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Taking control of Web browsing

VICKI L. HANSON*
IBM T. J. Watson Research Center, 19 Skyline Dr., Hawthorne, NY 10532, USA;
Email: vlh@us.ibm.com

Adherence to accessibility guidelines for Web pages does not necessarily guarantee a usable or satisfying Web experience for all persons with disabilities. The needs of many of these individuals fall outside the guidelines for accessible content that most Web authors take into consideration. Many of these users wish, for example, that they simply could 'enlarge' what is on a Web page. They also express the wish that pages would be 'less confusing'. To meet these needs, Web browsers and various software applications provide for a variety of ways in which page presentations can be altered. The effects of these alterations often have unexpected consequences. Some designs accommodate these alterations better than others. This article discusses one such application that allows users to control features of Web page presentation and explores design features that facilitate such control.

Keywords: Web accessibility; Usability; Design

1. Introduction

Web designers will be influenced by many factors when designing websites. Critical will be the message to be conveyed along with concerns about branding and other client requirements. Usability and accessibility may be low priorities, if considered at all. Even when accessibility is considered, the definition may be overly narrow. Accessibility is often interpreted strictly as a requirement to make a page capable of being rendered by a screen reader. Thus, if a designer seeks to make a page 'accessible', this may result simply in making sure that all the graphics have ALT tags. The content of the tags is often given little consideration as to whether the tag is useful or helpful. For example, tags such as the 'click here to go home' are not uncommon. Such tags provide unnecessary (and time-consuming) instructions for users of screen readers and indicate a lack of understanding as to how these users navigate the Web.

This article presents a different approach to accessibility. First, it does not cover Web browsing by blind users or page usability with screen readers, which

*Corresponding author.

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are the subject of much other research. Instead, it will focus on Web browsing of persons with other difficulties in Web access due, for example, to limited vision or dexterity. Second, this article does not assume that Web designers need to bear the full burden for creating pages usable by persons with diverse needs. The approach to be discussed here involves user control of page presentation. With this approach, Web pages are changed 'on the fly' based on user preferences.

The article begins with a discussion of some of the factors that limit Web use for many individuals and then presents one software technology designed to give users control over the way Web pages are presented to them. The article ends with a discussion of some steps designers can take to allow individuals greater control over page presentation.

2. Factors limiting Web use

The research project to be described here began as an attempt to facilitate Web access for older adults. Declines in perception, dexterity and cognition often accompany aging (see, for example, McNeil 1997, National Institute on Aging 2002, Czaja and Lee 2003, Forrester Research, Inc. 2004). It is important to note, however, that the types of perceptual, motor and cognitive factors that make Web usage difficult for older adults are not unique to this user group. These same limitations apply to a number of other users, including, for example, persons with low vision, attentional deficits, developmental delay, neuromuscular disease, traumatic brain injury and limited reading proficiency.

It is understandably difficult for persons with limited vision to read Web pages. In many cases, these limitations can be addressed by using eyeglasses. This is an imperfect solution for others, however. People who use bifocals and spend much time at the computer tend to develop stiff necks from tilting their heads at an awkward angle to read through the bifocal lenses. Those who sit close to a computer screen in order to better see what is on a Web page may develop shoulder pain from sitting at an unnatural position.

For some, however, the use of glasses is not sufficient to be able to read Web pages. For users with more severe disability, such as age-related macular degeneration, glasses provide only limited improvement. Moreover, choices made by designers related to such things as colour combinations and page layout will impact their ability to read Web pages, regardless of acuity.

For designers, font choices regarding size, style and colour may be important, but more as they relate to the concerns of image and branding than whether they will be usable by a diverse population. Users with limited vision may need as much contrast as possible between text and background in order to read text on a Web page. It is not uncommon, however, for designers to use colour schemes that have low contrast. As another example, designers may wish to get as much information as possible on a single screen. This not only has the result of reducing the size of text and clickable areas on a page but also leads to visual

clutter. Critically, Web designers may make liberal use of graphics to ensure page presentation remains the same across various browsers (Gunderson 2004). As we shall see, graphics create a variety of problems for users who need to make changes to page presentation.

The work to be presented here differs from the traditional discussions of Web accessibility in that it does not require that Web content developers provide for all the adaptations that end users might wish. These transformations and adaptations are made 'on the fly' by the software. In this respect it is ideal for designers in that they need not consider the range of users who may visit their website. Rather, by making their page flexible to change, pages have the potential to better suit the needs of a diverse population. As we will see, however, choices made by Web page designers may limit the ability of the software to render pages as users wish.

3. Adapting Web content

There are various means by which users can alter page renderings to meet their needs. One available means is through features built into browsers. Web browsers (e.g. Internet Explorer®, Netscape and Opera) all have features designed to allow users some control over page presentation. The mechanics of utilizing these features may often prove difficult for users who need these features, however (Gunderson 2004). To provide additional needed features or ease of use, various technologies have been developed. Specifically, software applications, gateways and proxy servers have been designed (e.g. Asakawa and Itoh 1998, Zajicek *et al.* 1998, Brown and Robinson 2001, King *et al*. 2004).

The *Web Adaptation Technology* software is a research application we created for this purpose (Hanson and Richards 2004, Richards and Hanson 2004). Originally designed for older adults, the software is now in use by a number of organizations serving both seniors and persons with a variety of limitations that make Web access difficult. Consistent in concept with the User Agent Accessibility Guidelines (Jacobs *et al.* 2002), this research software allows for adaptations to page presentation and input as needed.

The software is an application that works with Windows Internet Explorer® to transform the content of HTTP requests. Changes made by individuals apply only to their own viewing of a page – no changes are made to the page source. The design requirements motivating the application creation and the features of the *Web Adaptation Technology* have been described elsewhere (Hanson and Richards 2004, Richards and Hanson 2004). In particular, descriptions of the keyboarding enhancements are given in detail elsewhere (Trewin 2004) and will not be considered here as they are not directly relevant to concerns of designers. Descriptions of some of the features will be used to highlight design considerations.

3.1 Enlarging page content

When people are asked what they need in order to make Web pages more legible, the first response is always that the content should be larger. The *Web Adaptation Technology* software allows for easy enlargement of text and other page content, providing banner text, text enlargement, enlargement of browser controls, enlargement and enhancement of images, and page magnification.

Figure 1 shows an example of one enlargement feature, banner text. Banner text is useful for persons with low vision who typically would sit very close to the screen in order to be able to read Web pages. As illustrated in Figure 1, people can 'try out' features of the software, such as banner text, on Web pages they are using. To do this, they bring up a band at the bottom of the browser window by clicking a 'Settings' button in the toolbar. This 'Settings' button and band are shown in the screen shot in Figure 1a (left side). The band comprises a series of panels that enable access to the different features of the software.

In Figure 1a, the user has the option of trying out banner text, with either black text on a white background or white text on a black background. Shown in Figure 1b on the right is banner text selected for black text on a white background. Having been selected, the band can be closed, as illustrated. Users would then continue their Web browsing. All subsequent pages will be shown with the banner text. Settings are saved from session to session, so that users do not need to be constantly setting their preferences.

As shown in Figure 1b, banner text displays one line of text at time, in very large font, across the top of the browser window. Users move through the text under their own control by clicking the **Enter** key, space bar or down arrow key on their computer. This method allows the rate of text presentation to be under user control, which is very important as persons who use this option will often read at unpredictable rates due to their limited vision.

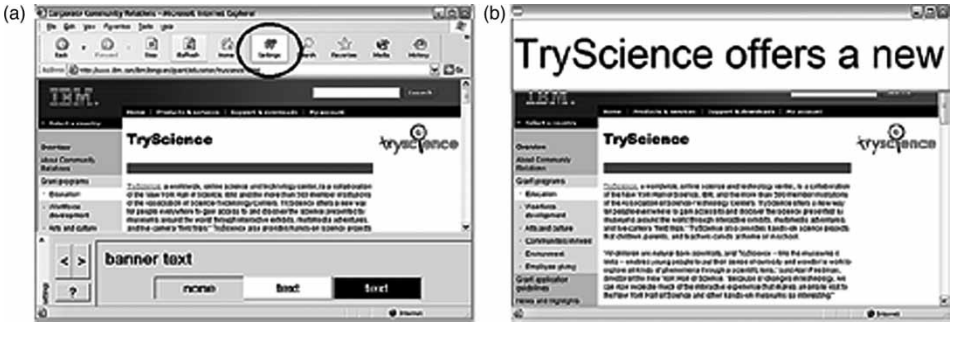

Figure 1. The banner text feature of the *Web Adaptation Technology*. (a) 'Settings' button that brings up the band at the bottom of the browser window. Also depicted in the panel are the buttons for the banner text option. (b) Banner text black on white option.

Text selection is also under user control. Users simply use their mouse cursor to hover over text they would like to have displayed in the banner text area. This could be whole stories, links or alt tags from images. Users who have dexterity limitations are able to use alternative keyboard methods for selecting text (Hanson and Richards, 2004).

3.2 Adjusting font

Persons with vision limitations not only exhibit a decrease in acuity that requires larger text and images but also experience difficulties with contrast discriminations, colour perception and visual crowding (e.g. Faye and Stappenbeck 2000a,b, Making Your Web Site Senior Friendly 2001, Arditi 2003). The *Web Adaptation Technology* software provides a number of features designed to address these issues, including increasing the spacing between letters, increasing the spacing between lines, changing text style and changing colours for better contrast.

While changes in font style are fairly simplistic in nature, colour changes illustrate how complex some changes can be. The complexity of colour changes exists on two levels. The first level is that several different aspects of colour are set with one key click. Shown on the left in Figure 2 is the settings panel for colours. Clicking one of the colour change options, such as white text on black background, sets not only the text and background colours but also the link colours. Unvisited links, visited links and hover colours are all set with this one click. The colour combinations were selected to be maximally contrasting. An example of these changes is illustrated on the right panel of figure 2.

The second level of complexity is the necessity of additional page analysis. The reason for this is that Web designers often use transparent GIFs to create visual effects, with transparent GIFs often containing text designed to display over a particular background colour or image. In this case, changing the background colour can make text or other information difficult to read. In the worst case,

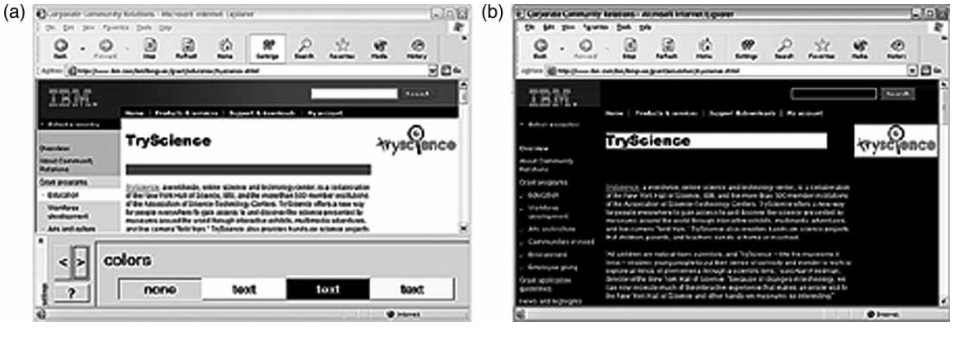

Figure 2. The colours change feature of the *Web Adaptation Technology*. (a) Panel with buttons for the colour options of this feature. (b) White on black colour scheme option.

information can completely disappear as the text and background colours become the same when the new background colour is the same as the colour in the non-transparent part of a GIF. To correct for this problem, the *Web Adaptation Technology* software analyses the GIF and background colours every time a page colour change is requested. If needed, the software changes transparent GIF colours to the original background colour.

3.3 Reducing distractions

There is much complexity in the design of some Web pages. There can be so much complexity, in fact, that it interferes with the ability of people to comprehend the page (Chadwick-Dias *et al*. 2003, Poulson and Nicolle 2004). Some users have difficulty understanding page layouts and navigation, resulting in problems interpreting multi-column layouts and multiple selection options. Animations are distracting to many users, making it hard to concentrate on pages having moving images. Users with processing limitations may be unable to cope with a great deal of information at one time. These processing limitations can be the result of poor literacy, attentional difficulties, memory limitations, learning disabilities or aging. The *Web Adaptation Technology* software provides a number of different ways in which distractions can be reduced, including removing backgrounds, not showing images, stopping GIF animations, magnifying pages and changing page layout.

It is easy to understand that not showing backgrounds or images and stopping distracting animations can reduce cognitive load. The utility of page magnification is less obvious. This feature was initially implemented for the purposes of enlarging page content, as discussed above. We learned from some of our users, however, that they often use this feature for a different reason. As shown in Figure 3, magnification also has the effect of reducing the amount of information presented on a page. Figure 3b shows a Web page with 150% magnification.

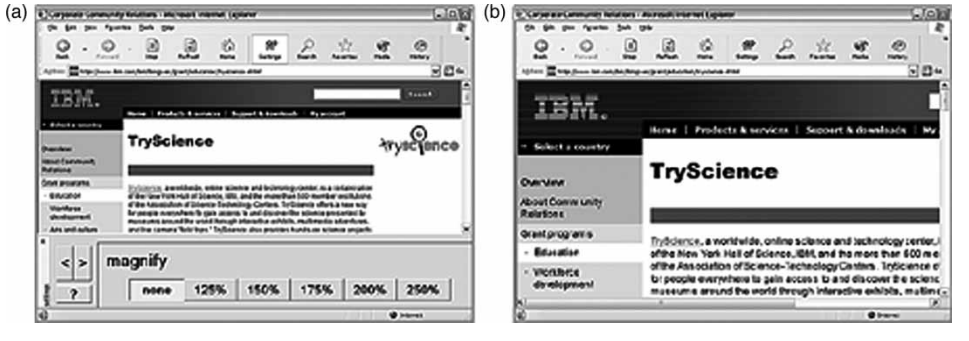

Figure 3. The page magnification feature of the *Web Adaptation Technology*. (a) Panel with buttons for the various magnification options. (b) Page with 150% magnification selected.

A consequence of page magnification, however, is that information may go off the right-hand side of the screen, as shown in Figure 3b. In order to see the full content, users must use horizontal scrolling. Horizontal scrolling is difficult for most users and, as can be imagined, could make it difficult to comprehend a story if the user had to be continually scrolling right and left. To correct this, the *Web Adaptation Technology* software has a feature that changes the page layout, as shown in Figure 4.

Figure 4a shows the option to change the page layout. This option, in effect, linearizes a page, putting all the information in a single column formatted to fit the width of the browser window. This enables the layout of multi-column pages to be transformed into a single column. Using this one column option, the horizontal scrolling is eliminated, as shown in Figure 4b. In this case, the page is magnified and reformatted for a simplified view.

An interesting aspect of this feature is that in cases where Web authors provide skip navigation, the transformed page brings the user directly to the main page content. This is shown in Figure 4b, where the left navigation links, for example, are 'skipped' for presentation. This information is not lost, however. As indicated by the vertical scrollbar, these links are simply above the displayed information. The original intent of skip navigation was to enable screen readers to skip over lists of links to enable rapid access the main content. With the *Web Adaptation Technology* software, this skip navigation similarly allows users, without a screen reader, to immediately go to the main content of a page.

3.4 Reading text aloud

Having Web content read aloud has been a very popular feature of the *Web Adaptation Technology* software (Hanson and Richards 2004, Richards and Hanson 2004). This feature uses text-to-speech technology to read aloud selected portions of a page aloud. Screen readers linearize pages and read them aloud

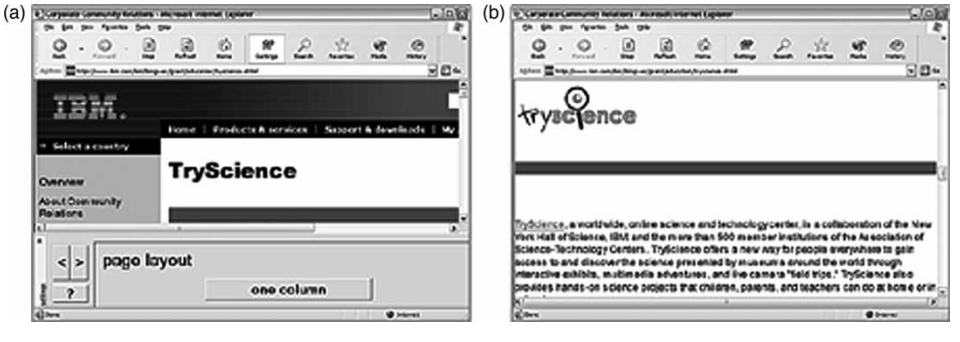

Figure 4. The page layout feature of the *Web Adaptation Technology*. (a) Panel with the button for the one column layout option. (b) One-column layout combined with the 150% magnification.

from top to bottom, using keyboard commands for navigation. These keyboard commands require memorization that can add unacceptable difficulty to the Web experience for users, particularly older users (Zajicek 2001). In contrast, the speak text feature of the *Web Adaptation Technology* software is engaged when the user points their mouse cursor at a portion of the page they want to have read aloud. This feature, therefore, selects passages for reading in the same manner as the banner text feature previously described. At the user's request, sections selected for reading can be a number of page entities, including text passages, single words, banner text, headings, links or ALT tags. Figure 5a shows the speak text panel. Figure 5b shows a passage being reading aloud. The passage is highlighted as it is read aloud.

Figure 6 illustrates two of the other ways in which the speak text feature can be used. In Figure 6a, the user double clicks on a single word to have it read aloud. In Figure 6b, speak text is combined with the banner text feature previously described. When speak text and banner text are used in combination, the text-to-speech is synchronized with the banner text such that it reads aloud only the text currently showing in the banner. As a user moves through a passage with banner text, the text displayed in the banner and the text read aloud are in step, allowing the user multi-modality input.

Individuals with limited vision use this feature for reading Web pages. In some cases, it may serve simply as reinforcement or confirmation when reading. Individuals with cognitive disabilities and low literacy report that this feature has enabled them to use the Web independently. The added confidence that they will be able to understand Web pages has motivated them to go online more frequently. In short, the speak text feature is helpful to anyone who could benefit from aural presentation of materials. This includes people with poor vision, dyslexia and English as a second language (ESL) who have used the software.

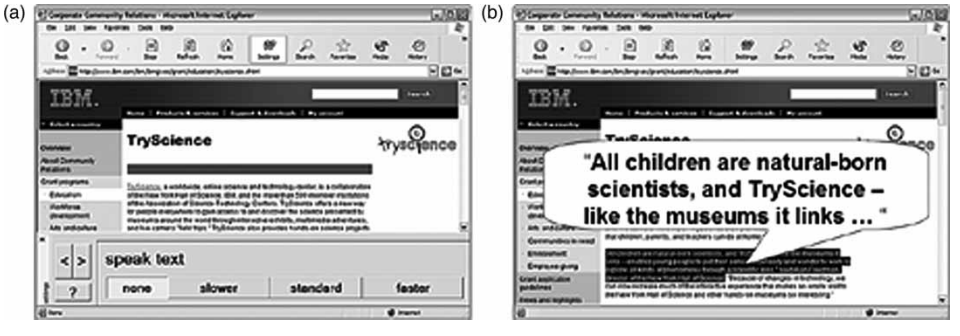

Figure 5. The speak text feature of the *Web Adaptation Technology*. (a) Panel with buttons for the options for reading text aloud. (b) Part of a text passage being read aloud.

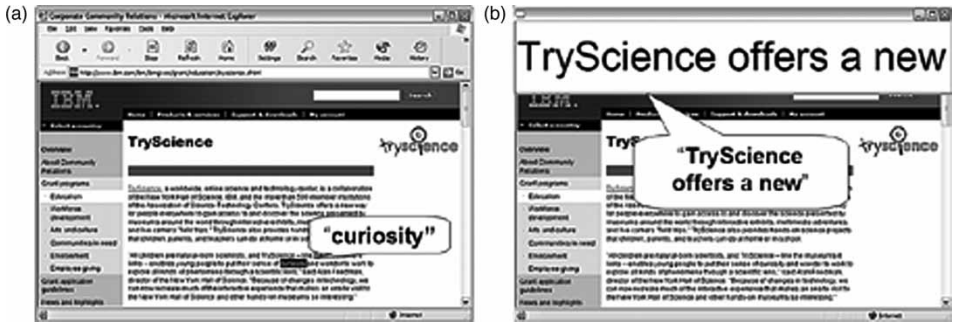

Figure 6. The speak text feature of the *Web Adaptation Technology*. (a) Single word selected for reading text aloud. (b) Banner text being read aloud.

4. Designing for accessibility

The software discussed in this article, as mentioned, is currently in use by a number of older adults. Its use has also expanded to include persons with visual and dexterity disabilities, students with learning disabilities or developmental delays, and speakers of ESL. Developed originally in English the software has since been translated into six languages and used by organizations serving these communities globally. There are now a few thousand users of the software and their usage of the software has been reported elsewhere (Hanson and Richards 2004). In brief, the most commonly used features of the software are speak text and various features for enlarging content (text size and page magnification) and adjusting font (text style and colours). On the whole, most users make relatively small changes to size (e.g. 125% page magnification); however, an interesting pattern emerged when we looked only at users who presumably had the most limited vision – those who used the banner text option. Most of these users also used other content enlargement, bold sans serif font for the text style, and were more likely than the group as a whole to use both speak text and line and letter spacing.

Often the consequence of allowing users to control presentation will be that the designer's sense of how a page should look will be violated. This can be readily seen in Figures 1–4. In addition, user changes to page presentation may result in the removal of some of the information considered relevant to conveying the message of a page. It should be kept in mind, however, that the ability of users to render pages according to their needs will allow them access to pages that they might not have been able to read without these changes. In this sense, allowing for the changes to page presentation will potentially increase the number of people who come to a website and use it. It may be that one challenge to designers is to ensure that their message is not so dependent on presentation format that the message will be lost if individuals exert control over the presentation.

Transforming the content of Web pages is not straightforward. A number of decisions made in the page design and creation can limit the effectiveness of the transformations. Discussed here are some of the factors that can help to make Web pages more suitable for user changes to rendering.

4.1 Standards

User control of page presentation complements technical accessibility guidelines (e.g. Section 508, available at http://www.section508.gov/ and Web Accessibility Initiative, available at http://www.w3.org/WAI/).Software that transforms Web pages must often analyse the content of pages in order to perform the renderings. In the *Web Adaptation Technology* software, for example, transformations work on the Document Object Model (DOM) to alter the page presentation (for more detailed information, see Richards and Hanson 2004, Hanson and Richards, in press). HTML input to the DOM that follows the guidelines will enable the best page adaptations.

In addition, it is useful to note that to the extent Web content providers meet accessibility guidelines, more individuals than just those originally intended can benefit. Thus, rather than removing the need for accessible Web pages, it is possible to develop user controls that capitalize on accessibility features to give any person a more usable Web page. For example, take the case of the skip-navigation tag. As discussed with the one column feature of the *Web Adaptation Technology* software, that application uses this tag to skip to the beginning of the page content when pages are reformatted.

4.2 Graphics and graphical buttons

Gunderson (2004) has reported that designers typically wish to have their pages look exactly the same when displayed in all browsers, resulting in extended use of bitmapped graphics to guarantee this result. As he notes, such design often has unfortunate consequences for users with disabilities. Not only do such graphics have the potential to be displayed in colours difficult for some users to distinguish but also there are other specific problems for user control of page presentation.

The use of text embedded in graphics can be especially problematic for the user control of presentation. It is not uncommon for designers to use graphics to lay out major text sections of a page, such as title or navigational links, as text in graphics. To the user, this may look simply like text. It does not behave as text, however. Some issues to consider when designing graphical elements containing text are considered here.

The use of ALT text is required for images in order to meet basic accessibility requirements that allow users with screen readers to know about the content of Web pages. This is particularly important when text is embedded in images. Screen readers and other software applications that read text aloud typically do

not contain the recognition technology that would allow them to be able to 'read' the words in the images themselves. Without ALT text, the text embedded in graphics will not be available to the user who relies on text-to-speech for reading the content of a page.

Additionally, the ALT tags may benefit persons who turn off images or need enlarged text.

- Users may choose to turn off images for a variety of reasons. If no ALT text is provided for the image, the user, like a user with a screen reader, has no information about what is contained in the image. If the image contained text or other information critical for navigation or getting the message, the user will not be able to use the page.
- Users may choose to enlarge or adjust text. Text included in images is not changed when users make these adjustments. Of particular concern is graphical buttons that have text embedded. If the Web design requires users to click on a specific button (e.g. 'Go' or 'Click here') to effect an action, the website can be unusable. Persons with poor vision may not be able to read the text embedded in these buttons, will not be able to adjust the font, and may not have text-to-speech software that could read the content of the buttons if ALT tags were provided.

Whether or not text is embedded, the size of a clickable target is critical both for seeing the targets and for selecting them. Smaller targets are more difficult for low vision individuals to use than are larger ones, although this appears to be true only up to a point (Jacko *et al*. 2000, 2001). Increasing size beyond an optimal one has been shown to provide no additional benefit, at least for persons with age-related macular degeneration (Jacko *et al*. 2000). While research on factors influencing target detection and selection by users with vision and mobility limitations is ongoing, it is clear that size and the number of items on a page are among the factors that will influence the ability of low vision users to detect and click targets.

The use of transparent colours in GIFs can potentially render text unreadable. As discussed above in the section on changing colours, if users change background colours in the browser, the text may 'disappear' if the new background colour is not distinct from the GIF colour.

4.3 Animations

The use of animations should be done judiciously. Is animation crucial to the message? Is the animation informative or, rather, is it simply distracting? Many older adults and a number of other users, particularly those with cognitive limitations, find it difficult to process pages that have animations that pull their attention away from the main content. These users may avoid sites with large

amounts of animations. In other cases, individuals may miss the main message of a page if distracted by animations. If given the opportunity, they will turn off or stop animations. For animated GIFs, stopping the animation freezes on one frame of the animation. Messages that are presented throughout the series of frames will be lost when users stop the animation.

4.4 Backgrounds

Finally, background images and colours should be carefully considered in the design process. Background images, particularly photographs, nearly always decrease legibility. It is difficult to read text that is presented across a changing background. If this background uses colours that reduce contrast, legibility is similarly reduced. There is some evidence to suggest that blue, white and black backgrounds are best suited for persons with some forms of low vision (Jacko *et al*. 2000).

5. Conclusions

Although Web accessibility standards provide for features that designers must incorporate if their pages are to be accessible, these standards do not guarantee a good experience for all Web users. It is not uncommon to have Web pages that meet standards for technical accessibility but are still difficult to use by persons who have disabilities (see, for example, Neilson Norman Group 2001, Mankoff *et al*. 2002, Powlik and Karshmer 2002, Leporini and Paternò 2004). This article has discussed user controls that make a number of adaptations 'on the fly' that can greatly increase the usability of Web pages for people with diverse needs.

Accessibility guidelines typically specify that if accessibility standards cannot be applied to a website, a text-only version of Web pages can be provided. Such an alternative is difficult for website providers in that they must maintain updated versions of two pages rather than one. It is also not necessarily the best alternative for users. Text-only versions are poorer alternatives for some persons, such as those with learning disabilities, who rely heavily on graphics for comprehension. Similarly, it does not address the needs of persons who may need alternative colour schemes or very large text to be able to read Web pages. While a text-only alternative will be necessary if accessibility goals cannot be met otherwise, providing for user control of presentation allows for an experience much better tailored to diverse individual user needs than does the provision of text-only shadow pages.

If individual users are to change page presentation from the way designers intended the presentation, this has both positive and negative consequences for design. On the positive side, user control of presentation means that individual needs can be met. Designers need only provide for appropriate flexibility for page display. Such flexibility is already specified in HTML and accessibility content

standards. On the negative side, however, designers must be aware that their pages will not always look as intended. It is important, therefore, to consider whether redundancy of the message is needed to make sure that important information is not lost by the types of changes to the page presentation that users can make.

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