.

Instead, go out and make the world a better place, by making the world of computing more inclusive.

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