

# Barriers to Use: Usability and Content Accessibility on the Web's Most Popular Sites

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## ABSTRACT

Content accessibility is a key feature in highly usable Web sites, but reports in the popular press typically report that 95% or more of all Web sites are inaccessible to users with disabilities. The present study is a content accessibility compliance audit of 50 of the Web's most popular sites, undertaken to determine if content accessibility can be conceived and reported in continuous, rather than dichotomous, terms. Preliminary results suggest that a meaningful ordinal ranking of content accessibility is not only possible, but also correlates significantly with the results of independent automated usability assessment procedures.

## Keywords

Web usability, content accessibility, universal design

## INTRODUCTION

"The power of the Web is in its universality."

-- Tim Berners-Lee, W3C Director and inventor of the World Wide Web [2]

From its inception, the World Wide Web (WWW) was conceived and implemented as a platform-neutral, device-independent means of accessing information. The Web has been characterized as a "great Equalizer," cutting across cultural boundaries, as well as breaking down both personal and geographical barriers [6,7].

Despite this emphasis, many Web sites seem to ignore issues of content accessibility and universal design. Recent reports in the popular press [9] characterize "95-99%" of the Web's sites as "inaccessible." Such reports imply a widespread disregard among Web designers for all but a technological elite and suggest that social boundaries still limit access to this rich source of information.

It seems plausible, however, that content accessibility, like usability, can be conceived and reported as a continuous, rather than as a dichotomous measure. Does a single instance of noncompliance with accessibility standards truly render a Web page "inaccessible," any more than a single usability problem renders a Web page "unusable"? Or are meaningful distinctions possible, for example, between a page containing a single image without a text equivalent (which may impair slightly its rendering by an audio client), as compared to a page containing dozens of images, systematically devoid of text equivalents? To answer these questions, the present study examines pages from 50 of the Web's most highly trafficked sites along 8 dimensions of content accessibility to determine if reliable and valid distinctions among "degrees" of accessibility are possible. Preliminary results suggest that a meaningful ordinal ranking of content accessibility is not only possible, but also correlates significantly with the results of independent automated usability assessment procedures.

## BACKGROUND

"Worldwide, there are more than 750 million people with disabilities. As we move towards a highly connected world, it is critical that the Web be usable by anyone, regardless of individual capabilities and disabilities."

-- Tim Berners-Lee, W3C Director and inventor of the World Wide Web [3]

Throughout the Web's history, various standards and guidelines for content accessibility have been proposed by both individuals and organizations. But only one set of accessibility guidelines has been reviewed by the 300+ members of the World Wide Web Consortium (W3C) [10]. As the nominal standards-setting body for the WWW, the W3C's mission is to promote the evolution and interoperability of the Web through the development of common protocols and standards. Typically, the W3C lists "Universal Accessibility" first among its organizational goals [11, 12].

As part of its commitment to accessibility, the W3C launched the Web Accessibility Initiative (WAI) [14] in April of 1997. The purpose of the WAI was to reinforce the Web's basic platform-independence and to provide Web

developers with specific techniques for increasing the accessibility of Web sites. The WAI is a threefold effort, including guidelines for web content, user agents, and authoring tools.

Under the auspices of the WAI, the Web Content Accessibility Guidelines (WCAG) [13] were published in May of 1999, to provide both general and specific guidance to Web content developers for assessing and ensuring the accessibility of their content. Over a year in development, the WCAG guidelines underwent extensive review by W3C member organizations.

Rather than discouraging developers from exploring new techniques and technologies, the WCAG stresses ways in which equally informative alternatives may be implemented to ensure universal access to content. For example, providing a text equivalent for a multimedia presentation allows alternative user agents (such as audio browsers) to render information in a way that is accessible to a wide spectrum of users.

Content accessibility issues are often, though not exclusively, focused on accessibility for users with disabilities. Certainly, accommodation of special-needs users continues to be a matter of both private and public concern. For example, effective in the year 2000, the U.S. Government has expressed its intent to impose accessibility requirements upon many federally-funded Web development projects, under the Rehabilitation Act of 1997 [4]. Several private organizations, such as Web Accessibility In Mind (WebAIM) [15], have been created to increase awareness of accessibility issues and to help

developers explore and understand issues of content accessibility and assistive technologies.

## WCAG COMPLIANCE AUDIT

### Method

The WCAG contains a total of 14 broadly phrased content accessibility guidelines, each of which has one or more specific "checkpoints" associated with it. Each checkpoint explains how a particular guideline applies in a typical content development scenario; checkpoints are divided into three groups:

1. Priority 1 checkpoints; which **must** be satisfied
2. Priority 2 checkpoints, which **should** be satisfied
3. Priority 3 checkpoints, which **may** be satisfied

WCAG Priority 1 checkpoints provide the basic, minimal standard for accessibility. "Single A" conformance with the WCAG indicates that the site has met a minimum standard for content accessibility by satisfying all applicable Priority 1 checkpoints. (Similarly, "Double A" conformance indicates satisfaction of all applicable Priority 1 and Priority 2 checkpoints, and "Triple A" conformance indicates satisfaction of all applicable checkpoints, regardless of priority level.) Because they represent a minimum standard for content accessibility, Priority 1 checkpoints are the focus of the present study.

There are a total of 17 Priority 1 checkpoints within version 1.0 of the WCAG. Some checkpoints (such as checkpoint 14.1) require a qualitative judgment regarding site content, while others are applicable to only a small subset of the Web's content (such as pages with synchronous multimedia

<p>Guideline 1. Provide equivalent alternatives to auditory and visual content</p> <p>1.1 Provide a text equivalent for every non-text element</p> <p>1.2 Provide redundant text links for each active region of a server-side image map.</p>
<p>Guideline 2. Don't rely on color alone.</p> <p>2.1 Ensure that all information conveyed with color is also available without color, for example from context or markup.</p>
<p>Guideline 6. Ensure that pages featuring new technologies transform gracefully.</p> <p>6.1 Organize documents so they may be read without style sheets. For example, when an HTML document is rendered without associated style sheets, it must still be possible to read the document.</p> <p>6.3 Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page.</p>
<p>Guideline 7. Ensure user control of time-sensitive content changes.</p> <p>7.1 Avoid causing the screen to flicker.</p>
<p>Guideline 9. Design for device-independence.</p> <p>9.1 Provide client-side image maps instead of server-side image maps except where the regions cannot be defined with an available geometric shape.</p>
<p>Guideline 11. Use W3C technologies and guidelines.</p> <p>11.4 . . . provide a link to an alternative page that uses W3C technologies, is accessible, has equivalent information (or functionality) . . .</p>

Table 1. WCAG Guidelines/Checkpoints used in the present study

or those written multiple languages). We limited ourselves to 8 of the Priority 1 WCAG checkpoints (summarized in Table 1) which we deemed to be generally applicable to a broad range of Web content.

### Selecting Sites

For the purposes of this study, we used Alexa [1] to identify the "top 50" most popular sites on the WWW. Alexa obtains Web traffic statistics by logging (anonymously, via browser plug-in) the sites that Alexa users browse. Traffic rankings are based on the number of times users have accessed a site in the last six months. Alexa's sample is known to be biased towards users of Microsoft Windows, particularly those who use Microsoft Internet Explorer. In all, 73 sites were examined, but 23 sites had to be excluded from subsequent analysis because of linguistic or content considerations.

With one exception, all of the sites in the present study are in the ".com" Top Level Domain. We appended the "www" prefix to each domain name, and checked only the main page of each site. Because the main page for a site ultimately serves as users' primary gateway to all its subordinate content, we felt that analysis of the site's main page would provide a meaningful if imperfect representation of content accessibility for the site as a whole. WCAG checkpoint 11.4 allows content developers the option of providing an "accessible alternate" page. If a site's main page pointed to a text-only alternate (and 4 did), we based our assessment on that text-only alternate.

Each page was examined, via both manual and automated means, to determine the number of potential points of failure (or "accessibility opportunities") that it presented. For example, a Web page containing 100 inline images can be conceived of as having 100 potential points of failure/accessibility opportunities, each of which requires the availability of a text alternative.

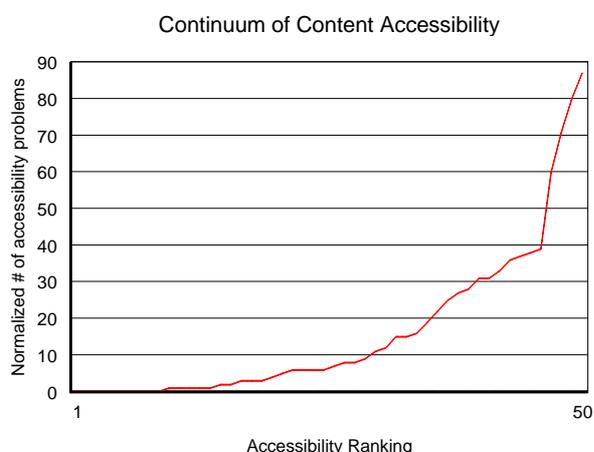
Results based on a simple comparison of these potential points of failure against the actual points of failure present in a given page are potentially unreliable and possibly misleading. For example, if a page provides alternative presentation for 90 out of 100 inline images, a simple percentage computation would lead one to conclude that this page is "more accessible" than one that provides text alternatives for 20 out of 25 images. However, the very act of designing a page containing 100 "accessibility opportunities" may indicate that the designer may have (perhaps inadvertently) erected accessibility barriers that must subsequently be overcome. Alternatively, construction of a page with only 25 potential points of failure may suggest that the designer has deliberately and systematically avoided potential accessibility problems.

To balance this inherent tension between potential and actual points of failure for content accessibility, we computed a normalized incidence figure for the accessibility opportunities presented by each page.

Specifically, we computed the ratio of actual to potential points of failure for a given page, and then multiplied that percentage by the page's potential points of failure. This method allows a page with a single ALT-less image (with a corresponding "failure" rate of 100%) to be deemed more accessible than one with 20 images, when only 15 of those images present a text alternative.

### Results

When the normalized incidence of accessibility problems is depicted graphically (as in Figure 1), it becomes clear that content accessibility can indeed be conceived and presented as a continuous, rather than a discrete phenomenon.



Using the normalized incidence of accessibility problems, it was possible to segregate sites into three broad categorizations:

- High-accessibility -- sites with no detected accessibility problems.
- Medium-accessibility -- sites with a few accessibility issues, whose core content or function may still be (at least partly) usable by people with disabilities.
- Inaccessible-- sites that present significant barriers to use due to content accessibility issues.

Medium-accessibility sites were further divided arbitrarily at 5 and 10 extant accessibility problems. Four distinct tiers of site accessibility were thus identified, as summarized in Table 2. Medium and low accessibility sites (Tiers 2 through 4) are listed in approximate order of accessibility -- that is, sites appearing higher on the list are generally more accessible than those lower on the list, though fine-grained quantitative distinctions among sites within each tier are not possible.

These results lend strong support to the idea that content accessibility can be meaningfully conceived of in continuous, rather than dichotomous, terms. Indeed, when accessibility is reported in traditional, dichotomous terms ("accessible" versus "inaccessible"), fully 41 of the 50 sites

<i>Tier 1</i> <i>Highly Accessible</i>	<i>Tier 2</i> <i>Mostly Accessible</i>	<i>Tier 3</i> <i>Partly Accessible</i>	<i>Tier 4</i> <i>Inaccessible</i>
amazon gohip google goto hotbot microsoft monster MSN snap	altavista att.net excite icq tripod geocities lycos angelfire iwon yahoo infospace go	dogpile looksmart preferences xoom bluemountain ebay ZDNet netscape	100free mp3 homestead quicken ancestry webshots real msnbc freeserve cnet about cnn AOL hitbox askjeeves networksolutions ragingbull ign weather cdnow this

Table 2. Four-Tiered Accessibility Ranking of Popular Web Sites  
(All sites in Tier 1 are identically accessible, and are therefore listed alphabetically.)

tested (82%) would be characterized as "inaccessible," by virtue of presenting at least one accessibility problem. However, 12 of these 41 sites (those in Tier 2) were characterized by a handful (5 or fewer) of detectable accessibility issues. Thus, when accessibility is viewed in continuous terms, over 40% (21 sites in all) exhibited so few accessibility problems that characterizing them as "inaccessible" seems both fundamentally misleading and unnecessarily pejorative. Quantitative characteristics of the sites include:

- High-accessibility sites: -- the number of "accessibility opportunities" presented in high-accessibility sites ranged from a low of 0 to a high of 47. No accessibility issues were detected among these sites.
- Medium-accessibility sites -- the number of "accessibility opportunities" presented in medium-accessibility sites ranged from a low of 1 to a high of 118. The normalized scores ranged from a low of 1 to a high of 9.
- Low-accessibility sites -- the number of "accessibility opportunities" presented in low-accessibility sites ranged from a low of 15 to a high of 99. The normalized scores ranged from a low of 11 to a high of 87.

#### **AUTOMATED USABILITY TESTING**

The mere suggestion that a continuum of content accessibility exists does not in and of itself indicate whether

this variation in accessibility reflects a genuine design artifact. In other words, simply elucidating the continuous nature of accessibility does not tell us if site designers are actively attempting to create accessible sites, or whether the observed differences in content accessibility are merely a happy accident.

However, it seems reasonable to expect that sites that rate high on both accessibility and usability are more likely to reflect a deliberate design effort on the part of the site developers. That is, it seems likely that high usability coupled with high accessibility is more indicative of a fundamental commitment to user-centered design. We therefore undertook an examination of site usability and its possible correlation to content accessibility.

#### **Method**

It is clearly beyond the scope of this paper to conduct usability tests on each of the 50 sites included here, so we chose to use results from an automated usability assessment tool as a useful if imperfect indicator of site usability. Recent research [5] has compared several widely available automated usability assessment tools, and the LIFT Online service [8], launched in Spring of 2000, was found to provide the greatest breadth of coverage across a wide range of usability problems. We therefore used LIFT as our preferred tool for the automated usability assessment. LIFT provides 6 different initial "settings" for the type of site being analyzed, but we chose to use LIFT's "generic" setting for all sites, to provide a common baseline for comparison across all the sites tested.

<i>Tier 1 Most Usable</i>	<i>Tier 2</i>	<i>Tier 3</i>	<i>Tier 4 Least Usable</i>
amazon freeserve google microsoft preferences this webshots	100free about altavista att.net bluemountain goto homefree hotbot monster mp3 yahoo	angelfire cnn ebay hitbox icq infospace iwon looksmart lycos networksolutions quicken ragingbull snap tripod xoom	ancestry AOL askjeeves cdnow cnet dogpile excite geocities go gohip ign msnbc MSN netscape real weather ZDNet

Table 3. Four-Tiered Usability Ranking of Popular Web Sites (Sites in each Tier are listed alphabetically.)

LIFT results are reported based on a four-point categorization scheme (excellent/good/fair/poor), but we noticed a tendency for LIFT to report a disproportionately high number of "fair" ratings. Such homogeneity is necessarily of limited discriminatory value. However, LIFT also categorizes individual types of usability errors along a four-point severity scale, ranging from 1 (cosmetic errors) to 4 (catastrophic errors). We were able to rank sites in the study by multiplying the presence of a given usability problem by its LIFT severity ranking, thus creating an ordinal ranking that permitted more fine-grained distinctions among candidate sites.

### Results

Results of the automated usability assessment ranged from a low of 0 (representing no detectable usability problems) to a high of 38 (consisting of 7 "major" problems and 8 "minor" ones). Once again, we created four tiers of overall page usability, as summarized in Table 3.

### CORRELATION BETWEEN ACCESSIBILITY AND USABILITY

To determine if a substantive relationship exists between content accessibility and usability, we undertook quantitative comparison of the relationship between these

<i>High Usability/Accessibility</i>	<i>Low Usability/Accessibility</i>
altavista	ancestry *
amazon *	AOL *
att.net	askjeeves *
google *	cdnow *
goto	cnet *
hotbot	cnn
microsoft *	dogpile
snap	ign *
	msnbc *
	netscape
	quicken
	ragingbull
	real *
	weather *
	xoom
	ZDNet

Table 4. Concordance/Discordance Summary of Sites on Usability and Accessibility (Sites are listed alphabetically. Those marked with an asterisk are in Tier 1 or Tier 4 (respectively) on **both** usability and accessibility.)

two variables. First, each site was ranked on each variable, and then a Spearman rank-order correlation coefficient was computed. It should be noted that some content accessibility issues (such as images without a text alternative) are themselves among the usability problems reported by LIFT, and these "duplicates" were eliminated prior to computation of the ordinal correlation coefficient. The obtained value of rho ( $r=0.23$ ) lies exactly on the borderline for statistical significance at  $p=0.05$ . Thus there is a weak suggestion that there may be a fundamental relationship between content accessibility and overall usability. Further research is necessary to examine this possible interrelationship in further detail.

A qualitative representation of the obtained correlation is provided in Table 4. Sites listed in Table 4 include only those sites that ranked in the top or bottom tier (Tier 1 or Tier 4, respectively) on either usability or accessibility, and in the same or immediately adjacent tier on the other variable. The comparatively large number of sites ranking low in both usability and accessibility suggests that the much of the obtained correlation is the result of designer inattention to user experience issues.

## CONCLUSIONS

Advances in development technology are not always paralleled by advances in developer awareness. Guidelines for content accessibility and usability are available to Web developers, and are widely known and heavily publicized. Yet our results suggest that many Web designers either remain ignorant of, or fail to take advantage of, these guidelines. A truly world-wide Web implies an audience that inevitably becomes more global and thereby more diverse with time. That increasing diversity of audience makes the need for broadly inclusionary design principles and practices an increasingly important element of any successful Web design.

Similarly, commercial Web sites that demonstrate sensitivity to the inherent diversity of a global audience will place themselves at a strong strategic advantage, relative to their less inclusionary counterparts and competitors. It is interesting to note that, among the high-traffic sites in the present study, only one is an Internet-only e-commerce site. That site, amazon, ranks in Tier 1 in both content accessibility and usability. It is similarly interesting to note that amazon reports that the majority of their business (over 70%) is from repeat customers [16].

The commodity of the new century is information. With the advent of the Web, that commodity is both more powerful and more precious than ever. At present, many users face unnecessary barriers to use when attempting to access Web-based information. The great information design challenge of the new century is to make the Web's rich potential available to an increasingly diverse audience with a constantly changing technology base--to maximize the information usability of the Web and all its contents.

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