Usability Guidelines for Accessible Web Design

Based on Usability Studies with People Using Assistive Technology

By: Kara Pernice and Jakob Nielsen

Additional research by:
Susan Farrell
Sachi Mizobuchi
Naoko Ishida, UDIT
Amy Stover
Michael Yohay
Elizabeth Franko
Aimee Richardson

NN/g
Nielsen Norman Group

About This Free Report

This report is a gift for our loyal audience of UX enthusiasts. Thank you for your support over the years. We hope this information will aid your efforts to improve user experiences for everyone.

The research for this report was done in 2001, but the majority of the advice may still be applicable today, because people and principles of good design change much more slowly than computer technology does. We sometimes make older report editions available to our audience at no cost, because they still provide interesting insights. Even though these reports discuss older designs, it's still worth remembering the lessons from mistakes made in the past. If you don't remember history, you'll be doomed to repeat it.

We regularly publish new research reports that span a variety of web and UX related topics. These reports include thousands of actionable, illustrated user experience guidelines for creating and improving your web, mobile, and intranet sites. We sell our new reports to fund independent, unbiased usability research; we do not have investors, government funding or research grants that pay for this work. Visit our reports page at https://www.nngroup.com/reports/ to see a complete list of these reports.

HOW TO SHARE

Do not link directly to the PDF file (the hosted address could change). Instead, we encourage you to distribute the following link to the report's page on our website to allow people to decide whether to download it themselves:

www.nngroup.com/reports/usability-guidelines-accessible-web-design

REPORT AUTHORS

Kara Pernice and Jakob Nielsen

Copyright Notice

Please do not post this document to the internet or to publicly available file-sharing services.

This report is free, but it is still copyrighted information that may be updated from time to time, so please don't distribute this file or host it elsewhere.

Even when people post documents with a private URL to share only with a few colleagues or clients, search engines often index the copy anyway. Indexing means that thousands of people will find the secret copy through searches.

Contents

Executive Summary

The Internet opens up many opportunities for people with disabilities. Most fundamentally, the Internet is liberating. For example, people with visual impairments can read the daily newspaper the minute it is published, rather than wait for a taped transcription. The participants in our study embrace the Web, and most said that they would never want to give up their Internet connection. Every user mentioned at least one thing that they can do using the Web that they could not do before. As in our previous Web user studies, participants' Web use varied greatly: Everyone has different interests and needs. The beauty of the Web is the diversity of specialized things it lets users do.

While the opportunity is certainly there, the Web is unfortunately very far from fulfilling its potential to serve users with disabilities. Inaccessible and unusable sites abound. Even sites that are theoretically accessible often have low usability for people with disabilities. Our studies indicate that Web usability is about three times better for sighted users than for users with visual impairments.

Most of the usability problems are not quite as severe for users with motor skill challenges. However, these users would be much better served if sites were designed with accessibility in mind and followed usability guidelines for users with disabilities.

USABILITY STUDY WITH USERS WITH DISABILITIES

To derive the usability guidelines in this report, we conducted a series of usability tests of several different websites. In total, 104 people participated in the evaluations, including 84 users with disabilities and 20 users without disabilities who served as a control group.

We conducted a qualitative study with 44 users, including 31 in the United States and 13 in Japan. Of these users, 35 had visual impairments and 9 had motor skill impairments. Because the Web's use of audio is currently limited, we did not include users with auditory impairments. In the qualitative study, we observed participants using ten U.S. sites and six Japanese sites. The various targets included corporate, high-tech, government, e-commerce, and nonprofit sites.

We also conducted a quantitative study in the U.S. to measure the magnitude of usability problems for users with disabilities compared to non-disabled users. The quantitative study had 60 participants, including 20 users with low vision, 20 users with no vision, and a control group of 20 sighted users.

People who are blind typically use screen readers, as do some people with low vision. A screen reader basically converts a Web page's text into spoken words using a synthesized voice. Experienced users can often run their screen readers at very high speed. People with low vision also use screen magnifiers, which basically take a small area of the computer screen and make it huge. Screen magnifiers also let users invert or otherwise adjust colors.

In the quantitative study, we asked users in all three groups to perform the same four tasks:

- Fact-finding: Find the average temperature in Dallas, Texas in January. (For this task only, we did not ask participants to use a specific website; they could use any site they wanted.)

- Buy an item: Purchase Janet Jackson's CD "All for You" from www.target.com.

- Information retrieval: Find a bus departing from O'Hare airport to a specific address in Chicago, using www.transitchicago.com.

- Compare and contrast: Find the best mutual fund satisfying certain criteria on www.schwab.com.

DISABLED USERS VS. SENIOR CITIZENS

This report covers our studies of users with serious functional impairments. There are many more users with minor impairments—often so slight that they are not considered "disabled." These users still have trouble using websites that disregard their special needs.

The worst problem is the lack of consideration for senior citizens, who constitute the fastest growing segment of Internet users, who are usually very affluent, and who often have time on their hands that they may spend on the Web. Many seniors are slightly disabled, but in addition to their physical impairment, they also have issues caused by slightly reduced cognitive capacity.

Catering for senior citizens is the largest accessibility issue facing most websites, both in terms of number of users and in terms of lost profit potential when these users are turned away from the site due to low usability.

The special guidelines for designing to accommodate seniors are not covered in this report, because they arise from separate studies with older users. For more information, please see Nielsen Norman Group report *Senior Citizens (Ages 65 and older) on the Web*: www.nngroup.com/reports/senior-citizens-on-the-web

RESULTS OF QUANTITATIVE USABILITY STUDY

The following table shows the measurements of four usability attributes averaged across the four tasks.

Table 1	SCREEN READER USERS	SCREEN MAGNIFIER USERS	CONTROL GROUP
Success Rate	12.5%	21.4%	78.2%
Time on Task (min:sec)	16:46	15:26	7:14
Errors	2.0	4.5	0.6
Subjective Rating (1–7 scale)	2.5	2.9	4.6

Success rate indicates whether participants completed the tasks. Each task was scored on a scale from 0 (no part of the task was performed) to 4 (complete answer). In the table, we converted these scores into percentages to facilitate comparisons with other studies. The control group's success rate was 78%, which is considerably higher than the success rates we've found in most of our other studies. Usually, success rates in Web usability studies range from 40% to 60%, so the current average of 78% for the control group probably indicates that the test tasks were a little bit easier than those in our other studies. At the same time, the tasks

were not overly easy, as many members of the control group did not complete tasks, and the average task performance time was more than 7 minutes.

The *time on task* measure indicates the time users needed to perform a task. The averages in the table do not include users who gave up on a given task. Users who gave up did so after 12 minutes on average. We included these users in the success rates, scoring them based on how much of the task was accomplished before they gave up (typically 0).

The *error* count indicates the number of erroneous actions performed during a task; these typically took the form of users visiting a part of the site that did not contain the answer to the question.

Finally, the *subjective rating* indicates users' average response to three questions that assessed their satisfaction, confidence, and frustration levels. They rated these attributes on a 1–7 scale, with 7 indicating the most positive answer (highest satisfaction and confidence; lowest frustration).

The differences between assistive technology users and the control group are all significant at the $p < 0.01$ level, except for the number of errors on tasks 2 and 4, both of which are significant at the $p < 0.05$ level. The differences between the two types of assistive technology (screen reader users vs. screen magnifier users) are statistically significant only on the error-rate measurements.

The table below shows, somewhat surprisingly, that overall usability was the same for the two groups of assistive technology users. When we started the study, our assumption was that screen magnifiers would provide higher usability than screen readers, but this was not the case. Screen magnifier users experienced higher success rates than the screen reader users, but the difference was not statistically significant for most of the tasks. Also, whatever advantage screen magnifier users may have had in terms of success rate was compensated for by a significantly larger error rate and a correspondingly lower rate of error avoidance.

There was a huge difference between the assistive technology users and the control group users, who accessed the Web through traditional browsing. We estimate that the Web is about three times easier to use for sighted users than it is for users who are blind or have low vision.

The table below shows the relative value of the four usability metrics. We have normalized all measures relative to the geometric mean of the two groups of assistive technology users. Numbers higher than 100% indicate better usability[1] than the average experience of users with visual impairment.

---

[1] For success rates and subjective ratings, higher scores on the original metrics indicate better usability, so it is straightforward to convert these scores into normalized values. For time on task, smaller numbers (faster performance) would be better, so instead of the time, we looked at task throughput as measured in terms of number of tasks performed per hour. Similarly, for errors, smaller raw numbers are better, so we also inverted this measure before computing the normalized scores. Thus, in the table, higher numbers indicate better usability for all four measures.

Table 2	SCREEN READER USERS	SCREEN MAGNIFIER USERS	CONTROL GROUP
Success Rate	76%	131%	478%
Task Performance	96%	104%	222%
Error Avoidance	148%	67%	481%
Subjective Rating	92%	108%	172%
Overall Usability (geometric mean)	100%	100%	306%

In addition to the four usability parameters, the table also shows the overall usability, computed as the geometric mean of the four individual measures.

We are not talking small differences here. A factor of three is a drastic outcome for a usability measurement study.

In the Web's early days, nothing much was going on except cool sites and brochureware. So, one might argue that it mattered less that some people had difficulties using it. These days, however, Web usability is of much greater importance: Knowledge workers must be able to research company partners, vendors, and customers on the Web, and they must be able to exchange information and operate mission-critical applications on intranets.

To truly achieve equal opportunity and broad benefits from the Internet, we must consider all users when we design, and stop treating one group three times better than others.

INTERNATIONAL DIFFERENCES
The main finding from our research in terms of international use was that there were no big differences between the U.S. and Japan in terms of usability for users with disabilities. The Japanese users did have some special issues related to understanding which character sets were allowed or expected in different designs. Also, Japanese users seemed less bothered by website clutter. Mainly, though, U.S. and Japanese users encountered the same types of problems.

In most other Web usability projects, we find big differences between users in different countries. It would seem that the usability issues relating to accessibility are so strong that they dominate the findings and turn out much the same in different countries.

USABILITY GUIDELINES FOR ACCESSIBLE WEB DESIGN
As a result of our usability tests, we have developed 75 design guidelines for making websites and intranets easier to use for people with disabilities. Many of the guidelines would actually make the designs easier to use for everybody.

These usability guidelines are an addition to existing technical guidelines, which ensure that websites offer users with disabilities basic access. Obviously, if you cannot access a site, you also cannot use it. Technical accessibility is crucial, and we strongly recommend that websites follow the official HTML standards for proper encoding of Web pages.

However, technical accessibility is not sufficient to make a website easy to use for people with disabilities. It is very easy to get lost on a site, even if you can access every individual page. It is also very easy to get fatigued and slowed down by overly long pages that don't let you quickly access key information.

Lack of context often reduces usability for users with disabilities for two reasons: they cannot easily scan a Web page and they cannot take in multiple design elements in parallel. Many modern Web designs are highly two-dimensional and rely on an intricate layout of a big canvas to communicate the user's options and navigational location. Converting such designs into a screen reader's linear presentation or a screen magnifier's out-of-context snippet has serious usability implications when the site is not designed to accommodate such use. When you cannot see the entire page in a single glance, the site is often significantly harder to use.

The usability problems relating to reduced context and scannability explain why, when it comes to assessing accessibility, it's insufficient to follow the old advice of simply looking at a Web page in a text-only browser such as Lynx. Even after all graphics have been removed, sighted Lynx users can still scan an entire monitor's worth of information and thus get context to help them focus on the salient parts of the page.

Other usability issues follow more indirectly from some users' special circumstances. For example, people who are blind and do not use Braille are not exposed to words in written form. Thus, they are not constantly reminded of how words are spelled, which increases the probability that they will misspell words when entering search engine queries. You can thus increase usability for users with disabilities by adding spell-checking to search engines and other interface forms and fields that ask users to enter words.

INCREASED CUSTOMER LOYALTY AND EMPLOYEE PRODUCTIVITY

Considering that current Web designs are three times easier to use for non-disabled users than for users with disabilities, there are huge benefits to be gained for companies and organizations that emphasize accessible and usable design on their websites and intranets. Employee productivity will skyrocket for employees with disabilities, but productivity will also increase for other employees, since many of the guidelines are helpful for all users.

Users with disabilities are understandably frustrated with sites that are overly difficult to use, and the companies behind these sites suffer significant damage to their brand reputation—not just among these individual users, but also among their friends and families. At the same time, companies that offer a pleasant user experience to people with disabilities can benefit from the fact that so many other companies do not design their sites for accessibility. Users with disabilities may be more loyal to usable sites and reject competing sites with low accessibility.

It's not surprising that users with disabilities have a strong preference for websites that are easiest for them to use. In our study, we found a very strong correlation between the success score for the test tasks and users' subsequent subjective rating of the sites: $r = 0.95$, which is much higher than we have found in most other studies.

To improve the usability of your website and intranet for users with disabilities, we recommend the following three steps:

- Ensure compliance with the World Wide Web Consortium's technical accessibility standards for page coding.

- Check your design against the usability guidelines in this report and modify the design accordingly.

- Once you've modified the design to both follow as many of the usability guidelines as possible and comply as much as possible with the technical accessibility standards, run a user test with members of your own target audience who are disabled.

CONDUCTING YOUR OWN USABILITY TESTS WITH USERS WITH DISABILITIES
We have written a separate methodology report with guidelines for planning and running usability evaluations when the test participants are users with disabilities. Our experience with conducting large numbers of such sessions indicates that there are many special considerations relative to more traditional usability test sessions.

You should only get this other report if you are (a) planning to run your own usability tests, or (b) thinking about whether to conduct such studies and you want to be better informed about what's involved and what the budget would be. The other report does not contain any design guidelines (they are all in the present report which you are reading right now!) — only advice on test methodology.

Download from: www.nngroup.com/reports/how-to-conduct-usability-studies-accessibility

Changes Since 2001

The user research described in this report was conducted in 2001, using the assistive technology available at the time. Sadly, the most widely used assistive technology—such as the screen reader JAWS—has not progressed much in usability during the many years since our study.

Still, even though the pace has been slow, there *has* been some progress in screen readers, screen magnifiers, and other assistive technologies since our study. This means that some of the specific technical comments in this report may not apply to recent versions of these products.

The main thrust of the report remains useful, despite these changes in technology: the observations of *user behaviors* and what they mean for designing better user experiences for people with disabilities. The idea behind our research—and the reason we originally named this report "Beyond ALT Text"—is to consider usage scenarios and find out how to design for users' real needs; not simply to view accessibility as a checklist item on the coding side. Often, what you name links is more important for speeding up use by a blind user than how you code page elements that they don't need anyway.

This report is a gift for our loyal audience of usability enthusiasts. Thank you for your support over the years. We hope this information will aid your efforts to improve user experiences for everyone.

This report is free, but it is still copyrighted information that may be updated from time to time, so please don't distribute this file or host it elsewhere.

Do not link directly to the PDF file (which may be rehosted at different cloud services). Instead, we encourage you to distribute the following link to this report's summary page on our website, in order to reduce PDF shock and to allow people to decide whether to download it themselves:
www.nngroup.com/reports/usability-guidelines-accessible-web-design

Overview of This Research

The goal of our research was two-fold: to learn how people with low vision, no vision, and motor-skill challenges use assistive technology and the Web, and to find examples of usable and unusable designs. We selected participants from both the U.S. and Japan. Our participant group did not include people who are hard of hearing, deaf, color-blind, or cognitively impaired, as this was beyond the study's scope.

This report includes design recommendations based on our behavioral research. We hope this will help Web designers and other product designers better understand how people use assistive devices, how design elements can enhance or impede accessibility, and how to create designs that are easy for everyone to use.

To evaluate usability, we gave people tasks, watched them work, and analyzed their behavior. We conducted the studies in participants' home or office so they could use the computer and assistive technology that they were most comfortable with.

In addition to collecting qualitative data, we collected quantitative data on how well the Web is currently designed for people using assistive technology.

We conducted most studies in the U.S. and a smaller number in Japan. However, the quantitative data is solely based on our U.S. studies.

QUANTITATIVE STUDY

- We gave all users in the quantitative study the same tasks: We asked them to look at three specific websites, and to do a search on the Web. We did not recommend any particular method of searching.

- Sixty people participated in the quantitative research: 20 used screen readers, 20 used screen magnifiers, and 20 had no vision or physical disabilities and thus used no assistive technology.

QUALITATIVE STUDY

- Specific tasks in the qualitative study differed depending on the tested sites, though we gave users the same type of tasks on each site.

- We asked users to look at ten different websites in the U.S., and six different websites in Japan. All users and test facilitators in the U.S. spoke English and used sites written in English. All users and test facilitators in Japan spoke Japanese and used sites written in Japanese.

- Of the 44 qualitative study participants:
    - 15 used screen readers (10 in the U.S., 5 in Japan),
    - 12 used screen magnifiers (8 in the U.S., 4 in Japan),
    - 8 used Braille devices (all in the U.S.), and
    - 9 used assistive technologies for a physical disability (5 in the U.S., 4 in Japan)

FLASH ACCESSIBILITY

Before the release of Flash MX in 2002, multimedia and dynamic applications in Macromedia Flash were not accessible for the vast majority of users with disabilities. Happily, Flash MX introduced support for accessibility and the main vendors of assistive technology have been adding support for Flash in subsequent releases of their products.

Of course, simply being technically accessible dues not guarantee that a user interface will be easy, efficient, or pleasant to use for users with disabilities. In a separate project, we have conducted studies of some of the initial accessible Flash applications with users with disabilities and discovered a range of usability guidelines that should be followed to improve the quality of Flash design for users with disabilities.

The findings from these studies are available as a section within our free report on the usability of Flash and Rich Internet Applications, *Website Tools and Applications with Flash*:
www.nngroup.com/reports/website-tools-and-applications-flash

Current State of Affairs

There is a number of good information sources on the technical and page-coding aspects of accessibility, and some of these begin to cover design and usability.

We were impressed with how forthcoming participants were, and with their willingness to allow us into their homes and offices and discuss what were sometimes very personal topics. The users' resilience and stamina make the current status of Web accessibility design all the more striking. The state of affairs is not good: Today, websites are not designed well for people using screen readers or screen magnifiers. While this declaration is not news to many, we were surprised by just how poorly the Web is designed for people with low or no vision. In our studies, sighted participants and those who used no assistive technology were:

- about six times as successful at completing tasks as people using screen readers, and

- three times as successful at completing tasks as people using screen magnifiers.

Further, compared with participants using assistive technologies, sighted participants were significantly

- less frustrated,

- more satisfied, and

- more confident.[*] [φ]

---

[*] We did not include participants with physical disabilities in these numbers since they participated only in the qualitative part of this study. These figures also exclude users who are blind and use Braille assistive technologies instead of a screen readers or screen magnifiers.

[φ] We included the subjective ratings of users who ran out of time (at 20 minutes) and were asked to stop working on their task. It is possible that the fact that they did not have enough time impacted their ratings, for better or worse, but we are not sure of the effects.

In the graph below, the higher the lines, the more positive the user experience. This graphically demonstrates the average success figures (most successful=4, least successful=0): users with screen readers, .50; users with screen magnifiers, .86; users without assistive technology, 3.13.

Task Completion
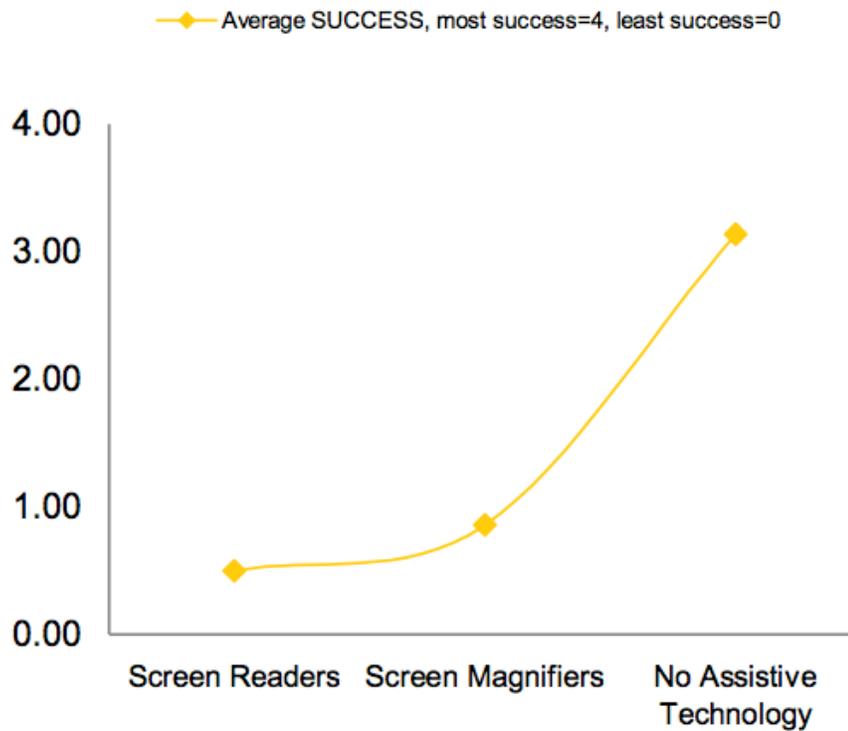
Average SUCCESS, most success=4, least success=0

In the graph below, the higher the lines, the more positive the user experience. This graphically demonstrates the following figures:

- Average confidence ratings (7=most confident, 1=least confident): users with screen readers, 2.23; users with screen magnifiers, 3.01; users without assistive technology, 5.04.

- Average satisfaction ratings (7=most satisfying, 1=least satisfying): users with screen readers, 2.60; users with screen magnifiers, 2.90; users without assistive technology, 4.19.

- Average frustration ratings (7=least frustrating, 1=most frustrating): users with screen readers, 2.55; users with screen magnifiers, 2.75; users without assistive technology, 4.55.

User Subjective Ratings

—✕— Average User CONFIDENCE Ratings, 7=most confident, 1=least confident
—✶— Average User SATSFACTION Ratings, 7=most satisfying, 1=least satisfying
━ ━ Average User FRUSTRATION Ratings, 7=least frustrating, 1=most frustrating
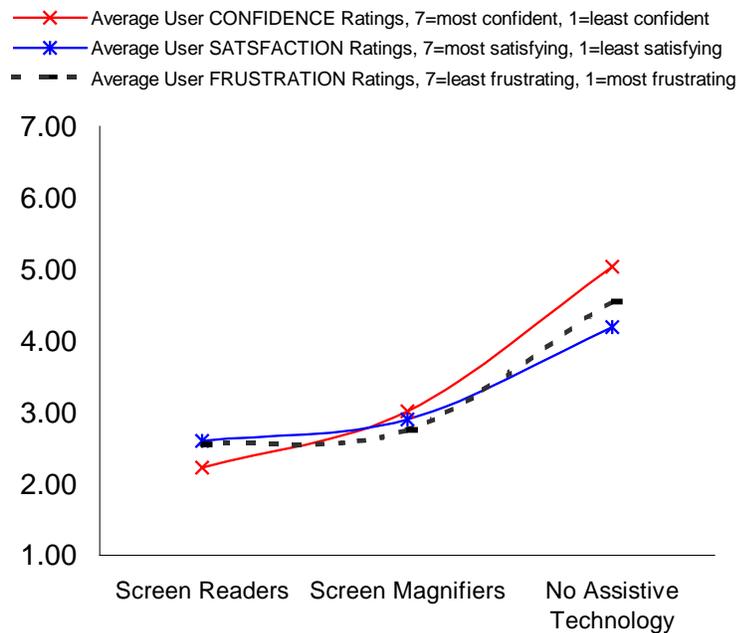
As we've seen in previous studies, there is a very close relationship between participants' actual success and how they rate their confidence, satisfaction, and frustration. In this study, the correlation is very strong: R-square is 0.91, meaning that the success scores explain 91% of the variability in the subjective ratings. (In theory, correlation doesn't indicate causation, but it's highly unlikely that things would work the other way around.)

The scatter plot below demonstrates the correlation between success and user satisfaction as averaged across three questions about confidence, satisfaction, and frustration. (The red line indicates the best-fit regression line for the data points.)
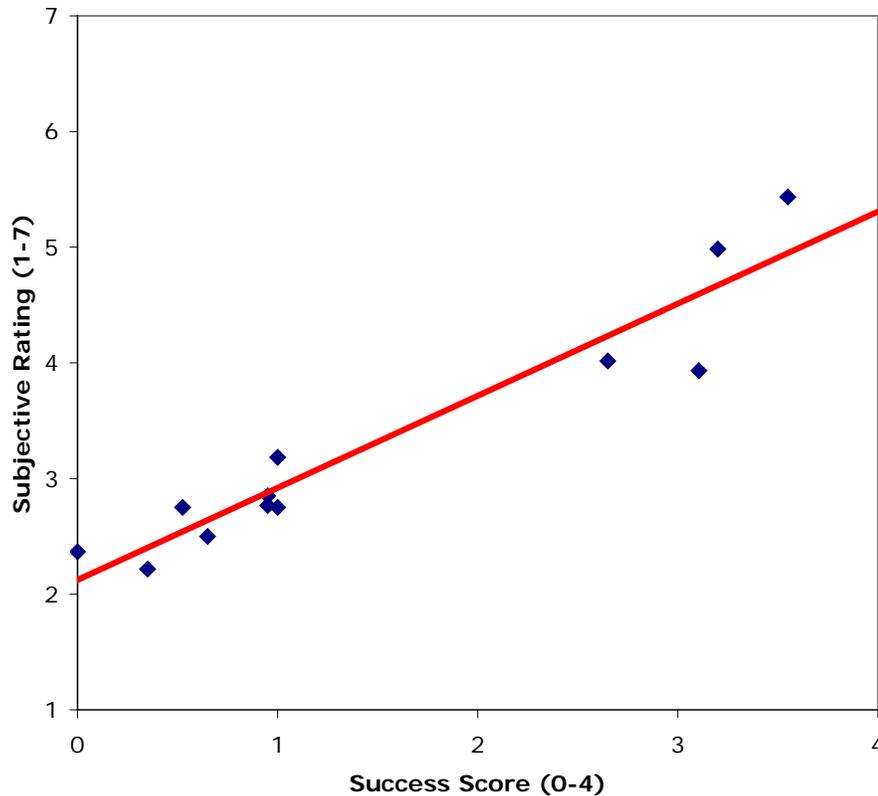

Why do users end tasks? In our study, the answers to this question substantiate our conclusion that the Web is not currently well designed for people using assistive technology. In the quantitative part of the study, we gave users a 20-minute time limit on each of the four tasks. We did this because we knew users would get very fatigued after that point, and wanted all users to at least attempt each of the four tasks. People using screen readers and magnifiers took longer to complete each task. There are a few obvious reasons for this. People using screen readers must listen to items being read. Some users set their screen readers to an extremely high reading speed, up to 550 words per minute. People using screen magnifiers must scroll many times just to see a single page. This obviously requires more scanning time than for fully sighted readers viewing the same text. Nonetheless, while text-to-speech systems may not always operate perfectly now, we need not resolve that people using screen readers or magnifiers always require more time than sighted people to use the Web. Better design, and specifically, how you order and organize text and links, can significantly decrease this time.

In our study, most of the users who ran out of time on a task were screen reader or magnifier users. Of the sighted participants not using assistive technology, very few reached task time limits.
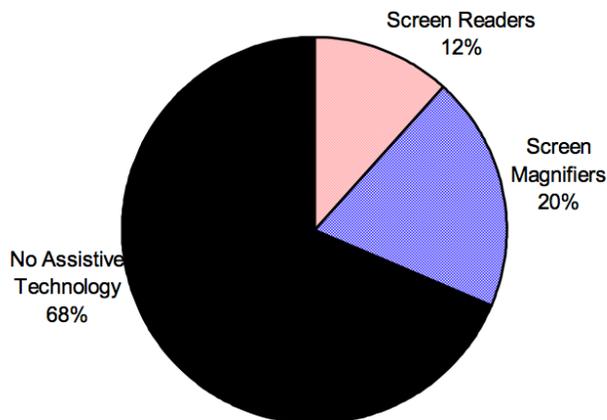
The pie chart below demonstrates that in instances where participants timed-out on a task, 53% (40) were screen reader users, 44% (33) were screen magnifier users, and 3% (2) were users without assistive technology.

**Tasks Ended Because
User Ran Out of Time and Was Stopped**

No Assistive
Technology
3%

Screen
Magnifiers
44%
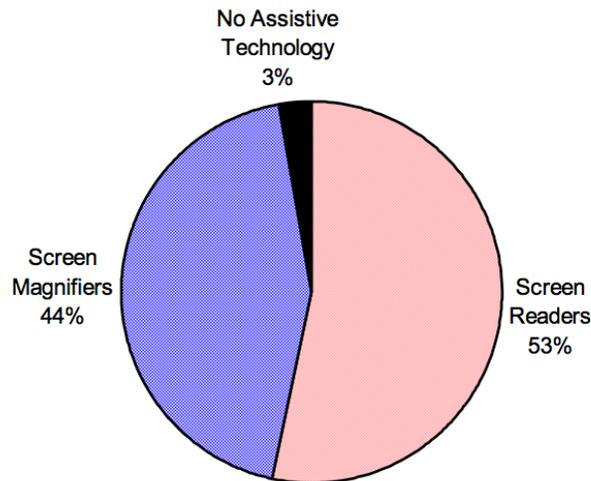
Screen
Readers
53%

The pie chart below demonstrates that in instances where participants completed tasks within the set time limit, 68% (70) were users without assistive technology, 20% (20) were screen magnifier users, and 12% (12) were screen reader users.

Tasks Ended Because *User Completed Task

Screen Readers
12%

Screen
Magnifiers
20%

No Assistive
Technology
68%

* a few users in each group stopped because they
believed they completed task but did not completely

The pie chart below demonstrates that in instances where participants decided to stop working on a task (usually out of frustration), 44% (28) were screen reader users, 43% (27) were screen magnifier users, and 13% (8) were users without assistive technology.

Tasks Ended Because User Decided to Stop (Quit)

No Assistive
Technology
13%

Screen
Readers
44%

Screen
Magnifiers
43%
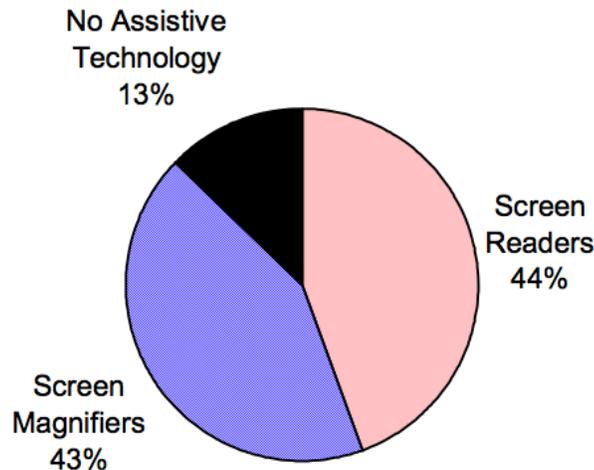
THE KILLER APP: INDEPENDENCE

Even with the prevalence of inaccessible design, participants in our study said they embrace the Web and find it helps them do many things they could not otherwise do.

Many users who are blind noted that one of the most valuable Web offerings is news. They can now read the newspaper on their own, and can choose the news source they want. "It's liberating," said one participant. "I used to have to ask somebody to read the news to me. Now I just do it…"

One person with low vision said she was never able to do crossword puzzles until she started using the Web. Now she does them on *The Boston Globe* website, www.boston.com. "It's really amazing," she said.

Another user said he researches his stock trading on the Web. "I love it," he said. "I can look up all my investments…"

Several users said they use the Web to find recipes. "It's very handy," commented one person who uses a screen reader.

Almost all participants use e-mail at home or at work.

Every participant in the qualitative study mentioned at least one thing they can do using the Web that they could not do before. Some look for HAM radio signals, others use the phone book. Still others look up directions to their own house so they can give them to people. Some look for jobs or listen to the radio. Others download

music or participate in fan site discussions. Many download books on tape to listen to. The list goes on. While users noted that the Web has many accessibility issues and that they want them fixed, a majority said their Web experiences are invaluable, and that they would never want to give up their Internet connection.

ONLINE HELP

Our study showed little difference between groups in terms of their using a website's *Help* feature: Although all user groups used *Help*, nobody used it very much.

The following bar graph shows that users with screen readers used site *Help* a total of 12 times, users with screen magnifiers used it 11 times, and users without assistive technology used it 14 times.

Total Times Help Was Used

■ Screen Readers ■ Screen Magnifiers ■ No Assistive Technology

		14
12		
	11	
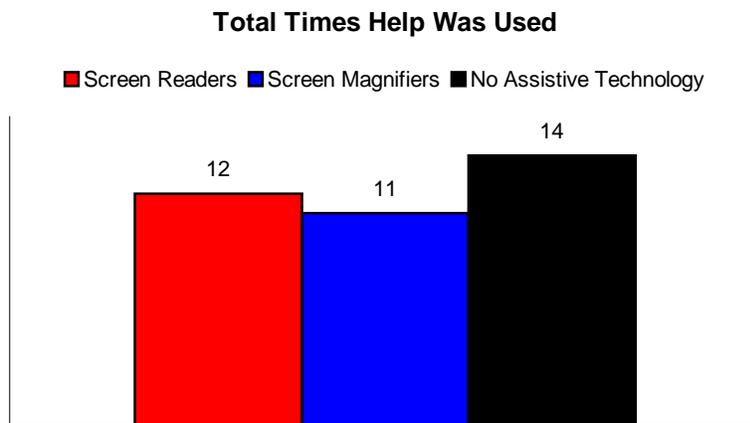
Assistive Technology Users: Observed Behavior

You can download or buy assistive technologies, and we recommend that you do. It is also very telling to watch people who actually need these devices using them. Obviously, the way they use the device will be very different from the way an interested developer might. Simply put, they will be both more experienced with the device and more dependent on it. Understanding how people use assistive technology will help you to design better for them. Watching people is the best way to learn. In the meantime, the following are some behaviors we observed while watching people use assistive devices.

FINDING AND SEARCHING (SCREEN READER AND SCREEN MAGNIFIER USERS)
One notable area that people using screen readers and magnifiers used much more frequently than sighted participants was the browser's *Find* feature. In both qualitative and quantitative sessions, these participants used *Find* at least once per session. Screen reader users typically used *Find* when they were looking for something specific on a page with a lot of text. In these cases, they often used *Find* immediately, rather than listening to the whole text being read. Screen magnifier users used *Find* when scrolling proved too slow (or they were simply sick of doing it). They also used it when they knew what they wanted to find on a page with a lot of text.

The user groups showed little difference in how they used website *Search*. The small difference in site searches (users with screen readers showed greatest usage, followed closely by screen magnifier users), can be attributed to the fact that these users sometimes used *Search* when they saw an item on a page, but didn't remember where.

We told users which websites to use in three of the four tasks in the study's quantitative session. If we had not given them specific websites, it's likely that people would have used Web search engines far more frequently.

The graph below shows that both screen reader and screen magnifier users used *Find* 35 times, and users without assistive technology used *Find* only once. Screen reader users used a website's search 55 times; screen magnifier users, 51 times; and users without assistive technology, 42 times. Screen reader users used Web search 39 times; screen magnifier users 51 times; and users without assistive technologies 34 times.

Total Times Each Feature Was Used

■ Screen Readers ■ Screen Magnifiers ■ No Assistive Technology

	"Find"	Site's Search	Web Search
Screen Readers	35	55	39
Screen Magnifiers	35	51	51
No Assistive Technology	1	42	34
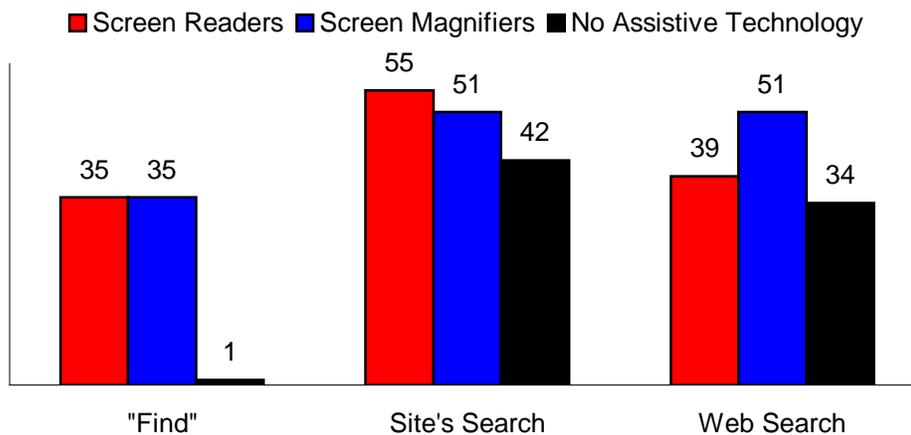
SCREEN READERS
When using a screen reader, users basically must wait for the device to read the words before they can make an educated decision about what to click. When users initially hit a page, the device reads either all texts or just the links it contains, and some users sit back and listen. Others skip around. The danger with skipping around, which many participants acknowledged, is that they don't know when they are skipping text or a link they might need or want.

Test participants were very adept at using their screen readers. They knew how to read links only, or all text. They knew how to switch to the mode that lets them type, rather than just listen. They knew how to bring up the "Links List" dialog box that listed all a page's links in alphabetical order. In the quantitative studies, we counted errors apparently resulting from the assistive technology. There were hardly any. (Although such errors are difficult to precisely determine and explain, it's similar to when graphical user interfaces became popular. At that point, for example, we sometimes saw users single-click when they needed to double click, and would attribute it to a mouse-related device error.)

As the following graph shows, we counted only two errors related to screen readers, and three errors related to screen magnifiers.

Total Errors Related to Assistive Devices

■ Screen Readers ■ Screen Magnifiers
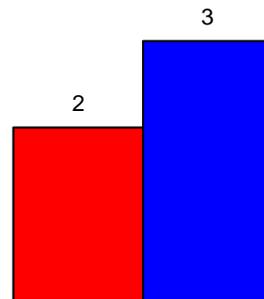
Participants, on the whole, were patient and waited for many of the words to be read. The more experienced the user, the more they decided to skip around on pages and read just links or the beginning of text sections.

People seemed to suffer from "ear strain," like eyestrain. They simply got bored with, annoyed with, or tired of listening to the screen reader. Many, at some point in the session, leaned way in toward the computer (or synthesizer), as if they were straining to hear, or focusing their concentration.

Also, at some point almost everyone told the screen reader to "shhh," "be quiet," or "shut up." At that point, if they were using a screen magnifier or Braille device with the screen reader, they usually silenced the reader and used the other device, taking a break from the electronic voice.

People apparently get very used to the sound of the electronic reader voice. Some people sped up the device so that it read at an extremely fast pace. (To facilitators, it sounded like another language, and we often had to really strain to understand anything it was saying.) People also get used to the reader's accent. For example, the word "link" often sounded like "lank" and "login" often sounded like "loge in." Also, the screen reader got some acronyms, like "dot com" right, but read others wrong, such as "ers," for "I.R.S." Users can set or fix many such preferences in their screen reader device.

In JAWS, users can choose from several voices, such as a woman's voice or child's voice. However, all participants used the basic male voice, which sounds like the familiar Stephen-Hawking output.

Several people said that using a synthesizer instead of the computer's built-in soundcard produced much higher-quality sound.

Also, several participants said they were terrible spellers, and a few said they could not write at all. Anecdotally, more people using screen readers said this, and indeed did have more trouble spelling words than those using screen magnifiers or those using no assistive technology. "Listening to a document is not the same as reading

it. Listening is not literacy."[2] The effects of this came into play primarily when they used search engines. Thus, it's important to design a forgiving search engine, and to provide alternates to search, such as clear browsing.

At times, people using screen readers are still dependent on outside help. For example, many said they need help installing software and troubleshooting products or sites. One user said that when she has problems with a website, she tries to use it for a long time, then calls an experienced friend. "I often call certain people I know who have a higher skill level than me if I cannot access a site," one user said. "Last week, I knew the company would not know the site was inaccessible. When I got so far, I called one of the best computer users I know (a screen reader user, too) to see how far they could go before I called the company." Also, most users said they would need some help from a sighted person when attempting e-commerce tasks.

All participants had monitors to go with their CPU, mostly because they sometimes need help from sighted people. Also, many users share their computer with other people who use the monitor. Several users said they do not turn on the monitors when they work. Others said they do turn it on, either out of habit or for reasons they couldn't identify. Some participants have some light perception, so if the screen goes black, they can tell there's a massive computer error. A few other people said that while they don't use the monitor, they felt it would be "strange" or "weird" not to have one or not to turn it on.

BRAILLE DEVICES
Some users in our study like to use the Braille device along with their screen reader. Of these people, a few seemed to listen to the screen reader almost exclusively, and only used the Braille to confirm something they heard or to check their own spelling when they typed in a form. Others use only the Braille.

One participant who uses Braille and a screen reader said, "I like the speed of the screen reader, but I retain more with the Braille…. I like the quietness of the Braille. Just like people can get tired of reading, you can get tired of listening."

This spelling checking was really one of the biggest values of the Braille display. Because the Braille display makes it easy to check spelling, people using it were less prone to spelling errors than those using screen readers.

Some Braille devices translate the screen reader to Braille, while others seem to take text right from the Web page.

As for owning and turning on computer monitors, Braille users' comments and reasoning were very much like those described by users in the *Screen Reader* section above.

One prevalent issue for Braille display users was that their workspaces were usually cluttered by the Braille device, the keyboard, and sometimes a voice synthesizer box. They were sometimes somewhat uncomfortable. While there were some strip-like readers that fit in front of the keyboard, in many cases, users had larger ones, and they would have to reach and cross arms so one hand was on the keyboard and

---

[2] International Braille Research Center, now part of National Federation of the Blind

one on the Braille display. Sometimes they put their Braille display just under the desk. Other times it was precariously positioned in drawers, or a few feet away from where they sat. Desks are often crowded enough with just a keyboard; imagine having an additional device, twice its size. Where would you put it?

The following picture shows a large Braille display.

The following picture shows a Braille display, wedged in a desk draw (we saw this several times in the course of our study).
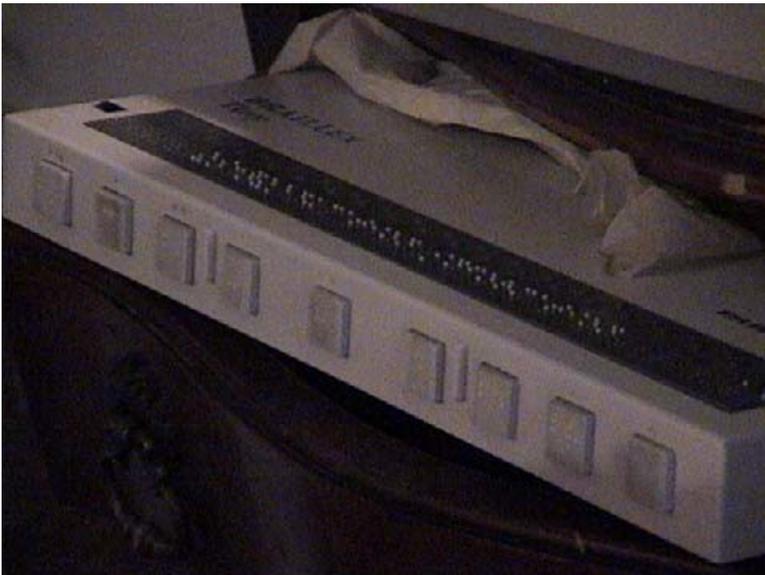
The following pictures show two smaller Braille readers, which fit pretty easily in front of the keyboard.

SCREEN MAGNIFIERS

Most people using screen magnifiers sat extremely close to the monitor, even when they had the magnification turned on very high. Some users almost had their noses literally touching the screen. Working this way is incredibly tiring, straining not only users' eyes, but also their back, neck, and shoulders. While working on test tasks, one user said, "You see why I get a headache trying to do this stuff?" Another, when answering the post-task questions, said, "A good question would be, 'Did it give you a headache or did your eyes hurt?' " Another user said, "I'll be honest with you. My eyes are driving me crazy. At least there are a few things I can see."

If you have never seen a screen magnifier, try to find and use one. As you'll see, the results are very different than simply increasing monitor resolution or selecting the largest text in your browser. Users working with screen magnifiers make text big—really big. To see an entire page, they might need to scroll horizontally and vertically many times. The bigger the page, the longer it will take them to see the whole thing, and the more difficult it will be for them to remember everything on it.

Our participants were very adept at using their screen magnifiers. They knew how to zoom, change contrast, filter colors, and most importantly, scroll vertically and horizontally.

Some users chose to simply highlight text, or chose *select all*, because highlighted text appeared as white text on a dark blue background.

One of the biggest issues for screen magnifier users is loss of context. Dramatically increasing text size means that sometimes elements that are obviously meant to be seen and read together—such as text, graphics, and buttons—are often separated. Users get very small chunks at a time.

Another issue with screen magnification software is that it sometimes acts very jumpy. For example, if you click in a window, not on a link, it jumps to the top left corner. But if you follow a link, the focus does not shift to that corner. Instead, it loads wherever you currently have the focus. For example, if you click a *Search* button that is in a page's top middle section, the results page will load with the magnifier centered on the middle top, not the top left as you might expect. One participant with low vision said, "Sometimes, when you click things, it [magnifier] jumps all over. The higher the magnification, the more it's going to jump."

In addition to making things very big, screen magnifiers let users switch between color pages and black and white. They also let users invert colors. We saw people using these features all the time, frequently switching between them. These are not default settings users just pick and leave; they use these features as frequently as a sighted person might use scrolling.

The following two pictures show monitors with screen magnifiers in use.

The following picture shows a monitor with the foreground and background colors reversed.
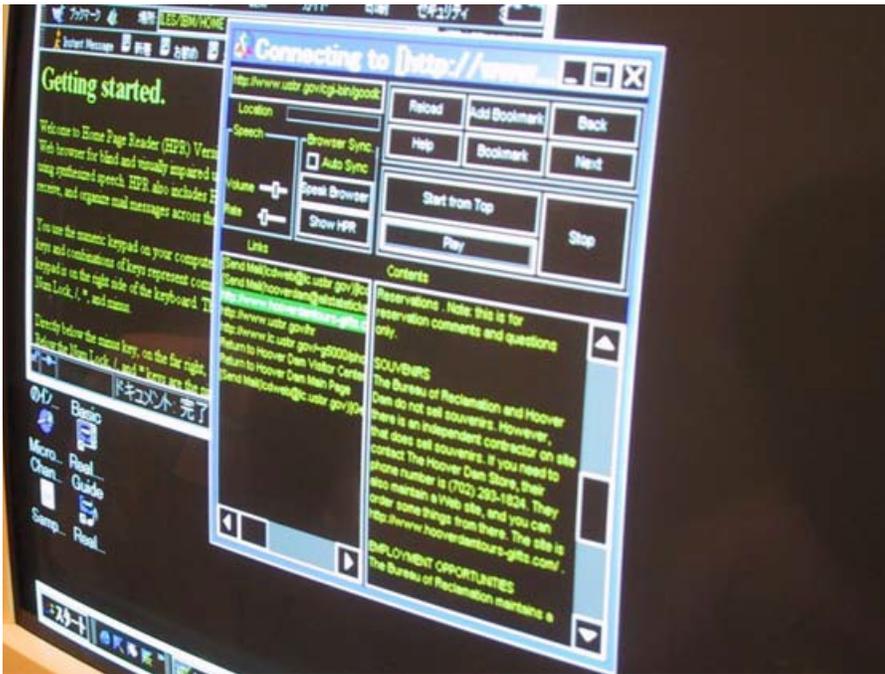
To make sitting very close to the monitor less strenuous, one user had a moveable monitor, pictured below.
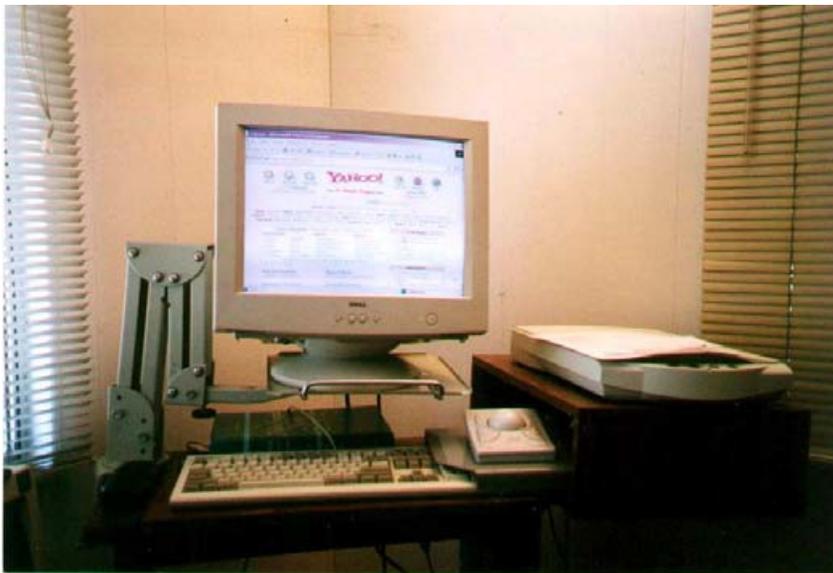
LOW VISION KEYBOARDS

Some participants with low vision used variations of traditional keyboards, such as ones that had large text and inverted the colors of text and background keys. Other users modified their keyboards by putting stickers on the home keys.

The following picture shows a keyboard with large text.
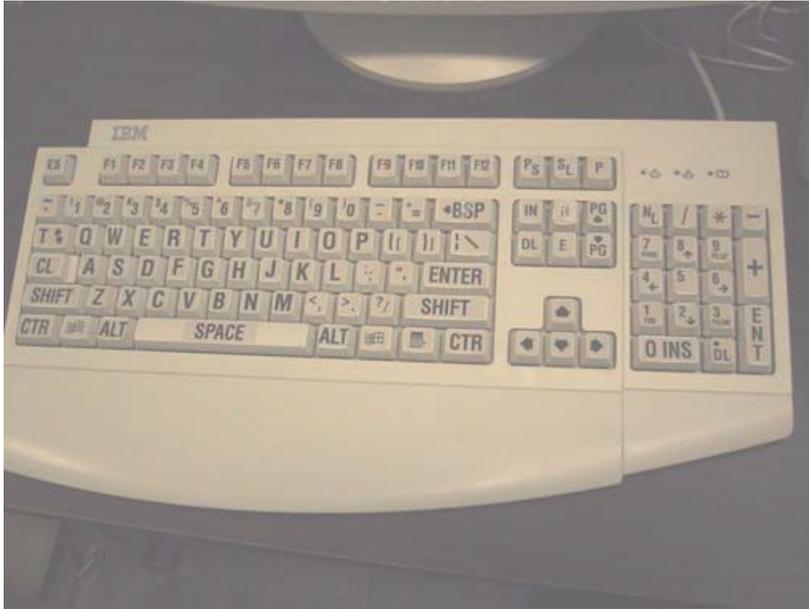
The following picture shows a keyboard with large text and inverted text and background key colors.

The following picture shows a keyboard with convex stickers glued on home keys.

TRACKBALLS, MICE, KEYPADS, KEYGUARDS, AND ARRANGED WORKSPACES

Keypads and trackballs are nice in that even if users have their hands permanently in a fist or some other closed position, they can still use these devices deftly. The drawback is that the devices are rather imprecise for selecting items or hitting targets. We saw many people take anywhere from three to ten tries to hit their target button, link, or field; such efforts are tiring.

Even though he had a keyguard, one participant with cerebral palsy had difficulty typing with precision. (A keyboard with larger keys might have helped him.) To prevent the keyboard from moving, he secured it to his desk with Velcro.

Users seemed to have trouble telling when and if they pressed the enter key. The Web's lack of feedback on this is problematic; an hourglass shows up only if you move the mouse exactly over the menu bar.

The following picture shows a keyboard with a keyguard.

The following picture shows a participant in Japan using a keyguard.

Some users arranged their workspace in special ways to accommodate physical disabilities.

The following two pictures show one user's workspace. The first shows the PC, which is fixed to the table vertically. The second shows a closeup of the *koneko no te*, Japanese for *kitten's hand* in English.

The following picture shows a *rakuraku mouse*, Japanese for *easy mouse* in English.

The following picture shows a trackball, used by several participants with cerebral palsy.

The following picture shows a voice synthesizer, used by participants with speech impairments.

SCANNERS

Many participants had document scanners, and said they use them regularly.

One participant, who is a Braille transcriptionist, had a very interesting device. She called it a scanner, and said it was made in the 1970s by Opticon. (When we called the company, the support person had no record of this device though, nor could we find it on their website.) The participant uses the scanner mostly to read printed documents, but also sometimes to read text on a computer screen. The way it works is that the user moves a small camera-like device across the screen or page. Her other hand is in a little box, which displays a single letter. The most amazing part is that the display is not Braille, but is actually a convex picture of the letter that the user moves the "camera" over. Her finger remains on this area, and she reads what is on the screen, letter by letter, as she moves the mouse. Obviously, this is slow process, and it has a very high learning curve.

The following picture shows one participant's scanner device.
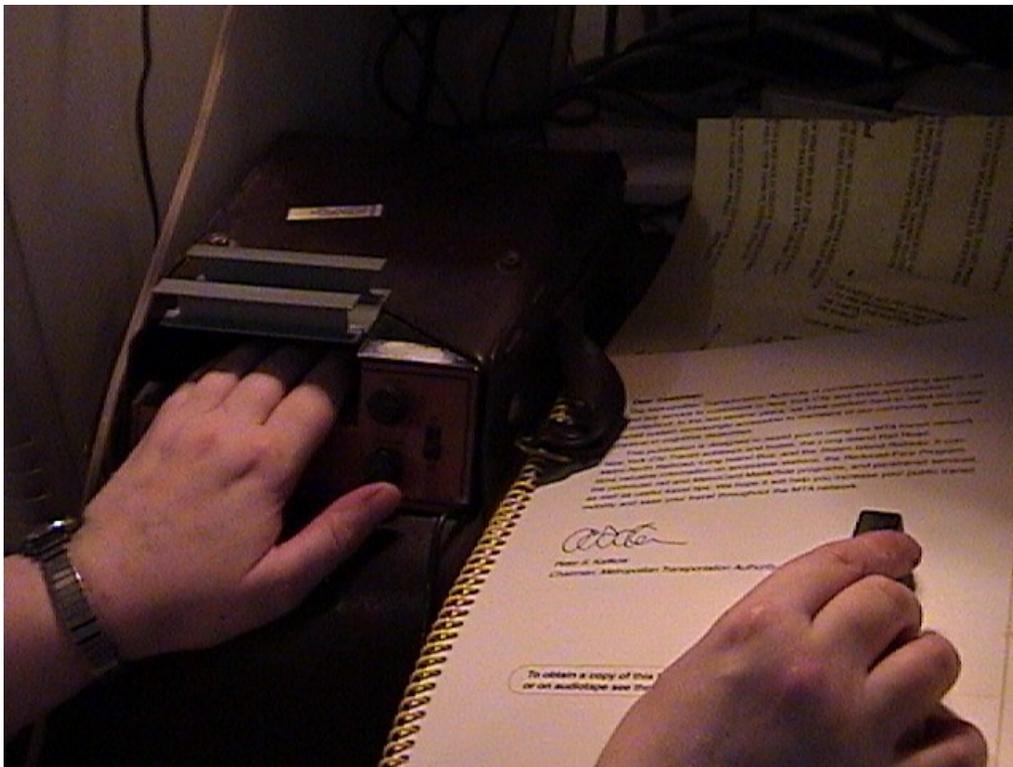
A NOTE ABOUT BROWSERS

We did not see people making use of the Accessibility features in their browsers. They mostly relied on the adaptive technology to use the Web.

There are "accessibility browsers" with built-in screen readers. Two notable ones are IBM's Home Page Reader, and pwWebSpeak Plus by Productivity Works, Inc. We did not study these in our sessions.

Very few participants used the Lynx text browser.

The following pictures show, first, a page on the Hoover Dam website as displayed in the Lynx browser, then the same page displayed in Internet Explorer.
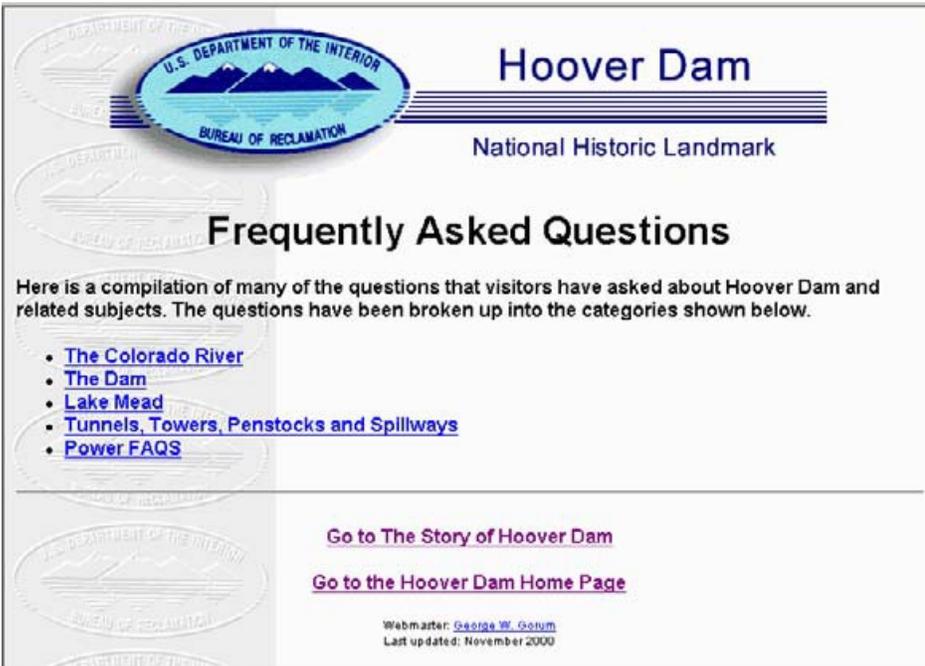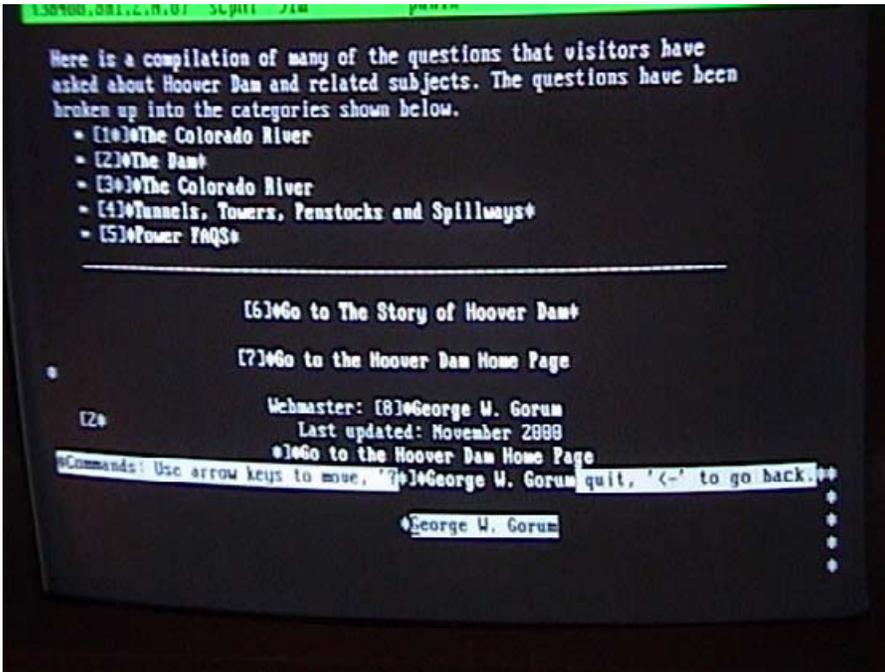
Guidelines

We based the guidelines below on findings from our test sessions. The following list comprises actionable recommendations for improving your website's accessibility. For examples and discussion of the reasoning behind these guidelines, see the referenced pages.

DO NOT ABANDON THE GOOD DESIGN RULES YOU ALREADY KNOW.

Discussion begins on page 40.

1. Follow basic rules of good design.

GRAPHICS AND MULTIMEDIA

Discussion begins on page 44.

2. Minimize the use of graphics.
3. Give all graphics (even advertising banners) names that are understandable and that thoroughly convey what the graphic is and does. Use ALT text to briefly describe images, and the LONGDESC attribute to thoroughly describe them.
4. Never blur pictures to indicate unavailability.
5. When graphics contain useful information, also provide the information in text.
6. Refer users to alternate ways for getting information contained in any graphics they encounter.
7. Do not shrink down a picture of an actual page on your site and use it as a graphic (or button) on another page.
8. When you do use graphics, always choose crisp and clear images.
9. Make it easy for users to skip any multimedia and Flash demos.
10. Do not automatically create a text-only version of your site.

POP-UP WINDOWS, ROLLOVER TEXT, NEW WINDOWS, AND CASCADING MENUS

Discussion begins on page 59.

11. Avoid using pop-up windows.
12. If you do use pop-up dialog boxes, make sure the default action is the most forgiving.
13. Avoid opening new browser windows.
14. If you do open new browser windows, always provide a simple way to get back to the site's main homepage.
15. Do not rely on rollover text to convey any information.
16. Avoid using cascading menus.

LINKS AND BUTTONS

Discussion begins on page 67.

17. Limit the number of links on a page.

18. Avoid very small buttons and tiny text for links.

19. Leave space between links and buttons.

20. Avoid using images as the only method for linking to something.

21. Ensure that important commands appear as their own unique links.

22. Underline all links.

23. Create links within text when it makes sense. Use additional buttons only when it's necessary.

PAGE ORGANIZATION

Discussion begins on page 75.

24. Immediately confirm the company name once the homepage has loaded.

25. Immediately confirm what the page is once it has loaded.

26. Do not associate the word *homepage* with your company logo if you plan to reuse the same graphic on all pages.

27. Minimize the need for scrolling.

28. When users must make a choice, keep all possibilities in the same vicinity.

29. When users must make a choice, warn them that the choice is coming, and tell them how many options they have.

30. Design pages consistently.

31. Carefully consider using "Skip Links" so users can skip links or navigational elements.

32. Choose a simple, informative Web address for your site, and keep that URL in the address field after the page loads. (Make whatever appears in the address field logical.)

INTERVENING PAGES

Discussion begins on page 81.

33. Avoid superfluous splash or cover pages before your actual homepage. Make the first page people will see the page that best describes your company and site.

34. Include only necessary steps and pages.

FORMS AND FIELDS

Discussion begins on page <u>84.</u>

35. Limit the amount of information that forms require; collect only the minimum needed.

36. Put text for field labels very close to the actual field.

37. Do not use only red text or yellow highlighting to indicate form errors.

38. Do not rely on only an asterisk (*) to indicate required fields.

39. Make sure tab order is logical.

40. Match the tab order to the visual layout when possible.

41. Stack fields in a vertical column.

42. Offer standard entry fields for phone numbers.

43. On any page with a single selection box or entry field, put the *Go* button as close as possible to that box or field.

44. In forms, put the *Submit* button as close as possible to the last field entry box or selection tool on the form.

45. Put any instructions pertaining to a particular field before the field, not after it.

46. Carefully consider how long it will be before a timeout will occur.

PRESENTING TEXT

Discussion begins on page 94.

47. Choose text colors for good contrast.

48. Do not use very small text for body text.

49. Do not use small or subtle text headings and categories.

50. Always create good contrast between text and the page background.

51. Do not rely on a background image as a page background to create contrast with text.

52. Test your site's text fonts and colors with screen magnifiers.

53. Make sure it is possible to magnify your site.

54. Write concisely, and remove superfluous text.

55. If the company name includes an initialism or acronym, tell screen readers how to pronounce it (you should do this for all abbreviations of this type on the site).

56. Rethink how you use parentheses and asterisks.

SEARCH

Discussion begins on page <u>101.</u>

57. Offer a search engine that is forgiving of spelling errors.

58. Do not rely solely on a browsing interface for your site's search capabilities.

59. Do not put the search box in an unlikely spot.

60. Clearly describe search results.

61. Inform users when they have entered nothing in the search query box.

62. Do not present search results' relevance ranking in a table.

SHOPPING

Discussion begins on page <u>108.</u>

63. Thoroughly describe images of items you are selling, as if there were no images at all.

64. Help users continue shopping after they make an order by giving them a way to get back to where they were.

65. Position the *Add to shopping cart* and *Checkout* buttons close to items for purchase. Consider having two of each button, one toward the top of the page, and one toward the bottom of the page.

66. For international customers, carefully consider any e-commerce terms you choose. (If you use English terms on non-English sites, consider using the LANG attribute.)

TABLES AND FRAMES

Discussion begins on page <u>112.</u>

67. Avoid using tables for aesthetic page design.

68. Avoid using large tables for any reason. If you must use them, consider providing the information in text as well.

69. Especially in tables, do not use graphics to indicate a state, such as yes/no or on/off.

70. Ensure that visible alphabetic lists in tables also match the alphabetic list screen readers will process.

71. Summarize all tables.

72. Before using a column layout, consider how it will appear for screen magnifier users.

73. Describe all frames.

Discussion begins on page 122.

74. Support your website with capable customer service representatives who have a basic understanding of accessibility issues.

75. Do not refer to people in wheelchairs as *wheelchairs* or screen reader users as *screen readers.*

Do Not Abandon the Good Design Rules You Already Know

> **> FOLLOW BASIC RULES OF GOOD DESIGN**

The most important accessibility guideline is simple: Design well. It is safe to say that most, if not all, good design rules still apply when designing for accessibility. Good design typically helps sighted people increase efficiency, complete tasks quickly, and feel less frustrated (perhaps even happy) when using a site. But for people with visual impairments, good design is needed simply to make task completion possible.

Some of the good design rules to be especially aware of include those that focus on simplicity,[3] such as:

- Design sites to focus on users' core tasks.

- Write concisely, and avoid superfluous marketing language.

- Offer fewer options, and include only the important ones.

- Don't include graphics or bells and whistles just for the sake of having them.

Designing for usability and accessibility will impact and improve the user experience for people beyond those included in this study, and beyond all people using assistive technology. We all encounter products every day that designers created for a specific user group, but that actually benefit people far beyond that group. An obvious example is curb cuts. They help people in wheelchairs, obviously. But, they also help people with baby carriages, shopping carts, luggage on wheels, delivery carts, or anything else on wheels. Following are a few basic examples of accessibility designs that help a broader user group.

- Logical tab order on Web pages helps people using a screen reader, a screen magnifier, or an assistive technology related to motor skill challenges. It can also help power users who want to use keyboard commands.

- Leaving white space between links on a Web page helps people with and without motor skill challenges hit targets accurately.

- OXO Good Grips Products, http://www.oxo.com, were designed by Sam Farber and inspired by his wife who had arthritis in her hands. The tools are easy to grip and useful for everyone, not just for people with arthritis.

- The nib on a telephone's "5" key obviously helps people who are blind get their bearings on the touchpad. It also helps people who are multi- tasking and can't look down (when they're driving a car, this is arguably a good thing).

---

[3] For more about simplicity in web design, see Jakob Nielsen's book *Designing Web Usability: The Practice of Simplicity*, New Riders Publishing, ISBN 1-56205-810-X.

The following picture shows OXO Good Grips products, a large TV remote control, and other products designed for accessibility that everyone can benefit from.

As designers know, any design change can help or hurt different groups of users. The most commonplace example is experienced users versus inexperienced users. Too much handholding annoys the experienced user, but not enough baffles the inexperienced one. Designers must also take care not to view people with accessibility issues as a single big user group. As a reminder, we need look no further than our simple curb cut example. As many people know, when some of the first curbs were cut they were smooth, lacking the ridges you see and feel on many newer curb cuts. Although smooth cuts posed no problem for people in wheelchairs, people who cannot see have difficulty with them, as they give no indication of the slope and immediate entry into the street.

The following image shows a makeshift curb cut. While it can help people in wheelchairs, it can be dangerous for people who cannot see.

Although curbs like the one shown above are certainly helpful for people in wheelchairs, they are quite dangerous for people who are blind. "We were in the street and didn't even know it," noted one blind participant in our study, who experienced this construction firsthand in New York City.

The following picture shows a curb cut with ridges, which have been added into curb slopes so that people who cannot see are aware of where curb cuts are.

It's easy to find poor designs and good designs after the fact. And it's even easier to write guidelines about what people should be doing. We acknowledge that the most difficult part of designing for accessibility, like designing for usability, is getting people in your development organization to make the time and spend the resources on something they might view as a foreign element. This becomes even more difficult when you work for a Web design firm and are trying to convince clients to spend the money. Governments in several countries, including the U.S., the U.K., and Australia have been helpful in this effort. But, in terms of widespread implementation of accessible designs in the business world, it really requires that designers, or in the best case, upper management, push the effort. "I think we have a moral responsibility as designers, because there are a lot of easy things we can do to aid accessibility," said Mark Sherwin, technical business director at Precedent, a London design firm. "I think you have to go out and tell clients about it. They are looking to agencies and consultants to provide advice, whether it be about technology or accessibility. So in order to get that message out there, we also need to tell them about it," he said.[4]

---

[4] *Create Online*, issue number 13: "The Big Issue: Blind Ambition"
http://www.createonline.co.uk/magazine/bigissue.asp?issue_no=13

Graphics and Multimedia

> MINIMIZE THE USE OF GRAPHICS.
In terms of inaccessible design, graphics are easily one of the worst offenders, and many Web developers are already well aware of this fact. The best thing for all users, whether they use assistive technology or not, is to minimize the use of graphics, increasing the speed of page load-time and decreasing superfluous noise. People using screen readers, Braille devices, and screen magnification software complained about how site graphics impair their work. And, when they hit sites that seemed to have minimal graphics, they frequently said they liked the site, even when they had barely used it.

One important point is that, because users have encountered so many inaccessible graphics, we saw many participants turn off graphics in their browser. So, bear in mind that some users won't see your graphics, even if you use them sparingly.

If you do choose to use graphics, and we acknowledge that some are necessary (like the company logo), there are some things you can do to make them more accessible.

On the Rock and Roll Hall of Fame website, one Braille and screen reader user said that when sites have too many graphics, she sometimes has trouble understanding the site's purpose, and gets frustrated. After looking at the following page full of pictures, she said, "I can't tell what the pictures are, so I can't tell you what the website is, and it seems to be there is a lot of them…. Doesn't [show] the company or organization… It could have nothing to do with rock at all for all I know, to be perfectly honest… It was frustrating to see how it looked but I couldn't get much from it. When you see something that leaves you so in the dark, you don't see anything you want to go back to, so it's sort of a waste of time."

The following picture shows a Rock and Roll Hall of Fame page with many graphics.

> GIVE ALL GRAPHICS (EVEN ADVERTISING BANNERS) NAMES THAT ARE UNDERSTANDABLE AND THAT THOROUGHLY CONVEY WHAT THE GRAPHIC IS AND DOES. USE ALT TEXT TO BRIEFLY DESCRIBE IMAGES, AND THE LONGDESC ATTRIBUTE TO THOROUGHLY DESCRIBE THEM.[5]

For screen reader users, there are few things more frustrating than waiting for a screen reader to read something meaningless. It's like waiting in a long line only to get to the front and find out the person behind the counter cannot help you.

The only indication people using screen readers have of what the image is is what the developer explicitly tells them. We saw many examples of poorly named images, poorly used ALT text attributes, or images with no ALT text at all. HTML affords elegant means for naming images. Use the ALT attribute after the image name to briefly describe the image. Use the LONGDESC attribute to thoroughly describe the image.

When writing ALT text, keep the text concise and simple. The goal is to let people using screen readers know what the image is. For example, there is probably no need to go into great detail about what the Major League Baseball logo looks like,

---

[5] See the current HTML working drafts, particularly the WAI and WAI-ARIA sections for rich internet application accessibility http://www.w3.org/html/wg/drafts/html/CR/ . Our advice is to use accessible HTML and allow the browsers to catch up. In cases where a page actually looks broken because of the elements, you might need some workarounds temporarily.

but telling users a particular graphic is the MLB logo would help. Conversely, the Charles Schwab site used an image to convey the risk level of a particular mutual fund. The images were named *Risk 1* through *Risk 5,* and they had no ALT text associated with them. The image itself did not use a numeric risk level, but rather indicated a high, medium, or low risk level. It would have helped screen reader users to have the images named *High Risk*, *Low Risk*, etc., or to have the ALT text provide this information.

If an image contains relevant information, use the LONGDESC attribute to thoroughly describe the image. This is obviously a good recommendation for any items that you are selling. Also, you should thoroughly describe any information in graphical timelines or hierarchical images.

On the Japanese e-commerce site, Ways Shop, several buttons were not properly labeled. The screen reader read only the words *Push button.* Sighted users would see these words in Japanese on the buttons:

- *Change amount* (white button)
- *See my shopping bag* (light blue button)
- *Check out* (red button)
- *Continue shopping* (navy blue button)

The picture below shows four buttons: *Change amount, See my shopping bag, Check out,* and *Continue shopping.* The screen reader read all of these as *Push button,* due to underused ALT tags and button naming.
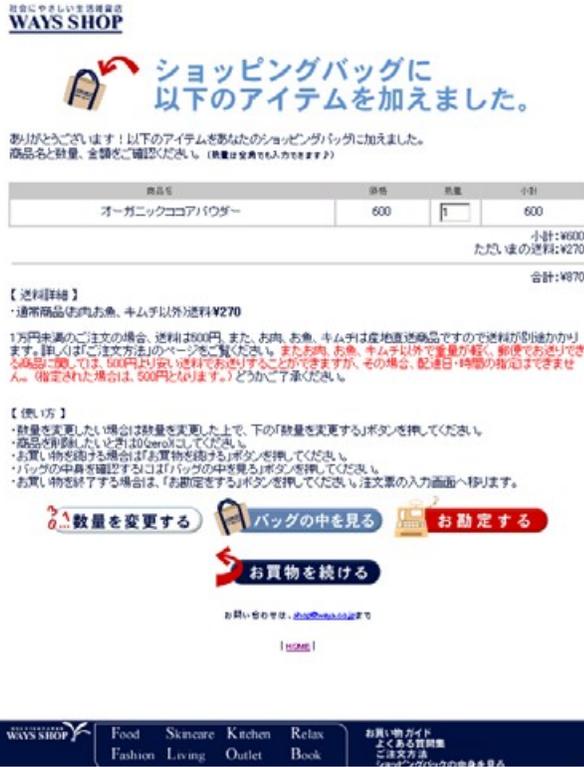
In another example, there was no clear difference between the buttons that appear under each item when read by a screen reader. The words on the buttons, as seen by a sighted user, are: *Description of product* and *shopping.* When the screen reader read them, it said: *Go to otsuka_product_detail,* and *Go to otsuka_product_select.*

The following picture shows a page on the site of the large Japanese company, Otsuka Plus-1, http://www.otsuka-plus1.com/. Screen readers do not differentiate well between the two blue buttons that appear under each item.

> **NEVER BLUR PICTURES TO INDICATE UNAVAILABILITY.**
When graphics are blurred, it makes it even more difficult for people with low vision to decipher the picture. And, since the screen is zoomed in so closely, the context provided by other unblurred graphics is often lost.

The U.S. Internal Revenue Service website blurred some graphics to indicate unavailability. A better idea is to remove graphics altogether when they are not available.

On the IRS website, when the *Previous* and *Next* buttons are inactive, the pictures are blurred. This is not a good design for people with low vision.
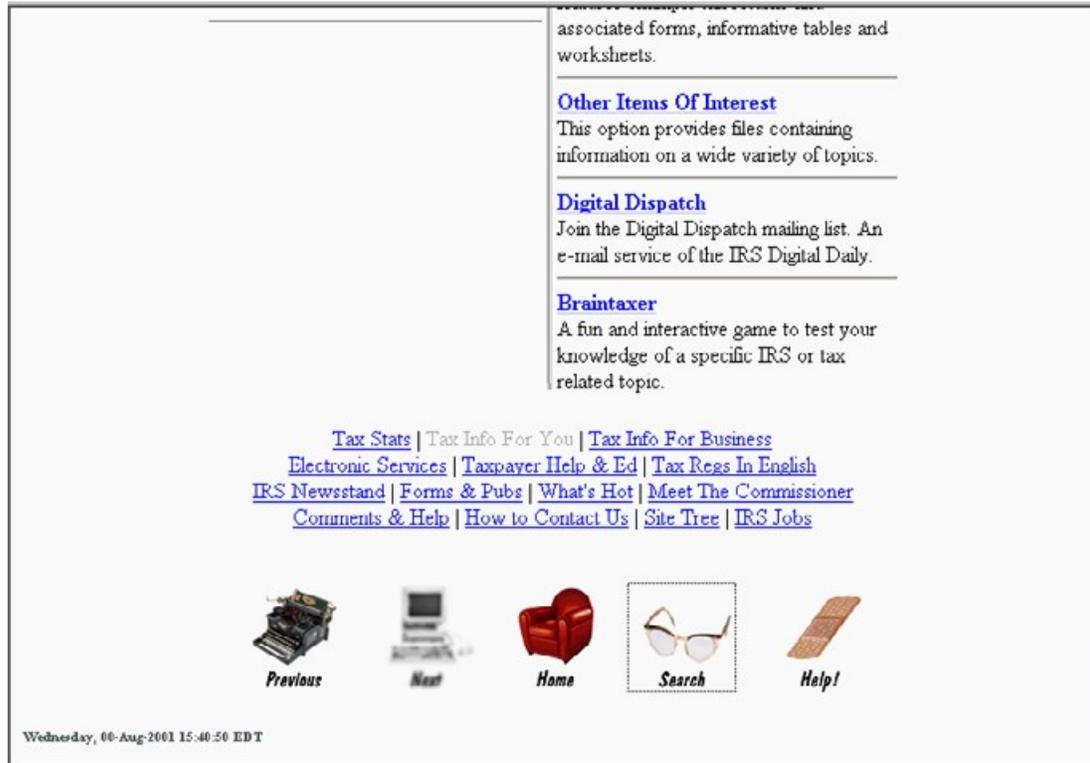
> WHEN GRAPHICS CONTAIN USEFUL INFORMATION, ALSO PROVIDE THE INFORMATION IN TEXT.

Some graphics are just stock art or logos, and even if described, a person who is blind or who has with low vision might not get much information from them. There are times, however, when graphics comprise useful information. When this is the case, users should be able to access it in HTML.

On the Rock and Roll Hall of Fame website, one screen reader and Braille user found a timeline of rock-and-roll related events. She initially thought she would be unable to read it; she was surprised and glad to find the timeline available in HTML.

On one of the Otsuka Plus-1 site's pages, all content is provided in graphics. Participants using screen readers could not understand any of the page's content.

The following page content was completely hidden in graphics that screen reader users could not access.

会員サービスのご案内

会員登録頂くと次のようなサービスが受けられます。　　会員登録は無料です

ギフトサービス　　　　　　　　　　　　　　　　　詳しくはこちら

用途に合わせたのし紙やラッピング、メッセージカードをお選びいただき
心のこもったギフトをお贈りいただくことができます。
中元歳暮時や陣中見舞い、差し入れなどにもご利用いただけます。

アドレスサービス

会員様ごとにインターネット上にアドレス帳を保管できます。
お届けされる住所をあらかじめご登録いただきますと
注文時に入力の手間が省けたいへん便利です。

クイックオーダー

プルダウンによる簡単選択で商品をお求めいただけます。
クイックオーダーサービスは定期的にご購入いただいている方、
ご購入される商品が決まっている方、商品の内容を既に
ご存知の方に便利です。

その他のサービス

管理栄養士による健康パーソナル相談が無料で受けられます。
会員優先のモニター企画にご参加いただけます。
健康、スポーツに関する情報の提供サービスが受けられます。

PRODUCED BY 大塚製薬

閉じる

> REFER USERS TO ALTERNATE WAYS FOR GETTING INFORMATION CONTAINED IN ANY GRAPHICS THEY ENCOUNTER.
Ideally, information in graphics and information in text will be tightly linked together. Until that ideal can be reached, some sites provide information both graphically and in text. The problem is that sometimes users find only the graphic, and are not aware that the alternate source exists.

On the New York City Department of Sanitation site, there is a very informative table of graphics that tells people which items they can recycle. This is very helpful for people who are sighted. But for people with low vision, it is extremely difficult to use. One person using a screen magnifier spent about 15 minutes trying to use it and said, "This is impossible for me. I can't use this."

The following page on the New York City Department of Sanitation site is very difficult for people with low vision to use, and impossible for people using a screen reader.

All the information in the recycling graphic is also available in text form on a completely different section of the site, but most users did not find it. Because they found only the graphic, they assumed that it was the only source for the information they needed.

A better design would show the text next to the graphic, or link to the text, so it is easier to find.

The picture below shows the text version of the information from the graphic above.

New York City Department of Sanitation

How Do I Dispose of ... ?

Don't Throw It Away! Before you throw anything away, the Department of Sanitation urges you to explore ways to help reduce the amount of garbage in New York City and make it an even better place to live.

A B C D E F G H I J L M N O P R S T U W Y

A

Abandoned Vehicle	see how to report Derelict Vehicles
Aerosol Can (empty)	see how to recycle Metal, Plastic, and Glass Recyclables
Air Conditioner	see how to dispose of appliances containing CFC / Freon
Aluminum Product	see how to recycle Metal, Plastic, and Glass Recyclables
Appliance	see how to donate appliances
Appliance (containing CFC / Freon)	see how to dispose of appliances containing CFC / Freon
Appliance (made of less than 50% metal)	see how to dispose of Regular Bulk
Appliance, Metal (made of at least 50% metal)	see how to dispose of Metal Bulk
Art Supplies	see how to donate art supplies
Automotive	see how to donate vehicles

> DO NOT SHRINK DOWN A PICTURE OF AN ACTUAL PAGE ON YOUR SITE AND USE IT AS A GRAPHIC (OR BUTTON) ON ANOTHER PAGE.
Because screen magnifier users zoom in to view pages, small images can appear extremely large. On the Chicago Transit Authority website, images of reduced pages were used as navigation buttons. When you see the whole page at once, the relative sizes make this use perfectly clear. But at 6x magnification, for example, those thumbnail page images look like real pages.

The button users needed to click to access the *Trip Planner* form was actually a small picture of the *Trip Planner* form. The graphic is blurry, so people using a screen magnifier zoomed in. When they did this, they thought they were looking at the actual form and tried to fill it in.

The following picture from the Chicago Transit Authority website shows the graphic users must click to access the *Trip Planner* feature. The button is a shrunk-down version of the actual *Trip Planner* form.

Click the image above for Trip Planner.

The Charles Schwab site also showed a small picture of an inactive tool. Users with low vision had magnified the picture of the tool so it looked the actual tool, and they tried to use it. One participant with low vision who had been clicking the arrows said, "Maybe this would be more meaningful to someone more familiar with mutual funds… Looks like they give you more info if you use these buttons to scroll back and forth. I'm reluctant to spend time fiddling with this because I'm not sure it has what I'm looking for… They seem to give some info about returns, but they don't seem to say what the content is, what kind of investment it is… I'm getting the impression that this perhaps is not their full list of funds, but just the funds they're promoting. Maybe what I'm looking for is someplace else… If I click on these samples, nothing's changing. It's not letting me select what I want from the chart."

Another user had the same problem and said, "OK, now I'm pretty much lost… I'm not getting anything."

The following picture shows a full page at the Charles Schwab site, which included a shrunk-down image of an actual tool.
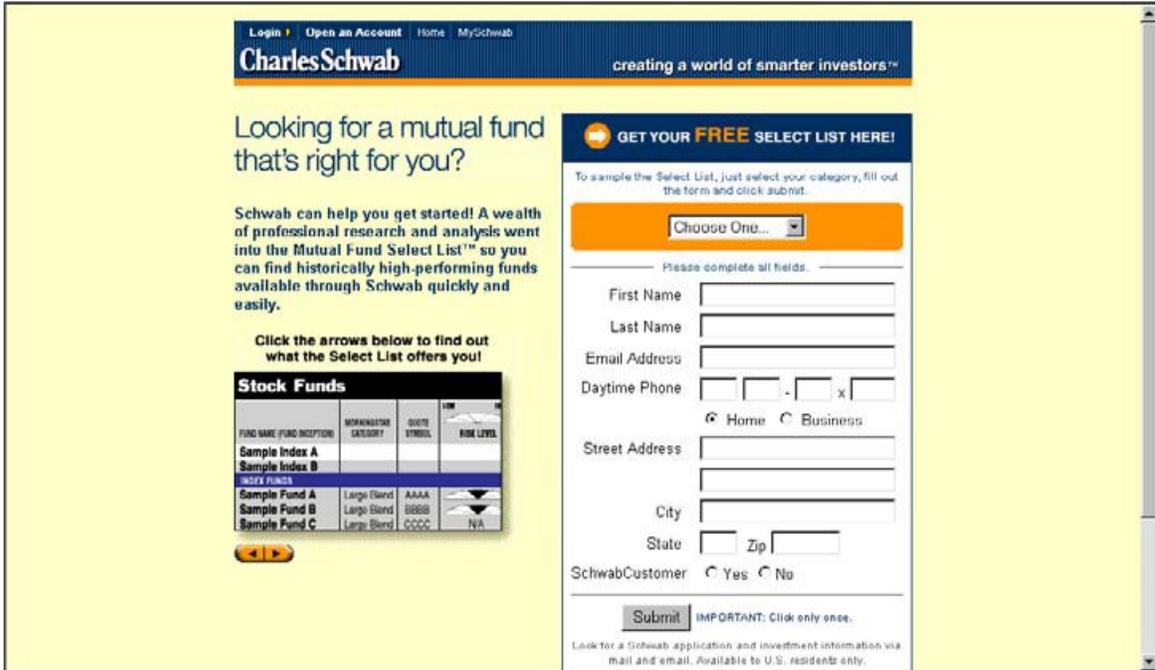
The following picture shows the shrunk-down picture of the tool as it appeared magnified.
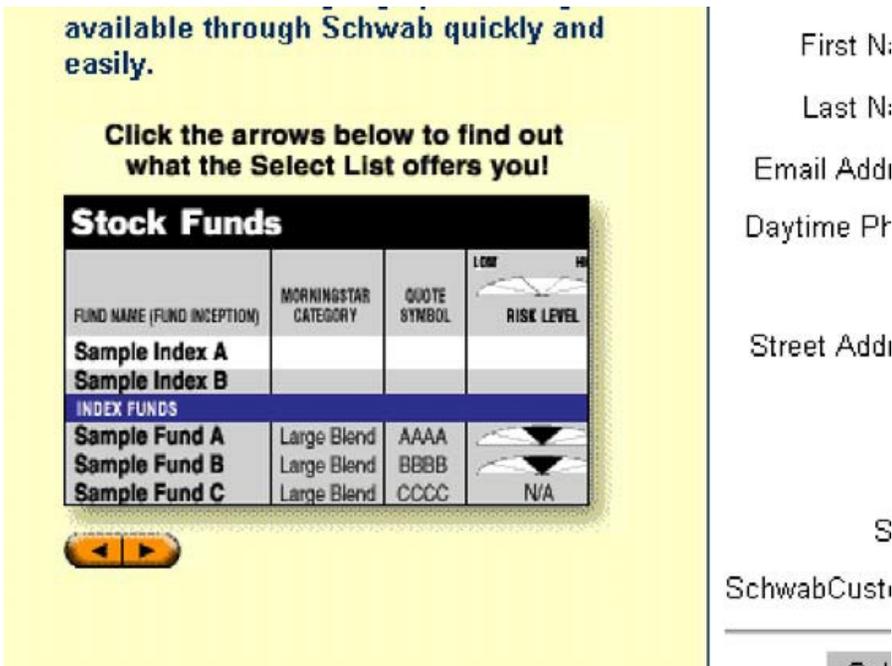
> WHEN YOU DO USE GRAPHICS, ALWAYS CHOOSE CRISP AND CLEAR IMAGES.
People with low vision have trouble telling what some blurry graphics are, even when they magnify them. Pictures of text pose problems as well, because the letters tend to get blurrier as they are magnified.

When one participant with low vision encountered a blurry graphic, he said, "Do I have to download something? If there's print here, I can't read it at all. Give me some information here. You're pretty, but… Is this something I'm supposed to download? It's not clear at all."

> MAKE IT EASY FOR USERS TO SKIP ANY MULTIMEDIA AND FLASH DEMOS.
Some screen readers simply cannot read Flash demos or other multimedia (or Java applications). Also, when any sounds play on a site, screen reader users often need to mute them in order to hear the screen reader.

Make it very easy for screen reader users to avoid any multimedia altogether.

> DO NOT AUTOMATICALLY CREATE A TEXT-ONLY VERSION OF YOUR SITE.
People using screen readers did use the text-only versions of sites when they were available, as did a few people using screen magnifiers. Offering a text-only version does not release designers from making the graphical version accessible, however. Knowing that graphical sites should be accessible, organizations must choose the best use of their resources; creating and maintaining two site versions is costly and time-consuming.

The best candidates for additional text-only sites are those companies that are attempting to use images or multimedia to portray a certain impression, feeling, sensation, or emotion with their site. If the "cool factor" is your business, do what is right for your company, and also provide a text-only version of the site. On this version, strive to describe in text the messages you are otherwise sending through multimedia.

Also, keep in mind that even in a text-only version, accessibility issues can still occur. For example, fields and buttons still appear and must be attended to. And in any case, the homepage users hit before they can choose text-only must be accessible.

The Internal Revenue Service, www.irs.gov, offers a text-only version of their site that gives the same information as the graphical site.

The homepage also reads several graphics and other information that is not understandable before users get the text-only option:

> "i r s dot gov h t t p colon slash slash dot irs dot gov slash
> page has twenty two links graphic printed daily and it's free
> graphic graphic of spinning globe and you don't have to recycle
> graphic the digital daily special edition dot sept twenty five two thousand one
> left paren two hundred two days until april 15 t h right paren dot dot
> visited link left bracket text only version right bracket go to the dot dot dot
> graphic side bar separator
> graphic link i r s disaster relief web page
> graphic side bar separator
> Graphic link message for i r s nyc dash metro area employees
> graphic side bar separator
> graphic link digital daily slash i r s dot gov home page
> graphic side bar separator
> graphic i r s addresses at"

Also, notice that there is a button and a field that users must be able to understand, even on text-only site pages.

The following picture shows a graphical page on the IRS site.

The following picture shows the text-only version of the page above.

Forms and Publications

Some days, finding your socks can be a real challenge. But putting your finger on a certain bit of information can be an even tougher task. That's why we're here to help you uncover those cumbersome layers and get right to the heart the matter. Just enter your keyword(s) below and select the 'Search' button to begin your pursuit of Forms and Publications available for downloading. Things are beginning to look brighter already

[Click for Graphics Version]

Keywords: [   ] [Search]

Tax Stats | Tax Info For You | Tax Info For Business | Electronic Services
Taxpayer Help & Ed | Tax Regs In English | IRS Newsstand | Forms & Pubs
What's Hot | Meet The Commissioner | Comments & Help | Site Tree

[Previous] [Home] [Search] [Help!] [Email]

Thursday, 28 May 1998 06:22:11 EDT

A few participants recommended the BBC, www.bbc.co.uk, text-only site.

The picture below shows the text-only version of the BBC's home page.

Pop-Up Windows, Rollover Text, New Windows, and Cascading Menus

> AVOID USING POP-UP WINDOWS.
Pop-up windows were disorienting and often bewildering to people using screen readers and magnifiers, and often to people with motor skill disabilities as well.

For people using screen readers, it can be a big problem if they click something, expect a certain page, and then hear something completely foreign like the contents of an unexpected pop-up window. The information they want, expect, and need is often right behind the pop-up window, but since the window focuses on the pop-up and that's what the screen reader reads, the user has no idea that what they want is right there. One participant noted, "You press a link and you end up someplace way far from where you were and *Back* won't work. The only thing you can do is close the window."

It is important to note that for users with screen readers or magnifiers, even a very small pop-up window eclipses the pages behind it. For example, on the Chicago Transit Authority's website, a person who is blind might go there to figure out how to take public transportation. Like many transportation sites, this one offers a *Trip Planner* feature that lets users type in their starting street and their destination. They can also choose arrival and departure times. When they click the *Trip Planner* graphic, the site takes them to the *Trip Planner* form. However, there is a pop-up window in front of it that is selected. Although it's a small window, for people using screen readers or magnifiers, it effectively eclipses the page behind it. In one instance, the screen reader read "*Trip Planner*" but the screen focus was still in the pop-up window. The user typed in her information, but the focus was not in a text box. She was lost and said, "I can't make heads or tails of this. I feel like such an idiot."

On this same site, when a participant found the *Trip Planner* window after missing it several times because of the pop-up, she asked, "Why didn't I see this before? How did this appear? I didn't even see where it appeared as an option. I would have gone here first."

The picture below shows the Chicago Transit Authority website's *Trip Planner* page, and the selected small pop-up window in the upper left.
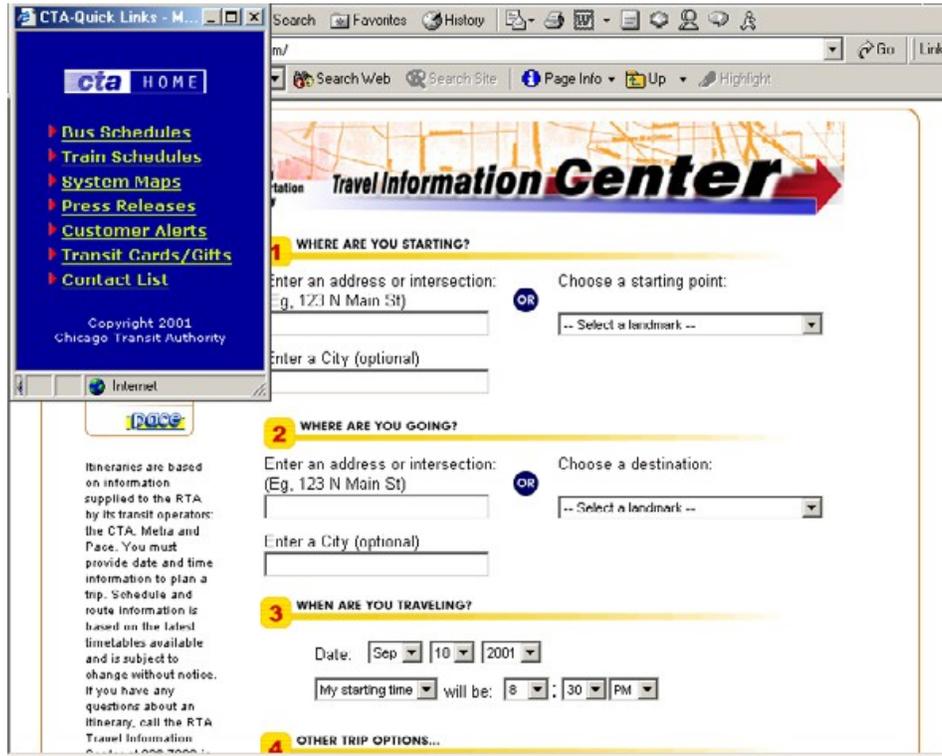
The picture below shows the same page as it looks with a screen magnifier.
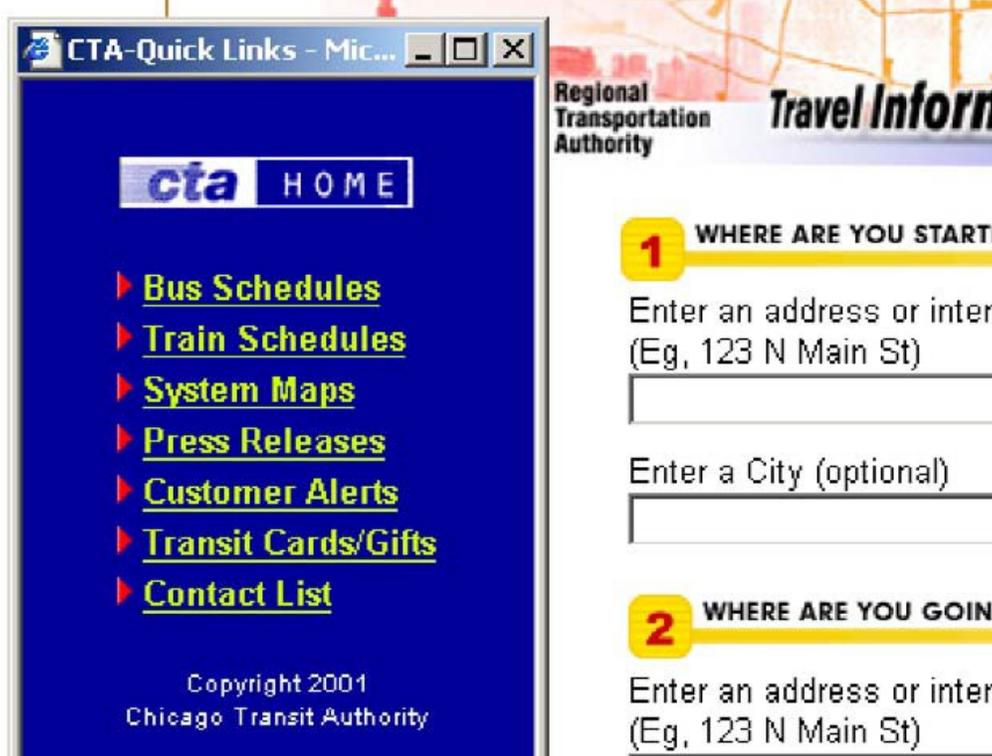
What JAWS 3.71 reads after the users clicks the graphic to get to the *Trip Planner* form is transcribed below; the small pop-up completely eclipses the form behind it. The user clicked *Trip Planner,* but the reader describes the pop-up window contents rather than the *Trip Planner* page.

> "h t t p colon slash slash w w w dot transit chicago
> dot com slash maps slash trip remote dot h t m l
> dash microsoft internet explorer
>
> page has eight links
>
> c t a dash quick links visited link graphic chicago transit authority
>
> graphic c t a link bus schedules
>
> graphic c t a link train schedules
>
> graphic c t a link system maps
>
> graphic c t a link press releases
>
> graphic c t a link customer alerts

graphic c t a link transit cards slash gifts

graphic c t a link contact list

copyright two thousand and one chicago transit
authority"

> IF YOU DO YOU USE POP-UP DIALOG BOXES, MAKE SURE THE DEFAULT ACTION IS THE MOST FORGIVING.
Users with low vision might not want to scroll through an entire dialog box that they didn't want in the first place. For example, with security alert boxes, some users just press the *Enter* key without reading the message. This got them into trouble in other instances; some inadvertently started down the path of installing Flash or Real Player, which they didn't want or expect to do.

> AVOID OPENING NEW BROWSER WINDOWS.
As with pop-up windows, we saw several instances where a new browser window opened and obscured the window behind it. When people tried clicking *Back* it didn't seem to work, and they usually ended up closing the browser altogether to recover.

> IF YOU DO OPEN NEW BROWSER WINDOWS, ALWAYS PROVIDE A SIMPLE WAY TO GET BACK TO THE SITE'S MAIN HOMEPAGE.
At times, people using screen readers did not realize that several browser windows were open at once. If a site automatically opened another window, and the *Back* button failed them, people looked for a link to get to the homepage.

The following image shows what a security alert message looks like to people using a screen magnifier.
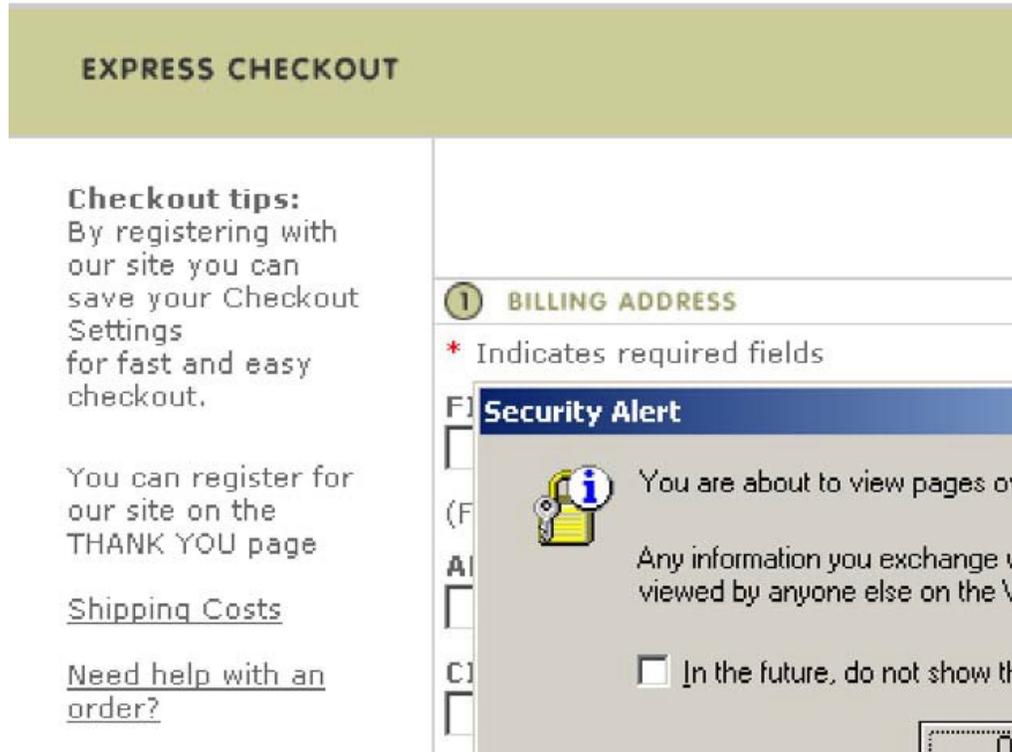
> DO NOT RELY ON ROLLOVER TEXT TO CONVEY ANY INFORMATION.
Words that appear and disappear because of user actions, such as pausing or moving the cursor over a specific area, should not contain important information; many users will not perform the action or be able to access the information for any number of reasons. Do not rely on rollover text. You need not remove it, just ensure that you supply the same information in another, more readily accessible form.

Typically, people using screen magnifiers cannot read rollover text. Often the screen is zoomed in so much that they see only small segments. When they move their mouse over an image and a description pops up, a few confusing things can happen: 1) They are not sure what is happening at all, or 2) they can only read part of the text, and 3) if they move their mouse so as to see more of the zoomed-in screen, they are no longer hovering over the image and the rollover text disappears. We saw these problems occur repeatedly, and in most cases, the person using the screen magnifier was never able to read the rollover text at all.

One participant with low vision commented, "When I go to move it, then I lose what it says. Very annoying… I could read it, but when I moved slightly, it wasn't there anymore."

Because it's nearly impossible to ensure that rollover text always appears directly over the image it describes, use ALT or LONGDESC instead. When rollover text appears far from the image it describes, it's even more likely that screen magnifier users will be unable to read it.

The following picture shows the Chicago Transit Authority website, zoomed in. When the mouse is over the *Maps and Schedule* link, a *Maps and Schedules* rollover appears, but not close enough to the image for a person using a screen magnifier to see it.
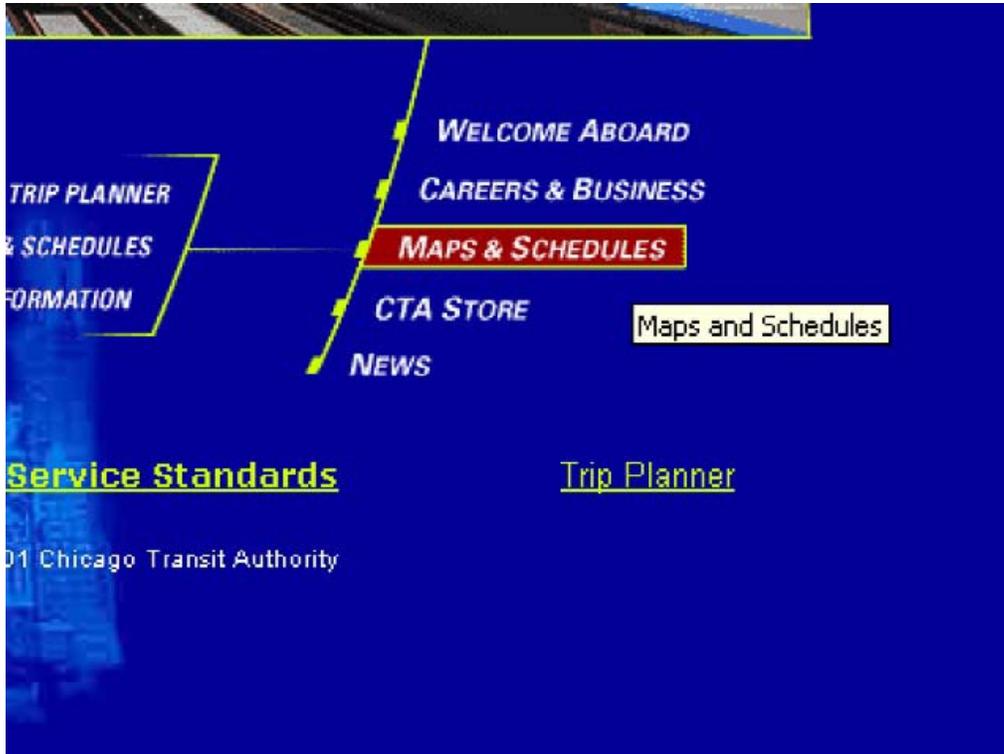
With the screen above magnified further, the user cannot read the rollover text. When the users scrolls to see it, moving the mouse makes the rollover text disappear. This is common, time-consuming, and extremely frustrating.
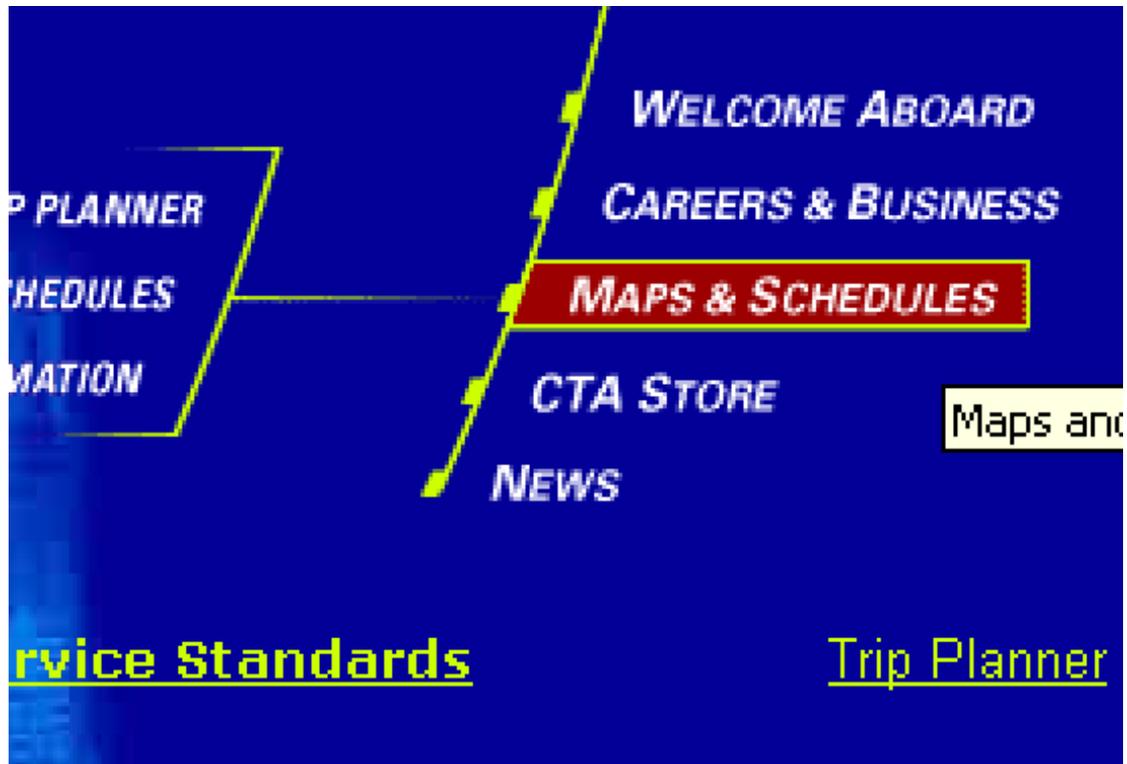
In some cases, if it's positioned very near or directly over the image, rollover text can help screen magnifier users. For example, on the Target website, a user had trouble reading the artist's name on a music CD. It was just too difficult to read the graphic. The rollover ALT tag text helped her identify the CD she was looking at.

The following picture shows a page of music CD's on the Target site, and an instance where the rollover text was more legible than the text on the page.
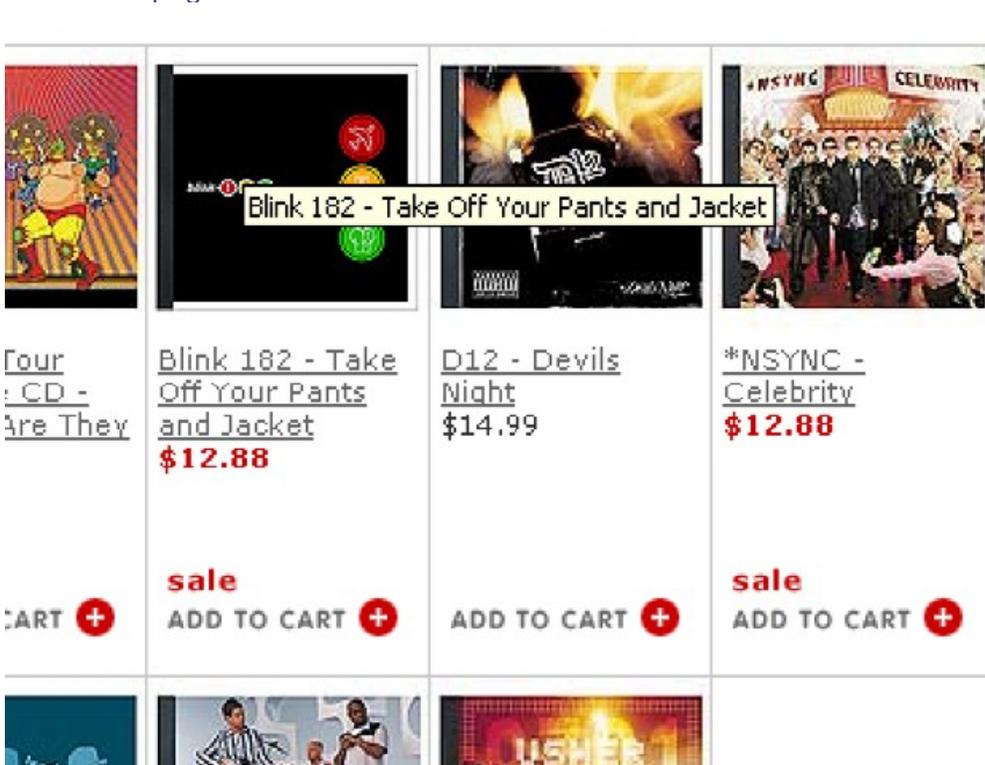
> **AVOID USING CASCADING MENUS.**

People using screen magnifiers and people with motor skill challenges had a difficult time using cascading menus. These implementations rely on users being able to drag and hold the mouse while clicking with precision. Also, for screen magnifier users, the same issues that arose in our pop-up tests occurred with cascading menus. In some cases, the screen was very jumpy and hard to follow. In other cases, important items fell off the screen and were not visible. Flat menus are easier to use.

Note: if your site's menu structure and navigation are based on pop-up windows or cascading menus and you can't change it, offering another version of your site in text-only might be a good solution.

Links and Buttons

> LIMIT THE NUMBER OF LINKS ON A PAGE.
We recommend that each page have no more than 20 links.

Listening to a screen reader is like looking through the links on a page. While some users speed-up screen readers to read many words per minute, they still can only hear words one by one. They cannot simply glance at things.

Some users listen to the whole page and don't click until they think the page has been completely read. One user said, "When it gets to stuff like *privacy policy,* that is usually a safe bet to assume that is the end of the page." This same user listened to 40 links before he realized he was on the wrong page. Other users click the first link they think might be right. The fewer links a page has, the more likely it is that people using screen readers will wait for the right one to be read.

One user with cerebral palsy used the arrow keys on his keyboard to move and scroll instead of using a mouse. Scrolling with the arrow keys made scrolling tedious and tiring. Pages that were very large or had many links exhausted him.

It is also difficult for users with low vision to scroll to see many links. One user commented, "One site had 162 links, and that's a lot of reading in large print."

Users do expect some links on pages, however. Don't go too far the other way and have only one link on a page. One user encountered this and said, "If there is only one link you know it's really weird, or you bypassed it [the homepage.]"

> AVOID VERY SMALL BUTTONS AND TINY TEXT FOR LINKS.
It's difficult and tiring for people with motor skill challenges to hit small targets. One user with cerebral palsy was using a touchpad and took several tries to get the mouse to hit the small picture. She was using the Environmental Protection Agency, www.epa.gov, jobs site. The following is an example of a design with links that are too small: The style sheet specified 8-point type.

On the page shown below, from the EPA site, the links in the *Highlight* section on the right, including the *Jobs* link, are very small, making it difficult to read for people with low vision.

The following picture shows a tiny blue link at the bottom of a page on the Japan Weather Association site, http://www.jwa.or.jp. The link was difficult to find because of its position and size.

> **LEAVE SPACE BETWEEN LINKS AND BUTTONS.**
For people with motor skill issues or low vision, space between buttons and links is extremely important. Aiming for a specific target can be difficult, and it is troubling and frustrating for people when they accidentally miss the target, or worse, hit another target that is very close. Sighted users also sometimes accidentally hit the wrong links when links appear too close together. Leaving blank space between links and buttons helps eliminate this problem.

On CNN.com, one user with low vision tried to click *Weather* but clicked *Business* instead. She went back and tried again to click *Weather*, but clicked *Health* instead.

As the picture below shows, the links on the CNN site's blue, left-side navigation bar are too close together.

> **AVOID USING IMAGES AS THE ONLY METHOD FOR LINKING TO SOMETHING.**
On the Chicago Transit authority site, after users click *Trip Planner,* they are brought to another page where they must select the graphic of the shrunk-down version of the trip planner page. When listening to the page being read, screen reader users were not expecting to need to click another item to get to the trip planner. The description of what to do next was not helpful either, telling users to click "the image above" and "the image on the left."

When users click the *Trip Planner* button, JAWS 3.71 reads the following text. However, users have not yet reached the desired form; they are on an intermediary page and must click the graphic to get to the form.

"c t a vertical bar chicago transit authority dash trip planner dash microsoft internet explorer
page has nine links
table with five columns and four rows

graphic trip planner maps and schedules c t a back link graphic help visited link graphic home

plan your c t a trips on the web

visited link graphic click here for r t a's trip planner left paren 9 k b right paren click the image above for trip planner

for a convenient and easy way to plan trips on the c t a click the image on the left for the r t a's itinerary planning service

this service can help you find the quickest or most direct transit route to your destination using c t a buses and trains

table end

visited link graphic home link graphic help this page link graphic top of page visited link graphic back link contact us copyright two thousand one chicago transit authority"

> ENSURE THAT IMPORTANT COMMANDS APPEAR AS THEIR OWN UNIQUE LINKS.
Naming links and graphics is not always enough, and repeating what the visible page shows does not always help. When screen reader devices read pages, they usually don't pause in the right places, so unless the page designer adds it, there is no indication for pauses. It is the site designer's responsibility to separate all commands and links so that people using screen readers can hear important commands.

For example, some sites have an entry homepage, and users must click an *Enter Site* link. On the Rock and Roll Hall of Fame website, as a sighted user, it's relatively easy to see the *Enter>* link on the homepage. But, the word *Enter* is read by a screen reader and displayed on a Braille device as part of the image. (…graphic rock plus roll hall of fame and museum enter this website is best…)

Users completely missed the word "enter" and instead clicked the later, more obvious link to install Flash. They were really confused by this. After a few tries, one Braille user said, "I thought I got to a link, but I think it is a place where you can download something." After several minutes, she did click the graphic and said, "There is a picture here. It says *graphic*. Kind of annoying because there was no information except that it was a graphic. Oh, there is a ton of information here. There was nothing on that graphic that said, 'Oh, go look, here is what you want, the information.' I wasn't even on the homepage. This is the homepage. I guess that's another thing, I couldn't even tell before that I was on the homepage. There is a ton of information here. Jeez. There is all this stuff. All I had to do was click on this graphic… I really didn't know what that was."

The following picture shows the Rock and Roll Hall of Fame website, and the *Enter* link.
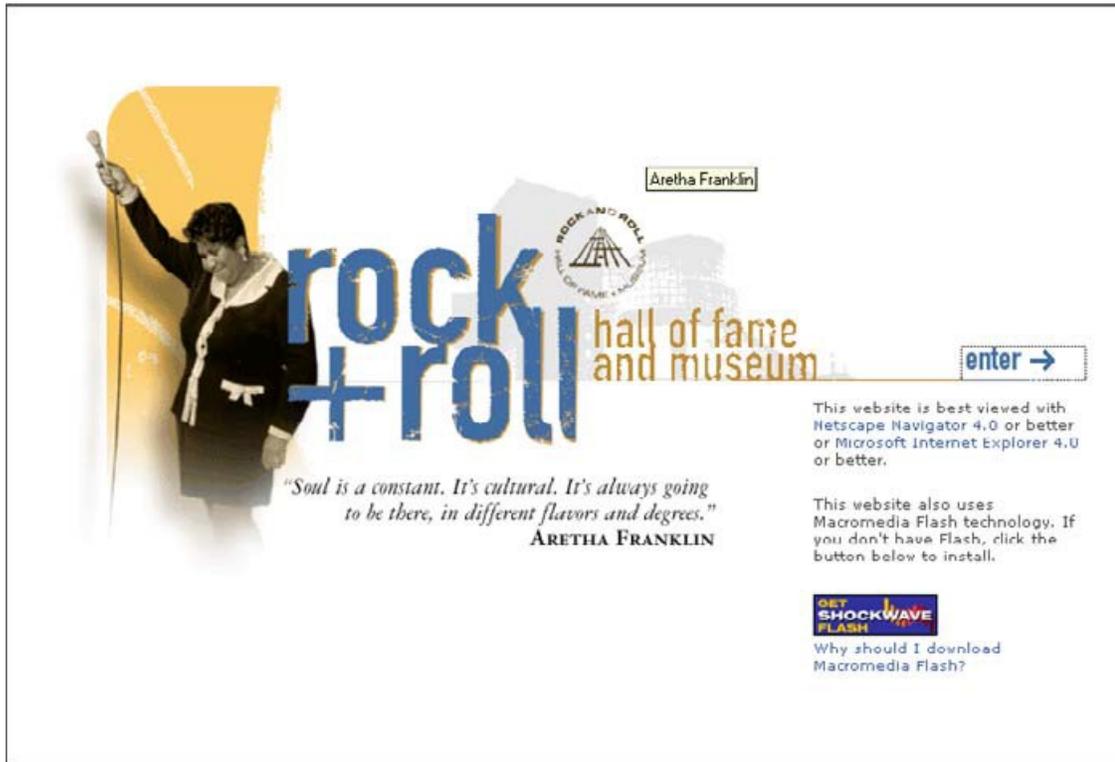
JAWS 3.71 read the www.rockhall.com page:

> "page has five links
>
> *small pause*
>
> graphic Aretha Franklin
>
> *small pause*
>
> graphic rock plus roll hall of fame and museum enter
>
> this website is best viewed with link netscape navigator four point oh or better or link microsoft internet explorer four point oh or better this website also uses macromedia flash technology
>
> *small pause*
>
> if you don't have Flash, click the button below to install
>
> *small pause*

link graphic get flash link why should I download
macromedia flash" *[small inflection to indicate question
on the word "flash"]*

> UNDERLINE ALL LINKS.
This is a common Web design recommendation but is worth repeating in this
accessibility context. (Note that underlining links is a browser function; designers
shouldn't try to defeat it.) Underlines are especially important for users with low
vision. When a page is zoomed in, it is difficult to discern some of the more subtle
link indicators, like bold or blue text. Underlines are easier to see when the screen is
magnified.

This shows a page from the Japanese Otsuka site. Users found it
difficult to tell which items were banners or text, and which were links.
The gray rectangle with the blue dot is a product ad that links
nowhere. Also, some links- under the red, purple, green, and blue
buttons- are blue text but are not underlined

> CREATE LINKS WITHIN TEXT WHEN IT MAKES SENSE. USE ADDITIONAL BUTTONS ONLY WHEN IT'S NECESSARY.

If it is simple to create an underlined text link, do this. On the Schwab site, the designers used a *Go* button. A better design would be to provide a link within the text. Users tried to click *Select List* when they really needed to click *Go*. They also tried to click *Mutual Fund Screening* when they needed to click *Go*. After a user with low vision finally saw the *Go* button, she said, "I didn't see the *Go*. Maybe they should have put the *Go* to the right instead of underneath."

Another user who didn't see the *Go* button said, "There should be a hyperlink for that."

The following picture shows a magnified page from the Schwab site. The *Go* button link should instead be just a link within the text.

Page Organization

Good page organization means different things for sighted users, screen reader users, and screen magnifier users. To help demonstrate this, we deconstruct the White House's homepage, www.whitehouse.gov.

One of the very first things a screen reader reads, is "Welcome to the White House." While writing this on a homepage seems outdated, for screen reader users, it is helpful to hear the page title. It confirms to the user, right away, that they have hit the right site. This particular example is noteworthy because the same address with a .com extension instead of a .gov extension is an adult site.

The White House home page does a nice job of organizing the order of what is read. Even though these links are invisible to the eye, one of the first options a screen reader will read is "skip to content." This lets you quickly skip the navigation area and go straight to the page content. And, even though this option is visibly available at the very end of the page, "text only" is also one of the first links a screen reader will read. Finally, "search" is also among the first audible links. This lets users know that search is available and that if they want to, they can easily select it and skip listening to all the text.

This handy trick is easily accomplished by using either small, visible graphics or transparent graphics at the top of the page that link to the various destinations. These invisible links are available to both screen reader users and browsers that provide link lists.

There are some things at www.whitehouse.gov that are not very usable for screen reader users. For example, the homepage has 62 links. This is a lot for a screen reader to read through. Also, there are several tables on the page, such as: "table with 2 columns and 7 rows…" This is not very informative or helpful.

The following shows the White House homepage.

For screen magnifier users, there are several issues. First, the classic cursive font used for some headers will most likely be difficult to read when the screen is magnified. Also, we saw in our studies that, ironically, the default royal blue color commonly used to indicate links does not show up when magnified. This is probably a bug, but we have seen this in several cases.

For users with motor skill challenges, there are also a few issues. The navigator links on the left are very small. The "Full story" buttons on pages are also tiny. It's difficult for some people to hit these small targets. Further, there is very little white space between these links. Hitting such small targets when they are positioned so closely together can be extremely difficult.

> IMMEDIATELY CONFIRM THE COMPANY NAME ONCE THE HOMEPAGE HAS LOADED.
Screen reader users, during our studies, were frequently unsure of the site they landed on. While a sighted person might see a company logo, a screen reader user often just heard a cryptic URL being read. It's important that sites use both TITLE tags to name pages and ALT text on the logo, or provide the name of the site in text very near the top of the page. Some screen readers are set to always read the window title (TITLE tag) and others start with the first link or the first text, depending on the mode they are in when the page is loaded.

A participant using a screen reader hit the Major League Baseball homepage and said, "I like this because it tells me 'the official site of Major League Baseball' right away."

> IMMEDIATELY CONFIRM WHAT THE PAGE IS ONCE IT HAS LOADED.

As with the homepage, screen reader users need to know that clicking a link brought them to where they thought it would.

On the Hoover Dam website's *Volunteers* page, one participant using a screen reader said, "This is a lovely site because the first thing I hear here is 'Hoover Dam, volunteer program."

> **Note for browser designers:** Users of both screen readers and screen magnifiers had difficulty knowing when pages had completed loading. Screen magnifier users did not often see the top of the browser to check the animated browser logo. For screen reader users, they sometimes thought a page had loaded, but the screen reader never read the page. In several instances, screen readers did not read pages at all, and there was no indication to users that anything was even on the screen. (Use the TITLE attribute to briefly define the page.)

>DO NOT ASSOCIATE THE WORD *HOMEPAGE* WITH YOUR COMPANY LOGO IF YOU PLAN TO REUSE THE SAME GRAPHIC ON ALL PAGES.

Many sites correctly use their logos for links to their homepage. Naming that link is very important, however. We encountered a few sites that used *<company name> home* as either the name or ALT text for the company logo graphic. For example, when a screen reader user encounters the Environmental Protection Agency site, www.epa.gov, the logo is read as *Environmental Protection Agency homepage.* This is helpful when users are on the homepage. However, when the same graphic appeared on other pages, such as search results pages, the screen reader still read it as *Environmental Protection Agency homepage.* It's good to include a logo on all site pages. It's also good to use the logo to link to the homepage, particularly for your sighted users. However, the logo's ALT text should say something like "Link to <company name> homepage." That way, users would know it was a link, rather than thinking it was the current page title.

> MINIMIZE THE NEED FOR SCROLLING.

Screen magnifier users already need to scroll many times to see the entire contents of even a small page. When people use the scroll bar to scroll down a page, they must leave wherever they are and scroll to the right hand side, then use the scroll bar to move down the page. When they have moved down, they can scroll back to what they were reading and continue. This is time-consuming and can be tedious.

One participant with low vision noted, "A sighted person just sees what they need and clicks. For me, it's finding what I need to clink on, and then click on it, and then go to it."

Another participant with low vision said, "You really have to move the mouse around to make sure you're accessing the whole screen. It's not going to show you everything."

A third participant with low vision said, "It's really kind of difficult to find what you're looking for. You really have to know what you're doing. I like when it's simple: type it in and go. Plus, when the type is big, you have to move around to see the whole thing."

Users with motor issues seem to get fatigued when they need to scroll or type for extended periods. A user with cerebral palsy was using his keyboard, not a mouse or touchpad, to move the cursor. (He did have a mouse connected to his computer though, for the rest of his family to use.) Every time he had to scroll a Web page, it was very time-consuming and fatiguing. After hitting a target, he would often let out a sigh of relief.

> **WHEN USERS MUST MAKE A CHOICE, KEEP ALL POSSIBILITIES IN THE SAME VICINITY.**
It is difficult to find the balance between putting buttons and links too close together and too far apart. Screen magnifiers force users to scroll many times to see the choices on a page.

When shopping on the Target website, users are offered a choice: *Express Checkout* or *Enhanced Checkout.* When the screen was magnified, users could not see the second choice.

The two pictures below show a page from the Target site's shopping process. The first image shows the two checkout options. The second shows the magnified screen, where the *Enhanced Checkout* option is not visible.
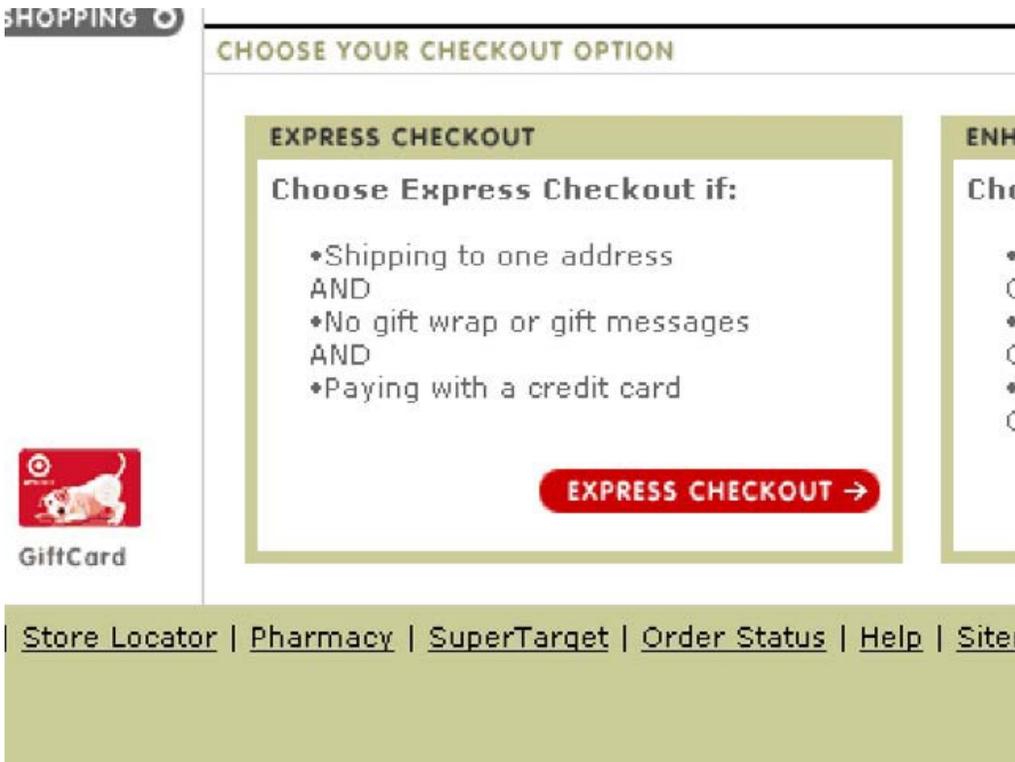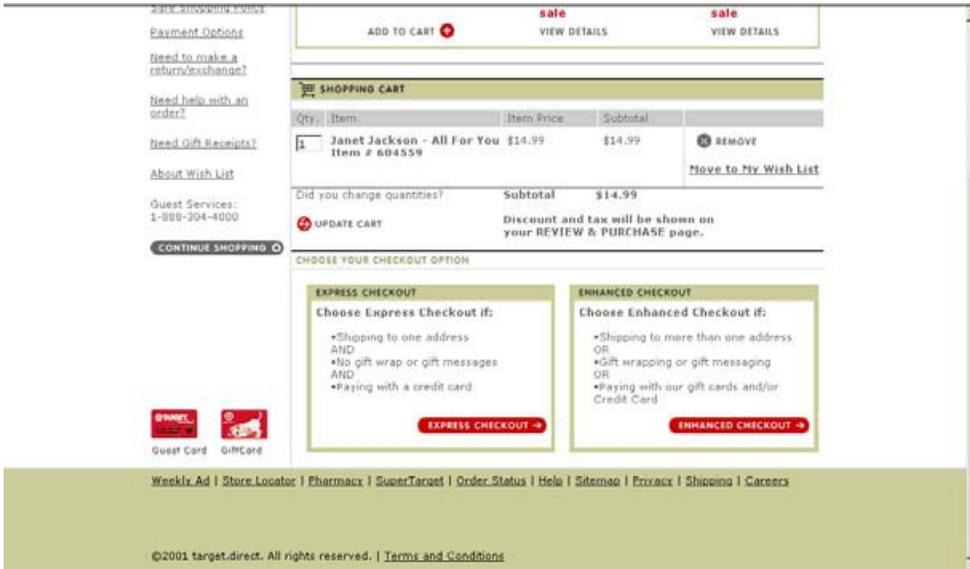
> WHEN USERS MUST MAKE A CHOICE, WARN THEM THAT THE CHOICE IS COMING, AND TELL THEM HOW MANY OPTIONS THEY HAVE.

When screen reader users are faced with choices, it is helpful if they know beforehand that they are about to hear a list of items that they're to select from. Also, since they must wait for the reader to read the choices, it's helpful to know how many choices are coming. This makes it less likely that users will become impatient and skip past the choices.

On the Target website, the *Choose Your Checkout* text which appeared above the checkout options was helpful because it indicated to people that they were about to hear more than one option for checking out.

> DESIGN PAGES CONSISTENTLY.

Design pages to use consistent navigation methods. This is particularly important for people with low vision using screen magnifiers. Since they cannot see the entire screen at once, the more they can predict where elements are, the easier it is for them to get an overall feel for a page. Organization should be as consistent as possible so people don't have to spend time relearning navigation on each page, which might prevent them from finding the page's actual content.

> CAREFULLY CONSIDER USING "SKIP LINKS" SO USERS CAN SKIP LINKS OR NAVIGATIONAL ELEMENTS.

When sites have a top navigation bar on all pages, it can be time-consuming for screen reader users to have to listen to it on every page on a site. They are looking for content, and can become frustrated when they must first wade through all the links at the top of a page. (This is also true when they are reading search results.) "Skip links" can help users avoid tedious repetitions of every single top and side navigation on each page.[6]

> CHOOSE A SIMPLE, INFORMATIVE WEB ADDRESS FOR YOUR SITE, AND KEEP THAT URL IN THE ADDRESS FIELD AFTER THE PAGE LOADS. (MAKE WHAT APPEARS IN THE ADDRESS FIELD LOGICAL.)

The page URL is often the first thing people using screen readers hear. Thus, it's important to choose an address that conveys the organization name or site's purpose. Some sites already have chosen a simple and understandable URL. But, this is meaningless if the URL that ultimately appears is not the simple one that the user typed to get to the site. A front-page redirect can destroy an otherwise great URL.

For example, when you type www.mlb.com, you get to the Major League Baseball site. But, the URL that appeared and that screen readers read and Braille displays showed was http://www.mlb.com/NASApp/mlb/mlb/homepage/mlb_homepage.jsp.

This is long and not very meaningful. Further, since the letters *NASApp* are in the address, one screen reader user thought she was on the NASA website.

---

[6] "Providing 'Skip Links'" by Frank Gaine May 1, 2001 frontend.com: Usability InfoCenter

Intervening Pages

When people are using a screen reader or screen magnifier, they are really listening and looking for the best clues on every page. Extra pages and extra clicks do not help their efficiency, and in fact, lead to frustration.

The Abercrombie and Fitch website's opening page has the company name and a young man wearing football padding. This tells screen reader and Braille users nothing about the company or the website's purpose. Further, this picture is probably meant to create a specific aura, but it's lost on users who cannot see.

> The following picture of a young man in football padding tells screen reader and Braille users nothing about what Abercrombie and Fitch sells. Further, this picture is probably meant to create a specific aura, but it's lost on users who cannot see.
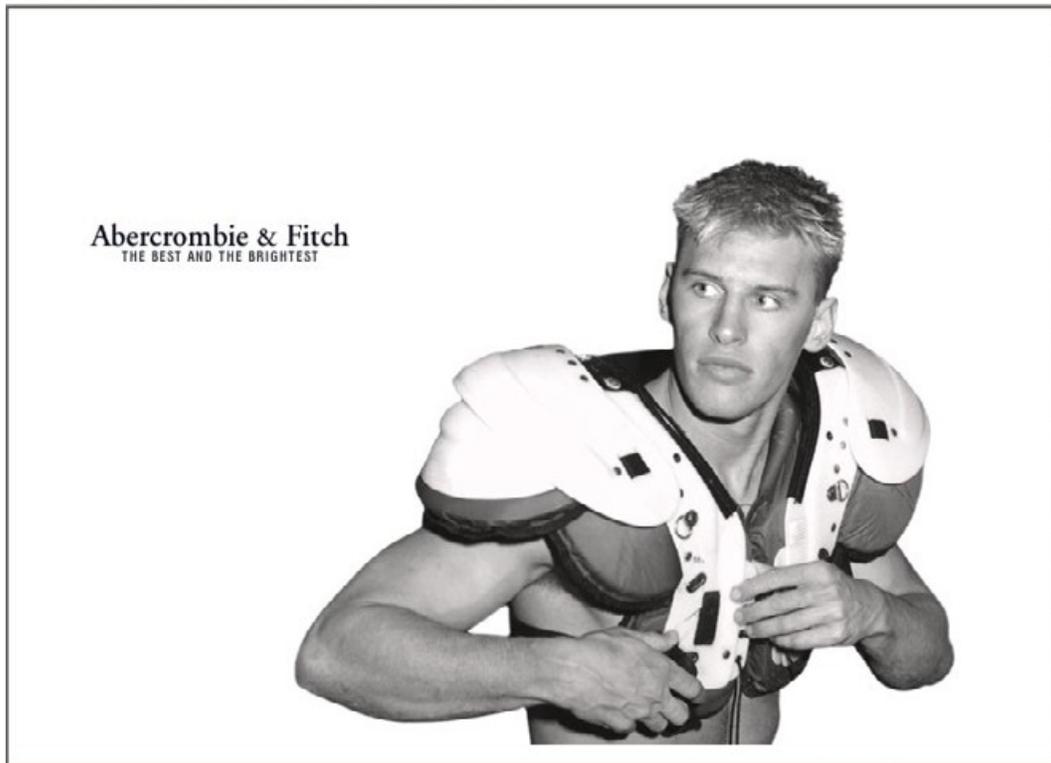
A participant using a screen reader hit the front page on the Abercrombie and Fitch website. She asked, "Why is there only one link... But all it tells me is there is a link. It just tells me HTML homepage. It just tells me Abercrombie and Fitch." Then she opened the links list dialog, using JAWS. "It just says 'HTML homepage, Abercrombie and Fitch. Lifestyles.' That's all it says. 'HTML homepage and Abercrombie and Fitch and lifestyles.' For reasons I cannot tell, I can't get by this." After some more thinking, she said, "It doesn't let me do anything, I can't get in there. You can't go anywhere. I happen to know their clothing. I know it is supposed to be HTML-based because it says HTML homepage, but I don't see

anything at all that lets me in. It says link one of one. If I look to see if there is a frame, there are no frames. And, there is nowhere to go. I think it is for development of their homepage. I don't think you can access their products from the homepage."

After the session, the facilitator explained that by clicking anywhere on the Abercrombie and Fitch first page, users were brought to another page that was more indicative of the company and products. The participant said, "I don't like that. It takes you to that one link, and you bypass all this other stuff I just found. [You never see the page with all the links.] I knew it should have been there."

Even though they could see the graphic, users with motor skill challenges were equally unimpressed with the intermediary home page. One user went to the home page and said, "This is weird."

The following page shows some jeans and says *shop*, giving a better indication of what Abercrombie and Fitch sells.
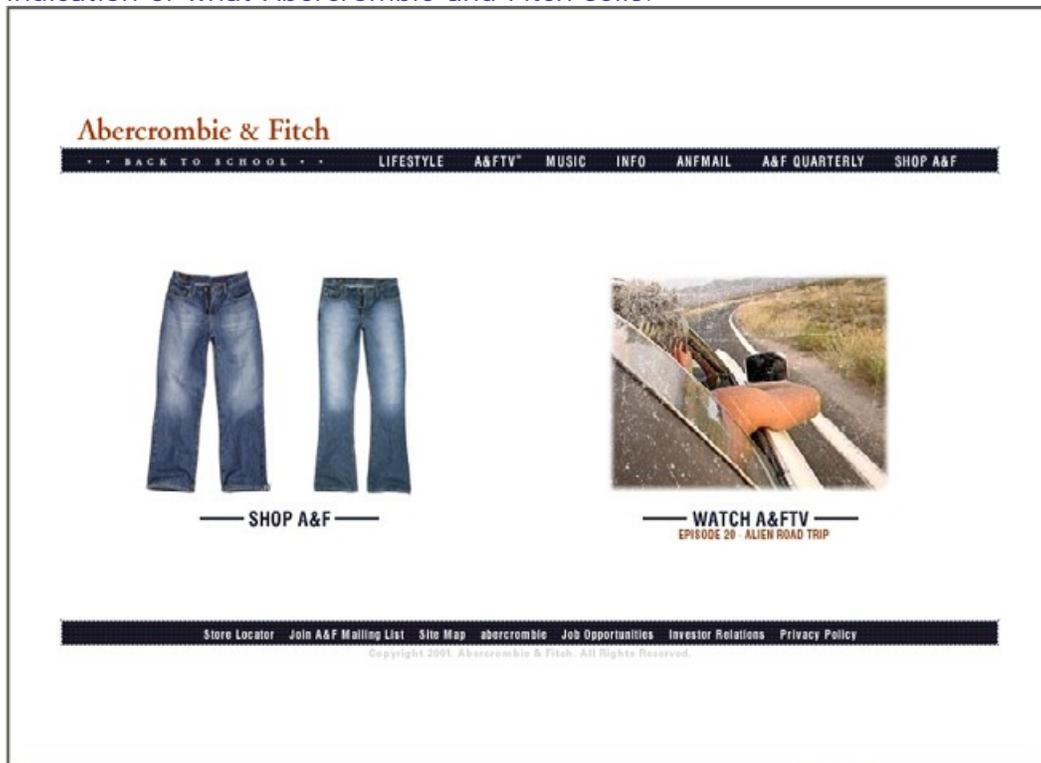
> **INCLUDE ONLY NECESSARY STEPS AND PAGES.**
Your site should lead users through the steps they expect and give them the pages they anticipate. Adding any extra steps is not helpful. For example, the Chicago Transit Authority website has a *Trip Planner* feature. Users click the *Trip Planner* button on the homepage, but rather than going to the *Trip Planner*, they are instead led to a page with a shrunk-down picture of the trip planner page. The user must then click the graphic to get to the real *Trip Planner*. There are numerous issues with the page's actual graphic (see the *Graphics* section of these guidelines*)* but the mere fact that users must take this intermittent step is a problem, and should be avoided.

The following picture shows the shrunk-down graphic users must click on to get to the *Trip Planner* on the Chicago Transit Authority website.

Forms and Fields

Some users with cerebral palsy had difficulty typing with precision, even when they were using a keyguard. This was especially true after testing for more than 30 minutes or so. They also had difficulty filling in very long forms.

The JWA site presents an order form logically. However, the form had so many items that users had to scroll a lot to see them all. One participant using a screen magnifier could not find a way to scroll down to order a book. He had magnified the page so that the right hand scrollbar was not visible, and when he moved the mouse pointer to the scroll bar, the book image on the left disappeared.

The following image shows the JWA book list page and a few of the many items on it.
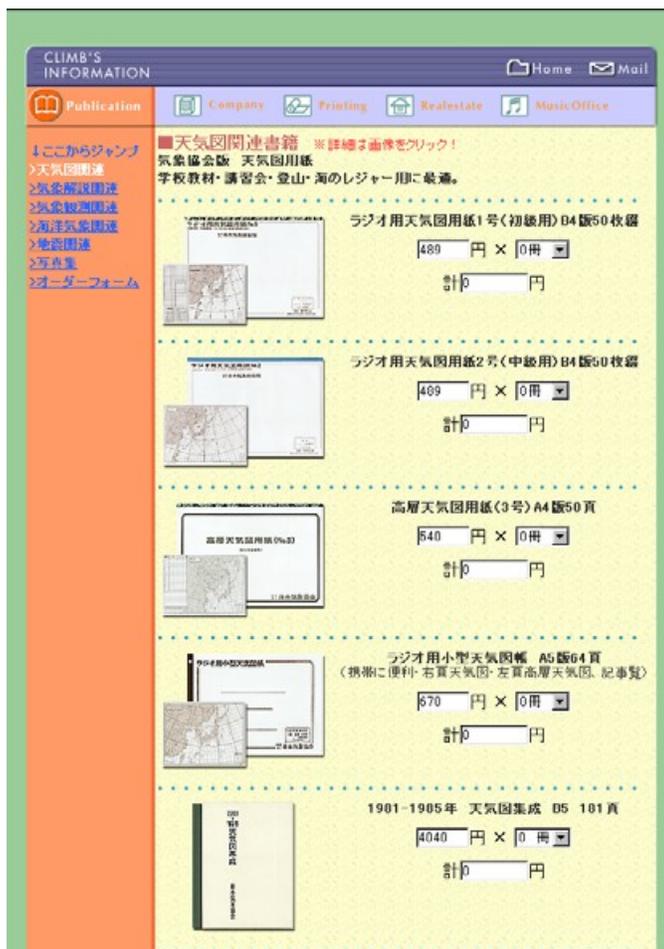
> PUT TEXT FOR FIELD LABELS VERY CLOSE TO THE ACTUAL FIELD.

When forms are magnified, parts of the page disappear. The farther a field's label is from its entry field, the more likely it is that magnified screen users will not see the label that accompanies the field entry box. Some users are aware of this and know they must scroll to see the label. Others look to the text that is visible and assume that the text closest to the open field belongs with that field. Also, when people increase font size through their browser, the designer's intended positioning of items can change.

On Ways Shop, a Japanese e-commerce site, the *OK!* button is close to the quantity entry field. Also, the box around the designated order quantity area may have helped users realize that they need to click *OK!*

The picture below shows a close relation between the *OK!* button and its entry field on the Japanese site, http://www.ways.co.jp/.

> DO NOT USE ONLY RED TEXT OR YELLOW HIGHLIGHTING TO INDICATE FORM ERRORS.

While it is essential to tell users the exact location of any form errors, red text is not the best indicator. Screen reader users and Braille users have no way of knowing which text is red.

On a magnified screen, red text is somewhat difficult to read. Also, screen magnifier users often invert colors to see things better. When they do this, the errors are no

longer red. When looking at an error page, one participant with low vision said, "I don't see any highlighted fields."

The following picture shows magnified red text on the Charles Schwab site. The red text indicates error, but when magnified it is difficult to read.

The following picture shows a magnified and inverted color error form
on the Charles Schwab site. The error text is no longer red.
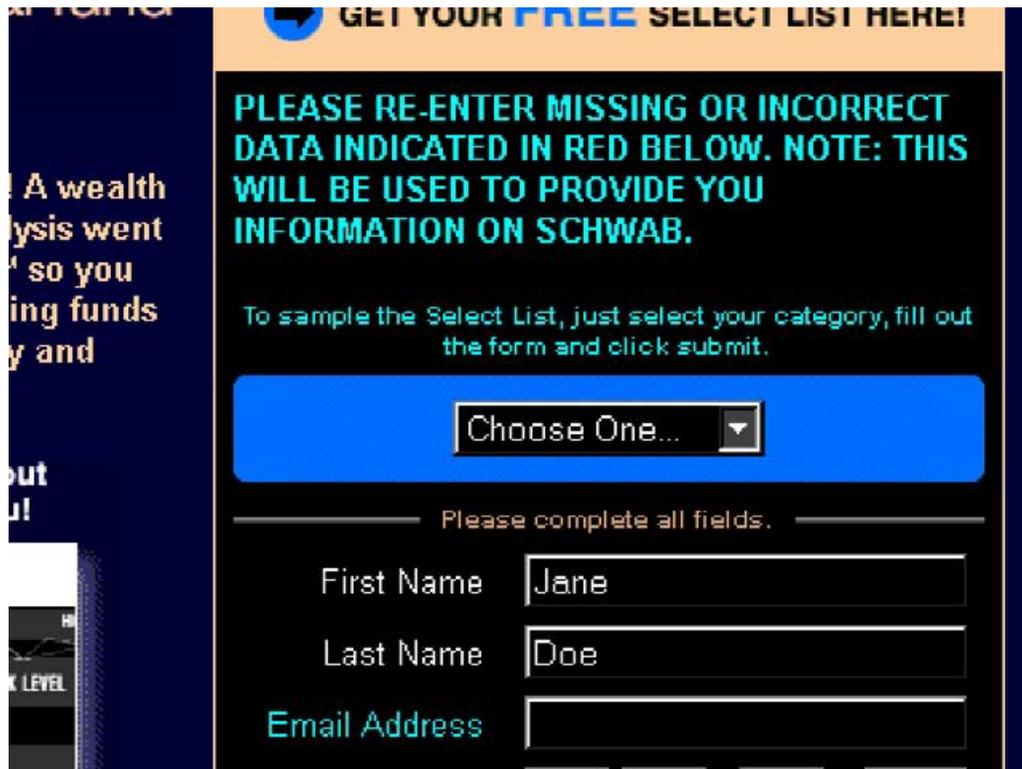
A better implementation for helping users complete their form is to show them only
the part of the form that has errors. Rather than making them go through the entire
form again (and wonder if fields they've completed correctly might be wrong) you
can show them only fields they need to fix or fill in. If the form has many errors, let
them whittle their way through it until everything is correct.

> DO NOT RELY ON ONLY AN ASTERISK (*) TO INDICATE REQUIRED FIELDS.
A screen magnifier reads an asterisk as *star.* Some screen reader users have
learned that the word *star* means *required field,* but several users in our study did
not know this. A few even said that they didn't know why they sometimes heard the
word *star,* and thought it might be a bug in their screen reader.

You can still use asterisks to indicate required fields, as many sighted users know
this convention. However, we recommend that you also provide another indicator.
Bolded text might work for some users. Better would be to only request required
information. Other than that, consider organizing the page so that all required fields
appear at the top of the form, and all other fields appear toward the bottom.

> MAKE SURE TAB ORDER IS LOGICAL.
Many people use the *Tab* key to move through fields when filling in a form. For
some people, this is simply easier. For others, including most of our study's
participants, using a mouse is impossible and *Tab* is their only option.

People listening to screen readers are especially dependent on the field order being logical because that is how the reader leads them through the form.

We found that many sites already have good, logical tab order.

> MATCH THE TAB ORDER TO THE VISUAL LAYOUT WHEN POSSIBLE.
In one instance, on the Target website, the tab order was logical, but did not match the visual design. So, while this worked for screen reader users, sighted users and those with low vision were thrown off.

The tab order went as follows:

> First name
> Middle initial
> Last name
> Address 1
> Address 2
> City
> State
> ZIP/postal code
> E-mail
> Please reenter e-mail
> Phone

But, the layout went as follows, so *phone* came before *please reenter email:*

First name	Middle initial	Last name
Address 1	Address 2	
City	State	ZIP/postal code
E-mail	Phone	
Please reenter e-mail		

The tab order was logical (email, re-enter email, phone), but the layout contradicted the tab order. For most fields, the tab order went left to right. In the visual layout, the *reenter e-mail* field appeared underneath the *e-mail* field. When the user tabbed through the fields, they were thrown off because, while logical, the fields broke with the design and went down, then up and right.

> STACK FIELDS IN A VERTICAL COLUMN.
When fields are placed side by side on a magnified screen, one field can fill the screen and thus users are unaware of other fields next to it. For users with low vision, it is easier to fill out a form when all the fields are stacked vertically. One user with low vision said, "It can be inconvenient on a form when you have two entry fields side by side. It's easier to see top to bottom."

Although the text labels are a bit too far away from the actual fields, the Ways Shop Japanese site does a nice job presenting fields in one column.

> OFFER STANDARD ENTRY FIELDS FOR PHONE NUMBERS.
Some sites seem to create their own method and design for collecting user information. Deviation from the norm in collecting phone numbers, for example, confuses people. The best presentation is either one field for the entire number or two fields (one for the area code and the other for the number).

A form on the Schwab site (shown below) asked for a daytime phone number and offered four fields: area code, prefix, number, and extension. None were labeled. The fields for area code and prefix were separated from the rest of the number by a dash, and there was an "x" before the field for extension. The layout was very confusing, especially to people with low vision. One user concluded, "I guess you don't need to do the area code."

The following picture shows a phone number entry form divided into four fields that are positioned somewhat oddly.

With magnified screens, the *Go* button that often accompanies entry fields and selection boxes is sometimes off-screen. Users with low vision would thus pause after entering text or clicking a selection in a drop-down list box, waiting for something to happen. They didn't realize they needed to scroll, find the button, and click it to actually submit their information.

A Japanese high-tech company, e-phone, positioned the *Continue* and *Calculate again* buttons too far from the *Choose the quantity* drop-down choice. When the screen is magnified, it is difficult to know the button exists, let alone to find it and invoke an action.

The following picture shows a page on www.e-phone.ne.jp where the button to submit quantity was too far from the related selection list.

> IN FORMS, PUT THE *SUBMIT* BUTTON AS CLOSE AS POSSIBLE TO THE LAST FIELD ENTRY BOX OR SELECTION TOOL ON THE FORM.

In several cases, we saw participants with low vision unable to find a form's *submit* button. After filling out forms and waiting for something to happen, users typically realized that they needed to submit it and would look for a *submit* button. Sometimes it took them minutes to find it.

On the Target website, a line spanning the billing form above the *Continue* button made participants using screen magnifiers think that the line indicated the end of the page. They could not find the *Continue* button below it. One user commented, "Continue was below a separator line." This line gave the illusion of completion.

The picture below shows the line above a form's *Continue* button, which confused participants using screen magnifiers.

It is also important to make sure that pressing the *Enter* key will submit the form when a user tabs to the *Submit* button and presses *Enter*.

> PUT ANY INSTRUCTIONS PERTAINING TO A PARTICULAR FIELD BEFORE THE FIELD, NOT AFTER IT.

People listening to screen readers need to hear instructions about fields before they get to the entry box. Once they get to the entry, they will want to proceed to type and won't necessarily know to look past the entry box and for further instructions.

On the Prime Minister of Japan and his Cabinet's site, http://www.kantei.go.jp/ there is a form with fields that gives instructions after the field. Namely, after one

field there is a note which reads: *Write in only single byte alphabet or numbers.* It is better to present such information before the input box, so screen reader users will hear the instructions before they begin typing. (Also, this particular field label would be easier to understand if it were not using programming jargon.)

The following picture demonstrates a Japanese Government site. An instruction appeared after the field it applies to. This is not helpful for people using screen readers or screen magnifiers.

首相官邸
コミュニケーション

小泉内閣メールマガジン

読 者 登 録

小泉内閣メールマガジンの読者登録を行います。

下記の事項を入力・選択の上、登録ボタンを押してください。

携帯電話からのメールアドレス登録は出来ません。

メールマガジンのお申込み**（必ずご記入ください）**		
メールアドレス	[　　　　　　　　　　]	（半角英数字のみ）

読者アンケート（差し支えなければご記入ください）	
性 別	○男性　○女性
年 齢	選択してください ▾
職 業	選択してください ▾
居住地	選択してください ▾

登 録　クリア

登録及び解除へ戻る

Note that Japanese (and any other language that uses two byte character sets) has some special issues related to understanding which character sets are allowed. Sometimes pronunciation could be written in Hiragana or in Katakana, and sometimes numbers and letters could be single byte or double byte. In most cases, websites don't differentiate between Hiragana and Katakana, but they do typically differentiate between single byte and double byte. If users type the form that the site does not expect, they will get an error message.

> CAREFULLY CONSIDER HOW LONG IT WILL BE BEFORE A TIMEOUT WILL OCCUR.
We saw several instances where people using screen magnifiers were faced with timeout errors while filling out forms. For example, on the Ticketmaster website, www.ticketmaster.com, users must complete the purchase within five minutes. Timeouts occurred several times when users were trying to order tickets.

Sites must give users sufficient time to fill out forms before timeouts occur. We recommend ten to fifteen minutes before a timeout occurs.

Presenting Text

> **> CHOOSE TEXT COLORS FOR GOOD CONTRAST.**

Users with low vision have trouble distinguishing certain colors. (There is information available elsewhere about how different users experience different color-related difficulties.[7])

On Yahoo's weather results, light text on a grid was difficult to read. One user said, "The colors on this are not very good. I have to change these colors."

One Target's homepage, one user said, "It has a lot of color. It is very hard to see. Sometimes I try to change the color." Referring to the white-on-red main navigation, the user said, "I can't read those at all."

On the Chicago Transit site, while looking at train maps, one user said, "Well, this blue and this orange are not working here. Let's get out of this before it hurts my eyes."

The following picture shows a map page on the Chicago Transit site. The colored text was problematic.

---

[7] See Lighthouse International's, "Effective Color Contrast."
http://www.lighthouse.org/accessibility/design/accessible-print-design/effective-color-contrast

> DO NOT USE VERY SMALL TEXT FOR BODY TEXT.
Use fonts that are at least 11 point, or better yet, let the user control the exact size while you control the relative size. With 11-point text, users with low vision will still have to zoom to read it, but when the original is that size, there is a good chance that letters will still be readable when magnified.

After using the Chicago Transit website, one user with low vision said, "The print should have been bigger. There was too much graphics. The writing was too small and it was hard to notice the links."

> DO NOT USE SMALL OR SUBTLE TEXT HEADINGS AND CATEGORIES.
When headings and category text was very small or subtle (like a muted gray), users with low vision did not see the headings. Category titles are important for users with low vision as they provide context. Making it impossible for them to see or notice the categories contributes to the existing context issues magnification brings.

> ALWAYS CREATE GOOD CONTRAST BETWEEN TEXT AND THE PAGE BACKGROUND.
Some users have trouble distinguishing text and images from the background. For example, a medium blue text on a lighter blue background might seem very legible to a sighted person, but is completely illegible to some people with low vision.

You can assume that some users with low vision will choose to invert colors on your page. They will also sometimes view it in monochrome. Make sure the default colors you choose for text, page backgrounds, and borders adequately contrast each other.

On the Chicago Transit site, one user said, "There is no way I can read this color." Another user said, "Not a good contrast there. They could make the text larger in that one." Another user said, "This is a terrible website to see."

The following picture shows the Chicago Transit site's Maps and Schedules page. The colors and background image made it difficult to read.

On the Japan weather site, the *Book Sales* link (in the lower right oval) was difficult to find because of the position and the size. Also, the contrast between black letters on the gray-green background was not strong and decreased visibility.

In the image below, from the JWA site, the lower right circle's small black text on a gray-green background is difficult to read.
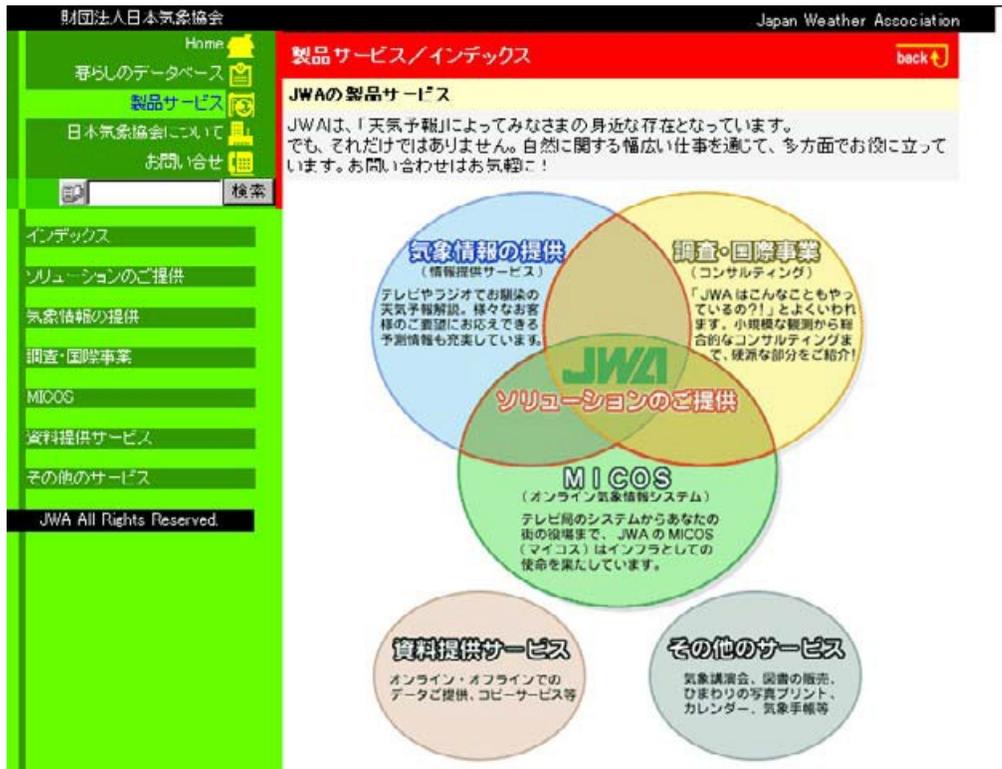
Note: An easy way to do a quick contrast check is to look at a page in grayscale, where a lack of contrast is more noticeable.

> DO NOT RELY ON A BACKGROUND IMAGE AS A PAGE BACKGROUND TO CREATE CONTRAST WITH TEXT.
We saw many users with low vision and no vision turn off graphics in their browser. If you use a black background image as the page background and use yellow text on the page, this will normally look okay. But if the user turns off graphics, the text will appear yellow on a white or gray page. This is almost impossible for people to read, no matter what their vision level. You can work around this problem by specifying a dark, Web-safe color for the page background.

> TEST YOUR SITE'S TEXT FONTS AND COLORS WITH SCREEN MAGNIFIERS.
Text size must be very large for people with low vision. Unfortunately, as text is magnified to very large sizes, it breaks up into squares of different colors and is difficult to read. We saw many cases where the standard text color for links (royal blue) got very pixilated when magnified. Even a sighted person could barely read it when the user turned their magnification all the way up (to 6X). Black text at the same magnification is readable. Also, pictures of text cannot be "smoothed" (a process screen magnifiers use to increase edge contrast in zoomed text).

When using the Target site, one user said, "The text has missing pixels." Another user said, "When I make it large enough to see, the text is no longer clear."

When looking at AOL search results, a user had trouble reading results because the links were blue and the text was pixilated. She said, "This is a big problem. It breaks up the blue words so they're not even connected and I can't read it." And when looking at the Schwab site, she said, "All that blue is too disconnected."

The following picture shows a page on Weather.com. Magnification pixilated the blue links.

> **MAKE SURE IT IS POSSIBLE TO MAGNIFY YOUR SITE.**
Before specifying fonts in pixels, consider this.

Participants in our study told us they cannot magnify some sites with their screen magnification software. When this happens, they usually just leave the site. Some users said they'd call a sighted friend to help them use the site. Regardless, they could not use the site on their own at all, and were frustrated by this. In the tests in Japan, one participant showed us a website that he could not magnify. The site designer specified the fonts in pixels, in the style sheet, making magnification and normal font enlargement impossible.

A screen magnifier user could not magnify the DLJ direct website shown below because the style sheet used fixed rather than relative font sizes.
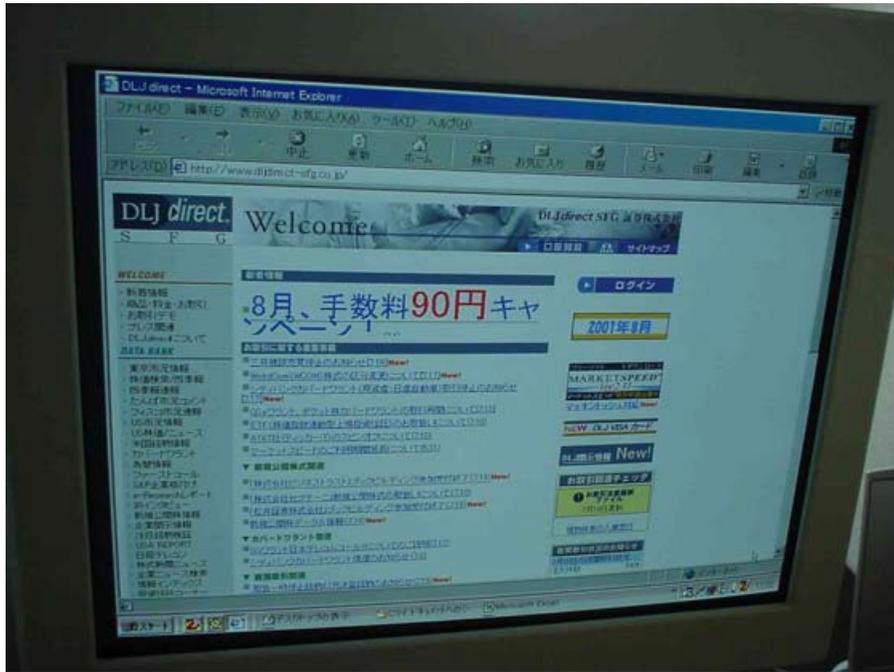
> **WRITE CONCISELY, AND REMOVE SUPERFLUOUS TEXT.**
Screen reader users became annoyed when they had to listen to an entire page of useless information. Screen magnifier users were also annoyed by this: To read, they have to scroll over each line horizontally, then scroll back to the left and down to see the next lines. This makes encountering irrelevant text all the more frustrating.

One screen magnifier user commented, "I don't want to read all that text." Another user said, "Since I read slowly, I never like all the PR stuff."

> **IF THE COMPANY NAME INCLUDES AN INITIALISM OR ACRONYM, TELL SCREEN READERS HOW TO PRONOUNCE IT. (YOU SHOULD ALSO DO THIS FOR ALL ABBREVIATIONS OF THIS TYPE ON THE SITE.)**
Users can change screen reader settings to recognize particular initialisms and acronyms and read them correctly. You can beat them to this by using the ABBR text element.[8]

Some organizations have an initialism or acronym as their name. For example, the EPA, pronounced *E P A*; or MoMA, pronounced *moe mah*. Some sites have programmed in their organizations' correct pronunciation; others have not.

---

[8] Index of text elements added in HTML 4:
http://www.w3.org/TR/html4/appendix/changes.html and the HTML 5 ABBR entry
http://www.w3.org/html/wg/drafts/html/CR/text-level-semantics.html#the-abbr-element .

Also, some initialisms are difficult to understand when hearing them read by a screen reader. For example, the Major League Baseball site lists *CHI* for Chicago, which the screen reader reads as *Chie.* Also, the same site indicates Eastern Time as *ET,* which the reader reads as *eht.*

> RETHINK HOW YOU USE PARENTHESES AND ASTERISKS.

Screen reader users hear sentence punctuation such as *comma* and *period.* People seemed used to this and were not bewildered by it at all. However, we did notice that people sometimes flinched or replayed sentences or headings that contained parentheses and asterisks. These seemed to distract people more than other punctuation marks did.

> This: (date)
> Sounds like this when read by a screen reader: *Left paren date right paren*
>
> And this: ** New York Yankees
> Sounds like this when read by a screen reader: *Star star New York Yankees*

Search

Several screen reader users (and a few screen magnifier users) claimed to be terrible spellers. When they spelled words incorrectly, most search engines did not help them spell their queries correctly. Offering spell-checking capabilities would help people.

When trying to find out how fast a cheetah can run, one screen magnifier user went to www.altavista.com and typed: *How fast can a chita run.* He said, "I didn't see anything right away on cheetah so I'm going to change my search." His new search was for *chita faq.* He read the entries and said, "Chita must be a place in Russia … unless I'm spelling it wrong." He went to www.google.com and also had no luck. He said, "I don't know what to do next. I don't usually go to sites about animals. Unless chita is spelled wrong. I'll try two "t"s. It doesn't look right, but I'll try it anyway." He conducted a new search on *chitta,* and had no luck.

One low vision user was helped by Google's *Did you mean* feature, which attempts to correct spelling errors in search queries.

The following picture shows a search for *temporature*, and Google's recommendation for the correct spelling, *temperature.*

> DO NOT RELY SOLELY ON A BROWSING INTERFACE FOR YOUR SITE'S SEARCH CAPABILITIES.

Always provide a search box, even if your main site model is a browsing directory interface (a la Yahoo!). Some users do not want to listen to a lot of links. Others do not want to scroll all around a page. They sometimes just want to type in a word and search. Let them.

When trying to find out how fast a cheetah can run, one screen magnifier user went to www.yahoo.com so he could walk through some categories. He said, "I don't like this [horizontal lists with words separated by bullets] scrolling like this [horizontally] sucks with Zoom Text." He read category headings, but skipped past *science> animals.* He was looking for "nature or something." He said, "I usually don't use Yahoo much if I know exactly what I'm looking for. I don't like going through all these categories, and their page layout is always different."

> DO NOT PUT THE SEARCH BOX IN AN UNLIKELY SPOT.

Put search in a place users expect to find it, like the upper-right or upper-left corner of a page. For users with low vision or no vision, this is particularly important. When the search box was located in unexpected places, users did not see or hear the search bar, and they assumed the site did not have search capabilities.

On Weather.com, users with low vision looked for a search and were disappointed when they found none. One user said, "There should be a search... How do they not have a search?"

The following picture shows Weather.com's homepage.
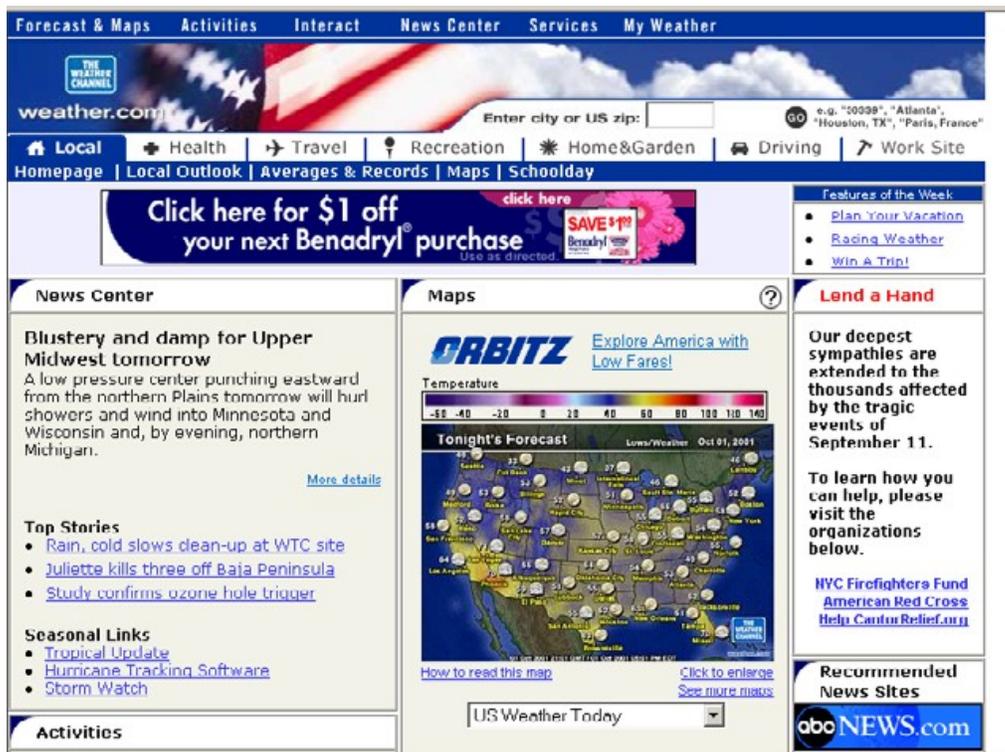
> CLEARLY DESCRIBE SEARCH RESULTS.
In some cases, screen reader users could not figure out how many search results they had, nor could they tell what the results were, since some results showed only a URL and no page title. Other results did tell users how many search results were found, but did not give users this information right away. Visually, it's easy to tell what part of the page contains the search results. But for screen reader users, it is often not easy to get this information right away. To a lesser degree, screen magnifier users also need to look to find the search results.

Even Google.com, which several participants said they like to use, does not tell users the number of results found right away. If a user is looking for the average temperature in Dallas, Texas in January, and searches for *average temperature dallas tx january,* they get many results. When the screen reader reads the page at the default reading speed, it takes about 38 seconds before users find out how many results were found.

The following picture shows the search results on Google.
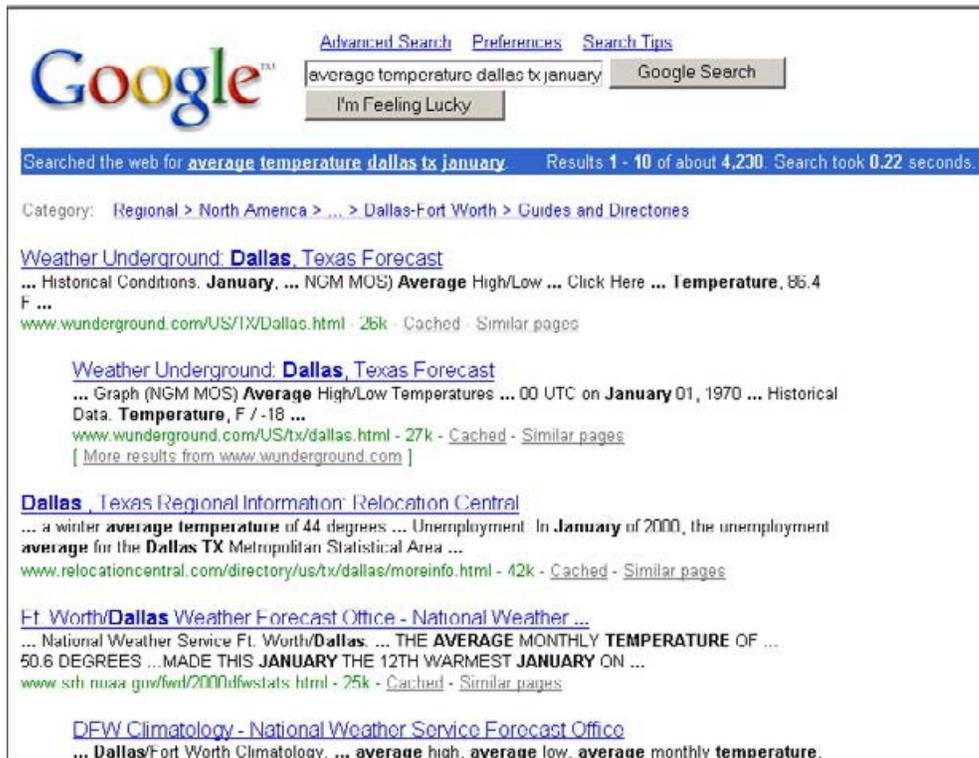
It takes about 38 seconds, at default reading speed, before the screen reader gets to the number of search results found:

"google dash microsoft internet explorer
edit average temperature dallas tx january
google search button
page has sixty seven links
visited link graphic go to google home link advanced search link preferences
link search tips
edit average temperature dallas tx january google search button I'm feeling
lucky button
searched the web for
link look up average on dictionary dot com
link look up temperature on dictionary dot com
link look up dallas on dictionary dot com
link look up tx on dictionary dot com
link look up january on dictionary dot com
results one dash ten of about four thousand two hundred thirty
search took zero point two two seconds
category colon link regional greater north america greater dot dot dot link
greater dallas dash fort worth greater guides and directories
link weather underground colon dallas texas forecast
historical conditions january dot dot dot n g m mos right paren average high
slash low dot dot dot click here dot dot dot temperature eighty six point four"

> INFORM USERS WHEN THEY HAVE ENTERED NOTHING IN THE SEARCH QUERY BOX.
On the Target website, users were allowed to conduct a search even when the search box was empty. What's worse is that it returned results.

In a few sessions, users typed keys on the keyboard and were obviously trying to type in the search query box, but didn't have the text field selected. They selected *Go,* and the search started. It returned a page of results, starting with *Search results found for you… 100 products found.* People naturally assumed that the results returned had something to do with what they were looking for, but in fact they hadn't searched for anything. This was especially confusing for people using screen readers and screen magnifiers, as they were unaware that they had not typed a search query.

You can't easily prevent users from searching for nothing. However, when this occurs, you should return a page that both tells them they left the search box blank and offers them a new search field so they don't have to go back to try the search again.

> DO NOT PRESENT SEARCH RESULTS' RELEVANCE RANKING IN A TABLE.
There is a section about using tables on *page 112* of this report. You should also thoroughly consider this topic when presenting search results. In particular, many sites use relevance rankings and present number rankings in table columns in the search results. Whether these numbers are read in columns down or in rows across, when they are presented in tables, such numbers rarely give screen reader users a context that helps them understand their meaning. Also, people using screen magnifiers do not see both the table's content and its top row, which describes the contents.

The Environmental Protection Agency does a good job describing how many links are found in search results, and it repeats the user's query, which is very good. However, result ranking (numbering or percentages) is not recommended. Screen readers read the number, then immediately read the link, giving users no context for what the number means. Also, because results are in ranked order, the number itself is redundant.

The following picture shows the EPA search results page, which looks fine to sighted users.

JAWS 3.71 reading an EPA search results page:

"yes button
search button button link graphic environmental protection agency home page link new search
key e p a pages for mercury and water colon additional recommended pages
your query matched one documents one documents are presented ranked by relevance
table with three columns and three rows
rank title and summary format

one link method sixteen thirty one colon guidelines establishing test procedures for the analysis of pollutants colon measurement of mercury in water this method measures mercury at the low levels associated with"

SETI-SEARCH: A GOOD EXAMPLE OF SEARCH

Many participants in our study who use screen magnifiers, screen readers, and Braille displays used the SETI-search search engine, www.seti-search.com. (Several people also used Google, Yahoo!, and Alta Vista.) The SETI-search has a simple layout, text only. It offers browsing capabilities for those who prefer it, but the search box is seen and read first. The colors are very simple (black and white) and the site lets users easily change the colors. Also, there is not too much text.

JAWS 3.71 reading the SETI-Search homepage:

"enter h t t p slash colon w w w dot seti dash search dot com
search the web for colon
page has twenty nine links
table with three columns and eight rows
seti dash search version four point oh
search the web for colon
select search engine colon
combo box all the web search now button clear phrase button
bringing access to everyone
link instructions link about this service link forums link feedback link quick search set up link change colors link tell a friend link background picture information
headline news left paren these links open in a new window which may not be accessible right paren
link analysts recommend switching from microsoft's web software to another product because of security concerns dot dot dot link nando times tue sept twenty five seven fifty eight colon forty four e d t two thousand one
link a t g to support i b m websphere dot dot dot link web host industry review tue sept twenty five seven forty two colon twenty seven e d t two thousand one link"

The picture below shows the SETI-Search homepage.

SETI-Search
Version 4 0

Search the Web for: [   ]
Select Search Engine: [AllTheWeb ▼] [Search Now] [Clear Phrase]

BRINGING ACCESS TO EVERYONE

Instructions

About this Service

Forums

Feedback

Quick Search Set Up

Change colors

Tell a Friend!

Background Picture
Information

Headline News
(these links open in a new window which may not be accessible)

Analyst recommends switching from Microsofts Web software to another product
because of security concerns
Nando Times   Tue Sep 25 07:58:44 EDT 2001

ATG to Support IBM Websphere...
Web Host Industry Review   Tue Sep 25 07:42:27 EDT 2001

Curtain rising on Internet potential for TV...
Orlando Sentinel   Tue Sep 25 07:39:00 EDT 2001

A Step Forward in Nanotechnology...
Cosmiverse.com   Tue Sep 25 07:34:06 EDT 2001

News powered by Moreover Technologies

Sign-Up for our Mailing List!

Your E-Mail Address: [   ] [Sign-up Now!]

Shopping

Some users with screen readers wanted to shop on the Web. What almost all of them said that they typically do when shopping is to ask a spouse, friend, or child about something they are thinking of buying.

In a situation where users are trying to shop, it is imperative that they are given information about the items they are thinking of buying. This is less important when buying books or CD's, as the title and author or musician might be enough. But it is extremely important when buying clothing or other items online.

On the Hoover Dam Tours and Gifts website, www.hooverdamtours-gifts.com , screen reader users were given no idea what items looked like. All they heard was the item's name and price. They said this was not enough for them to make an informed decision about whether they wanted to spend even a few dollars on an item.

The following picture shows the names and prices of Hoover Dam souvenirs that screen reader users heard about. They were given no information about what pictured items looked like.

> HELP USERS CONTINUE SHOPPING AFTER THEY MAKE AN ORDER BY GIVING THEM A WAY TO GET BACK TO WHERE THEY WERE.

Once users added something to their shopping cart, some sites did not make it easy to continue shopping.

On the Rock and Roll Hall of Fame website, a participant using Braille and a screen reader wanted to buy two mugs. She found one mug and ordered it. On the shopping cart page, she confirmed her order and clicked the *Keep Shopping* button. This took her back to the page of the mug she'd just ordered. She had to read through the entire top navigation bar to figure out where she was: on the page of an item she'd already ordered. It was not helpful to take her back to that page. A better destination might have been the page that showed all available mugs.

The picture below shows the shopping cart page on the Rock and Roll Hall of Fame website.
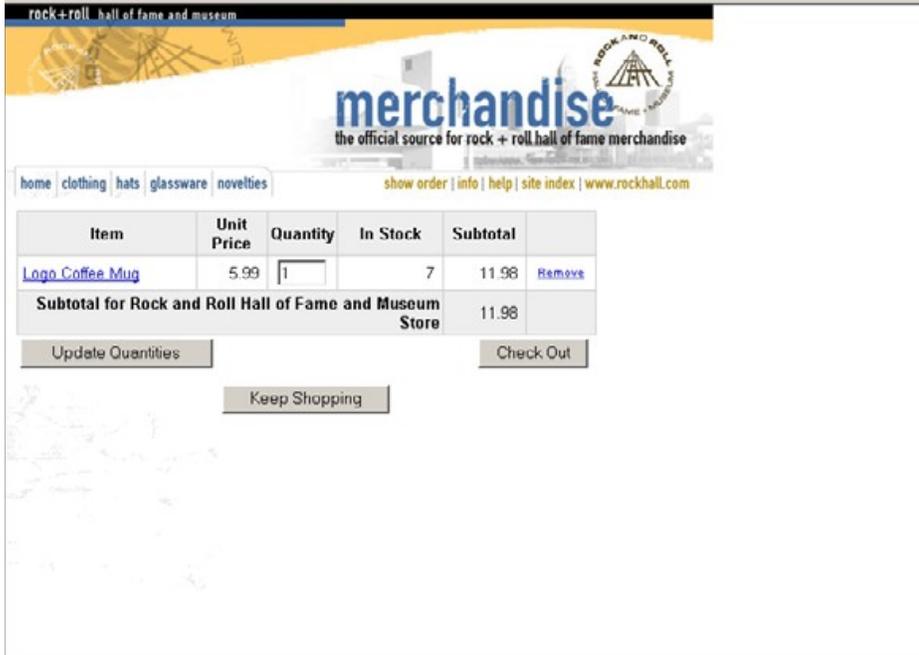
The picture below shows the page that appears after users click the *Keep Shopping* button: They go back to the product page for the item they added to the shopping cart, often the least useful page available.

The picture below shows the page that we recommend users go to after clicking the *Keep Shopping* button: The page for the category of items the user selected from.

> POSITION THE *ADD TO SHOPPING CART* AND *CHECKOUT* BUTTONS CLOSE TO ITEMS FOR PURCHASE.

We saw instances in which users found items they wanted, but could not find a button to add items to their cart. This happened several times in sessions with participants using screen magnifiers. They expected the *Add to Cart* button to appear near the actual item, but some sites put this button on the top or bottom of the page. This was difficult to find for people using screen magnifiers.

Also, it should be obvious to the user when he has added something to the cart. On the Target site, when you click the *Add to Cart* button the page remains almost the same, except that *Item added to cart* appears in red text above the image, along with a *View Order/Checkout* button. People using screen magnifiers had trouble finding this because their page loads at whatever was the last point of focus.

> FOR INTERNATIONAL CUSTOMERS, CAREFULLY CONSIDER ANY E-COMMERCE TERMS YOU CHOOSE. (IF YOU USE ENGLISH TERMS ON NON-ENGLISH SITES, CONSIDER USING THE LANG ATTRIBUTE.)

Facilitators noted that our Japanese study participants did not understand the word "checkout." As a sighted user, the location of the button might help you get context, even if you are not exactly sure what the button means. But, if you're using a screen reader, hearing a word that you do not understand will prevent you from completing a task. In this case, the accessibility design flaw could be costly, as it would deter sales.

If designers of non-English sites want to use an English phrase, consider using the actual English words and not translating it. Then employ the HTML LANG attribute,[9] which warns people using a screen reader that the text they are about to hear is in a different language, and tells them what that language is. This helps set the user's expectations.

Note also that a more descriptive word than "checkout," such as *buy,* would be a better choice.

---

[9] Index of the HTML 4 Attributes,
http://www.w3.org/TR/html401/index/attributes.html

Tables and Frames

While an often heard recommendation is to avoid tables altogether, this is probably not necessary. Users who once were sighted and lost their vision said they can usually picture tables pretty easily when the screen reader initially tells them how many rows and columns they have. One participant who used Braille and a screen reader said, "I am here on Rock Hall. They have a table listing. The nice thing… is says 'table with 16 rows" so you know what it looks like."

Avoid using tables for visual design, however. People using screen reader and Braille displays gain nothing from such use except confusion. They expect tables to organize information, and when they are instead used to fix page size, it is confusing.

The Major League Baseball site organizes their schedules in a table. They also include links that are not related to the table in the table's first column. The information is very difficult to follow when the table is read by a screen reader.

When the table in the picture below from the MLB site is read by a screen reader, it reads the row across the top (Monday, October 1, etc.), then reads the left side column (3-Day Outlook, Daily Schedule, Schedule Changes, etc.). This makes the table's information very difficult to follow and understand.

The first few seconds of a screen reader reading the table above:

"major league baseball schedule dash microsoft internet explorer
monday october first two thousand one
tuesday october second two thousand one
wednesday october third two thousand one
three dash day outlook
daily schedule
postseason schedule
schedule changes
two thousand one national broadcasts
full t v listings
full radio listings
schedule american league
anaheim
baltimore
boston
chi white sox
c w s pit at n y y at nym seven oh five p m et seven ten pm et
tor at bal seven oh five p m et
bos at t b seven fifteen p m et
c w s mon tex cin at n y y at fla at oak at c h c
seven oh five p m et seven oh five p m et three thirty five p m et two twenty
pm et
min pit c w s mon at det at nym at n y y at fla
seven oh five p m et seven ten p m et seven oh five p m et seven oh five p m"

> AVOID USING LARGE TABLES FOR ANY REASON. IF YOU MUST USE THEM, CONSIDER PROVIDING THE INFORMATION IN TEXT AS WELL.
With so much information in a table, it is difficult for screen reader users, Braille users, and screen magnifier users to make sense of it all and remember it. It is especially difficult to recall which column each cell belongs under as the contents are read.

On the Charles Schwab site, results of a search for specific mutual funds are displayed in a large table.

The following picture shows a large table displaying the results of a query for mutual funds dealing with *natural resources* and *precious metals.*

When this table is read by a screen reader, it starts this way:

"charles schwab vertical bar mutual fund screening dash microsoft internet explorer
as of zero seven slash thirty one slash two thousand one
click on fund symbol to view fund details containing quarter dash end performance
one source fund left paren no load and no transaction fee star right paren
this fund appears on the current mutual fund select list trademark
average annual total return since hypothetical risk inception growth of manager expense assets symbol slash name level three mo star star one year three years five years ten years left paren date right paren dollar ten thousand since ratio in dollar m m
tcsvx
twelve point nine oh thirty eight point one nine twenty two point two seven twenty one point two five
n slash a
nineteen point eight six dollar twenty six thousand two hundred six nineteen ninety six one point four dollar one hundred seventy three turner small left paren zero two slash nineteen ninety six right paren"

> ESPECIALLY IN TABLES, DO NOT USE GRAPHICS TO INDICATE A STATE, SUCH AS YES/NO OR ON/OFF.
When listening to the information in a table, it is extremely difficult to match the graphics in a column to what they are meant to indicate.

It is difficult to recall what graphics in a legend mean. In addition, it is extremely difficult to listen to a table and recall that the presence (or absence) of a particular graphic means something specific.

On the Charles Schwab site, in a mutual fund description table, a legend says that a red square appearing in a column (which is not labeled) indicates that the fund is "OneSource Fund," and a blue square with the word *list* in it indicates that the fund appears on the current Mutual Fund Select List. This is a lot to remember. It would be better to have the words: *This is a OneSource Fund,* and *this fund appears on the current Mutual Fund Select List.*

The following picture shows part of a large table that includes a legend of what certain graphics in certain cells indicate. This is extremely difficult to decipher when listening to it.

■ OneSource Fund. (no load and no transaction fee*)

SELECT LIST This fund appears on the current Mutual Fund Select List™

	Symbol / Name	Risk Level	3 Mo.**	Average Annual Total Return					Since Inception (Date)	Hypothe Growt $10,
				1 yr.	3 yrs.	5 yrs.	10 yrs.			
■	FSTEX INVESCO Energy Inv	LO HI RISK	-17.31	4.01	19.87	15.86	9.67		8.54 (01/1984)	$20,
■ SELECT LIST	UMESX Excelsior Energy & Nat Resources	LO HI RISK	-15.02	6.70	15.40	14.69	N/A		13.63 (12/1992)	$19,
	VGENX Vanguard Energy	LO HI RISK	-11.49	15.78	12.51	12.37	11.59		12.10 (05/1984)	$17,
	PRNEX T. Rowe Price New Era	LO HI RISK	-7.02	13.61	11.49	10.55	10.25		N/A (01/1969)	$16,
■	BGRIX American	LO HI	-10.95	3.82	8.10	6.47	N/A		6.78 (09/1994)	$13,

> ENSURE THAT VISIBLE ALPHABETIC LISTS IN TABLES ALSO MATCH THE ALPHABETIC LIST SCREEN READERS WILL PROCESS.
In our studies, we saw a few examples in which the visual alphabetic listing did not completely match what the screen reader read. If a user is trying to skip text and links, and they realize something is presented alphabetically, this can be a big problem.

On the e-phone site, a directory is listed in alphabetical order. The United States appears in the area with the U's. When its link is read, however, it is read as *America,* a name which should logically appear under "A."

The following picture shows an alphabetical column with an item out of order for screen reader users.

> SUMMARIZE ALL TABLES.

When listening to a screen reader read a table, users often hear something like: *Table has four columns and two rows…* It then immediately launches into reading across the first row. Since the user can't scan the table all at once, its difficult to get a sense of what the table contains. Users basically have to interpret what the items in the first row are, and from that get an understanding of what might be in the rows to follow. Even a simple table that is relatively easy to follow can be easier to understand if the developer first summarizes the table. (Use the SUMMARY attribute to describe tables.[10])

> BEFORE USING A COLUMN LAYOUT, CONSIDER HOW IT WILL APPEAR FOR SCREEN MAGNIFIER USERS.

Some screen magnifier users had difficulties using pages that were laid out in columns because it was confusing to follow without having the context of the whole screen. Before you lay out pages in columns, consider how the information in your design will look when magnified.

---

[10] Index of the HTML 4 Attributes,
http://www.w3.org/TR/html401/index/attributes.html

The following page on Weather.com shows a column layout with weather information about Dallas, Texas.

The following picture shows the page magnified by about 5x. Users must scroll several times, vertically and horizontally, to see the information in the table.
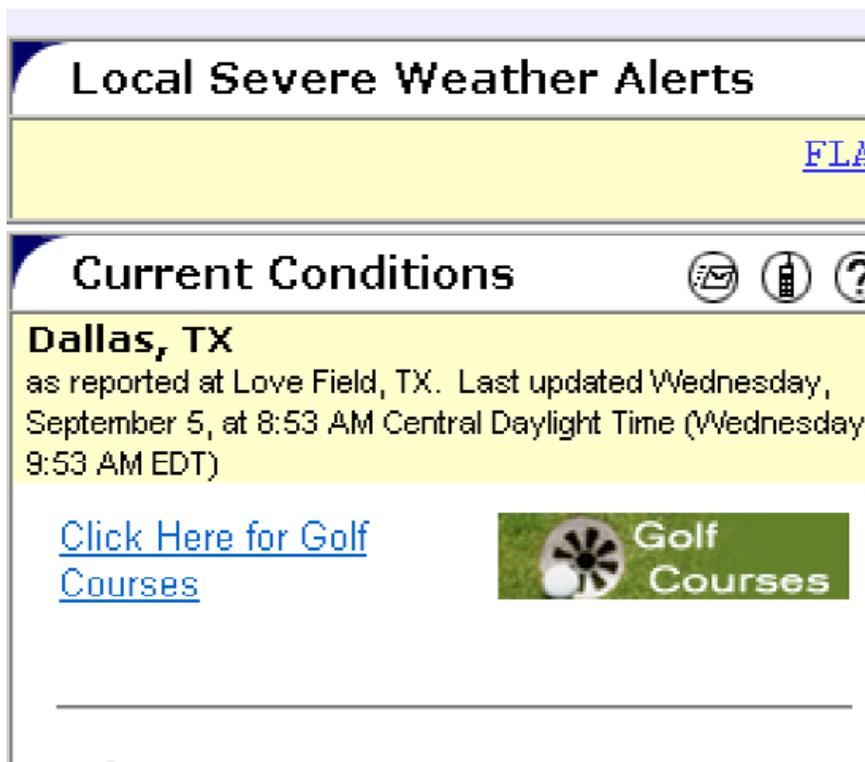
One participant brought to our attention a website of a company that makes natural pet food, which is important for guide dogs with food allergies. This is her account: "I found a website today that is totally inaccessible to the users who are blind who could benefit from it… www.naturapet.com… When I visited the site, the initial screen contained frames, but also some general text describing the company and its products. Each frame (most of them anyway) was appropriately labeled with alternative image text. However, when I entered the frames, I got more frames— sometimes the same ones, sometimes a different set. I never could get to the text I wanted to read. The text I wanted was a frame labeled *Encyclopedia of Ingredients.* There is also another frame containing a side-by-side comparison of ingredients between different brands of dog food. This is the information that I wanted."

The following picture shows Natura's home page.

The first minute of this homepage, read by JAWS 3.71:

"natura pet product dash dash innova and california natural pet food for dogs and cats dash microsoft internet explorer
home link
page has seven frames and forty three links
natura pet products dash dash innova and california natural pet food for dogs and cats
a one frame natura pet products
link home link products link innova link ca natural link healthwise link graphic dog link best friend link research tools link ingredients link find a store link community link help a one frame end
a two frame natura pet products a two frame end
b eleven frame natura pet products link graphic home b eleven frame end

b twelve frame natura pet products b twelve frame end
b thirteen frame natura pet products graphic return to natura's home page b thirteen frame end
b two frame natura pet products dash dash innova and california natural pet food for dogs and cats
link graphic send this page to a friend link graphic site map link graphic banner slash banner zero dash zero dash one link graphic banner slash banner"

The following picture shows Natura's *Ingredients* page.

The first 39 seconds of the above *Ingredients* page, read by JAWS 3.71:

"natura pet products dash dash innova and california natural pet food for dogs and cats dash microsoft internet explorer
a one frame natura pet products
link home link products link innova link ca natural link healthwise link graphic dog link best friend link research tools link ingredients link find a store link community link help a one frame end
a two frame natura pet products a two frame end
b eleven frame natura pet products link graphic compare ingredients b eleven frame end
b twelve frame natura pet products b twelve frame end
b thirteen frame natura pet products graphic return to natura's home page b thirteen frame end
b two frame natura pet products"

A NOTE ABOUT FRAMES
We had some participants with low vision who did not use screen magnification software. Those people typically increased font size in their browsers, but the font size only changed in the selected frame. As a result, they had to select the target frame before changing the font size. This was tedious.

> DESCRIBE ALL FRAMES.
Frames are one of the commonly known causes of accessibility issues. The biggest problems with frames occurred in our studies with people using screen reader and Braille devices. Basically, such devices sometimes fail to read the content frames. At other times, users see one frame's contents, but that frame eclipses other content that users are unaware of and thus never look for. These are probably understatements of the problem, but as many developers and users know, the issues are severe.

If you use frames, tell screen reader users how many frames are on a given page. Always summarize every frame so users are aware of the general contents before they decide to listen to the entire frame. (Use the LONGDESC attribute to describe the contents of frames.)

Trust, Strategy, and Company Image

Several users said that when they encounter websites that have poor accessibility, they are unlikely to go to the site again and are less than pleased with the sponsoring company or organization. It is probably no surprise that users said they are more likely to return to and shop on sites that are accessible. They also said, anecdotally, that they trust the organizations more if the sites are accessible. One participant using a Braille display said, "If they don't even try to make this [the site] so I can use it at all, why would I ever want to go back... I certainly wouldn't buy anything."

> SUPPORT YOUR WEBSITE WITH CAPABLE CUSTOMER SERVICE REPRESENTATIVES WHO HAVE A BASIC UNDERSTANDING OF ACCESSIBILITY ISSUES.

One participant, who did not test the Schwab site, said he uses it daily. While we did find usability issues with the site, this particular person had great things to say about Charles Schwab as a company and how they support customers who are blind. He said the phone representatives are always very willing to help him, and never act annoyed that he asks a lot of questions. "They are the best. The people there are so helpful," he said. They also send him his statements in Braille, which lets him do all his trading and investing without needing help from a sighted person.

> DO NOT REFER TO PEOPLE IN WHEELCHAIRS AS *WHEELCHAIRS*, OR SCREEN READER USERS AS *SCREEN READERS*.

One user with cerebral palsy was reading the *Accessibility* section on a website. When he read a part that referred to people in wheelchairs as *wheelchairs.* He said, "I didn't know I was a wheelchair. I thought I was a person in a wheelchair."

International: United States and Japan

In the qualitative findings, we also looked for any possible differences in behavior or issues between the users in the U.S. and the users in Japan. For the most part, the way they worked through the tasks and the issues they uncovered were the same. There were a few notable differences, however.

DIFFERING VIEW OF WHAT IS *CLUTTERED*

In our U.S. studies, we frequently hear people complain about clutter on Web pages. This study was no different; users who were sighted, used screen magnifiers, or had motor skill issues all complained about clutter on pages with lots of text, links, and graphics. What's interesting is that pages on the Japanese sites look overwhelming by U.S. standards, but it didn't seem to bother users in Japan.

The discernible tendency toward putting more information on Japanese sites does not mean that Japanese users can easily work with these sites. It's possible they would have an easier time if the sites contained less. What we're noting is that users in Japan seemed to expect very full-looking pages and did not seem to mind it. Also, this finding is not an excuse for U.S. designers to load up pages with information. The pages on the Japanese sites we studied have a definite style to them, something that might be difficult to replicate on sites designed in the U.S.

USING CHARACTER SETS

The Japanese users did experience some special issues related to understanding which character sets were allowed or expected in different forms. Sometimes pronunciation could be written in Hiragana or in Katakana, and sometimes numbers and letters could be single byte or double byte. In most cases, websites don't differentiate between Hiragana and Katakana, but they do typically differentiate between single byte and double byte. When users typed the form that the site did not allow, they got an error message.

Screen reader users in Japan also experienced some issues relating to listening to character sets. Chinese characters, Kanji, were imported from China in ancient years and adopted in Japanese. A single Chinese character could be pronounced several different ways. One way is based on original Chinese pronunciation, and the other way is the Japanese pronunciation applied to the character based on the meaning.

When using the Lake Yamanaka website, screen reader users were confused because the lake's name was read as *Sanchu*, instead of the correct way, *Yamanaka.*

The lake is called *Yamanaka,* and in Japanese: 山中湖 .

The first character, 山, means *mountain.* It can be pronounced as either *Yama* or *San.*

The second character, 中, means *in the middle of.* It can be pronounced as either *Naka* or *Chu.*

The last character, 湖, means *lake.* It can be pronounced as either *Mizuumi* or *Ko.*

People can judge which way to pronounce these characters based on context and experience. However, screen readers sometimes do not correctly judge which way to pronounce characters. In this case, the screen reader pronounced the lake name as *Sanchu* instead of the correct way *Yamanaka.*

NEWER DEVICES IN JAPAN
People in Japan are exposed to technology all the time, probably more so than most people in the U.S. "In a world of technology driven exponential change, the Japanese have an acquired edge: They know how to live with it. Nobody legislates that kind of change into being. It just comes, and keeps coming, and the Japanese

have been experiencing it for more than a hundred years."[11] This was apparent in the small sample of users in our study. Users in Japan had new types of mice and keyboards that we did not see in the U.S. studies. We are not sure how much of this had to do with the differing participant recruiting methods employed, or the actual prices or amount of aid offered to the disabled in each of the countries. We suspect the attitude toward changing technology and the device availability contributed to the likelihood of Japanese users having new assistive devices.

The lesson? If you are in the U.S. and designing software products for use in Japan: Keep abreast of the devices out there, and be aware that the keyboard and standard mouse are only two of the numerous input devices that exist and are to come.

SESSION FACILITATION OBSERVATION
The participants in sessions in Japan spoke less than participants in the United States did. This may have been due to the facilitation and user preparation. However, facilitators in Japan, before sessions began asked users to think out loud as much as possible. During the session, they asked participants what they were trying to find and what they thought happened at various points. However, these steps did not seem to encourage participants to talk.

Whether users articulated their thoughts or not, facilitators in Japan and in the U.S. were able to draw conclusion by watching users work and analyzing their behavior.

---

[11] *Wired*, Issue number 9.9, September 2001, "Is Japan Still the Future?" William Gibson, p. 119

Participants in the Study: General Information

We conducted this study in three parts. The first part was a quantitative study. In it, we measured task success, errors, and timings, and collected, via an oral questionnaire, subjective satisfaction ratings from participants. The second part was a qualitative study, in which we analyzed participants' comments and behavior. We divided the qualitative study into two sections: tests in the U.S. and tests in Japan.

We had 104 active participants. (This number does not include the people we simply interviewed or who gave us product demonstrations, nor does it include people over 65 years old, who will be included in a future report.) In the quantitative part of the study, 60 people participated. In the qualitative part of the study, 44 people participated.

In each of the groups, with the exception of the control group in the quantitative study, the people who participated had different disabilities. We included people with low vision, no vision, and motor impairments. Many of these physical impairments were the result of cerebral palsy. Some people had speech disabilities.

NOT INCLUDED IN THIS STUDY

In this research, we did not include people who are hard of hearing, deaf, or color-blind, nor did any participants have cognitive disabilities. Of course, there is much evidence that such disabilities do impact the way people work with a computer,[12] but this was beyond the scope of our study.

Please consider this before attempting to apply our conclusions to all Web users with disabilities.

EMPLOYMENT AND OCCUPATIONS

Participants in the study were almost all employed. This is certainly a debatable profile for study participants, as some people pointed out to us when recruiting for the study. One could argue that our participants do not accurately portray the disabled community; in the U.S., only one in three people of employment age who are visually impaired is employed.[13] The unemployment rate for people between the ages of 21 and 64 with severe disabilities is 73.9%. And, for people with less severe disabilities, the rate is 47.7%.[14] One might also argue that employed participants are more Web savvy than those who are not, though we cannot prove that.

For our purposes, we decided that asking employed people to test the sites makes the results more accurate for designers interested in supporting a company's employees, business partners, and customers.

---

[12] "Getting to Know the Disabilities Community," Michael G. Paciello, March 9, 2001, Webreview.

[13] Braille Institute, http://www.brailleinstitute.org/

[14] "President's Committee on Employment of People with Disabilities, Basic Facts," 1994 figures.

The following is a list of participants' occupations. In some cases, more than one participant had the same job or job title; we listed these only once.

Accessible technology specialist/ instructor
Advisor for blind students
Artist
Art therapist counselor
Attorney
Backup singer
Blind rehabilitation specialist
Braille program supervisor
Braille transcriptionist
Camp counselor
Client account administrator
COBOL programmer
Computer technician
Consultant
Cook (at a delicatessen)
Copy editor
Customer service representative
Data entry clerk
Director of audio production
Director of a center for independent living
Director of development and communication
Director of an information center
Director of strategic relationships
Empowerment leader
Entrepreneur (owner of typing business)
External relations officer
Founder and CEO
General manager
Grocery bagger
Historian
Housing advocate
Internet developer
Investor
Librarian
Masseuse
Medical transcriptionist
Motivational speaker
Network security officer
Nurse
Office clerk
PC & Braille instructor
Physician's assistant
Producer, film and video
Production coordinator
Professor
Project manager
Psychotherapist
Real estate agent

Receptionist
Research worker
Researcher & instructor
Retired (former computer programmer)
Sales associate
Secretary
Securities inspector
Social worker
Student
Support specialist
Systems administrator
Teacher
Teaching assistant
Technical expert of rehabilitation
Technical writer
Unemployed
Union organizer
Vocal coach
Writer (freelance)

Participants in the Quantitative Study

In the quantitative part of the study, we divided the user groups into three basic categories: 1) people who use screen readers, 2) people who use screen magnifiers, and 3) sighted people who use no assistive technology. We included twenty people in each group, for a total of sixty participants.[15]

The following charts and explanations describe only those users who participated in the measurement (quantitative) part of the study.

VISION ASSESSMENT AND ASSISTIVE TECHNOLOGY USED

The chart below shows the following about our quantitative study participants:

1) Almost all screen reader users have no vision, but a few have low vision.
2) All screen magnifier users have low vision.
3) None of the control group users have notable vision issues, nor do they use assistive technology.

Vision and Technology Used
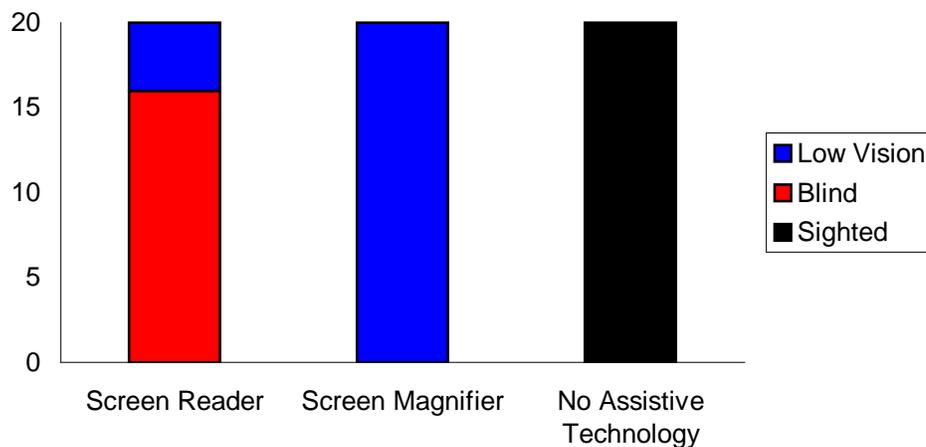
TIME USING THEIR ASSISTIVE TECHNOLOGY

On average, participants have been using the assistive device they used in the study for more than three years. Participants have used their screen reader, on average, for 3.15 years. Participants have used their screen magnifier, on average, for 3.81 years.

---

[15] Note that there were actually 80 participants in the quantitative part of the study. We studied a fourth group of people, all over the age of 65. Those results are in the Nielsen Norman Group report *Senior Citizens (Ages 65 and older) on the Web*.

GENDER DISTRIBUTION

Participants were almost exactly evenly distributed between men and women.

As the following chart shows, 52% of the participants were men and 48% were women.
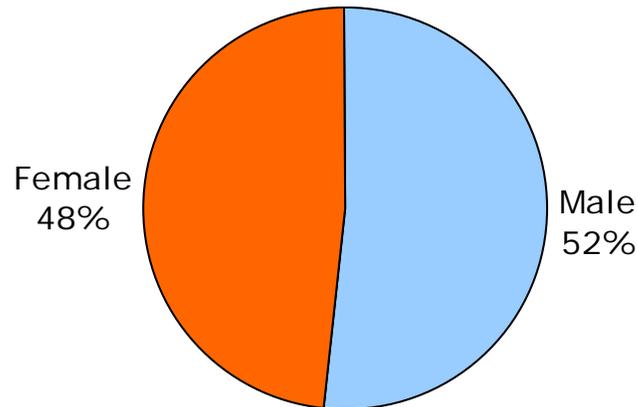
AGE DISTRIBUTION

All test participants were between the ages of 20 and 64.

As the following chart shows, most participants were between the ages of 20 and 49.

Age
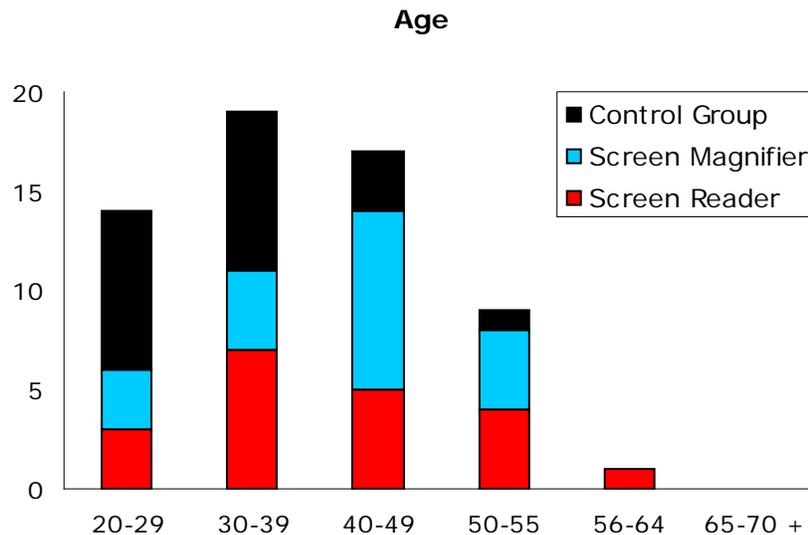
INTERNET EXPERIENCE

All participants had been using the Internet for at least three months. Most had been using it for more than three years. Most participants use the Internet every day, or at least several times a week. This frequency and the time using the Web indicate that a majority of participants are intermediate or expert Web users.

As the following chart shows, 41 testers have been using the Internet for more than three years, 16 have been using it between one and three years, and three people have been using if for between three months and a year.
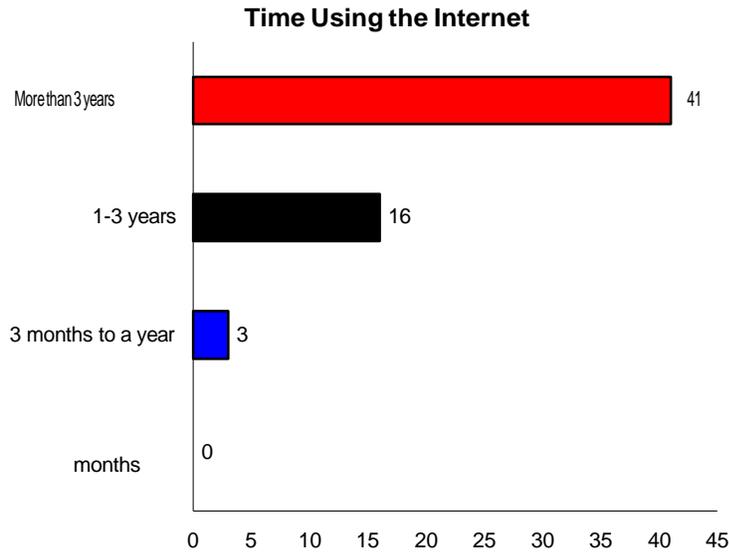
Time Using the Internet

Category	Value
More than 3 years	41
1-3 years	16
3 months to a year	3
months	0

As the following chart shows, most participants use the Internet every day, or at least several times a week.

Frequency of Internet Use

Category	Value
Never	0
Less than a few times a month	0
A few times a month	10
Several times a week, but not every day	21
Every day	29
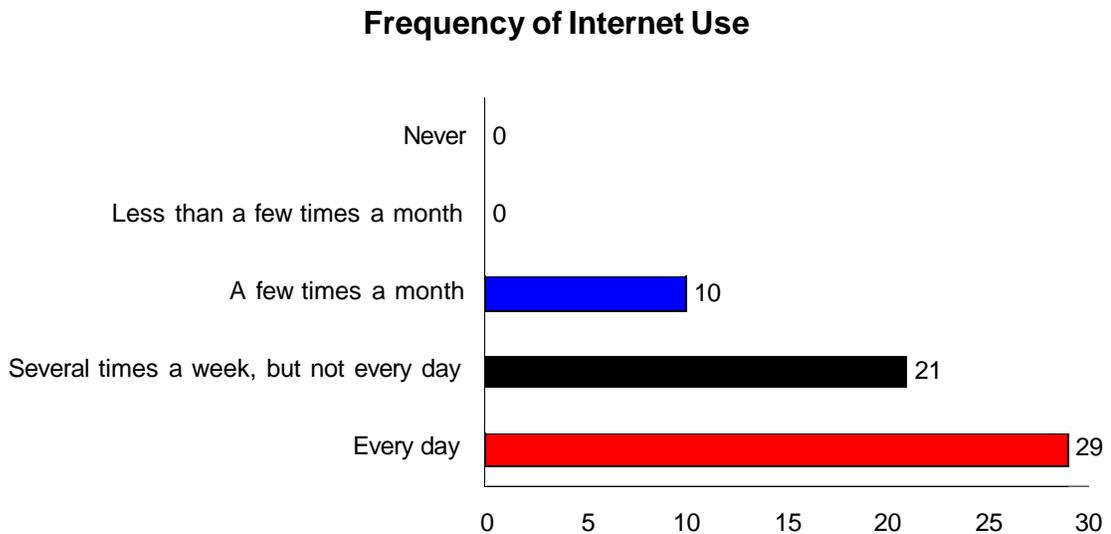
BROWSER AND INTERNET CONNECTION

Most participants used a high-speed Internet connection and Internet Explorer for their browser. We did not probe into why people chose their particular browser, but several did mention that they just use the browser that came with their computer.

As the following chart shows, most participants used Internet Explorer (82%), followed by Netscape (15%) and AOL (3%).
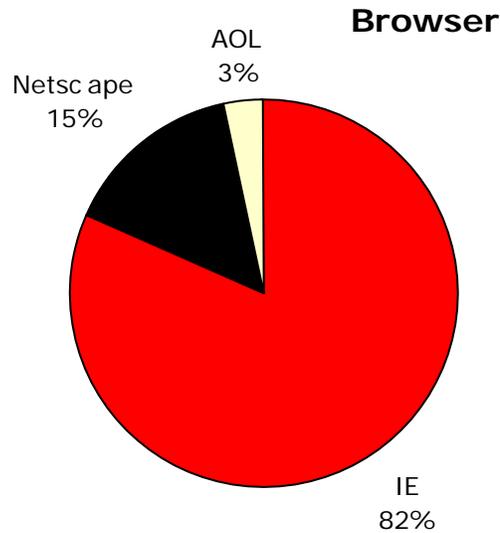
(Note: As we mentioned above, this section and the graph above includes users in the quantitative study only. In the qualitative study, most participants also used these browsers, but four people either used Lynx or tried to use it but could not because sites were using something that didn't render in Lynx, like Java applets, and so they switched to IE or Netscape.)

As the following chart shows, most participants used a high-speed Internet connection.

Connection Speed
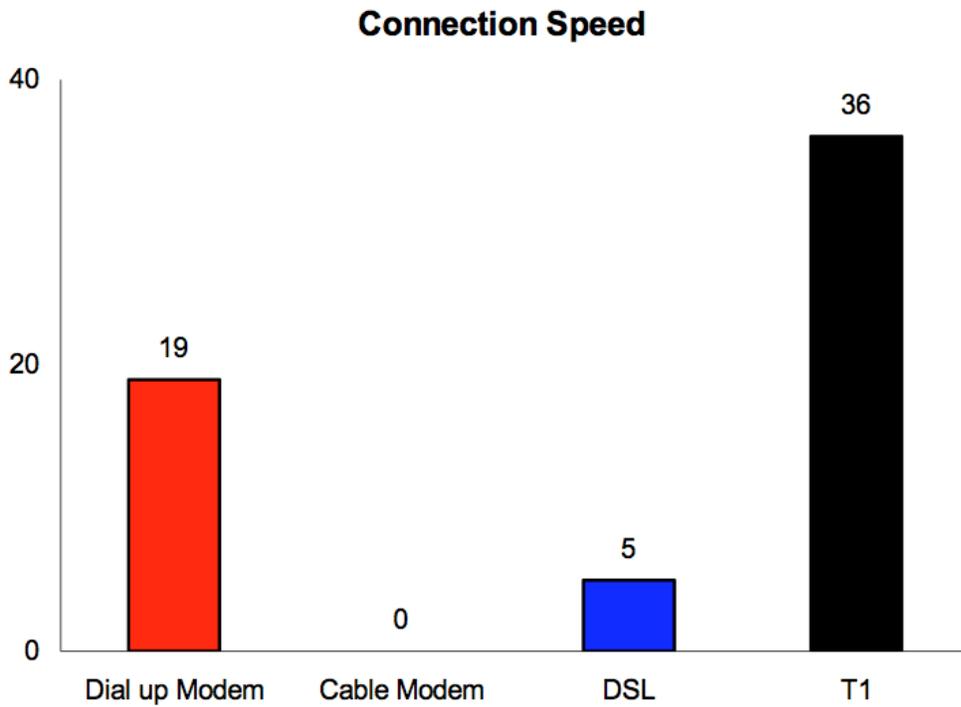
YEARS WORKING IN THEIR FIELD

Most participants have been working in their current field for between one and five years.

The following chart represents the participants and the number of years they have worked in their current employment field: less than a year, 11; between one and five years, 23; between five and ten years, six; between ten and fifteen years, five; more than fifteen years, 15.

Years Working in Current Field

Category	Value
Less than 1 year	11
Between 1 and 5 years	23
Between 5 and 10 years	6
Between 10 and 15 years	5
More than 15 years	15
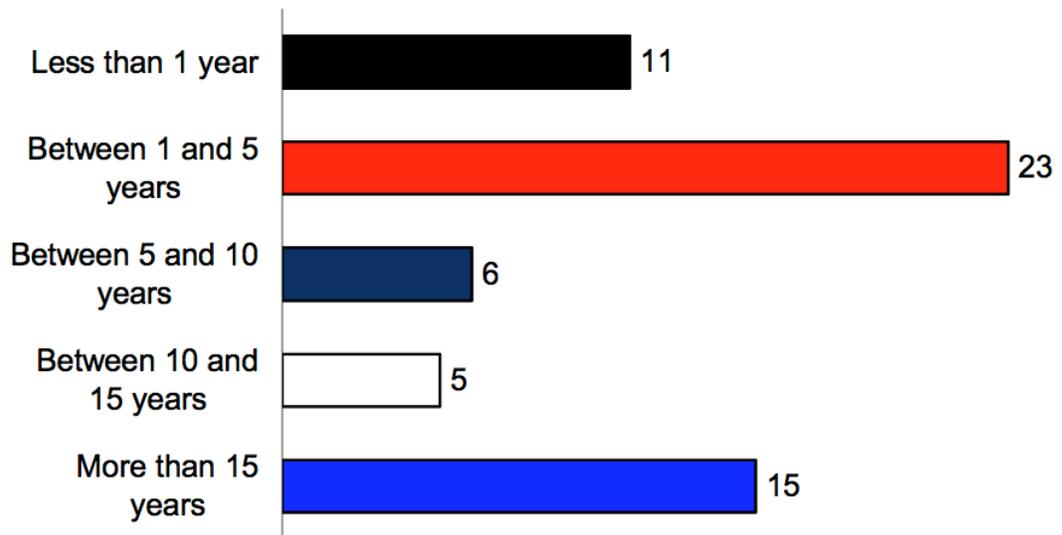
Participants in the Qualitative Study

In the qualitative part of the study, we divided the user groups into four basic categories: 1) people who use screen readers, 2) people who use screen magnifiers, 3) people who use Braille devices, and 4) people who use some technology or device to overcome a motor skill challenge. Each group was represented in the U.S. studies, and participants were split between the East Coast and West Coast. In the studies in Japan, the same types of users were represented, except for the Braille device users. In Japan, we found that Braille displays currently only work on MS-DOS, so users browsing the Web with Braille were difficult to find.

Forty-four people participated in the qualitative studies. The table below shows the number of people in each group, and country we tested them in.

QUALITATIVE DISTRIBUTION OF ASSISTIVE TECHNOLOGY PARTICIPANTS				
	Screen Readers	Screen Magnifiers	Braille Devices	Motor Skill Assistive Devices
United States	*10*	*8*	*8*	*5*
Low vision	1	8	1	0
No vision	9	0	7	0
Physical disabilities	0	0	0	5
Japan	*5*	*4*	*0*	*4*
Low vision	3	4	0	0
No vision	2	0	0	0
Physical disabilities	0	0	0	4
Totals	**15**	**12**	**8**	**9**

Screen Readers	Screen Magnifiers	Braille Devices	Motor Skill Assistive Devices
JAWS	ZoomText	Braille Lite 40	Touchpad
JAWS (Japanese Version)	ZoomText Xtra	Braille Lite Millennium 20	Trackball Foot
Window-Eyes	Coloristic	Power Braille 65	trackball
IBM Homepage Reader		Power Braille 40	Stickers on the keyboard
Windows 95 Reader		Braille Tiny	Keyguard
Windows 2000 Reader		Alva Braille Display 40	Pathfinder speech synthesizer (for speech)
VE2000 (Japan)			Chu-Chu Mouse
Winbes (Japan)			Raku Raku Mouse (customized)

Websites Studied

We studied various types of sites, based on design, industry, and type of company.
In the quantitative session, we studied the following websites:

Websites in the Quantitative Study

Company	URL	Info.
Charles Schwab	www.schwab.com	Large investment company
Chicago Transit Authority	www.transitchicago.com	Public transportation system for the city of Chicago
Target	www.target.com	Large retail/e-commerce company

Websites in the Qualitative Study

Company	URL	Info.	Language
Rock and Roll Hall of Fame	www.rockhall.com	Museum (non-profit organization)	English
The Hoover Dam	www.hooverdam.com	Tourist attraction	English
Real Audio	www.real.com	High-tech company	English
Guru	www.guru.com	Job recruiting/seeking site (simulation of intranet task an employee might do)	English
Internal Revenue Service	www.irs.gov	U.S. government	English
Environmental Protection Agency	www.epa.gov	U.S. government	English
New York City Department of Sanitation	www.nyc.gov/sanitation	U.S. state government	English
Major League Baseball	www.mlb.com	Very large company	English
Ticketmaster	www.ticketmaster.com	E-commerce site	English
Abercrombie & Fitch	www.abercrombie.com	E-commerce site (clothing; sells internationally)	English
Japanese prime minister's official page	www.kantei.go.jp	Japanese government	Japanese
Japanese Weather Association (JWA)	www.jwa.ne.jp	Japanese government	Japanese
Otsuka Corp.	www.otsuka-plus1.com/	Very large Japanese company (drug manufacturer)	Japanese
E-phone	www.e-phone.ne.jp	Japanese high-tech company (Internet phone service)	Japanese
Ways shop	www.ways.co.jp	Japanese e-commerce site	Japanese
Lake Yamanaka	http://www.fujigoko.org/yamanakako/	Japanese non-profit organization/tourist attraction	Japanese

Test Tasks

We chose test tasks based on what we consider to be basic things people want to accomplish using the Internet.

The quantitative study covered the following tasks:

- Fact-finding: Find the average temperature in Dallas, Texas in January.

- Buy an item: Purchase Janet Jackson's latest CD, "All for You," from Target, at www.target.com.

- Information retrieval: Find the schedule for a bus that would take you from O'Hare airport to 300 W. Division Street using the Chicago Transit Authority website, www.transitchicago.com.

- Compare and contrast: Find a specific kind of mutual fund on www.schwab.com.

In the qualitative study, we covered several areas as follows. Unlike the quantitative studies, participants did not use the same sites.

- Search (on the Web)
  No site was given for these tasks. Instead, we told users to find answers to specific questions any way they wanted, doing a general Web search or going to a particular website. The search tasks were:

  - When and where are the Boston Red Sox next playing the New York Yankees?

  - How long is the Great Wall of China?

  - What are Elvis Presley's parent's names?

  - Think of a musical group you like (if you cannot think of one, please use "Sting"). Where is the group (or person) playing next?

  - How fast can a cheetah run?

  - What is the most significant geological feature of the Red Rock Canyon in Nevada, USA, and how was this feature formed?

  - What are two materials that fly-fishing waders could be made of?

- Research and learning
  Examples include: Tell me a little about the types of fish that contain mercury. How long did it take to build the Hoover Dam and how many generators does it keep running? Which of the three outfield positions usually has the fastest runner? Assume that you recently donated $6,000 to a local high school for its marching band. Find out whether this is tax deductible and how to claim this on your taxes.

- E-commerce
  Buy an item online. For example: Buy yourself an article of clothing or a souvenir. Some sites, like the NYC Department of Sanitation and the EPA, did not exactly sell products. For sites like these, we instead asked users to

make some kind of online request, such as for service or a free pamphlet or report. For example: Order a free "Small Business Resource Guide" online.

- Information retrieval/fact-finding
  Examples include: Find the Abercrombie & Fitch store closest to you and its address and phone number. Find out who founded Guru, when they founded it, and where the company is based. Assume you want to volunteer at the Hoover Dam Visitor Center. Find out what your duties might be and how to apply. Find out how many U.S. Presidents have thrown out the first ball on Opening Day of baseball season, and name three of them.

- Compare and contrast
  Examples include: Find the best report about how mercury affects human health. Assume you sold your home recently and need to report income from the sale. Find the tax form you will need to submit to the IRS.

Assistive Technology, References, and Pricing

The following table includes information about some assistive (or *adaptive*) devices that people used in our study (in 2001 US dollars). As you can see, some devices are extremely expensive, which can prohibit some people who would like to use these technologies from buying them. Even on the low end of the price spectrum, we encountered a few users who, rather than buying the screen magnification software for example, are content to increase their browser default point-size to large, and sit extremely close to the monitor to surf the Web. Others say they exploit the free accessibility features in MS Windows. Several test participants did say that some US Government assistance helped them in buying devices, and some people have had computers and other devices donated to them.

PRODUCT/TECHNOLOGY AND URL	PRICE
FOR VISION ASSISTANCE	
PowerBraille 80 (Braille display) http://www.4access.com/Refresh_Braille.asp	$10,495
Speech synthesizer/communication tool (can be trained and used as input device) Prentke Romich Company http://www.prentrom.com/	$7.995
Braille Lite 40 (Braille display) http://www.4access.com/Refresh_Braille.asp	$5,495
JAWS Job Access with Speech (screen reader) http://www.hj.com/JAWS/JAWS.html Free trial software download available.	Between $795 and $1,195
DECTalk Express (speech synthesizer) http://www.gwmicro.com/catalog/	$1,095
Window-Eyes (screen reader) http://www.gwmicro.com/catalog/ Free trial software download available.	$595
ZoomText (screen magnification software) http://www.aisquared.com/ Free trial software download available.	Between $395 and $595
MAGic (screen magnification software) http:// www.hj.com/MAGic/MAGic1.html Free trial software download available.	$295 and up.
Opticon (handheld scanner and reader) http://www.opticonusa.com	$120 and up
FOR PHYSICAL ASSISTANCE	
Infrared Headpointer (input device for people with better head control than hand control) Prentke Romich Company http://www.prentrom.com/	$580 and up
Raku Raku Mouse (intended for people who cannot use a standard mouse because of hand tremors) Fukushi Media Station http://www.fukusi.softopia.pref.gifu.jp/eng/sub/kk/kiki02.htm	About $250.00 (29,800 Japanese Yen)
Keyguard (a plate fits over the keyboard so users with hand tremors can press one key at a time) http://web.ukonline.co.uk/specialaccess/whatis.html	Between $20 and $100

The above list is far from exhaustive. There are many more assistive devices, both low tech and high tech. In our study, some people used magnifying glasses to read Web pages. Several people with low vision had 19-inch monitors, so they could see more of the screen at once.

Some users hold a mouth-stick between their teeth and use the stick to type, pressing one key at a time on the keyboard. Infrared devices help those who cannot use their hands or mouths. Skullcaps help others to move the cursor or type, just by thinking. In much more complicated examples, people are getting anything from surgically fixed electrodes in their hands to mimic nerves, to sub-cranial cortical implants so they can communicate and use the computer and the Internet.[16] There is amazing research happening in these areas.

We recommend that designers, whenever possible, try a free software download and do a quick test of their own site or product. (In the table of assistive devices, we note which software products have free evaluation copies available for download.) While designers cannot exactly simulate the usage of the device, trying will help them find the most grievous design errors. An interesting idea is to create a low-tech packet that designers can use to do a simple test of their designs.[17] Such test include: to simulate physical manipulation difficulties, try simple tasks while wearing a pair of oven mitts or unplug the mouse; to simulate no vision, wear a blindfold or turn off the computer monitor; and, to simulate low vision, wear goggles with tape over them. These ideas may seem peculiar, but trying some of them can help designers uncover the most severe errors before the products either go through usability evaluations or are put in front of real users. Of course, as we mentioned before, you cannot simulate a real user experience with these models; they are intended just for "smoke testing" and not as a replacement for usability evaluations.[18]

---

[16] *Wired,* Issue number 9.8, August 2001, "The Next Brainiacs," John Hockenberry.

[17] Trace Center, "Trace Usability Screening Kit," Chris Law, Kitch Barnicle, and Shawn Lawton-Henry, http://trace.wisc.edu/docs/usability_screen_techs_UPA2000/usability_screening_techs.htm

[18] Also refer to Nielsen Norman Group report *How to Conduct Usability Evaluations for Accessibility*, available for download at http://www.nngroup.com/reports/how-to-conduct-usability-studies-accessibility/

About Disabilities and Assistive Technology Usage

The following figures are a reminder of how many people in the U.S. alone can be affected by good or bad accessibility design.

VISUAL IMPAIRMENTS

At least 1.5 million American computer users are blind and visually impaired.[19] Two common descriptions for blindness include *legally* and *functionally* blind.

- *Legal blindness* refers to clinically measured visual acuity of 20/200 in the better eye with best correction, or a visual field of 20 degrees or less.

- *Functional limitation* refers to the consequence of different levels of visual ability for the performance of common activities. The activity usually measured is the function of reading. Functional limitation in seeing print is measured by self- or proxy-survey reports for two levels:

  o *Severe* functional limitation refers to people who say they "are unable" to see words and letters in ordinary print, even with their eyeglasses on.

  o *Non-severe* functional limitation refers to people who say they "have difficulty" seeing words and letters in ordinary print, even with their eyeglasses on... includes those who say they are "unable" to see words and letters.[20]

The following numbers, as of 1996, apply to the U.S.:

- More than eight million Americans have visual impairments.

- Nearly three million Americans are color-blind.

- More than 700,000 Americans have cataracts, which causes hazy vision.

- Nearly three million Americans have glaucoma, which can cause loss of peripheral vision.

- As of 1994, approximately 500,000 Americans use assistive technology devices to accommodate vision impairments.[21]

SCREEN READERS

It is important to note that people who use screen readers are not always totally blind. Some people with partial vision also use these devices. Also, people with dyslexia and learning disabilities sometimes use screen readers as well, since they can't easily read text on the screen.[22] Additionally, while some people with no vision use Braille devices in lieu of screen readers, others use a Braille device and a screen reader to complement each other. In the latter case, some people use the Braille device as their main reader and input mechanism, while others rely mostly on the

---

[19] American Foundation for the Blind, http://www.afb.org/info/blindness-statistics/2#comp

[20] American Foundation for the Blind, 9/27/00 ibid.

[21] National Center for Health Statistics, http://www.cdc.gov/nchs/fastats/disable.htm

[22] According to sources at Recording for the Blind and Dyslexic http://www.rfbd.org

screen reader and use the Braille just to check their spelling. (A few participants said that using a screen reader is much faster than using a Braille device.) Both devices convert on-screen information to text, which can either be displayed auditorily via speech or tactilely via dynamic Braille.

BRAILLE

We included Braille devices in only the qualitative part of the study. We wanted to learn about these devices, but did not include them in the quantitative part of the study because, "The estimated 85,000 Braille readers constitute fewer than 10 percent of the estimated number of persons who are legally blind in the United States and slightly fewer than 40 percent of the estimated number who are 'functionally blind' (defined as those whose ability to see is light perception or less)."[23] It's worthwhile to note that these Braille figures include people over the age of 65 who are blind (about 5.5 million people).[24] It is very possible that the percentage of people who are blind between the ages of 20 and 55 who read Braille is much higher. Also, some experts attribute the low percentage of people who read Braille to the following: "As blind students were integrated into public school programs, the teaching and use of Braille decreased. There is a significant shortage of qualified teachers of the blind who know Braille and can teach it. The use of tape recorders and computers with synthetic speech have reduced the use of Braille."[25]

CEREBRAL PALSY

Cerebral palsy is characterized by an inability to fully control motor function, particularly muscle control and coordination. Depending on which areas of the brain have been damaged, one or more of the following may occur:

- muscle tightness or spasm
- involuntary movement
- disturbance in gait and mobility
- abnormal sensation and perception
- impairment of sight, hearing, or speech
- seizures[26]

Approximately 500,000 people in the U.S. have some degree of cerebral palsy, but the country has no system for monitoring cerebral palsy's occurrence.[27] More people have cerebral palsy than any other developmental disability, including Down's syndrome, epilepsy, and autism.

As of 1994, approximately 7.4 million people in the U.S. used assistive technology to accommodate mobility impairments.[28]

---

[23] American Foundation for the Blind, "Estimated Number of Adult Braille Readers in the United States."

[24] American Foundation for the Blind, http://www.afb.org/info/blindness-statistics/2#comp

[25] International Braille Research Center, http://www.braille.org

[26] Cerebral Palsy Facts .com, http://www.cerebralpalsyfacts.com/stats.htm

[27] Ibid.

[28] National Center for Health Statistics, http://www.cdc.gov/nchs/fastats/disable.htm

SPEECH AND HEARING

Almost 2.7 million Americans have speech impairments, and approximately 22 million are hearing-impaired.[29] Including people with hearing impairments was outside the scope of this study. We did include a few users with speech impairments in the qualitative part of our study. With the growth in multimedia use on the Web and voice recognition systems, there are most certainly usability issues for these groups.

---

[29] National Center for Health Statistics, http://www.cdc.gov/nchs/fastats/disable.htm

Methodology

Five people contributed to writing the test tasks and pilot testing them. The lead facilitator wrote the facilitation notes packets, including tasks, questionnaires, and very specific instructions. Two research assistants conducted the quantitative sessions. Since more than one person ran the quantitative studies, they referred to a very explicit, tested script throughout the studies.[30]

MEASUREMENTS
In both the quantitative and qualitative studies, we measured success and collected subjective satisfaction ratings. However, in the qualitative sessions, we did not measure timings, or errors, as the facilitators had more interaction with the users.

SUCCESS RATINGS
For each task, we pre-assigned success scores and criteria for complete success. Users' answers dictated the success scores. The highest score a website and user combination could achieve on each task was four points. We also evaluated the users' steps and answers after the study, to ensure fairness and consistency across sessions.

TASK TIMINGS
In the quantitative studies, the facilitator started the stopwatch once the website was visible on the page. Since we were not testing whether users could find a site, we gave them the URL in the tasks, and only started the timer after those sites were loaded. If the user's browser was minimized, the stopwatch was started once the screen reader began reading the page. If the user asked the facilitator to reread a task, the facilitator stopped the timer, read the task, and started the timer again.

For the general Web search task, we did not give users a URL. Facilitators started the stopwatch once the browser was launched and the homepage was loaded.

If a user answered the phone or was in some way interrupted, the facilitator stopped the clock. If the user's Internet connection went down, the facilitator stopped the clock.

CLICK ERRORS
When a user clicked a link that led them to the wrong place or down the wrong path, it was counted as an error. Once they were down an error path, more clicks down that path were not counted as errors, nor was clicking the *Back* button to recover from an error. For example, say a user is buying a CD, has the right one selected, in the correct quantity. They now need to check out. Instead of clicking the *Checkout* button, a user clicks the *Login* button on a site they have never visited. This is counted as one error. They then fill in the *login* field with their email address, thinking they can just go ahead and log in, even though they have never registered with the site. This is not counted as an error. They then click the *Back* button because they realize what is happening. This is not counted as an error. And so on.

What is and is not an error is very difficult to measure. We discussed and documented some guidelines in the facilitation notes. Often we needed to discuss

---

[30] For more information about how to conduct usability accessibility studies see, "How to Conduct Usability Evaluations for Accessibility," available for download at:
http://www.nngroup.com/reports/how-to-conduct-usability-studies-accessibility/

these again after sessions. (This is why writing down exactly what a user clicks during each session is extremely important.)

Please note that we don't consider click errors to be user errors. Instead see them as instances where the website was misleading to the users.

SUBJECTIVE SATISFACTION RATINGS
After each task, in both the quantitative and qualitative studies, we asked participants to rate their confidence, satisfaction, and frustration on a 1 to 7 Likert scale. Facilitators read the questions and scale to people, and wrote down their responses.

Accessibility "Audit" Software

There are several tools and websites that can help you begin to test the quality of your site's accessibility. While these cannot replace usability evaluations, they can help you find the most grievous errors. Note that these applications seem to be weighted more toward predicting how well screen reader technology would fare and less toward screen magnifiers or other assistive devices.

A Note about Government Efforts

Many countries are moving ahead with accessibility design at a faster pace than some businesses. Laws, policies, and guidelines have been in the works for years, in the U.S. and in many other countries. This report does not analyze these efforts, nor does it interpret them. However, you should be aware that the U.S. and other countries are beginning to enforce accessibility-related laws.

The Web Accessibility Initiative site, http://www.w3.org/WAI/, does a very thorough job of summarizing and linking to government information and laws in various countries. The following are some of these links:

- Australia, http://www.w3.org/WAI/Policy/#Australia
- Canada, http://www.w3.org/WAI/Policy/#Canada
- Denmark, http://www.w3.org/WAI/Policy/#Denmark
- European Union, http://www.w3.org/WAI/Policy/#EU
- France, http://www.w3.org/WAI/Policy/#France
- Ireland, http://www.w3.org/WAI/Policy/#Ireland
- Italy, http://www.w3.org/WAI/Policy/#it
- Japan, http://www.w3.org/WAI/Policy/#Japan
- Portugal, http://www.w3.org/WAI/Policy/#Portugal
- United Kingdom, http://www.w3.org/WAI/Policy/#UK
- United States of America, http://www.w3.org/WAI/Policy/#USA

Resources

There are many good resources, on the Web and in print, about designing for accessibility. The list below is not exhaustive. On the contrary, we deliberately present only the few resources we found to be among the most helpful. Note that we've also referenced a few others as footnotes within the report.

WEBSITES

World Wide Web Consortium (W3C), Web Accessibility Initiative (WAI)
This site has excellent resources, and many consider the WAI guidelines to be the de facto standards for Web accessibility. http://www.w3.org/WAI

The Trace R&D Center
The Trace R&D Center, part of the College of Engineering at the University of Wisconsin-Madison, is involved in numerous research and development activities concerning accessibility to standard technologies. http://trace.wisc.edu

Lighthouse International
This not-for-profit organization enables people of all ages who are blind or partially sighted to lead independent and productive lives. It was founded in 1905 and is headquartered in New York. http://www.lighthouse.org

United States Government
Section 508 requires that Federal agencies' electronic and information technology is accessible to people with disabilities. The Federal Information Technology Accessibility Initiative is a Federal government interagency effort to offer information and technical assistance to assist in the successful implementation of Section 508. http://www.section508.gov

Index of Government Guidelines for Web Sites
http://www.standards-schmandards.com/projects/government-guidelines

IBM
IBM publishes some good accessibility information and design guidelines in their Accessibility Center. http://www-03.ibm.com/able/guidelines/

NVDA
NonVisual Desktop Access is a free, open source, portable screen reader for Microsoft Windows that was developed since this report was first written. http://www.nvaccess.org/

Google Accessibility Course
https://webaccessibility.withgoogle.com/course

BOOKS

Just Ask: Integrating Accessibility Throughout Design
by Shawn Lawton Henry, Lulu.com, ISBN 1430319526

Maximum Accessibility: Making Your Web Site More Usable for Everyone
by John M. Slatin and Sharron Rush, Addison-Wesley, ISBN 0201774224

Access by Design: A Guide to Universal Usability for Web Designers
by Sarah Horton, New Riders Press, ISBN 032131140X

About the Authors

Kara Pernice is managing director at Nielsen Norman Group and heads the company's East Coast operations. Since joining NN/g, Pernice has led several intercontinental research studies and wrote associated reports about topics such as intranets, the Web and accessibility, senior citizens, public relations, and site maps. She has developed and taught numerous seminars about these topics and about a variety of usability methods, such as the product life cycle, field studies, emotion and design, usability testing, and eyetracking. Additionally, Pernice has worked with clients in many industries. Before joining NN/g, she established successful usability programs at Lotus Development; Iris Associates, an IBM subsidiary; and Interleaf. She managed the first usability program for Lotus Notes and the Domino server, and after her team's work, *PC Magazine* wrote, "If this were summer camp, Lotus Notes would walk away with the Most Improved Camper award." Pernice chaired the Usability Professionals' Association conferences in 2000 and 2001, was presentations chair for UPA 1999, and was conference advisor for UPA 2002. She is on the editorial board for a new intranet magazine, *The Journal of Intranet Strategy and Management*. She has an MBA from Northeastern University and a BA from Simmons College.

Dr. Jakob Nielsen is a principal of Nielsen Norman Group. He is the founder of the "discount usability engineering" movement, which emphasizes fast and efficient methods for improving the quality of user interfaces. Nielsen, noted as "the world's leading expert on Web usability" by *U.S. News and World Report* and "the next best thing to a true time machine" by *USA Today*, is the author of the best- selling book *Designing Web Usability: The Practice of Simplicity* (2000), which has sold more than a quarter of a million copies in twenty-two languages. His other books include *Usability Engineering* (1993), *Usability Inspection Methods* (1994), *International User Interfaces* (1996), *Homepage Usability: 50 Websites Deconstructed* (2001), and *Prioritizing Web Usability* (2006). Nielsen's Alertbox column on Web usability has been published on the Internet since 1995 and currently has about 200,000 readers. From 1994 to 1998, Nielsen was a Sun Microsystems Distinguished Engineer. His previous affiliations include Bell Communications Research, the Technical University of Denmark, and the IBM User Interface Institute. He holds 79 US patents, mainly on ways of making the Internet easier to use.

Acknowledgements