

**First Impressions: Empirically Evaluating the Initial Website Experiences Encountered by  
Visually Impaired Users**

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University of Pittsburgh, 2024

## **ABSTRACT**

As the internet increases in size, our body of research into what visitors prefer for website design is leaving out a growing group of people. Those with visual impairments are one of the fastest growing minorities with a disability online. This extremely under-studied group uses the internet for as many different purposes as sighted users do, but comparatively little is known about their preferences or experiences online. This qualitative study is intended to serve as an initial exploration to increase understanding and serve as a foundation for future research. Using a blend of grounded theory, thematic analysis, and content analysis techniques, it focuses on the interactions blind and low vision visitors have when visiting websites for the first time.

To accomplish this, 31 individuals with vision levels falling on the blind or low vision spectrum were interviewed about their online experiences. It examines the problems they encounter that detract from their experience of the site, possibly causing them to leave immediately or discourage them from using the site further. Divided into structural, content, and ad-related issue categories, the issues reported by both low vision and blind participants are compared within each group and to each other for commonalities and differences. Finally, the reported issues are compared to the currently accepted accessibility guidelines to evaluate how well the guidelines cover the issues.

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# INTRODUCTION

It is no secret that the internet has infused almost all aspects of our lives. We shop there, work there, pay our bills, learn new skills, entertain ourselves, and stay connected with friends and loved ones. Independent of our own tiny spheres of influence and awareness, the internet continues to grow at a staggering pace. One estimate places its growth at 252,000 pages added per day (Huss, 2022). This growth prompts our natural curiosity (and desire to earn increasing amounts of money) to study the behavior of users in this gigantic space.

As a result of these inquiries, researchers are slowly learning more about what users of the internet want and expect when they visit new websites. Some have learned that visitors are quick to judge a new site based solely on appearance. It only takes them 50 milliseconds to form an opinion that will influence the remainder of their visit (Lindgaard et al., 2006; Tractinsky et al., 2006). We can then take these insights and focus them to design more intuitive, more appealing sites that engage visitors within those 50ms and convince them to stay. Properly utilizing these insights is important, because without them, new visitors are less likely to trust an unknown website's intentions. This may result in them being less likely to stay and browse or be less likely to purchase something from an unknown e-retailer (Ou & Sia, 2010), for example. Another investigation studied how particular colors may influence our opinions of websites (Cyr et al., 2010). The not-so-secret hint? They do. Thus, designing a website in a way that entices visitors to stay is an essential part of the creation process. With all this discovery, however, we are leaving a large group of people behind: those who have visual impairments.

Consider how common it is to have a friend or relative who cannot see without the use of their glasses, or still has issues even with them. Following diabetes, those with visual impairments represent one of the top ten most rapidly growing disability groups of adults in the United States (Center for Disease Control, 2020). A 2014 estimate predicted that by 2032, over

64.3 million Americans would be impacted by some type of visual impairment (Wittenborn & Rein, 2014). This represents a 48.8% increase over the 2014 figure of 43.2 million Americans affected. On a global scale, over 295 million people, roughly 4.3% of the world's population, live with visual impairments ranging from moderate to severe (Bourne et al., 2021). Of those global figures, 43 million people live with blindness, a 14.3% increase from an earlier study conducted by Ackland et al. in 2017. Compounding this, vision issues are more common as a person ages (Congdon et al., 2004; Swenor & Ehrlich, 2021; Killeen et al., 2023), meaning that as the median age of the world population increases, so too does the occurrence of vision issues. Ritchie & Roser (2019) found that from 1950 to 2018, the estimated median age in the world increased 6.4 years, from 23.6 to 30. Projections estimate the world median age increasing a further 6.1 years by 2050, placing the average age of the world population at 36.1. Given how common visual impairments are, especially in older populations, the online preferences of people with visual impairments need to be considered when designing web pages.

At present, the vast majority of research into website design and visitors' experiences with them only reflects the preferences of sighted visitors. On initial examination, this makes sense because the majority of visitors are sighted. However, consider a hypothetical situation to illustrate the scale. Suppose a web developer was asked to design a new site for a business. If the proposed design was largely uninterpretable and inaccessible to the entire population of the United States, a country with a population of roughly 335 million (United States Census Bureau, 2023), how many businesses would consider that design acceptable, let alone successful?

One possibility is that businesses severely underestimate the spending power of those with visual impairments. In a 2018 study, Yin et al. determined that within the United States, the disposable, or after tax, income of individuals with vision impairments was \$46 billion. Once basic living expenses were paid for, the same group had \$3 billion in discretionary income remaining for purely luxury purchases. In a follow-up study in 2020, Yin et al. found that these figures had more than doubled to \$99.44 billion in disposable income and \$7.24 billion in

discretionary income. This then begs two questions: how much higher are these figures worldwide and why is more attention not being paid to this population?

Whatever the cause, this oversight or misunderstanding is the situation this thesis addresses. By exploring the online user experience of people with low vision or blindness, we can begin learning about their difficulties and preferences when accessing websites, and ultimately, begin altering how websites are designed. Before initiating that transition, we need some understanding of the current foci of web design research, how guidelines have been developed to promote website accessibility, and the current state of accessibility research.

Using a blended grounded theory, thematic analysis, and content analysis approach, this paper has several goals. First, to explore the experiences that blind and low vision groups of users have with websites, often referred to as user experience, or UX. More specifically, to identify what issues these users are encountering -- the things that detract from their enjoyment or ease of use when accessing websites for the very first time. It then compares the issues of both groups to see how similar or dissimilar they are to each other. Finally, this paper examines each group's most frequently reported problems in the context of the current accessibility guidelines to determine how well the guidelines address them.

One additional note is in order. Consideration was given to determine the proper terminology for paying proper respect to the communities being interviewed. When asked whether it was more appropriate to say "users/people with low vision/blindness/visual impairments" versus "blind/low vision users/people," respondents in the study stated that there was no universal consensus on which to use and neither term was particularly offensive or inappropriate. Many mentioned that it often comes down to personal preference on which ought to be used. Both sets of terms are also in frequent use on large support websites for those with VI, such as the National Federation of the Blind. As such, both sets of terms are used

interchangeably within the research and no disrespect is meant for any readers preferring one term over another.

## BACKGROUND & LITERATURE REVIEW

### Vision & Assistive Technology

Before beginning a discussion of accessibility, a few explanations are in order. The Cleveland Clinic states that there are “...hundreds of different eye disorders and diseases,” (Cleveland Clinic, 2022). To that end, it is important to bear in mind that vision is a spectrum, rather than a binary circumstance. Multiple people with low vision or blindness may display differing symptoms, types, or levels of vision, even within the same medical diagnosis. Provided below are some examples of low vision and blindness presented in the study, as well as a brief explanation of the most common technology used by both groups.

#### Low Vision (LV)

One user with low vision may have peripheral vision issues, resulting in a narrowed field of vision, sometimes referred to as “tunnel vision,” and a reliance on their central vision. They may be able to see well within this field, but might be able to see only one quarter of their computer screen at a time. They may need to move their gaze across the screen to different quadrants to fully read the page. Browsing may require frequent scrolling left or right and repositioning a web page often if the entire page is not displayed on a single screen. Utilization of zoom features native to the browser may be necessary in order to see the text.

Alternatively, the opposite may also be true. A user may instead have issues with their central vision, meaning they may only be able to perceive the presence of words or graphics on the periphery of the screen. As one participant with central vision issues described, “I don’t



know what you've heard from other people with low vision, but you can't read with peripheral vision." In these situations, a screen reading program becomes a necessity.

A third possible user with low vision may experience an overall reduction in their perception of light accompanied by blurriness in their entire field of vision. They may zoom in on web pages, shift the brightness of a computer monitor, or switch entirely over to a screen reading program, depending on the severity of the vision impairment.

## Blindness

Contrary to common conception, blindness is not solely the absence of the perception of light. It may include some limited or occasional light perception. Some blind individuals can perceive light and determine time of day or whether they are in direct sunlight or not. Some are also able to perceive colors in addition to light. In any of these cases, the amount of light or color perception is not sufficient on its own for daily navigation or completion of routine tasks.

It is also possible to have some combination of any of the above circumstances with varying levels of severity. So, one individual could have worsening peripheral vision with an overall decrease in the perception of light. Another may experience an overall blurriness of vision at both near and far fields such that objects beyond a foot or two away are unclear. Within the blindness spectrum, blindness with the occasional presence of light, resulting in light sensitivity or color perception but no object perception exists alongside the traditional idea of blindness as no light or color perception at all. Ever further still, having a type of blindness in one eye and low vision in the other can also occur.

## Screen Readers (SR)

When understanding how a blind or low vision user interacts with websites, it is beneficial to know how screen readers convert a page into an audible format. Instead of the multidimensional layout sighted users are familiar with, screen reading programs will essentially

turn the entire webpage into one column of content. It may be helpful to think of it like a large Word document. The screen reader user uses keyboard shortcuts within this column to move a cursor to different sections of material. From there, the screen reader will read aloud text at the point where the cursor is placed and users can access links or hear about various graphics on the page. The user can then decide to continue reading the current page, follow links to move deeper into the page, or back out and navigate elsewhere, beginning the process anew.

## Understanding Website Accessibility

### In the US: The ADA & Section 508

In the United States, the Americans with Disabilities Act (ADA) of 1990 was enacted and intended to eliminate discrimination against individuals in the population with disabilities. Title II prohibited “discrimination against people with disabilities in all services, programs, and activities of state and local governments” (US Department of Justice [DOJ], 2022). Title III required that all businesses provide “full and equal enjoyment of their goods, services, facilities, privileges, advantages, or accommodations” (DOJ, 2022). At the time of the Act’s inception, internet use was not widespread. However, in 1996, once internet use had become more ubiquitous, the definitions set forth in the original 1990 text were expanded to also include their electronic analogs online. Currently, the DOJ’s ADA website explicitly states that all of the ADA requirements apply to anything on the above lists that are offered on the web.

Then, in 1998, Section 508 of the Rehabilitation Act of 1973 was expanded to include provisions requiring all electronic resources and information technology from federal agencies be accessible to people with disabilities. The intention of the expansion was to include all federal websites, present and future, and any technologies developed for use on those websites. Section 508 has been refreshed twice since then, once in 2008 and again in 2018, to include updated requirements and definitions for meeting accessibility guidelines. Each of these

refreshes coincided with release updates of the Web Content Accessibility Guidelines (WCAG) 2.0 and 2.1, respectively (“Section 508 Amendment to the Rehabilitation Act of 1973,” 2023; Web Accessibility Initiative [WAI], 2023). Presently, nothing in the wording of Section 508 poses any requirements on privately owned websites.

#### Internationally: W3C, WAI, & WCAG 2.2

The World Wide Web Consortium (W3C) is an organization founded in 1994 at the urging of companies seeing the investment potential of the developing internet. It is comprised of businesses, non-profits, universities, governmental agencies, and individuals interested in developing a set of universally recognized and instituted standards for websites worldwide (W3C, n.d. a; “World Wide Web Consortium,” 2023). W3C is composed of several smaller work groups that focus on specific initiatives. The reports from these working groups often become the recommendations for standards set forth by the W3C.

Formed in 1997, the Web Accessibility Initiative (WAI) is one of W3C’s groups that focuses on researching and developing recommendations related to improving the accessibility of web content for all users with disabilities. Their first official completed set of recommendations, the Web Content Accessibility Guidelines 1.0 (WCAG 1.0), was released in 1999. This version was primarily intended for developers and webmasters. It consisted of 14 recommendations for making online content accessible (W3C, 2021b) (Appendix A). For example, the second guideline, “Don’t rely on color alone,” contains two checkpoints for fulfilling this guideline and each checkpoint has a technique link. The first checkpoint recommends that any information presented with color have an additional version of the information that does not use color. There are two technique links beneath this that lead to a larger discussion of how this checkpoint fulfills a need in web design. The second checkpoint mentions designing a site with sufficient color difference between background and foreground elements to account for visitors with color deficits or viewers with a black and white screen. Two links follow underneath with

examples of how to accomplish this in both HTML and CSS. The 14 guidelines in WCAG 1.0 were accompanied by 65 checkpoints such as these, each intended to elaborate on how their associated guideline could be enacted.

As the complexity of the internet increased and after receiving multiple rounds of feedback from different disabled communities, revisions were made to the WCAG guidelines, resulting in the release of WCAG 2.0 in late 2008 (W3C, 2023a). This edition reduced the number of guidelines to 12 and grouped them according to four principles: perceivability, operability, understandability, and robustness (W3C, 2008) (Appendix A). Perceivable guidelines related to the presentation of information, emphasizing the conveyance of information in ways that could be interpreted by multiple senses. Operable guidelines were meant to ensure actions on a webpage could be performed by all users, regardless of the inputs used. The third category, understandable guidelines, dealt with ensuring the language used in web content was easy to understand by all users. The final principle in WCAG 2.0, robustness, had guidelines that applied to content remaining accessible as the accessibility technologies used to access it advanced.

The next update, WCAG version 2.1 (W3C, 2018) (Appendix A), used the same grouping categories for guidelines as 2.0 (perceivability, operability, understandability, and robustness), with some minor revisions. A 13th guideline was added, the 5th under operability. This guideline related to designing websites such that input devices other than a keyboard could be used to interact with them. Another guideline under operability was revised to discourage content on sites that would cause seizures or other negative physical reactions. The most recent update, WCAG 2.2, released in October 2023 (W3C, 2023c). It provided nine additional examples for successfully fulfilling criteria related to navigability, input types, predictability, and input assistance.

Each of these guidelines contained under these principles has an associated conformance level whereby websites could be evaluated and graded according to their

accessibility (W3C, 2020a. & 2020b). A-level compliance, which requires resolving Priority 1 errors, is the most basic level. It is considered the set of standards that developers *must* meet to ensure accessibility as not meeting them means that the website is likely to be entirely inaccessible to multiple groups. The next tier, AA-level compliance, is the middle level. It requires resolving all of the Priority 1 *and* Priority-2 errors, thus meeting the requirements for A-level compliance in addition to the requirements for AA-level compliance (W3C, n.d. b). AA-level guidelines are factors a developer *should* meet, since multiple groups may have issues accessing the content without them, but many of the barriers present in A-level compliance are removed. The highest tier, priority 3 errors or AAA-level compliance, meets all requirements for the A and AA tiers. A developer *may* meet these guidelines, going beyond what the previous ranks cover to further ease access for groups with disabilities. Compliance with the three tiers of guidelines may be marked on websites with a certification logo, but per the W3C website, these claims are not certified by W3C themselves and maintaining compliance with the guidelines is to be done by the website operators themselves.



**Image 1. Examples of W3C A-AAA compliance logos for WCAG 2.1 (W3C, 2020b)**

The WAI is also in the process of developing the next version of the guidelines, WCAG 3, with the first draft of recommendations released in January 2023 (W3C, 2023b). This new version is intended to be more specific in its guidelines than WCAG 2.0, address an expanded set of user needs that affect online interactions, and include recommendations applicable to a

wider variety of platforms than web content alone. WAI also intends to include a revision of the current conformance models. The WAI plans to release updated drafts of WCAG 3 every 3-6 months until the full official publication.

## Website Accessibility Levels - United States

Since the passing of the ADA and Section 508 along with the publication of WCAG 1.0, 2.0, and 2.1, there exists a trail of studies indicating that accessibility issues on websites persist, despite most of these guidelines having been publicly available for over 25 years. These studies and reports find that, at best, online accessibility is a continuing issue and websites are only showing incremental improvements as time passes, be they public or private.

A study from Loiacono and McCoy in 2006, building on their 2005 study discussed below, compared the accessibility of 417 federal government, 96 non-profit, and 97 corporate websites to see if there were significant differences in their levels of accessibility. They utilized an automated program to conduct evaluations of each website according to Section 508 and A-rank compliance with WCAG 1.0 guidelines. Government websites were the most accessible of the three groups with a 23% (93 sites) compliance rate for Section 508 guidelines and 28% (117 sites) for WCAG 1.0. This percentage dropped for non-profit sites, with 11% meeting 508 compliance and 14% being WCAG 1.0 A-rank complaint. Corporate pages were mixed, coming in at 6% compliant for 508 guidelines and 18% compliant with WCAG 1.0. The most common compliance failure across all three categories of sites was the omission of alternative text (alt-text) to describe images included on the website.

The following is a discussion of some articles detailing how this trend has continued across different sectors.

## Government Sector

In 2005, Loiacono, McCoy, and Chin examined 417 federal and federal contractor websites in the United States. Following the legislation laid out in the ADA and Section 508 of the Rehabilitation Act, these sites should all be accessible. In the study, Loiacono et al. used online accessibility testing and found that 28% (117) of the sites met the requirements for an A ranking for WCAG 1.0 guidelines and only 23% (93) of the sites met the requirements established by Section 508. None of the sites evaluated met the requirements for an AA or AAA ranking for WCAG 1.0 compliance. The most common issue that these websites failed was WCAG's first and most essential guideline: "Provide equivalent alternatives to auditory and visual content." 62% (259) of the sites failed to include alt-text.

Olalere and Lazar conducted another study into the accessibility of federal websites in 2011. In it, they examined 100 federal government websites with both automated testing and human participants. They found that only four sites had no accessibility issues, meaning that 96% of the websites had some sort of barrier to accessing the content. This was despite the websites having accessibility policy statements on the site. Some statements merely described the site as 508 compliant, while others included detailed descriptions of accessibility features or steps taken to ensure accessibility was maintained. Many of these statements were misleading, as 18 of the 58 sites that claimed 508 compliance still contained accessibility issues.

In a related study, Bai (2019) examined 342 US county government home pages and web portals to evaluate their accessibility according to the WCAG 2.0 guidelines. At best, only 30% of the sites tested exhibited partial conformance to some of the guidelines, meaning fewer than 30% met the requirements for A-level compliance according to the updated accessibility guidelines. While state and county-level sites are not held to the same standards as government sites, these numbers indicate an even lower level of overall compliance with accessibility

guidelines than federal government websites. Thus, despite legislation, the majority of government websites continue to have issues meeting basic accessibility guidelines.

A paper published by Khawaja in 2023 assessed the accessibility of 120 public library websites. Similar to county or state government websites, library websites are also subject to less strict accessibility regulations than those for federal government sites. Sites were randomly selected from libraries across the country. Each site had four different pages tested: the homepage, catalog, events, and hours/location or contact information pages. Using an online automated program, these sites were checked for WCAG 2.1 compatibility. The author reported that none of the sites were free from violations, thus none met the minimum guidelines for WCAG 2.1 compliance.

#### Education Sector

Some universities and university libraries receive funding from federal sources, making them subject to federal accessibility guidelines. Others are privately funded and are not held to these requirements. Overall, this results in these sites tending to fare better than their government counterparts.

Thompson et al. (2010) published a longitudinal study with 127 higher education institutions in the northwestern United States, evaluating their homepage accessibility four times over a five-year period. All participating institutions were offered accessibility training and support during the longitudinal study. They found some success in increasing levels of accessibility on the participating institutions' homepages. By 2009, 41% of the sites had meaningful alternate text on site images, up from the 2004 figure of 27%. They also found increases in sites using skip navigation, site elements that allow users to move from section to section freely like a table of contents. Usage of this element increased from 7% to 19%. One element that saw a decrease in use was accessibility for keyboard users, meaning that all aspects of a site are available to them without needing to employ a mouse. This fell from 78% in



2004 to 65% of all sites in 2009. They concluded that while some improvements were being made, additional research was needed to identify motivational factors that would encourage longer-term commitment to accessibility.

In 2014, Solovieva & Bock evaluated 509 separate webpages at their university for both WCAG 2.0 A-level and Section 508 accessibility compliance. They used two different automated testing programs, one for each set of compliance guidelines. They discovered that while 51% of the included sites were Section 508 compliant, the number dropped sharply to 35% compliance when the stricter WCAG 2.0 evaluation was performed. Similar to the government studies, a lack of alt-text and missing labels were the most commonly identified issues.

More recently in 2017, Kimmons attempted an evaluation of 3,141 higher education websites in the United States according to four of the 16 guidelines required for a WCAG 1.0 A-rank compliance rating: usage of clear and simple language, including titles for all frames on the site, having alt-text for all non-decorative images, and having row and column names for all tables. Even testing with this fraction of the A-rank guidelines present in WCAG 1.0, he found that only 0.4% (14) of these sites were entirely free from all four issues. He believed that had all of the guidelines been used, this number would have been even lower, possibly even reaching zero. Sharing a finding with previous studies, the most common issue occurring was the absence of meaningful alt-text, the problem being present in 98.2% (3086) of the websites examined.

#### Private Sector

The numbers are not better in the private sector. A 2004 study by Loiacono and McCoy examined 44 corporate or service sector websites from various industries. This study found that only four of the sites, just over 9%, met Section 508 guidelines and seven of the 44, 15.9%, were compliant with WCAG 1.0 recommendations. As with the government website study, the

**TABLE 1. Summary of Included Domestic Web Accessibility Studies**

<b>Year</b>	<b>Authors</b>	<b>Category</b>	<b>Guidelines</b>	<b>Sites</b>	<b>Evaluation Type</b>	<b>Findings</b>
2004	Loiacono & McCoy	corporate	WCAG 1.0, A-AAA, Section 508	45	Bobby WorldWide	9.09% met A-level, none met AA- or AAA-level Alt-text missing most often
2005	Loiacono, McCoy, & Chin	government	WCAG 1.0, A-AAA, Section 508	417	Bobby WorldWide	28% met A-level, 23% met Section 508 requirements Alt-text missing most often
2006	Loiacono & McCoy	government non-profit corporate	WCAG 1.0, A-AAA, Section 508	417 96 97	Bobby WorldWide	Government: 23% met A-level Non-profit: 11% met A-level Corporate: 6% met A-level Alt-text missing occurred most often in all three categories
2009	Loiacono, Romano, & McCoy	corporate	WCAG 1.0, A-AAA	100	Watchfire Bobby 5.0	A-level compliance increased from 30% to 45% from 2000 to 2005 AA- and AAA-level compliance decreased from 6% and 2% to 1% each
2010	Thompson, Burghstahler, & Moore	education	WCAG 1.0, A-AAA, Section 508	127	Web Accessibility Toolbar (WAT) & human assessment	Alt-text usage increased from 27% to 41% from 2004 to 2009 Skip navigation usage increased from 7% to 19% Full keyboard accessibility fell from 78% to 65%
2011	Olalere & Lazar	government	WCAG 1.0, Section 508	100	AChecker, Workspace, & human assessment	96% of sites had accessibility issues 18 sites with logos indicating compliance still had compliance issues present
2012	Lazar, Wentz, & Olalere	corporate	n/a	16	human assessment	28.1% of applications were successful and did not require any sighted interventions to assist participants 94% of sites contained layout or screen reader incompatibility issues 88% contained missing or misleading labels
2014	Solovieva & Bock	education	WCAG 2.0, A, Section 508	509	Web Accessibility Evaluation Tool (WAVE) & Cynthia Says	51% of sites passed Section 508 guidelines 35% of sites met A-level
2017	Kimmons	education	WCAG 1.0	3,141	PHP/MySQL script	0.4% of all sites tested passed compliance with four of the 14 guidelines in WCAG 1.0

2019	Bai	government	WCAG 2.0, A-AA	342	Functional Accessibility Evaluator 2.0 (FAE2.0)	Less than 30% of sites met A-level guidelines 84.8% lacked non-English versions of translation functions 81.3% were missing a site map for navigation
2023	Khawaja	government	WCAG 2.1, Section 508	120	axe	0% of the websites met WCAG 2.1 guidelines

biggest failure point on these sites was a lack of alt- text describing images. They did not find any significant differences in accessibility between industries, indicating that all of the industries studied had issues equally.

In a 2009 follow-up to the 2004 study, Loiacono et al. conducted a broader study of corporate websites by including data sets from 2000, 2002, 2004, and 2005. Their findings indicated that the overall trends in WCAG 1.0 compliance for corporate websites were mixed. Compliance with A-rank guidelines increased from 30% in 2000 up to 45% in 2005, but there was an overall decrease in compliance for the more complicated AA- and AAA-rank guidelines over the same time period. AA-rank compliance dropped from six websites in 2000 to one in 2005 and AAA-rank compliance dropped from two sites down to one. The authors concluded that deeper, more complicated errors were being overlooked in favor of increased attention fixing the easier to correct, obvious errors.

A 2012 study by Lazar et al. found that job websites are particularly difficult for users with visual impairments to access. They selected 16 different companies, distributed amongst different industries and in different geographic locations, then asked 16 blind participants to apply for two different jobs online. Each website received two applications, totaling 32 applications altogether. Only nine of the 32 applications could be completed independently (28.1%), without some form of sighted intervention. Every other application required some form of assistance when an aspect of the job application process became impassable. One participant gave up after spending 229 minutes on the task without being able to complete it. Of the attempts that were completed, many interventions involved sections where clicking the mouse in a specific area was required to progress, because labels for boxes were blank or uninformative, or pop-ups were present without having notified the participant.

## Website Accessibility Levels - International

Regardless of where or when the research takes place, accessibility errors are found on commonly used websites of all types. Similar to findings in the United States, these studies indicate that over time, accessibility continues to be an issue that makes little headway in being resolved. One organization, WebAIM, has conducted an evaluation of the top one million websites in the world each year since 2019. They have found that in that time, the overall number of sites that lack accessibility errors has only increased by 1.5% (WebAIM, 2019; WebAIM, 2023), an improvement of only 1,500 websites. This indicates that, regardless of the country of origin, progress forward is not occurring. In the section below, research into the accessibility problems for countries other than the United States are explored in more detail.

### Regional Comparisons

Kuzma et al. (2009) studied the accessibility of government websites in four countries each throughout Africa, Asia, and the European Union (EU), totaling 12 countries altogether. In each country, six different websites were tested, for a total of 72 websites included in the study. They found that countries with more developed disability laws tended to have websites with fewer accessibility errors present. For example, of the EU countries, 17 (71%) websites of the 24 websites tested were reported as having zero errors and thus met WCAG 1.0 A-rank certification requirements. Two countries in the study, the UK and Germany, had all six websites report zero errors. By contrast, the African countries, where disability regulation is considered to be much weaker, had only two (8%) websites of the 24 examined report no errors. Asian countries also trailed far behind the EU with five (21%) of their sites being error-free. The Philippines was the stand-out example of the countries included in the Asian component of the study. Having stronger accessibility laws and a vocal web accessibility group, it hosted four of the five error-free Asian government sites. No site in the study met the requirements to be AA- or AAA-compliant.

In 2013, Luján-Mora compared the official government, Parliament, and Senate websites (when present) for all 27 members of the EU. All 67 websites, 27 each for government and Parliament with 13 for Senate, were evaluated for WCAG 2.0 accessibility via two automated programs. The first program analyzed the markup language across the websites and reported back on the number of errors it encountered. The second checked the HTML and CSS contents of each page and assigned a score, from 1 to 10, for the compatibility with WCAG 2.0 criteria. For the second tool, the higher scores meant higher levels of compatibility. No country received a perfect score, although some did score highly across the board - Austria, Germany, and the Netherlands, for example, all scored above 7 for all three sites and had relatively few errors recorded. However, many countries still showed significant numbers of errors present in the base code of their websites and multiple accessibility errors violating WCAG 2.0 compatibility.

A later study comparing regions, conducted by Alahmadi and Drew in 2017, looked into potential differences in the accessibility error rates of university pages for three different regions: worldwide, Oceanic, and Arabic. The authors randomly selected 20 universities each from the top 100 world universities, top 50 Oceanic universities, and top Arabic universities, for a total of 60 universities. Then, on each university's site, the home page, a randomly selected course description page, and a randomly selected admission page were chosen. Of these 180 pages, all were evaluated with an automated program to count the number of WCAG 2.0 AA-AAA compatibility errors occurring on each page. Errors were found on all website types in all three regions, with no statistically significant difference between the three regions, indicating worldwide accessibility issues. The most common issues were those with missing alt-text, missing descriptions, and broken links.

Another 2017 study (Verkijika & De Wet) examined 279 e-government sites from 31 countries in sub-Saharan Africa (SSA). Utilizing automated and human assessment, they measured each site on six different accessibility dimensions representing WCAG 2.0 guidelines. The score for each dimension was added together and the resulting score (measured out of

100), gave an overall measure of the accessibility of the website. The highest-scoring country was Mauritius with 50.74% and the lowest was Djibouti scoring 29.57%. The overall mean score for SSA countries was 36.2%. The authors concluded that while e-government sites had gained in prominence, accessibility needs were still not a priority in any country.

Acosta-Vargas et al. (2018) assessed the homepages of 348 randomly selected universities across 26 countries in Latin America. This is roughly 9.5% of the total number of universities in this region. Once selecting the sites, the authors evaluated their accessibility compliance with WCAG 2.0 guidelines using an automated program in the Chrome browser. After processing the results generated by the program, they found that no site met the minimum requirements for A-level compliance. They also compared the number of errors returned versus the ranking the universities held within the region. Their results indicated that there was no correlation between the quality, or high rank, of a university and the number of errors found on their websites. For example, a Brazilian University ranked at 192nd in Latin America had more errors (147) present than one in Chile ranked 282nd (78 errors). The researchers felt their results indicated an overall lack of inclusivity on the websites and that a stronger effort to improve accessibility was warranted.

#### Individual Countries

Latif and Masrek conducted a study on the accessibility of Malaysian e-government websites in 2010. They selected nine different sites that had high amounts of traffic and evaluated their homepages for WCAG 1.0 accessibility with an automated tool. They included evaluations while using two different browsers, Firefox and Internet Explorer, after pilot testing revealed that some testing would return errors in one browser, but not the other. They found that none of the pages passed A-level compliance in either browser. All pages had errors on them, with missing alt-text being the most common.

In a 2012 study, Al-Khalifa tested 36 Saudi Arabian government websites for WCAG 2.0 compliance. Human evaluation of the sites was necessary as the researcher found that the available automated assessment tools could not evaluate Arabic script. Every website tested had failures on each of the A-, AA-, and AAA-rating levels. None met the criteria to be certified as accessible at any level. In 2017, she followed up on these findings with two co-authors, Baazeem and Alamer. They evaluated the same set of websites used in the 2010 study, minus two belonging to ministries that had been merged, to measure any changes in accessibility during the intervening years. Then, three pages were selected from each of the 34 websites. Contrary to the 2010 study, the researchers employed two types of automated testing for WCAG 2.0 compliance after judging that the automated tools were mature enough to accurately detect errors. After automated testing, they also used human evaluation of the websites to measure compatibility with mobile devices. As in the 2010 study, all websites evaluated had errors on all three levels. However, there were fewer errors present than in the earlier study, and the researchers found this a promising indication of accessibility improvements being made to the sites.

An examination of 393 Canadian higher education websites was conducted by Zap and Montgomerie in 2013. The Canadian government had recently adopted the new WCAG 2.0 standard in 2011 and the deadline for implementing this new standard had not yet elapsed, so the authors evaluated the websites according to the previous WCAG 1.0 standards with an automated tool. All websites were evaluated at the A, A-, and AAA compliance levels. 26.6% (102) of the websites were found to be A-level compliant, and surprisingly, 1.8% (7 sites) reached the very rare AA-level of compliance and 1% (4 sites) reached an almost unheard-of AAA-level of compliance. The paper also included a comparison with earlier research findings from 2001, 2002, and 2012 using the same category of websites. The researchers found that while the incidence of priority 1 errors had decreased from 85.1% in 2001 to 73.4% in 2012, the overall occurrence of type-2 errors had increased from 88.9% in 2001 to 98.2% in 2012. This



echoed the findings of Loiacono et al. (2004), with the possible implication that more serious errors were being overlooked in favor of fixing simpler ones.

Adepoju et al. (2016) focused on studying Nigerian government websites. Utilizing two automated evaluation programs, they checked the primary websites for all 36 states in the country. The first tool checked for WCAG 2.0 compliance while the second tool evaluated the code, text, and multimedia contents of the pages. None of the sites fully met the WCAG guidelines and errors related to perceivability guidelines, such as missing alt-text or issues with form elements not being labeled, were the most frequently reported issue. Following that, robustness problems, such as markup language or auto-generating labels for fields in PDF files, were the next most common.

Another Malaysian study, undertaken by Ahmi and Mohamad in 2016, also examined government sites. This study sampled 25 federal government homepages and evaluated them for WCAG 2.0 compatibility by utilizing two different automated evaluation programs. The first program indicated that three (12.5%) of the sites passed compliance checks up to the AAA level. The second program evaluated the occurrence of several machine-detectable accessibility errors. In this test, six sites (24%) were reported as having zero errors, but none of those sites were the same ones as reported in the first evaluation's results. This indicates that the different tests were detecting different errors and issues were still present within each site selected. In this study, labels for form elements (checkboxes, drop-down menus, radio buttons, etc.) was the most common error, followed by links lacking any descriptive text and missing alt-text.

Also in 2016, Rau et al. published a study covering accessibility in Chinese websites. 38 websites from 2009 and 50 from 2013 were included. The websites sampled were from a variety of different fields, including personal (e-mail, social media), e-commerce, service-based, and governmental. The researchers used an automated tool to evaluate the sites according to

**TABLE 2. Summary of Included International Web Accessibility Studies**

<b>Year</b>	<b>Authors</b>	<b>Country</b>	<b>Guidelines</b>	<b>Sites</b>	<b>Evaluation Type</b>	<b>Findings</b>
2009	Kuzuma, Yen, & Oestreicher	UK, France, Germany, Switzerland, China, India, Cambodia, Philippines, South Africa, Liberia, Kenya, Namibia	WCAG 1.0, A-AAA	72	Test de Accesibilidad Web (TAW)	Countries with more developed accessibility policies/laws had fewer violations. Europe: 71% met A-level compliance Asia: 21% met A-level Africa: 8% met A-level
2010	Latif & Masrek	Malaysia	WCAG 1.0, A-AAA	9	Bobby	0% of sites reached A-level Missing alt-text was the most common error
2012	Al-Khalifa	Saudi Arabia	WCAG 2.0, A-AAA	36	human assessment	All sites failed at all three levels Missing alt-text was the most common error
2013	Luján-Mora	All 27 EU members	WCAG 2.0	67	Markup Validation Service & eXaminator	No country received perfect scores Many showed significant numbers of errors in base code and in accessibility
2013	Zap & Montgomerie	Canada	WCAG 1.0, A-AAA	393	TAW	26.6% reached A-level compliance 1.8% reached AA-level 1% reached AAA-level A-level errors on the same sites had decreased 85.1% since 2001 AA-level errors increased by 9.3%
2016	Adepoju, Shehu, & Bake	Nigeria	WCAG 2.0, A	36	TAW & Site Analyzer	0% of sites reached A-level Perceivability issues (missing alt-text & missing labels) were the most common error
2016	Ahmi & Mohamad	Malaysia	WCAG 2.0, A-AAA Section 508	25	AChecker & WAVE	12.5% of sites passed AAA compliance with AChecker 24% of sites passed AA compliance with WAVE No sites passing the first check passed the second check, indicating errors on all sites
2016	Rau, Zhou, Sun, & Zhong	China	WCAG 1.0, A	88	Hera	No site met A-level standards from the 2009 or the 2013 website samples

2017	Al-Khalifa, Baazeem, & Alamer	Saudi Arabia	WCAG 2.0, A-AAA	34	AChecker, Total Validator, WAVE, & human assessment	Errors found at all three levels on all sites Fewer errors found than in 2010 study of the same sites
2017	Alahmadi & Drew	Worldwide, Oceania, & Saudi Arabia	WCAG 2.0, AA-AAA	180	AChecker	Errors found on both levels on all websites Most common issue was missing alt-text
2017	Sohaib & Kang	Australia	WCAG 2.0, A-AAA	30	AChecker	0% of sites met A-level compliance Background/foreground contrast and missing labels were the most common
2017	Verkijika & De Wet	31 sub-Saharan African countries	WCAG 2.0	279	FAE 2.0 & human assessment	No site scored highly in all accessibility measures and no single site scored higher than 64.82%
2018	Acosta-Vargas, Acosta, & Luján-Mora	26 Latin American countries	WCAG 2.0, A	348	WAVE	0% of sites met A-level compliance No correlation found between university ranking and number of errors
2022	Ismail & Kuppusamy	India	WCAG 2.0, AA	44	TAW & axe	Mean number of errors per page was 419 Color contrast and alt-text issues were the most common

WCAG 1.0 guidelines due to the amount of content on Chinese sites causing issues with WCAG 2.0 evaluation programs at the time. The checks revealed that none of the websites in either sample passed A-level compatibility. When comparing the two samples, the accessibility of the latter group was worse overall than sites in the first sample, with the exception of e-government, accessibility, and service websites. In both samples, issues with providing alt-text occurred most often. The researchers concluded that accessibility is a major difficulty for Chinese sites and that the levels of compliance are worsening over time.

An examination of Australian e-commerce websites was completed in 2017 by Sohaib & Kang. In it, they selected top 30 e-commerce websites for the country and applied an automated evaluation program to detect WCAG 2.0 conformance. They discovered that none of the websites selected passed A-level accessibility and increasingly higher numbers of errors were detected for the AA- and AAA-level criteria. The most common results were two different perceivability issues. 65% of the websites evaluated were reported to have missing labels for elements on the page and 68% had insufficient contrast between components in the foreground versus the background.

Moving forward to 2022, a study conducted by Ismail and Kuppusamy investigated 44 Indian college homepages associated with the University of Kashmir and Cluster University Srinigar. Each site was evaluated with two automated accessibility tools to test for WCAG 2.0 conformity and to count the total number of times errors occurred in different categories. Since only AA-level conformity was evaluated, the number of sites meeting basic accessibility guidelines was not mentioned. On average, each page contained 419 accessibility violations by WCAG standards and no page was mentioned as being free from errors. Color contrast issues(perceivability) accounted for 2,567 violations with the next closest issue being a lack of alt-text (perceivability) with 380 violations. The researchers suggested that more focus needed

to be paid to the levels of accessibility on websites and that responsibility to do so lay with the web administrators running the websites.

It's clear that improving the levels of accessibility of websites has a long way to go. The topic is broad and difficult as it includes accommodating the needs of *all* visitors with disabilities, not only those with blindness or low vision. As seen above, accessibility issues are rampant across websites of all types in nearly every country despite newer, more well-defined guidelines for creating accessible websites and more advanced tools for assessing accessibility. Different tools are able to detect different types of errors (Ahmi & Mohamad, 2016; Campoverde-Molina et al., 2023) and no automated tool is capable of detecting all accessibility violations. Even further, not all accessibility violations are detectable with an automated tool. For example, automated evaluation tools can determine if an alt-text description is included for an image or photo, but it cannot determine if that text is consistent or sufficient in the context of its usage. At best, researchers can examine websites with multiple automated tools and compare the results. Human assessors are better at detecting website accessibility issues, but utilizing them is both more costly and more time-intensive.

## UX - What's in a Website?

When a website is created, the designer typically has some specific task or goal in mind. "We want the visitor to be interested in this section here," "We want visitors to buy these products," or "We want visitors to return." In order to accomplish this, the website is designed in such a way so as to emphasize those characteristics and produce a particular type of interaction for visitors. For example, Hartmann et al. (2008) determined that merely the way in which information was presented to visitors could influence their reactions to it. This means that designers need to be purposeful in how websites are constructed. This effect was found to carry over not merely to the presentation of the information on a site, but also the site itself. In 2014,

Djamasbi et al. compared the user reception of two versions of the same website that was being tested on mobile devices: one optimized for mobile devices and one not. They found that the users rated their experiences on the site optimized for mobile devices much higher than the non-optimized version.

So then, user experience, or UX, can be considered to be a branch of research largely concerned with the various aspects of how users interact with technology and feel about those interactions. In their 2012 book, Hartson and Pyla define it as:

...the totality of the effect or effects felt by a user as a result of interaction with, and the usage context of, a system, device, or product, including the influence of usability, usefulness, and emotional impact during interaction, and savoring the memory after interaction. (unpaginated, Section 1.1.3)

Applying this to websites, UX would be the interactions visitors have with sites, how they feel about both the site and the interactions themselves, and the design characteristics of websites intended to create those interactions. By designing websites in specific ways intended to elicit responses from visitors, owners of websites seek to manipulate the visitor responses. Pallud & Straub (2014) found that when the aesthetic aspects of a museum's website were emphasized, not only were visitors more likely to return to the museum's website, it also positively influenced their intentions to physically visit the museum itself. Similar findings for e-tourism sites were found in by Vila et al. (2019). Participants rated their experiences on tourism websites that emphasized aspects of usability and identifiable branding in their design more positively than experiences on sites that did not focus on those aspects in their design.

## Visual Design Principles: Vestis Virum Facit

“Clothes make the man,” or in the case of websites, the visual design. When considering web design principles and the overall UX of a site, it is safe to assume that a large component of website design is devoted to enticing visitors to stay on the website. Research has shown that the visual aspects are a major factor contributing to a user’s initial judgment of a website and will affect their willingness to return (Van der Heijden, 2003; Jiang et al., 2016; Tsai, 2017; Hartono & Holsapple, 2019). With e-commerce sites, it can also influence a visitor’s inclination to make a purchase from the vendor (Lee & Kozar, 2012; Lorenzo-Romero et al., 2013; Haglund & Román, 2020).

Often, this goal is to create feelings of trustworthiness or reliability. Trust, in particular, can have different definitions, depending on the field of study they are used in. Its meaning in an e-commerce setting, believing that another person or entity has characteristics that would be beneficial to oneself (McKnight & Chervany, 2001), is rather different from the same term applied in management, a willingness to be vulnerable to another party and reasonably expect that they will perform a requested action without being monitored or controlled (Mayer et al., 1995). Regardless of the definition used, numerous studies have found support for feelings of trust being important determinants of users visiting sites, both initially and in the future (McKnight et al., 2002, Wakefield et al., 2004; Wang & Emurian, 2005; Flavián et al., 2006; Urban et al., 2009; Kaabachi et al., 2019) or making purchases from them (Wang et al., 2010; Reinicke et al., 2013; Xu & Schrier, 2019; Qalati et al., 2021). Thus, it often happens that web designers are inclined to focus on a website’s visual aspects in order to increase a user’s trust in a website.

No matter the desired emotion, it has been found that manipulating the visual aspects of a website can influence how visitors feel about the site (Kim & Moon, 1998; Deng & Poole, 2010; Jungmans et al., 2022). Of these elements, two of the largest are color and graphics.

Depending on how they are applied, they can positively influence trust in a website, increase the user's perceived usefulness of the site (Pengnate & Sarathy, 2017), increase customer engagement with the site (Islam et al., 2020) or just have a significant effect on a visitor's reaction to the website as a whole. When influenced positively, appropriate utilizations of color and graphics can determine whether a visitor plans to stay or go elsewhere.

## Color

Color plays a large part in our experience on websites. When we land on a page, even before we start reading the content and making an evaluation of it, we're taking in the colors on a site and how they're arranged (Reinicke, 2013). This could be the number of colors, their arrangement in the foreground or background, the way they play off of (or against) each other, or possibly their hues and levels of saturation (Sulikowski et al., 2021). All of these aspects of color that we would normally take for granted play a part. When evaluating the importance of different components of a website, it ranks even higher than structure, layout, or usability (Hsu, 2011).

It can be extremely effective at evoking emotional responses. Colors used to enhance the appearance of a website can result in viewers feeling like the site is more credible, leading to increased trust in the site's purpose (Flavián et al., 2009). Color isn't a one-size-fits-all situation, either. For Germans, the trustworthy color may be blue, a color that increases the overall appeal of a site for Canadians is grey, and the Japanese don't have a stronger preference for either color scheme (Cyr et al., 2010). The same study also found that these increased rates of appeal and trust were also tied to increased feelings of loyalty to a site. In India, members of Gen Z prefer color combinations of blue or orange paired with amber or green on a website instead of other possible combinations (Mythili & Kiruthiga, 2022). So, while a specific color preference is not universal, different colors or color combinations can have noticeable effects.



Alternatively, the lack of color can have an effect on our emotions. In a Korean study by Kim et al. (2003), the participants felt more tense towards websites when the main image was not yellow or red and the background contained a dark color. When the colors of a site don't pair well together, we may feel like the site is less professional or lacks a sense of coherence (Rosen & Purinton, 2004). This can result in visitors being less interested in spending time on the site or less inclined to delve into it more deeply.

Outside of emotion, there is some evidence suggesting that using particular colors on a site may enhance our recall of the material in certain ways. Bonnardel et al. (2011) found that participants in their study reported easier navigation on sites with a predominantly orange color scheme and had increased rates of recall for non-linear pieces of information (bulleted lists) from the site. Participants in the same study exposed to the same site with a blue color scheme were better at recalling linear sequences of information instead and reported a greater level of appreciation for the site, even though this didn't result in them staying on the blue site as long as the orange one.

## Graphics

In terms of visual design components, graphics are as important, or possibly more important than, the use of color. Acknowledged as another integral component to UX and visual design (Wang & Emurian, 2005; Cyr et al., 2006; Karimov et al., 2011; Islam et al., 2020), graphics include pictures or images, as well as the use, placement, type, meaning, and quality (resolution) of those images. This category is not restricted to images alone, either, and encompasses the text utilized on a website, meaning that the font, size, and density of text is included in graphic design (Rosen & Purinton, 2004; Karimov et al., 2011). Graphical content also branches out to overlap with other categories used to evaluate websites, depending on their application. Appropriate graphics set the tone and influence the atmospheric design of a site, positively influencing visitor attitudes and purchase intentions (Wu et al., 2013). Graphics

can be considered as content components of a site when used in an e-commerce environment (Flavián et al., 2009). The high-quality images that provide details to consumers about products being sold straddle a line between aesthetic adornment and functional information.

As with color, graphics also influence a visitor's feelings of perceived credibility (Fogg et al., 2001), expertise, and competence (Pengnate & Sarathy, 2017), all of which are components related to feelings of trust towards a website. Well-placed images can cause a site to be perceived as more professional, and thus more trustworthy (Wang & Emurian, 2005). The quality of company logos positively influences credibility, sometimes defined as a combination of trustworthiness and expertise (Lowry et al., 2013), and this effect is further augmented when the rest of the website's design correlates with the logo. The contents of any photos or images also have documented effects. Human photos or images including facial features increase appeal to visitors and signify a higher degree of social presence, both in turn are correlated with increased trust (Cyr et al., 2009). A study involving hypothetical non-profit websites tested several conditions involving the inclusion of images of aid workers responding to a disaster or images of the disaster's effects (Burt & Dunham, 2009). In the condition where both images of the workers and the disaster were included, as opposed to the workers or the disaster alone, participants perceived the organization as being more trustworthy. The reverse is also true, a misuse of graphical content can reduce trust or confidence in a site. If a site includes banner ads, these can reduce the trustworthiness or credibility of the site (Fogg et al., 2001). The effect is stronger if the ad content itself is perceived as disreputable, such as a banking service (reputable) versus a gambling website (disreputable). Poorly chosen graphics, or graphics indicating incompleteness ("We're under construction! Come back soon!"), can reduce visitors' perceptions of the site (Everard & Galletta, 2005). The effect is strong enough that even the *impression* of the issues is enough to decrease site perceptions.

Moving past effects on trust, the inclusion of appropriate graphics has other demonstrable effects, namely increasing the perceived aesthetic appeal of the site (Wang et al.,

2010; Lin et al., 2013; Coursaris & van Osch, 2016). This increased visual appeal can then be connected to increased engagement with the site (Islam et al., 2020) or a greater desire to explore the site more fully (Rosen & Purinton, 2004). Higher levels of aesthetic appeal have also been linked to improved reports of perceived online service quality and satisfaction with a site (Wang et al., 2010; Coursaris & van Osch, 2016). When used appropriately for the context, high quality graphics can also compensate for the longer loading times (Pengnate & Sarathy, 2017). This relates to the findings of Sears and Jacko (2000), who found that users would become upset with slow-loading sites when they perceived the delay due to poorly managed graphics. Pengnate and Sarathy's findings indicate that if of sufficient quality, well-used graphics may be able to compensate for other failings of the site.

## Accessibility Research

Despite the wealth of research on the visual aspects of web design, all of this is not to say that *no* research has been conducted regarding blind or low vision people. So, with this in mind, we can turn to look at research that has been done regarding how those with visual impairments interact with websites. Of the branches of research related to the blind and low vision communities, two are more directly relevant to this paper than others: examinations of the online search behaviors of B/LV individuals and explorations into the types of problems these same groups encounter while online.

### Information Scent: How Do They Search?

Briefly, information scent relates back to the information foraging work of Pirolli and Card (1999). They theorized that when users are searching for information within a networked system, they will actually use foraging patterns similar to those of animals searching for food. The user follows cues found within the network, the "scent" of the information, and decides if following that scent is likely to lead them to the desired information or if they would be better to

follow a different trail. This concept was extended to online search behaviors in later papers (Chi, Pirolli, & Pitkow, 2000; Chi, Pirolli, Chen, & Pitkow, 2001). Though initially studied using sighted participants, researchers have since studied how these principles may be utilized by blind web users.

### Task Completion Behaviors

One study conducted by Ivory, Yu, and Gronemyer in 2004 sought to compare the search behaviors of blind users versus those of sighted users. They brought in 10 sighted and six blind participants and had them complete a total of 11 tasks, two training and 9 for the study, on a computer in the research lab. Each task consisted of five steps. Participants were presented with a description of a fact they were supposed to find via an online search. Then, they were shown a search result and asked if they felt clicking on the link would lead them to the desired information. This was followed by a short questionnaire intended to elicit details for why the participants felt the search result would contain the intended information. After evaluating the search results, participants explored the site connected to the link and tried to find the information to complete the task. Finally, the participants completed a second questionnaire related to how well the site matched their expectations and any features they would have liked to know about before visiting. Each participant was encouraged to think aloud while completing the tasks. For later analysis, the computer screen was recorded as was the audio of participants. Their study used a 2x2x3x4 factorial design to examine the effects of user sight levels (sighted and blind), whether pages contained the desired information (contained or didn't contain), effort required to process the contents of the page (low, medium, or high), and additional included search information (ads, word count, quality, or no additional information provided). The researchers found that in the majority of the tasks, level of sight had no impact. Participants would explore the site listed in the search results the majority of the time.

Additionally, the primary pieces of information used to evaluate the sites were the summary and title, rather than any of the optional information included in some versions of the tasks.

Another study comparing behaviors during the completion of informational tasks was conducted in 2020 by Upadhyay. In this study, 10 sighted and 10 blind users were asked to perform a “knowledge crystallization task.” Each was to search for three graduate schools with a psychology program, then summarize the information about the schools in a Word document. The sighted participants exhibited two behaviors: one group executed many searches to find possible keywords that might lead to the desired information, then selectively followed few links to obtain information. This might have looked like an initial search of “graduate programs in psychology, IL,” leading into “XYZ school psychology graduate program” to reach a specific school’s page for the program. The other sighted group conducted few searches and clicked on few of the search results, but followed many links after clicking on a result to find information. In contrast to the behaviors exhibited by both of the sighted groups, the blind participants employed an entirely different tactic. They conducted fewer searches overall and would initially scan only the headings of the results to see if one fit the task. For search results they deemed relevant, they would return to the result and read the rest of the information (summary, description, or url), then follow the link to the page or return to the other search results. Once information had been gathered from a page, they would hit the commands to back out of pages to return to their search list and begin again. The authors proposed that this behavior could be explained by the higher cost in time and effort of exploring new search results as opposed to more thoroughly examining known ones.

### Web Browsing Strategies

In 2007, Bigham et al. remotely tracked the web browsing behavior of both blind and sighted participants for a week to compare the two groups in terms of several different behaviors. Among these were accessing links within pages to skip down to content (skip links),

probing (visiting a site, leaving, then quickly returning), and visiting sites with dynamic or Flash content. After analyzing the results, the researchers concluded that there were demonstrable differences in the search behaviors of both groups and some similarities. Blind visitors were far more likely to utilize skip links on a page when they were present, 5.6% of the time versus 0.07% of the time. The blind participants were almost three times more likely to engage in probing behavior on sites than their sighted counterparts. When content on a website was presented dynamically, sighted participants were more likely to interact with it, indicating that the blind participants may not have been aware that the dynamic content had shifted. Regarding Flash content, both groups visited sites with this type of content almost equally, resulting in no significant difference between the groups.

An examination of different browsing strategies for exploring a webpage were outlined in a study by Lunn, Harper, and Bechhofer (2011). They sat with students in a classroom at a charitable organization for the blind in a total of 11 two-hour sessions (22 hours altogether). Employing thematic analysis, they used their observations to outline six primary strategies employed by blind users when interacting with websites in search of information. Some may seem familiar to a sighted user. For example, Candidate Chunk Discovery Strategy. In this method, a visitor moves to an area on a web page, partially reads a section of information (a chunk) and decides if it is useful or not. If it is not, they move to another section of the page and repeat the process. If the section is useful, the visitor reads the section more thoroughly. Other strategies seem designed more for screen reader (SR) users. Masthead Avoidance Strategy might be employed on pages that have similar contents at the top of the page, like search results or index homepages. In order to avoid repetition of previously encountered content, the user would quickly tab past it, or move to the bottom of the page, and then work their way around the page to find new content.

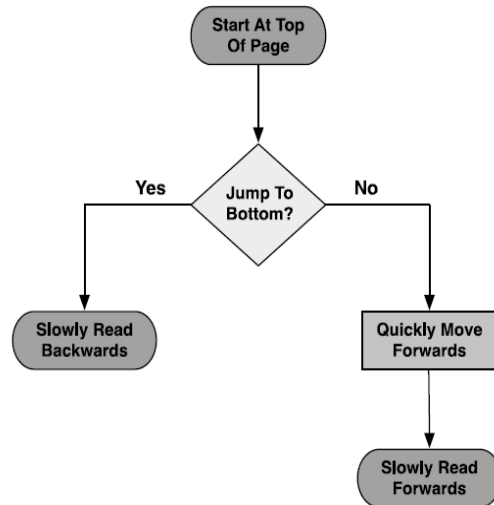


Fig. 4. The Masthead Avoidance Strategy allows users to avoid the frustration of listening to the same content repeated for every page of a Web site.

**Image 2. Diagram of Masthead Avoidance Strategy from Lunn, Harper, & Bechhofer (2011)**

Contrasting information-seeking behaviors, a study by Vigo and Harper in 2013 indicated that not all search behavior exhibited by blind browsers may be utilizing information scent tactics and some may focus on moving forward through content. Instead, they observed that when blind users encountered accessibility issues online, their browsing behaviors sometimes centered around bypassing the current problem, instead of following the scent. When encountering absent or poor labeling, a user may click on a random link or a low-scent link in an attempt to get away from the current page. In a situation where a user has lower mobility on the page, like encountering a dead-end page with no apparent links to proceed further, users may backtrack to an earlier page that did not contain such an accessibility issue. If a page lacks an index or skip links to transport the user to the desired section, a blind user may employ a gambling approach. A “gambling” approach is when users quickly tab down through content that was ordered in a sequential manner without fully listening to it, in case the desired information is further down, even if that might mean skipping past it. This approach shares similarities with the Masthead Avoidance Strategy detailed by Lunn et al. (2011). The researchers concluded that

when not encountering issues online, blind users were likely to adhere to information foraging practices. However, once the same group encountered difficulties, it resulted in behaviors centered more on escape and returning to a page where they had more control over movement through content.

The overall conclusion that could be drawn from previous information scent research is that blind users as a group do share some characteristics with sighted users (Bigham et al. 2007; Ivory et al., 2004). In other situations, such as information gathering tasks, they can behave quite differently (Upadhyay, 2020). This may be a result of how they receive the information, which can result in accessibility issues sighted users don't encounter (Vigo & Harper, 2013) or due to different strategies they employ while searching for information (Lunn et al. 2011).

### Online Difficulties: What Sighted Users Don't See

Another line of accessibility research seeks to identify the issues that those with vision impairments experience while online. As their browsing habits have some differences from those of sighted web browsers, so too are there some differences in the difficulties they face while online. For example, sighted users may run into issues browsing if their browser itself crashes. SR users also deal with this issue in addition to the possibility of their SR program crashing as well. When encountering a website with photographs of text included on it, a sighted user can proceed as normal while VI users are brought to an abrupt halt if the contents of the image text isn't included within the description of the image itself. To learn that situations such as these even exist, it has been necessary to examine the online experiences of the VI communities.

A study conducted by Lazar et al. in 2007 instructed 100 blind participants to keep a daily journal of their experiences online and to record any frustrating experiences they



encountered. For each incident, the participant was asked to record details about what the incident was, how they felt about it, and what response they had to the incident. When analyzing the results, the researchers found that the participants' most commonly encountered issues were page layouts that resulted in confusing feedback from the SR, issues or conflicts between the SR and the web page itself, and unlabeled forms. The most common response to these issues was to feel angry or frustrated with the computer and when reacting, participants often simply felt frustrated or had ideas on how to solve issues because they had encountered them previously. Additionally, Lazar et al. found that the participants reported losing an average of 30.4% of their time spent online due to frustrating issues. This indicated that for any task they were attempting to complete online, blind individuals needed to spend significantly longer than sighted ones.

In 2010, Babu et al. took a different approach to studying online experiences. Instead of a diary that participants filled out over time, the researchers sat with six participants in a computer lab and asked them to verbalize their thoughts while completing an online quiz containing multiple choice, multiple answer, and short answer questions. The intention of the study was to assess the most common issues the participants encountered while completing the task on a common academic platform, Blackboard. When reviewing the transcripts and recordings from the sessions, the researchers noticed that the four most common issues all related to how the website interacted with the SR. For instance, when filling out an essay-type question, some fields were formatted such that the backspace key was not recognized as a legitimate input. As a result, when the participant went to hit that key and correct something they had written, they were instead ejected from the assessment and unable to re-enter it. In the problems that were found within this study, each could be tied back to an issue with the website relating to unclear explanations of how to interact with the site to complete content.

In addition to complications encountered when going online with a computer, VI users encounter additional problems while online with mobile phones as well. Carvalho et al. (2018)

compared the experiences of both blind and sighted users completing tasks on two different phones (one iPhone and one Android). Similar to Babu et al.'s 2010 study, the participants were asked to think aloud during the tasks and the screens they used were video recorded. The six blind and four sighted participants were asked to visit a government app and website as well as a commercial app and website to carry out hypothetical tasks, such as selecting a book to purchase for a relative's birthday. The results from the study indicated that not only did VI users encounter issues almost four times as often as sighted users (409 total reported issues for blind participants vs. 104 reported errors from sighted ones), but that these errors also resulted in a lower successful completion rate of the tasks. The sighted participants were successful with 91.67% of their tasks compared to the 78.6% completion rate of the blind participants. The most common issue encountered by blind participants was a lack of feedback from the website to indicate what was happening on the page. This occurred in places such as payment menus where the payment icons were represented by graphics for different credit card companies, but the graphics did not include details for SR users of the graphics' content. The researchers mentioned that while they did not conduct a thorough comparison of common issues encountered by both groups, when such errors did occur, they affected the blind participants more significantly. This calls back to the findings of Lazar et al. in 2007 that blind users needed to devote additional time to complete tasks than their sighted counterparts.

The result of these additional problems VI users encounter online is that using a SR is more mentally taxing than merely looking at the computer screen (Sahib et al., 2012, Sahib et al., 2014; Giraud et al., 2018). The requirement of not only focusing on the task at hand, but also processing the speech from the screen reader, means that VI users must keep more pieces of information active in their memory at a time than those not using a SR. This is a concept known as cognitive load and it means that it's necessary for VI users to expend additional mental resources to perform a task that sighted users might take for granted. In the Sahib et al. 2012 study, this can be seen when sighted participants opened multiple tabs while

searching online while SR users generally operated in only one. The additional tabs served to save the memory of sighted browsers by not needing to keep all of the information in mind at once and only reference it when needed. The 2014 paper by the same researchers explored this concept in the context of a multi-session search task, namely planning for an overseas trip in multiple stages. Using a tool developed for the study that was intended to reduce cognitive load, VI users in the first session could essentially bookmark or save pages they found to have useful information. In the second session, the participants utilized the tool to recall this information. They ultimately conducted fewer searches to find the required information and used fewer search terms while conducting those searches. Another approach to reducing cognitive load was taken by Giraud et al. in 2018. They created web interfaces that removed redundant or irrelevant information (such as logos, menus, and ad space) from the page. When viewing the filtered pages, participants reported significantly lower levels of mental effort required to complete tasks and were less likely to give up on the task. They concluded that reducing the amount of complication on web pages, or clutter, can address one need for VI users browsing the web.

## The Research Gap

Bearing all of this in mind, several questions arise. If websites are primarily designed for sighted people, with many of the prominent aspects being based around visual cues, what happens when those cues are removed from the equation? What aspects or elements of a website remain that are important for visitors then? Users with visual impairments go online and complete the same types of tasks that sighted users do. This means that they are also deciding that, for whatever reason, one website is better for their current purposes than the other options available to them. Research supports the notion that their approach to completing online tasks is different than that of sighted users and that they face different obstacles. It has also been shown that they require more time than sighted users to complete the same tasks. When visiting

a site for the very first time, what are the most important factors figuring into their decisions? What issues do they encounter that would cause them to immediately leave? This initial visit to a website is the most crucial, as a poor UX creates a poor impression, meaning visitors never return.

This is merely one aspect of the picture, however. Despite the studies conducted by researchers into accessibility and refinements to accessibility standards, the overall levels of website accessibility stubbornly refuse to make meaningful progress at increasing. This would imply that the issue is more complex than merely understanding what a blind or low vision person wants and expects from a website. So then, what other complications may exist? In a 2012 paper, Power et al. suggested that WCAG guidelines may shoulder some of that responsibility. When studying issues reported by blind web users, they estimated that just under half were not adequately covered by WCAG 2.0 guidelines. These findings implied that websites were not adequately implementing accessibility guidelines. At the time, the 2.0 guidelines were only 4 years old and many organizations had not yet adopted them. Given that two updates and 11 additional years have elapsed since that study, it would be reasonable to see if those coverage rates have improved.

Another consideration is the construction of research studies involving VI users themselves. Accessibility studies often include combinations of sighted and blind participants, only blind participants, low vision participants, or sighted and low vision participants. What may be missing is an examination of the topic including the experiences of both the low vision *and* blind communities at the same time. The groups have similarities in how they experience web content. Some people with low vision may become blind later on if they have a degenerative ailment. When this happens, they have their transitional experience available to inform their experiences. So, including the perspectives of both groups at the same time on this topic could provide additional insight.

So, to summarize the aims of this thesis, it seeks to extend the current body of research by identifying the most recurrent problems encountered by blind and low vision visitors upon their first visit to a website, evaluating how well the current set of accessibility guidelines addresses those problems, and comparing the results between both groups to see which issues might ultimately be the most important to address for both.

## METHODOLOGY

Qualitative studies are especially appropriate in the early stages of studying a phenomenon of interest. Just as quantitative studies do, qualitative studies involve extensive considerations for determining the appropriate methodology. With qualitative studies, it is of particular importance to make a deliberate record of how and why methodological decisions are made. Schreier et al. (2019) identified a lack of transparency with regards to qualitative studies, particularly those employing qualitative content analysis, as this study also does. They state that “...there exists an assumption that the mere naming of the method creates sufficient clarity, and renders any further specification unnecessary” (p.11). In an effort to contribute to greater understanding of how these methods are determined, a more in-depth description of the mindset behind methodological decisions and processes used for this study is included.

### Overall Design

The study itself is a blend of grounded theory, thematic analysis, and content analysis design characteristics with each technique contributing to the approach. Broadly speaking, grounded theory influenced the initial stages of the study the most, thematic analysis the coding and code generation, and content analysis the numerical reporting of results. Each of these approaches

Grounded theory contributed much to the mindset and data collection approach in the study. Theories and hypotheses were not generated prior to data collection, nor were the interview questions written with the intention of testing particular hypotheses (Kvale & Brinkmann, 2009, p.202; Saldaña & Omasta, 2018, p.150-151). Instead, the goal was to ask broad, open questions about topics, allowing participants to speak freely and share what they deemed to be important.

The coding process itself was still similar to grounded theory in that the list of codes used in the study were not pre-generated a priori. The process of creating codes was where the influences of thematic and content analysis emerged. Codes were generated as interviews were read for their content, identifying common themes and similar issues, but it was not done iteratively in between interviews and did not alter the structure of the interviews (Arksey & Knight, 1999, p.162). Additionally, the entirety of each interview was not coded, as is common in grounded theory. Instead, only the portions relevant to the central questions and their associated categories were coded. The codes themselves were generated via multiple rounds of reviewing interviews and connected in a manner consistent with the six-step process of review in thematic analysis (Braun & Clarke, 2006; Stevens 2023, p. 304-308).

The effects of content analysis largely influenced the study's approach in that it also analyzes the frequencies with which topics were mentioned by the participants (Saldaña & Omasta, 2018, p.67, 153-155). This is seen later in the paper, when a discussion of the frequencies of common themes and their relationships to each other is discussed.

## Participant Criteria

The intended participants in the study needed to meet four criteria:

- being at least 18 years of age,
- having vision that would be categorized as either low vision or blindness,
- using the internet on a daily basis,

- and using assistive technology while online.

The age requirement simplified the recruitment process by not needing parental consent or presence during the interviews.

Daily use, even if for only a single purpose, would mean frequent encounters with websites. Even occasional encounters can leave an impression, so the intention was that frequent use would lead to more concrete opinions.

All participants confirmed that they had vision falling within a low vision to blindness spectrum defined for the study. Low vision was defined as "...vision loss that cannot be corrected by medical or surgical treatments or conventional eyeglasses" (American Academy of Ophthalmology, 2021). Affected activities include, per the National Eye Institute (2022), being able to "...read, drive, recognize people's faces, tell colors apart, see your television or computer screens clearly." Blindness was defined as including the previous description as well as complete, or almost complete, lack of the perception of light.

The final criterion was that participants also needed to use some form of assistive technology while online. This meant that they used software, hardware, or both for accessing content online. Software-based assistive technology may mean screen reading programs, magnification functions on the device or in the browser, or color scheme adjustments through 3rd-party applications. Physical assistance often took the form of telescopic lenses, large or small screens, or physical magnification hardware.

## Recruitment

The recruitment process was conducted in multiple stages in order to attract as heterogeneous of a group as possible. Interested respondents were asked screening questions to verify if they met the criteria for the study, then an interview time was scheduled if they did. Except where the participant explicitly asked not to be compensated (as happened in three instances), all participants received a gift card for their time.

Ultimately, four waves of outreach were conducted. Each varied in terms of efficacy, speed of recruitment, and heterogeneity of the respondents. In each wave, a different source was contacted and the aims of the study were explained to an administrative contact. Next a request was made to have the organization distribute a recruitment letter to potential respondents. This was done to ensure the privacy of members within the recruitment population who did not wish to participate. The recruitment letter explained the purposes of the study, the format it would take, and included multiple methods of contacting the study. It was left to the recipients to decide whether they wished to contact the study. Below are more detailed descriptions of each outreach attempt.

#### Zero Returns: University Outreach

The initial outreach attempt involved contacting the disability accommodation department at a local university. The recruitment letter was sent out, but only one respondent contacted the study. They met the criteria for participation and were accepted, but withdrew from the study shortly thereafter. After a week and a half with no further responses, another method of recruitment was attempted.

#### Low Returns: Regional Vision Assistance Programs & Referrals

For the second outreach attempt, over 30 county and state-wide vision assistance organizations were contacted in Pennsylvania and northeastern Ohio. These agencies then sent the recruitment letter to their members. The response rate was much improved from the university-level outreach attempt. However, many of the respondents did not use the internet regularly, thus failing to meet the requirements for participation. Additionally, of the respondents accepted, only one was younger than 50 years of age. The final issue with this method of recruitment was the speed. The rate of recruitment was slow, with only 5 successful participants



recruited within a 3-week timespan. It is possible that the initial goal of 28 participants could have been reached with this outreach method. Given the homogeneity concerns regarding age, as well as the time and effort required to arrive at 28 participants, this recruitment method was deemed insufficient.

Alongside the second outreach attempt, referrals for the study were also being screened. The researcher sent out a request to friends, family, and colleagues to please share the study's contact information with anyone they knew who might fit the study criteria. This method was beneficial in that respondents were already aware of the study guidelines, making screening them a simpler process. Three participants were recruited in this manner. As that was the extent of the participants who could be recruited from this method, additional approaches were needed moving forward.

#### Moderate Returns: Online Forums

Next, several online message boards for the blind and low vision communities were identified. After comparing their listed member counts and average number of concurrent users, one was chosen for the next outreach attempt. The moderators of the board were contacted and permission gained to post a thread containing the recruitment letter. Within three weeks, 13 participants had been screened and accepted into the study, most having expressed interest within the first week of the post. During the second week and beyond, responses to the recruitment post trailed off sharply as the thread was no longer new and fell farther down the list on the forum. At this point, 21 of the desired 28 participants had been accepted, but it was unclear where the best place to recruit the remainder would be.

#### High Returns: Online Newsletter

The final recruitment method was suggested by a participant during their interview, an online newsletter. The newsletter was contacted and they agreed to run the recruitment posting

for three weeks. This proved to be both the most effective and expedient method. The response rate was overwhelming, attracting over sixty interested participants in the first week alone. This led to the researcher needing to contact the newsletter and ask that the recruitment posting be removed as no further participants could be included. While the majority of respondents had to be turned away, all who responded indicated that they wished to be contacted for any future studies. Had this method been utilized from the outset, the entirety of the participant pool could have been reached within the first week, instead of multiple months.

Ultimately, the online forum and newsletter proved to be the outstanding recruitment choices, for several reasons. Respondents to the newsletter and message boards were better aligned with the intended participant populations, specifically, those who use the internet on a daily basis, than those reached through the regional organizations. This is likely due to both methods requiring internet use in the first place. Additionally, respondents from these two methods were more heterogeneous. The age ranges from these respondents were broader and more respondents who identified themselves as falling into the low vision (LV) group. The third benefit from these recruitment methods was the inclusion of participants from different countries and continents. This resulted in a wider range of experiences represented in the final participant count.

## Interview Questionnaire

The interview questionnaire itself consisted of 20 primary questions, with several optional sub-questions for each. Questions were developed in line with eliciting answers for the primary goals of the study: "What is the experience of those using assistive technology when browsing online and what aspects of websites do they find encourage their continued use of a site upon the first visit?" Follow-up questions were included whenever an unknown term was used or to delve deeper into a participant's response.

As is a common practice in qualitative research, the majority of the questions were written specifically for the aims of the study, to elicit information about different aspects of an individual's online experience, rather than drawing on questionnaires from previous studies (Creswell, 2013). To assist with this process, several of the questions were written in the style of the critical incident technique (Flanagan, 1954). In this method, a respondent is asked to provide a detailed account of an event, which could be either positive or negative. Questions are asked about the event to determine specifics and identify potential issues. Based on the information gathered, potential resolutions to the issues are suggested to try and address the root cause. This method was particularly well-suited for the study because it obtains information from the perspective of those experiencing an event in their own words. It is not tied to a particular methodology or approach and can be easily adapted into interview format.

The questionnaire did include two questions that were drawn from previous research utilizing this design. The original questions in Seckler et al.'s paper (2015) explored trust and distrust in website experiences and used the critical incident technique to create a more detailed account. The wording of these questions were adapted in this study to apply to web search experiences instead.

The complete question list was reviewed by five senior researchers for potential improvement areas, especially to avoid bias in the questions. The questions were then adjusted to become more neutral in their phrasing. For example: "What do you like about this technology?" (referring to assistive technology the respondent listed in an earlier question) being reworded to "How do you feel about this technology?"

After the initial revision, three pilot test interviews were conducted with three sighted volunteers. No data was collected during these tests. Using the test experiences, the questions were further refined. In this stage, the wording of questions was modified for clarity about what was being asked and the order questions were asked in was altered to produce a more natural flow of conversation during the interview. After these revisions were made, the question list was

once more reviewed by five senior researchers for any further changes needed. Once their approval was received, the questionnaire was considered complete. Please see Appendix B for the full screening and interview question list.

## Semi-Structured Interviews

The initial approach to understanding the experiences of an understudied population requires locating data on the desired topic. When archival data is nonexistent and a pre-existing body of knowledge is lacking, the most straightforward way to get the necessary information is posing questions to members of the group directly (Merriam & Grenier, 2019).

In 2019, Adams recommended that semi-structured interviews would be a tool ideally suited for such a task. They allow the researcher to employ a questionnaire composed of both closed and open-ended questions, but leave the interviewer the flexibility to change directions and explore more deeply into a participant's thought processes. This is of particular benefit in exploratory studies as unanticipated topics warranting additional exploration may surface during the interview. The need for this kind of plasticity makes employing a traditional survey with closed-ended questions and Likert scale measurement an inflexible, sub-optimal option. Semi-structured interviews are also ideal for exploration of understudied topics. As pointed out by Merriam and Grenier (2019), this format also allows the researcher to adjust the direction of the interview on the fly, depending on participant responses, rather than requiring they adhere to a more formal interview question structure. This leads to the discovery of topics related to study's goals that would not have otherwise been shared if only specific questions were asked.

The inclusion of open-ended questions within the interview begets the creation of a space for participants to feel comfortable narrating their experiences (Galletta, 2013). This more casual atmosphere results in participants feeling more comfortable sharing their opinions and observations. For example, one participant in the US mentioned that she had had to file an ADA complaint during the COVID-19 lockdown regarding a government reporting site in her state.

When trying to access information about the prevalence of COVID cases in her county, she discovered that she was unable to access the information because all of the heat maps on the website were color-coded. When she tried to contact the site about the issue, she encountered a CAPTCHA verification that did not have an alternative version for those without vision. Had a more rigid interview structure been chosen, this story might not have come up because the initial opening of the story, the mention of having filed an ADA complaint, was not immediately linked to the goals of the study.

To this end, semi-structured interviews were conducted with 31 individuals who met the criteria established for the study.

## Interview Protocols & Transcription

All interviews were conducted online over Zoom with the exception of one which was completed over email due to technical difficulties. Each interview was audio and video recorded after receiving consent from the participant. Every participant was asked all questions on the questionnaire and had the option to skip any questions they felt uncomfortable answering or did not have an answer for. After all official questions on the questionnaire had concluded, all participants had the opportunity to ask any clarification questions about the study or provide additional thoughts about any of the questions they encountered. While some participants could not recall an example for all questions, no participants requested any questions be skipped. Interviews ranged in duration from 40 minutes to 2.5 hours, with the average length falling just over an hour, depending on participant experiences.

After interviews were conducted, a number of revision steps needed to take place in order to convert the raw conversations into an analyzable format. This broke down into three broad stages: initial reading and break-up of text, annotation, and entry into NVivo.

The first stage involved working with the speech-to-text copies of the interviews. The entire corpus of 490 single-spaced pages needed to be read while listening to the interviews

themselves in order to break up the text into a recognizable back and forth dialogue structure. These initial drafts were entirely lacking in capitalization, punctuation, time stamps, and any indication of who was speaking. Additionally, much of the dialogue needed to be corrected from incorrect speech-to-text transcriptions (particularly in the case of slang), necessitating listening to certain parts repeatedly in order to correctly transcribe participant statements. Punctuation and spacing was added based on the flow of conversation and timestamps for questions were included for easier future reference to specific parts of the conversation.

These revisions resulted in the next evolution of the interviews being 655 pages, single-spaced, time-stamped, and with sufficient margin space included for notes and coding. This stage involved reading through the entire set of interviews again to add notes about the interview and preliminary highlighting of codes.

The third stage was conducted after uploading all interviews into NVivo 1.0. It required converting all handwritten notes from the previous stage into a structured and organized set of related codes based on participants' responses to the interview questions. Each interview was read again, for the 4<sup>th</sup> or sometimes 5<sup>th</sup> time, during this stage. While reading, some additional codes were identified and integrated into the codebook for later use. Similar codes were grouped together and similar sets of codes were grouped into themes, creating broader topics of discussion.

## Sample Size & Data Saturation

Data saturation was the primary consideration when determining an appropriate sample size for the study. The number of participants interviewed for the study was determined by considering the recommendations of previous authors discussing data saturation in qualitative studies, particularly those utilizing content analysis or thematic analysis methods. Additionally, the participants in the study could reasonably be divided into two groups: users with low vision and users who are blind. Since both aforementioned analysis methods were applied to the

study's data, as well as having two study populations included, recommendations for each set of circumstances were taken into account.

Multiple studies cite that there is no "one-size-fits-all" number to use when determining how many participants will be needed for a study and that the exact definition of how to get there is often unclear (Guest et al., 2006; Francis et al., 2010; Mason, 2010; Cleary, 2014; Fusch & Ness, 2015; Braun & Clarke, 2019). In order to arrive at a sufficiently saturated data set, there are multiple criteria that must be accounted for and considered.

Responding to a literature review done on data saturation, Guest et al. (2006) examined the claim that the point to cease gathering new data is that of theoretical saturation (Glaser & Strauss, 1967). Theoretical saturation in this circumstance being defined as the point when "no additional data are being found whereby the (researcher) can develop properties of the category" (p.65). Based on this definition, Guest et al. conducted sixty semi-structured interviews with two different populations, then created a codebook using a thematic analysis approach and analyzing the first 30 interviews. They found that 73% of the 109 codes were identified within the first six interviews and that 92% had been identified within 12 interviews. The remaining 9 codes were identified after analyzing the remaining 18 interviews. Upon adding in the additional 30 interviews from the second population, only five additional codes were identified. Their analysis indicated that data saturation had occurred at 12 interviews. They note that their study's population was "...relatively homogenous and had fairly narrow objectives" (p.75) and that applying their approach would not be suitable for an unstructured approach.

A continuation into the examination of theoretical saturation in studies utilizing content analysis was conducted in 2010 by Francis et al. They proposed the topic be examined according to four principles. They propose that a sample size for the first round of analysis be pre-determined, the number of additional interviews without the identification of a new theme or idea should be predetermined, analysis should be conducted by at least two coders and have pre-determined agreement levels, and that the data saturation findings should be reported for

readers to evaluate. They conducted two separate studies involving 14 and 17 participants, respectively, to evaluate these principles. Their results indicated that the findings from Guest, that 12 interviews resulted in over 97% of important codes being identified, was supported. In their conclusion, they make mention that the principles they propose are not as readily applicable to studies where there is “not an existing body of evidence to demonstrate their appropriateness” (p.14).

PhD research in particular was the focus of the 2010 article by Mason. In it, he focused specifically on the subject of data saturation being applied within PhD studies. His question was “How many participants are used in PhD studies utilising (sic) qualitative interviews? And do these numbers vary depending on the methodological approach?” (p.6). His study consisted of 560 dissertations that involved one on one interviews, mentioned the exact number of participants, had more than one participant, did not interview participants multiple times, and did not include the PI in the fieldwork. These dissertations were extracted from a UK and Irish database of all dissertations submitted since 1716, a grand total of 532,646 documents. Mason found that the mean and median number of interviews were 28 and 31, respectively, with the most common numbers being 20 and 30. His analysis indicated that PhD researchers and their advisors “understand the concept of saturation but they find it easier to submit theses based on larger samples than are needed “just to be on the safe side” (and therefore feel more confident when it comes to their examination)” (p.15). He agreed that an exact number for achieving data saturation is difficult to define and that reaching it will also depend on the experience of the researcher.

Finally, Braun and Clarke’s 2019 article on the definition and use of data saturation was evaluated for contextualizing the other data saturation articles specifically and for using data saturation in general. Braun and Clarke are often considered to be the experts in their field when it comes to thematic analysis, having published influential articles on the subject beginning in 2006 up through 2023, with the 2006 article having over 170,000 citations as of this



writing. In their 2019 article, they suggest that researchers should include an upper and lower bound for their expectations for reaching data saturation, then make conscious evaluations during the data collection process on a firmer stopping point. They emphasize that focus should be on obtaining rich, complex data, as opposed to meeting a potentially arbitrary predetermined number. They further suggest that some additional components of researchers applying thematic analysis to research should also include: the researchers' conceptualizations of data saturation as it is used in the paper and justifications of any numerical criteria used to determine data saturation.

This researcher is in agreement with providing increased transparency regarding how the participant pool and data saturation was determined for the study. The *a priori* participant pool was set at 28 to determine funding. Ideally, this would have meant 14 each from the low vision and blind communities. Interestingly, three participants declined compensation, permitting the inclusion of three extra participants. This leeway allowed the study to increase its diversity by including participants from additional continents and a wider age range.

Data saturation for the study utilized the common saturation definition of being the point at which new topics cease being mentioned. Attention was paid to identification and mention of new topics or topic areas during both the active interview and coding processes. New topics were brought up during interviews with lessening frequency through the mid-teens. Once the interview count reached the low 20s, this appeared to stop. Since the purposes of the research were, at least in part, exploratory, it was decided to continue conducting interviews through to the full 31 in case a new idea was mentioned in that span. When the funding cap was reached at 31 with only one additional code being identified, it was decided that the study had reached saturation and additional participants were not necessary.

One additional point regarding data saturation should be made regarding the low vision respondents. Throughout recruitment, an unexpectedly high number of respondents self-reported that they were blind. Low vision respondents were interviewed whenever they met the

criteria for participation in the study, but ultimately, only 12 of the intended 14 low vision participants were recruited. While this may mean that conclusions drawn from their interviews may not be as strong as those from the larger group of blind respondents, data saturation may still have been reached. Low vision respondents share many similar characteristics with members of the blind community and their interviews reflected that.

## Demographics

Ultimately, the participants themselves were heterogeneous even within the blind and low vision demographics, presenting a useful cross-section of their communities. Of the 31 people interviewed, 17 (54.8%) were male, 13 (41.9%) were female, and one was non-binary (3.2%). The age for participants ranged from 19 to 73, with a mean age of 40.5 and median age of 34. Within the groups, the low vision participants were slightly older than the blind participants, having a mean age of 47.7 and median of 50 versus the blind group's mean and median of 34.8 and 34 years old. For the levels of vision as defined by the study, 12 (38.7%) participants self-identified as being on the LV spectrum and the other 19 (61.3%) self-identified as being on the spectrum of blindness.

All of the participants reported using at least one form of assistive technology to access the internet, with most being familiar with two or more different assistive technologies. It was not uncommon for participants to utilize three different programs on a regular basis and two participants were familiar with more than four. The most common assistive technologies were VoiceOver (from Apple) on mobile phones (67.7%) and NVDA (from NV Access) on computers (48.3%).

The respondents in the study were geographically diverse as well, hailing from every populated continental region, with nine different countries represented altogether. The majority of responses were from North America, Canada, and the UK, which is unsurprising as the initial

outreach attempts were administered in the United States and the study was conducted in English.

When going online, 29 (93.5%) used a computer and 30 (96.8%) used a phone, with two (6.5%) participants using only a phone and one (3.2%) using only a computer. When going online with a phone, the majority of participants used iPhones (24, or 77.4%). However, this did not carry over into computer and laptop usage, with the reverse being true and 24 participants preferring Windows computers to Macs.

Over half of the respondents were employed, with 16 (51.6%) currently having jobs. Of those employed, eight (25.8%) worked in information technology-related positions such as coding, tech support, web design, or systems engineering. Five others and two from the IT group (for a total of 7, or 22.6%) worked in accessibility-related fields such as disability accommodation, website remediation, and accessibility education.

For more detailed demographic information, please see Appendix C.

## RESULTS & DISCUSSION

The initial results were drawn from reading the participant transcripts and identifying points where participants discussed encountering issues with sites they visited. Similar responses were grouped with each other and additional categories were created as new issues were reported by participants. As more issues were cataloged, individual issues were grouped together into broader categories when necessary. When possible, participants were asked to provide examples of websites containing the issues they reported. Ultimately, participants reported 31 different issues, which were grouped into 3 broad categories and 31 sub-groups (see Tables 3, 4, and 5 in the Results section and supplemental tables D1-D3 in Appendix D for additional information and examples provided by participants). Issues broken down by group

(blind and LV) are contained in the Discussion section on tables 6-14 and cross-referenced on Tables E1 and E2 within Appendix E.

## Overall Results

The following is a description and explanation of all issues reported by participants. The issues themselves have been grouped into three overarching categories: structure, content, and ads. Structural issues pertain to how the website is constructed and the mechanics of interaction with the site itself. Content-related issues deal with the information contained within the website and how that information is presented. Ad-related problems are related to ads specifically, or with content within a page that behaves similarly to ads. Within each section, the topics are discussed in the descending frequency with which they were reported, with the most frequently reported issues discussed first.

### Structural Issues

#### Layout Issues

Reports in this category dealt with various different layout problems encountered by the participants and often included elements of inconsistent design of pages within a website. Websites that had an inconsistent placement of buttons or elements from one page to the next, having too many clickable elements within a single page, or overall having a poor page layout were included in this category. As one participant described it:

*Sometimes there's like menu buttons that I don't... They take me forever to find, because they're not always in the top left or top right corner. All of a sudden, there's another on the bottom right. And yeah, I'm not even thinking about looking for it there. So, I'm like looking over the whole screen trying to figure out where there's something*

**TABLE 3. Summary of Structure-Related Website Issues (All Participants)**

Issue	Participants (n = 31)	Description
Layout	15	(1) inconsistent layout, (2) inconsistent placement of menu buttons, (3) too many different sections on the page, (4) too many clickable elements, (5) poor page structure
Labeling	11	(1) unlabeled or mislabeled buttons, (2) unlabeled or mislabeled links, (3) unlabeled or mislabeled fields, (4) unlabeled or mislabeled menus
CAPTCHAs	10	
Navigation	10	(1) elements cause SR to move unexpectedly (to the end, to random locations), (2) menu expands without notification, causing SR to get lost, (3) keyboard traps, (4) headings don't focus and user has to hit KB shortcuts repeatedly, (5) page refreshes and moves SR cursor to top, (6) removing functional tables
Security or Scam Concerns	9	(1) missing "About" information, (2) suspected unnecessary information gathering/asking for unusual PPI (3) alarming messages/pop-ups, (4) lacking two-factor authentication (TFA), (5) odd domain names, (6) unexpected/unusual file downloads
Overlays	5	(1) changes hotkeys for navigation, (2) may move content to different locations, (3) promotes feelings of segregation, (4) implies website doesn't know anything about accessibility ("participation trophy"), (5) implies website is lazy, (6) deposits tracking cookies
Missing or Misused Headings	4	
Broken Links or Buttons	3	(1) clicking on a link and nothing happens, (2) clicking on a menu and it doesn't load, (3) clicking on a radio button in a menu and there's no dropdown

Inconsistent Dialogue Boxes	3	Difficulty closing a pop-up dialogue box because the close button is: (1) not always in an obvious or consistent place (upper right), (2) appears to be missing (3) non-functional
Missing Landmarks	3	(1) large spaces without or absence of landmark headings, (2) placement of important elements not near any landmark elements,
No Attempt at Accessibility	3	
Slow Operation (site or SR)	2	
Visual-Only Notifications	2	(1) using color to highlight error fields, (2) representing things via color only, (3) dialogue box popped up without notification of an error, (4) new message appeared at bottom of page with no notification

*that I'm trying to get to. It's like, "Oh, it's over there," and I just didn't see it because it was not where I thought it would be.*

In these cases, VI users have issues interacting with web pages because the page does not follow common layout from one page to the next, altering where buttons for navigation may be placed or changing the location of transition buttons like "Next," "Back," or the Search field. Participants often complained that sites like these lacked cohesion or felt "cluttered."

*I hate websites where, on the home page, the menu is across the top. And then, when you click on one of the things, there's a menu on the left, and then when you click on another one, you know, there's like a menu across the bottom. You know, I cannot learn to use this website because it does not use any paradigms, right? It just does whatever it feels like.*

Other occurrences of this problem involved how blocks of text or tables might be integrated into a site. When done poorly, VI users with screen readers found these sites to be difficult to parse because screen readers would read across one line of text, resulting in half of a sentence from one block of text and half of a sentence from another.

*It doesn't know which order it should read that text. Like, it reads across several boxes together so you're getting, you know, the first four words of one sentence, and then the first four words of the second sentence, and the first four words of the third sentence. So, it's just, it's nonsensical.*

#### Labeling Issues

This category of issues related to a lack of labeling or mislabeled elements on a website. On sites, if an element is not specifically coded with a name (Next, Click Here, Index, etc.), then a screen reader (SR) will default to reading it as the type of element it is. If this occurs on a button, SR-users will have to guess what the element does when they click on it.

*(There are) times where links are just blank. They do things, but they just say "link link link link." They don't actually say what they are, so you just have to play explorer. You basically just have to go through the maze of links with your control enter and closing tabs like "Oh, that's what that does." It's kind of infuriating. Same with buttons.*

This aspect of labeling issues has connections to layout issues on websites as well. In other instances, labels for fields or elements are present, but are not placed relative to the element they're referencing. This can lead to issues when filling out forms because it may not be clear to SR-users what information is supposed to be entered into a given field.

*So, there might be this table of fields that maybe aren't necessarily labeled, or there might be a label, but the label isn't on the control itself. like the edit field itself. it might be on top of it, or below, it so then just trying to guess which field that label applies to. and also, when tabbing using a screen reader, if it's not labeled correctly, it'll just say "edit box, edit box." so then you have to get out of that edit box to figure out what it actually is that you're supposed to be typing in it.*

## CAPTCHAs

Problems in this category deal with any security measure that falls within the CAPTCHA family, among which are CAPTCHAs, reCAPTCHAs, and hCAPTCHAs. These are the security puzzles meant to deter bots or automated programs from interacting with sites and keep traffic that is human only. However, these tasks are often designed with only sighted users in mind and can prevent VI users from completing them unassisted.

*I was trying to get a report because I had some fraud or somebody stole my identity a while ago. and so, I went to the check systems website to see if anybody had opened any bank accounts and I tried to order the report online. I believe there was a CAPTCHA that had no alternative. There's no audio alternative. No, you know, any other alternative to that. So, I mean, you kind of hit a stopping point like you can't really move forward with that unless you find some eyeballs.*

Even in instances where the CAPTCHA has an audio alternative, there is still no guarantee that the security check will be accessible for VI visitors. In some cases, the audio alternative is "...so fast or the volume's so low or it's an unclear audio file that you can't understand it."

hCAPTCHA specifically makes claims that they will place a cookie on the visitor's computer, indicating that this particular machine has a VI user, and will be exempt from future



CAPTCHA verifications at the site. However, this has its own set of issues accompanying it. These cookies often require the SR-user to make security allowances in their browser that could result in unsafe browsing elsewhere on the web.

*CAPTCHAs, don't even, oh God, get me started on CAPTCHAs. So many of them have audio options which makes them better, but now there's this accursed thing called hCAPTCHA. It decides that they, that company, has decided that they are too good for audio options and they're just going to give you an accessibility cookie. Well, okay, but if you are a person with a cognitive disability who doesn't understand the directions on how to get an accessibility cookie or the account sign up process isn't digitally accessible, how is that going to work?*

So, in addition to the issues faced by VI users, hCAPTCHAs may be problematic for other groups as well.

### Navigation Issues

The general problem with navigation issues is that some element of the website actively disrupts the VI user's ability to move through either segments of the site or the entire site itself. It shares some similarities with layout issues as sometimes navigation issues are caused by layout issues. However, navigation issues tend to be more immediately disruptive to the visitor, whereas layout issues have a more generalized overall disruption to interacting with a site. For example, a specific issue reported by the participants was the occurrence of "keyboard traps." As one participant described it:

*So, of course, screen reader users navigate only with a keyboard. And so a keyboard trap happens when you're navigating through a website, you find an area of the website*

*where you get stuck, your keyboard gets stuck and you go in a loop, round and round and round and you can't get out of that area of the website.*

Keyboard traps occur when a website is structured such that keyboard shortcuts used to interact with the site do not function to move away from a particular section. Usually when this occurs, the only options available for VI visitors are to close out the page and start over or find sighted assistance to move them away from that section of a site with the mouse.

Another common occurrence in this category is the SR focus being forced to a different section of the website without the user's prompting. Often, this occurs when clicking on a link or other element on the site, but it can also happen unprompted by the user, such as when the page refreshes itself. As one user explained it, "Sometimes it happens that my cursor is brought to the end of the website, so I have to scroll back up again to navigate to the edit fields where I can put my information."

#### Security or Scam Concerns

This category addressed a number of different issues encountered by participants on sites, all related to their concerns about the security and legitimacy of the site in general. In some cases, participants felt that a site's security or authenticity were questionable when it did not contain an "About" section with information about the website's purpose, lacked two-factor authentication for transactions, or when forms asked for an unusual level of personal identifiable information (PII). Other reports were tied to activities that seemed to cast the website in a suspicious light, such as requesting an unprompted download of a file or having an unusual web address that may not be secure.

## Overlays

Overlays on a website are an additional layer of code applied to a website that directs VI users to utilize it when they visit the site. These overlays can be problematic because the overlay may rearrange sections of the website, or alter the way a screen reader functions on the site.

*Oftentimes, these overlays cause more problems than they do good. So, say you have two people, one of them is using JAWS, one of them is using VoiceOver. An overlay is going to send them both into screen reader mode, but those two screen readers don't navigate web pages in the same way. So, it's that whole idea of not all screen readers are created equal and the overlay AI has just assumed they are.*

There are also certain attitudes among VI users when encountering overlays. Depending on the individual, an organization with a site overlay could be seen as making an attempt at accessibility (“*Oh, it's you know, like they get an “e” for effort.*”), but they could also be seen as being clueless about it as well.

*This website has a system for assisting blind and visually impaired. Press Control + F10 to enable it.” Like oh god. They think this is how accessibility works which means they probably didn't try and they're just relying on this stupid overlay to actually do things for them. And sometimes it helps, and other times it doesn't. So, I'll try it, but who knows, right? Half the time, the funny thing is, half the time they add them and they don't actually even need them because their site's fine, but someone clearly convinced them they need it.*

Even further, sites with overlays could be seen as promoting a “separate but equal” site experience for visitors, ultimately leaving VI users with a bad aftertaste for the experience.

*It's segregation, isn't it? You're saying, "You're not capable of using what the main customer base is using, so we've given you a special door. And go through this one, you'll be looked after differently." As a programmer myself, I know there is no need for that. I know that websites don't need to be designed that way.*

Some overlays also share a similarity with some CAPTCHAs in that they will embed a cookie on the visitor's system without their consent, marking them as a VI user. In some cases, this cookie will change the user's screen reader settings without their consent when visiting the site in the future.

#### Missing or Misused Headings

On a website, headings denote different sections and subsections of the site, similar to how a restaurant menu is divided into appetizers, entrees, and desserts, with the entree section being further divided into types of entrees. When considering that screen readers format the entirety of a website into a large column of text, headings allow an SR user to locate and jump to portions of a site that may be more relevant for their visit. When headings are missing, or misused, SR users may be unable to locate relevant information or need a much longer period of time to find a specific section.

*To get to where you choose all the options for the filters, like how many stars and what manufacturer? Well, there's no separation of like headings or anything between the sections. So, you just kind of have to scroll your way through the whole brand list to get to the price thing. Whereas, if there were headings between them, you could just jump*

*between the different filter sections. Like, I could go, “Okay, well I want to go choose how many stars minimum, and now I want to go to choose the brand, and now I want to go to choose the price” and you can't do that easily because they're all smooshed together. Just a bunch of checkboxes, radio buttons, and edit fields.*

## Broken Links or Buttons

Broken items on a page are one of the few problems that would cause almost as many issues for a sighted visitor as a VI one. These occur when the visitor attempts to interact with an element on the page and nothing happens. It could be a menu that doesn't load, a menu that is supposed to open a dropdown and doesn't, or a link to another page that doesn't load. In many of these cases, there is no notification that the element is broken, so VI users must spend time figuring out that the element is broken, then devise workarounds to proceed that don't involve the element in question. If this happens on something like radio buttons in an online form, VI visitors may not know why they cannot proceed until receiving an error after attempting to submit a form, if they receive one at all.

## Inconsistent Dialogue Boxes

Dialogue boxes themselves can be disruptive to SR users as they prevent forward progress until the box is closed. This issue is exacerbated when it is difficult to locate how to close the boxes. If the closeout button is placed in a non-standard spot (in the lower left instead of the upper right of the window, for example) or appears to be missing altogether (such as being attached to a timer before the closeout button appears), SR users may be unable to locate it. When this happens, they may decide to abandon the site altogether if sighted assistance isn't available or practical at the time. The experience is made worse when clicking on the closeout buttons doesn't appear to work. One user said of this issue, “Dialogues you

can't close because the close button doesn't freaking work? Like, what do you do then? I don't know. Pray?"

### Inconsistent Landmarks

Similar to headings, landmarks are code embedded in a webpage that indicate where different sections are, such as headers, footers, or sidebars containing complimentary content to the main body of information. When these are placed in a logical fashion, such as at regular intervals or next to their corresponding contents, SR users can utilize them to navigate throughout a page quickly. However, many pages sprinkle landmarks haphazardly throughout the page, disrupting an SR user's ability to regularly move through content. One participant mentioned that "It happens a lot with websites of other shopping websites. When you just click through items, you're gonna get these spaces, redundant elements, between those items." The flipside of this is a website forgoing including them altogether, resulting in content feeling stranded out in space without a reliable way of accessing it.

### No Attempt at Accessibility

This problem is often a result of many other issues combined, resulting in a website that is largely or wholly inaccessible to VI visitors. The time needed to interpret a site with no accessibility features increases dramatically. Thus, when visitors feel that not even a rudimentary attempt has been made to create an accessible website, they are more likely to leave the site and never return.

### Slow Operation

Long loading times on a site is something that VI users have historically been more patient with as they often require more time to parse a website. It could manifest as either a website whose elements are slow to load for the screen reader to scan or as the screen reader itself only reading a small number of words at a time. Regardless of the origin, it is important to

note that SR users could be encountering this issue for a number of reasons and not all of them are a result of a website's design. It could also occur as a result of network connectivity or settings within the screen reader itself.

### Visual-Only Notifications

An issue that is more common on websites with form fields is that notifications of missing or incorrect information will only display via a highlight on the relevant field or through a dialogue box with no notification to the screen reader. When this happens, the VI visitor is left guessing why they're unable to proceed, where the error might be, or if their commands to continue have even been received.

### Content Issues

This family of problems contains one smaller category, that of information issues. These are all problems that relate to the information contained within a website, thus firmly placing them within the content category. However, they are distinct enough from each other that a single group is not sufficient to cover the breadth of problems present.

### Graphics

Graphics pose one of the largest hurdles for VI visitors on sites as there are a number of things that can go wrong when including them. The most common issues are poor alt-text, or images missing alt-text altogether. When this occurs, the images often have either the basic file names included for describing the image content, or a string of random numbers and letters.

*Sometimes they do this where they'll have some kind of default alt-text that's just a series of letters and numbers that are absolutely impossible to like understand or get to grips with. That's really frustrating because if it's off, if I go onto the image and I think it's something important, I'll have to go through all of those letters and numbers just to find*

**TABLE 4. Summary of Content-Related Website Issues (All Participants)**

<b>Issue</b>	<b>Participants (n = 31)</b>	<b>Description</b>
Graphics	12	(1) missing alt-text, (2) poor quality alt-text, (3) pictures of text, (4) excessive amounts of graphics
Information - Poor Information Quality	9	(1) unverifiable claims, (2) unreliable sources, (3) hyperbolic or overinflated claims, (4) no information sources listed
Solicitation	8	(1) paywall pop-ups, (2) prompts to sign up for emails/newsletters, (3) requiring an account before being able to access information
Poor Color Schemes	6	(1) bad color combinations, (2) bad text/background color combos, (3) bad backgrounds
Information - Overt Bias	6	(1) inflammatory speech, (2) over politicizing
Poor Grammar or Spelling	6	
Inconsistent Support	5	(1) support without accessibility training, (2) support denying problems, (3) support not listening, (4) communication issues
Information - Hard to Find Contact Details	5	(1) absent or hard to access contact information
Text & Font	5	(1) lots of ASCII characters, (2) small fonts, (3) AJAX content
Information - Burying the Lede	3	burying pertinent information or making it otherwise hard to find
Information - Unprompted Information Presentation	2	irrelevant information presentation
Transcripts for Non-voiced Videos	2	videos with only music and embedded (non-readable) text
Reputation or Word of Mouth	1	



*out that it's actually an image of nothing useful that I can interact with. So, that's really irritating.*

This can also happen when sites include pictures of text. For example, commerce sites that include a picture of a schematic for a product, or a picture of a list of features. These pictures alone can result in meaning and context being lost for VI visitors. If this is combined with the same image lacking appropriate alt-text, the problem compounds. In one example given by a participant, “Down at the bottom of the web page was a picture, I guess, or sort of an icon that gave a phone number within it, but that was inaccessible because it was a picture of a phone number.” Even one step further than that, sites with a large number of pictures on them pose significant problems for SR-users, all of which is worsened if any of the previous problems with graphics are included.

#### Information Issues - Poor Information Quality

The quality of information contained within a site is not immediately apparent for VI visitors. Some things that may stand out to sighted visitors and provide clues (outdated designs, clashing colors, or grainy gifs, for example) will not necessarily be apparent to a VI visitor. So, they must explore the site a bit before these problems are identified. Largely, they consist of problems with the quality or rigor of information being presented. This may mean that claims being made are difficult to identify or are wildly hyperbolic.

*When I read, “Cure in seven days!” for a disease that’s been around for hundreds of thousands of years and somebody is saying cure? Give me a break! I mean, come on. If that were true, there would be no diabetes because it would have been cured 10,000 years ago... Like I may have said to you about finding what was clearly a scam about*

*diabetic cures, they were obviously a scam and you could tell that from the way it was written.*

It can also occur when the sources listed for information are suspect or considered to be unreliable.

*If I get to a website and find exaggerated or unfounded claims that are linked to, like if I got to a website that cited Breitbart as a source? I would probably block that site.*

#### Solicitation

Some sites include pop-up windows requesting that new visitors subscribe or sign up to receive content from the site in the future. VI users find this type of solicitation particularly frustrating as it can also tap into the issues with closing pop-up windows, as mentioned in the structure section. Beyond that, they find these messages frustrating to encounter. “Immediate solicitation. So, I hate websites where you start, you're about to read something, and you get a pop-up saying “Sign up for this!” or “Join our newsletter!” or something intrusive.”

This kind of issue also occurs with sites containing paywalls. There are times where the paywall might be mentioned peripherally (or not) on the site, and the notice goes unseen by a VI user until they are much farther along in the information-gathering process. This results in hitting a figurative wall in terms of progress.

*I don't understand how I'm supposed to do research on some things from authentic sources, from good sources, reliable sources, peer-reviewed sources, yadda yadda. But then, I'll go look for them and then I find out I can only read the abstract or a paragraph. And then, I have to pay for something? Or pay for a subscription to a database or*

*whatever it is. And I'm like, "Why did I?" I hate that I had to go into four menus deep to figure this crap out. Could you not have just told me?*

## Poor Color Schemes

Any time a site chooses to utilize colors or combinations of colors that make it more difficult to read the content of a site, this issue comes into play. It could be the result of a busy background that makes it difficult to separate out the text.

*There were sections of the account page, the background of that, of the whole website was like, starry cosmic sky. It looked real pretty and cool, but it was mostly dark. So, it's not as multi-colored as you might think. Sprawling colors. It was more dark-colored, but the text... It was a really dark blue background and it's not just picking on the blue. It's like, "What?? You have normal eyesight and I feel like you should know this is crappy!"*

This can also happen due to a combination of bad choices made about both the text and background colors. Depending on the intensity of the colors, even normal black and white can become problematic.

*The other thing they do with that is they do them in wild colors. So, they might have the instructions in a very pale green with a bunch of pink around it or whatever. So, like I said, color issues for me. I actually should be about better black and white. Basically, because my eyesight is, I'm kind of colorblind, too, actually. I have that issue as well. So the way they have the background and the foreground, as far as the print and text on some of them, makes it really impossible to see.*

## Information Issues - Overt Bias

Biases in information are related to situations where the bias is readily apparent or obviously influences the content included in the website. Most often, these biases are political.

*As soon as I see a political ax to grind or trying to paint a political opponent in a bad light, that right there tells me the information that I'm getting? It's not trustworthy.*

This category shares some overlap with poor information quality as a strong bias can sometimes result in a decrease in the information quality of a site. When this occurs, both issues are present within the content of a website.

## Poor Grammar or Spelling

Screen reading programs convert written text into audible speech, so poorly written content may be more readily apparent to the VI visitor. The occurrence of these issues is often taken as a sign of overall poor quality on the website, leading VI visitors to turn elsewhere for their information.

*For example, on newspaper websites, journalists who write content and write copy. I haven't seen a day go by where a newspaper article has had a piece of alt-text without a misspelling in it somewhere because they don't see it after they've clicked the button to add it in. It's not part of their cycle anymore.*

## Inconsistent Support

VI visitors often get frustrated when needing to deal with the teams supporting websites. Whether this is via phone, email, or on-site chat functions, they frequently run into issues where

the support agents do not know how to answer accessibility-related questions, or ignore the specifics of their questions altogether.

*When you email support personnel about the inaccessible websites, they're like, "What do you mean inaccessible? I don't know what that means. What do you mean a screen reader? I don't know what that is," because tier one support often never knows these things.*

The result of these interactions is that the VI visitors feel ignored and a frustrating situation they were attempting to seek assistance with becomes even more frustrating.

#### Information Issues - Hard to Find Contact Information

Sometimes, even getting in touch with support or an organization is a battle in and of itself. If contact or accessibility information for a site is difficult to locate on a webpage, possibly buried several layers deep, VI users are unable to get assistance for issues they're encountering or let the organization know about the issues they've had so that they can be remedied. In these cases, a lack of upfront presentation of contact information can lead VI visitors to other sites that are more willing to assist and receive feedback.

*No accessibility link? As in no contact if anything goes wrong? So, clearly, they don't give a crap. You know, it's usually at the bottom or in the About section. Sometimes, I look for the About section to see if there's an accessibility statement. They're usually boilerplate and don't actually mean much, but at least if it's there, then you know they at least kind of care.*

## Text & Font

Issues with the font or text on a website often go hand in hand with the color schemes on a site as it seems more likely that a site with a poor background or color scheme will also choose a poor font for the text on the site itself. These issues happen when the font is hard to read, such as when the font itself is too small or too elaborate, making it harder to read. For example, “If it's like really dark small font, if it's hard for me to read, then I might just like skip over that one because I just don't want to deal with it.” Small print can be adjusted by increasing the font size within the page itself by the user, but this method is not consistent as sometimes, this results in only a single word per line, or part of a single word in the case of longer words. This issue can also occur if a page contains a large number of ASCII characters, which are often used to create pictures. For example, the shrugging emoji “\\_(ツ)\_/” uses ASCII characters. Similarly, a full page of such symbols might produce a complex graphic decipherable to a sighted visitor and be meaningless to a VI one. While a sighted visitor will almost instantly see the arrangement of symbols, a screen reader will announce each symbol individually, making the entry seem like gibberish.

## Information Issues - Burying the Lede

VI users are also more heavily impacted when the salient points of a website are buried within the body of text on a site. An article or site with a relevant-sounding title may prompt a VI user to visit, but then they have to figure out where the information they actually want is. Being unable to quickly scan the page for relevant keywords like a sighted user, they must rely on the headings and landmarks within the site to navigate around. Essentially, they skip to random bits of text and hope that it will be part of the content they are looking for. If the structure of a site is not well-thought out and has missing or misused elements, finding buried information is akin to looking for a needle in a haystack.

## Information Issues - Unprompted Information Presentation

Unprompted information issues usually occur on shopping websites. The VI user will be searching for a particular item, then receive other, unasked for and unprompted search results unrelated to what they are trying to find. When this issue arises, it disrupts their search as the results can sometimes take the form of a pop-up window that they need to close and then reacquire their place on the page they'd been browsing before. Even when the results occur within their current page, they can sometimes be disorienting because they clutter the page and make it more difficult to find related results.

## Transcripts for Non-voiced Videos

Videos on websites can pose a special hurdle for VI visitors. If a video has only on-screen embedded text, screen readers cannot pick up this content and relate it to the SR-user. In these cases, a transcript of the video, including the text and describing what is happening during the video, is required for VI visitors to receive the video's information.

## Reputation or Word of Mouth

Some VI users will refrain from visiting sites until they have received feedback about it from other visitors. In this situation, it may be that they wish to know if the site is accessible before spending (or potentially wasting) any time on it, or that the site is likely to have content they're seeking.

## Ad Issues

Issues in this category are unique in that the problems they cause are also caused by non-ad-related content being presented in the same manner. However, whenever these problems were mentioned, they were first and foremost brought up in the context of ads behaving in these ways. Additionally, issues in this category are heavily exacerbated by

concurrent problems from other categories. Automatically playing ads are made worse by a lack of navigable elements on the page in order to locate and halt the offending promotion. Pop-up ads are several times more aggravating if they also contain auto-playing content or have difficult to locate close buttons. In this way, ads presented a unique set of problems that are problematic in and of themselves, but are often far more of an issue resulting from poor design choices made in other areas.

### Auto-playing Content

Auto-playing content occurs whenever a website contains some media that plays without the visitor's consent. This could be audio, video, or some combination of the two. This disrupts VI visitors as the volume of this type of content often overrides that of their screen reader, preventing them from hearing where their screen reader focus is on the page in order to shut down the offending media.

*If you go onto a page and it just starts playing a video. I really hate that as well. That's so annoying because you're trying to navigate through a page, and then suddenly you'll have this corporate video playing. It is honestly so annoying, and you can't stop it either. You're just... oh, it's awful. And also, sometimes it's so loud that I can't even hear my screen reader if it's playing.*

These kinds of occurrences, even if they don't entirely override the screen reader's narration, can interrupt it instead. This leads to a different type of frustrating problem as the VI visitor tries to locate the interrupting audio, but even the feedback of trying to find it gets interrupted.

*Sometimes, you see a little ticker that's like, "I will end in 30. I will end in 20. I will end in 10." Like, it interrupts itself. Especially on iPhone. It's like, I really wish the ad would just*



*shut up about it ending. And then, I can't read because it keeps interrupting my screen reader's speech. Oh, that one's bad. Especially on recipe websites for whatever reason. "I have one—thirty, twenty-nine, twenty-eight, twenty-seven." That's like, oh my god. It's the worst.*

**TABLE 5. Summary of Ad-Related Website Issues (All Participants)**

<b>Issue</b>	<b>Participants (n = 31)</b>	<b>Description</b>
Auto-playing Content	11	automatically playing ads, music, or video
Excessive Amounts of Ads	10	(1) high density of ads, (2) high frequency of ads
Pop-up Ads or Windows	10	(1) pop-ups that are not announced, (2) pop-up ads that pull the cursor away from the main content, (3) pop-ups that occur every time at a certain point on a website
Interstitial Ads or Elements	5	dynamic content inserted into text blocks such as ads, video, embedded Twitter links, or live feeds
Carousel Ads or Banners	3	ad or site content banners that periodically change appearance

#### Excessive Amounts of Ads

This problem is harder to quantify, as there is no objective measure of how many ads on a website is too many. However, since ads often cause screen readers to behave erratically, density and frequency of occurrences on a site can both affect VI visitors feeling that this problem has happened. As one participant stated that “There's no need for like four or five ads in a three-paragraph article.” Three to four ads on a page may not seem like a large number, but if the ads are encountered in such a way as to disrupt navigation, getting interrupted that many times in a short period of time can be a larger issue.

*I try to avoid sites with lots of ads. I will occasionally use ad blockers, but ads in general are kind of a pain. Especially on mobile, sometimes on both platforms. The screen reader kind of likes to jump around when they encounter ads and it makes it very difficult to get past them.*

## Pop-up Ads or Windows

Problems in this group tend to disrupt browsing in three different ways. First, If the pop-up windows are not announced, content may be blocked without the VI visitor realizing it. This can lead to confusion when the screen reader begins reading out the ad and the user hears the sudden shift in content. Other times, it may pull the screen reader's focus away from the content a visitor was browsing, immediately disrupting what they're trying to do. Ads initiating in this way may often have a difficult to locate closure button, which can abruptly halt navigation through the site.

*What happens a lot of the time is there'll be pop-ups that I can't close because there isn't like a definitive close button. So there'll be a part of the page that I need to access, that's blocked by this pop-up that I can't close... Those are really big for me because on the mobile experience, they're non-starters, really. There's not really much I can do oftentimes to kind of, to negate those being big issues. They kind of render a lot of websites unusable for me.*

These windows popping up can also block content if they occur at specific points within the website consistently. If they open at particular points, this may render the content past them inaccessible, meaning that VI visitors wishing to continue either have to give up if the window is not closable, or to proceed with extreme caution.

*Sometimes, you'll be scrolling down the page and some stupid dialogue pops up and you have to close it. And every time you get to that point on the page, it pops up again. So, you either have to go to the bottom and go up, or you just have to like try to skip over it with your element skip keys and just slowly approach the information you actually need while being constantly terrified that the dialogue's going to pop up like a wild animal.*

Pop-up windows may also be combined with solicitation requests, often when visiting a site for the first time, resulting in a negative first impression for VI visitors who have not even gotten to the contents of the site before being bombarded with requests to be sent further information.

#### Interstitial Ads or Elements

Given the multiple different ways that ads or other unrelated content on a website can disrupt the VI visitor's browsing experience, interspersing them between segments of content is equally as disruptive. Even when coded correctly, this is content that was not asked for or requested, interrupting the visitor's purpose for being on the website and causing it to take longer. This is all assuming that the interjected ad or other content is coded correctly.

*One of the ones that bugs me a lot nowadays is news articles where they've embedded tweets into the article instead of actually writing an article. You spend nine years trying to scroll through the damn "Twitter. Embedded Twitter" portion. Where, because the whole tweet is there, interactable with everything from "View all the replies," "Reply to this," "Like," "Retweet." You spend nine years of scrolling through those and I have not figured out a quick way to skip past them because they themselves aren't formatted properly. So even when you do everything you would do to skip past like an ad, you can't. Like skipping to just the next paragraph just lands you into the text in the tweet itself because*

*it's not formatted right. A lot of websites do that, too. They embed like a live feed of something. It's just like, "Oh, okay. Please stop doing this."*

## Carousel Ads or Banners

Carousel functions are pieces of website content that have multiple different images or videos that automatically change after a set period of time. These prove disruptive to screen readers because oftentimes, the change in content on the website refreshes the page without the SR-user's consent, abruptly pulling them from where they were browsing on the site back up to the new content on the carousel ad. Other times, the entire contents of the carousel ad will be read aloud by the screen reader, making it difficult to get anything done on the website. Even when a carousel banner does not auto-scroll is present, this type of content can still be problematic. If the screen reader does not recognize that there is additional content in the banner, the presence of the carousel banner and the additional contents may not be communicated to the VI visitor.

## Discussion

What follows here is a further exploration of the issues reported by participants. It looks at the entire list of issues reported, along with some comparisons and differences present in the results. Then, each group is considered separately, discussing the top third of reported issues from both the blind and LV groups. This breaks down to 10 issues for the blind participants, comprising 73 (61.3%) of the 119 issues they reported, and eight issues for the low vision group, containing 37 (52.8%) of the 70 issues reported by those participants. Then, the findings are evaluated in the context of coverage by the current WCAG guidelines. For the full lists of issues for each section, please see Tables E1 and E2 in Appendix E.

## Combined Results

Of the 31 different types of issues reported, 24 were reported by both groups, with only seven being unique to one group or the other. This indicates that the two groups share a large amount of shared experiences when browsing online. Amongst the issues themselves, the 31 issues could be sorted into three main groups: high, moderate, and low frequency, followed by separate sets for skewed and unique issues. This categorization does not indicate the severity of disruption or the impact on the VI user experience (UX) caused by the issues and instead indicates the degree to which each group of participants reported each issue.

When viewing the combined results after they are broken into groups, four issues show a high frequency of reports from both sets of participants. Each of these issues were reported by at least 30% of both groups, often more, indicating that these are the key issues both groups are encountering. In order of frequency, they are: layout, auto-playing content, labeling, and excessive amounts of ads. These high priority problems are split evenly between structural and ad-related issues. All four issues interfere with or stop a VI visitor's basic interactions with a site. Layout and labeling impede traversing content directly, resulting in delays and backtracking at best, or making focused interaction with a site impossible at worst. Both of the ad-related issues make it difficult to locate relevant information by cluttering up a page or making it difficult to hear what information is present.

Issues of moderate frequency tended to be slightly more prominent in one group than the other. Overall, the frequency of the issue being reported in each group tended to be 20-25% or greater from both groups. Issues in this category were CAPTCHAs, pop-up ads, poor information quality, security or scam concerns, and solicitation requests. The five issues in this group were more evenly dispersed between the three categories with two structural issues, two content issues, and one ad issue. These problems were also considered to be of moderate severity because only one of them typically resulted in outright halting interaction with a website

**TABLE 6. Combined List of Ranked Issues**

<b>Issue</b>	<b>Participant %</b>	<b>Blind %</b>	<b>Low Vision %</b>	<b>Participant Count</b>	<b>Blind Count</b>	<b>Low Vision Count</b>
Layout	48.3%	47.4%	50%	15	9	6
Graphics	38.7%	52.6%	16.7%	12	10	2
Auto-Playing Content	35.5%	36.8%	33.3%	11	7	4
Labeling	35.5%	36.8%	33.3%	11	7	4
CAPTCHAs	32.3%	36.8%	25%	10	7	3
Excessive Amounts of Ads	32.3%	31.6%	33.3%	10	6	4
Navigation	32.3%	47.4%	8.3%	10	9	1
Pop-up Ads or Windows	32.3%	36.8%	25%	10	7	3
Information - Poor Information Quality	29%	31.6%	25%	9	6	3
Security or Scam Concerns	29%	21.2%	41.7%	9	4	5
Solicitation	25.8%	26.3%	25%	8	5	3
Poor Color Schemes	19.4%	-	50%	6	0	6
Information Issues - Overt Bias	19.4%	10.5%	33.3%	6	2	4
Poor Grammar or Spelling	19.4%	21.2%	16.7%	6	4	2
Interstitial Ads or Elements	16.1%	15.8%	16.7%	5	3	2
Inconsistent Support	16.1%	10.5%	25%	5	2	3
Information - Hard to Find Contact Details	16.1%	10.5%	25%	5	2	3
Overlays	16.1%	21.2%	8.3%	5	4	1
Text & Font	16.1%	5.3%	33.3%	5	1	4
Missing or Misused Headings	12.9%	21.1%	-	4	4	0

Broken Links or Buttons	9.7%	10.5%	8.3%	3	2	1
Carousel Ads or Banners	9.7%	15.8%	-	3	3	0
Inconsistent Dialogue Boxes	9.7%	10.5%	8.3%	3	2	1
Information - Burying the Lede	9.7%	5.3%	16.7%	3	1	2
Missing Landmarks	9.7%	15.8%	-	3	3	0
No Attempt at Accessibility	9.7%	10.5%	8.3%	3	2	1
Information - Unprompted Information Presentation	6.5%	5.3%	8.3%	2	1	1
Slow Operation (site or SR)	6.5%	10.5%	-	2	2	0
Transcripts for Non-voiced Videos	6.5%	5.3%	8.3%	2	1	1
Visual-only Notifications	6.5%	10.5%	-	2	2	0
Reputation or Word of Mouth	3.2%	5.3%	-	1	1	0
Total Issues Reported				189	119	70
Issues Reported per Participant				6.09	6.3	5.8

**Total number of participants, n = 31; blind participants, n = 19; LV participants, n = 12**

- CAPTCHAs. The other issues in this group, while certainly frustrating, time-consuming, or concerning, did not necessarily make interaction impossible. Particularly in the cases of information quality, security concerns, and solicitation requests, the presence of these issues on a site may make a new VI visitor doubt whether spending time on the site is worth the effort, but it is still an option for them to continue.

Lower severity issues were those that were often reported by at around 10-15%% of each group, with some issues falling below 10% of a group reporting them. These issues tended to be favored by one group over the other, but not to as extreme of a degree as the skewed issues. Similar to the medium frequency issues, this group had an equal number of both structural and content issues accompanied by one ad issue. The low frequency issues contained seven of the 31 reported problems: poor grammar or spelling, interstitial ads or elements, broken links or buttons, inconsistent dialogue boxes, no attempt at accessibility, unprompted information presentation, and transcripts for non-voiced videos. The issues affect the UX of VI visitors at three increasing levels of severity. Poor grammar or spelling and unprompted information may make a site seem amateurish, leading the visitor to lose interest. However, they do not impede exploring content, merely decrease interest in it. Next, interstitial ads or elements and inconsistent dialogue boxes break the flow of a visitor's experience on the site by requiring them to interact with an unwanted element which may possibly prevent them from progressing. This is not guaranteed to occur, but is a definite possibility. Finally, sites that don't make any attempt at accessibility, fail to include transcripts for videos without voice narration, and broken links or buttons often halt interaction entirely. These issues generally mean that the VI visitor will not be able to move forward and need to either retrace their steps or try a different site altogether.

Next are the skewed issues, of which there were eight in total: graphics, navigation, overt bias, inconsistent support, hard to find contact details, overlays, text and fonts, and burying the lede. Skewed issues occurred when the reports of an issue were very



disproportionate between the groups. One group would report an issue at a rate several times more often than the other, often two or three times more frequently. Due to the sample sizes, this resulted in disproportionate percentages of reporting. It is also important to note that many of the problems falling into this category only had one or two people reporting them. However, this does not necessarily indicate a lack of importance of the issue overall and could instead be indicative of a lack of salience for other participants. A future study could evaluate this by presenting the full list of issues to VI participants and having them ranked. There was a certain method to the skewed issue occurrences for those with higher numbers of respondents, namely graphics and navigation. For example, it made more sense that the LV group reported issues with graphics or navigation less often than the blind participants. The LV participants have additional routes of resolving these issues, so they do not arise as pertinent problems as frequently. The inference that can be taken away from the issues in this category is to pay more attention to the cumulative number of reports rather than whether the issue is a problem for both groups or not. Again looking at graphics, a low number of LV participants (two) having issues with these compared to the number of blind participants reporting it (eight) does not mean that the issue is one of lesser importance because it only affects one group. Quite the opposite. It is the fact that the issue is *so heavily* reported by one group means that it should be addressed.

Lastly, there were seven unique issues. These occurred when only one group of participants mentioned them as being problems. This doesn't mean a unique issue brought up by the blind participants could never be a concern for the LV participants or vice versa, however. It is only that it was not brought up by the participants participating in this study. The unique issues will be discussed below in the sections specific to each group.

#### Content vs. Structure

Overall, the distribution between the structure and content were relatively balanced. Structure issues comprised 13 different sets of problems and made up 80 (42.3%) of the 189

issues reported. The other side, content, also had 13 issues that were 70 (37%) of the total issues participants mentioned. Within the frequency groupings (low, medium, and high), content and structure were often evenly matched. The exception there is that the four issues falling into the high frequency grouping included no content issues, only structure and ads. The presence of structure and content issues were less evenly distributed within the skewed and unique issues, which were opposites of each other. Skewed problems had more content issues, while unique problems had more structural issues. The implications of this are unclear and may need to be examined separately at a later date.

### The Problem with Ads

All of these findings bring us to ads. Ads posed a particular issue for the participants in this study and for the researcher when considering the results. On one hand, they would appear to be content on a website because they contain information that is presented to visitors, whether they want it or not. On the other hand, when ads are placed frequently within a site, in amongst desired content, they begin to change how visitors are forced to interact with a website to accomplish tasks. In this way, they could be considered to transition to structural components at some point.

Consider an example of a small site that needs ad revenue to continue operating. There may be a banner at the top that periodically changes content, maybe one of the ads it flashes through plays a short commercial for the product being advertised before changing to the next. Then, there is a small rectangular ad along the side, advertising a different product, and another ad or two could be placed strategically between paragraphs of text in an attempt to catch the eye of visitors reading through the page. Down at the bottom of the page, there's one more ad for visitors who have finished reading the text. This short example is easy to conceptualize, most people have certainly encountered a website with some permutation of the examples present, and yet, it also depicts the problem with every ad-related issue reported by the

participants in this study. The banner ad redirects the screen reader, interrupting flow. When the auto-playing commercial starts, the volume overrides the dictation or requires the VI visitor to stop what they're doing and figure out how to halt the noise. The ads included in between paragraphs of the main body of text are read out by the screen reader, interrupting browsing yet again. Ads on the side may also be interpreted as part of the main body of text, making otherwise understandable prose nonsensical. Then, after finishing, where the VI visitor might be expecting links to additional content or pages of the site, there's another block of ad content. In these ways the additional content has become a structural impedance.

So, when attempting to examine whether content- or structure-related issues were a bigger issue overall, ads are problematic. They straddle the line between content and structure, arguably falling into either category. Problems resulting from them also occur with such frequency that classifying ads as either structure or content would immediately position that category as being the most problematic overall. Ads contained only five different issues, but 39 (20.6%) of the total issues reported. They also cause large amounts of disruption to VI visitors in an assortment of different ways, meaning that they cannot simply be ignored.

## Separated Results

### Blind Users

For blind users, the most serious issues are structure-related. With four problems in the top ten, having been reported as issues 43.8% of the time (32 occurrences), this category beats both content-related problems and ad-related issues. The remaining two categories were both reported a similar number of times and had three issues appear within the top 10 most-reported problems, with content having 21 total reports (28.8%) and ad-related issues having 20 total reports (27.4%). This indicates that problems with the inherent design of sites poses the biggest hurdle to blind visitors being able to access the content.

**TABLE 7. Blind Participants' Most Frequent Website Issues**

<b>Issue</b>	<b>Participants</b>	<b>Participant %</b>	<b>Issue Category</b>
Graphics	10	52.6%	content
Layout	9	47.4%	structure
Navigation	9	47.4%	structure
Auto-Playing Content	7	36.8%	ads
Labeling	7	36.8%	structure
CAPTCHAs	7	36.8%	structure
Pop-up Ads or Windows	7	36.8%	ads
Excessive Amounts of Ads	6	31.6%	ads
Information - Poor Information Quality	6	31.6%	content
Solicitation	5	26.3%	content
Total Issues Reported	73		

***For blind participants, n = 19***

Taking a closer look at the reports, blind users are most frustrated by issues that either obscure access to content or prevent them from accessing it entirely. Layout and navigation issues can obscure content, making it harder to access and more time consuming. The same can be said of solicitation attempts and excessive amounts of ads. These are all hurdles that must be circumvented in order to get to the desired content of a site. Poor information quality is a method of obfuscation in and of itself, as a site not including high-quality, up-to-date information makes it harder to answer questions or complete tasks.

Graphics can block access to content entirely if they lack alt-text or are pictures of content on the site. When many graphics are included within one page, there end up being large swaths of the site that become unintelligible. There is only so much information that even well-constructed alt-text can convey in a meaningful manner. Additionally, CAPTCHAs, often

composed of graphics as well, can completely halt progress through a site if there is no sufficient audio equivalent, effectively bringing navigation through a site to a dead stop.

*I think because the alt-text isn't visible to the sighted, you put it in, you've done your good deed for the blind people, and then people forget about it...the sighted web developer, they will say, "Oh, it's for blind people." And so, because it's not seen as something they need to use, it's got short shrift.*

Additionally, any of these issues can cause both obscurement and blockage of content at the same time. For example, when labels are missing, this *can* be worked around, with an increased investiture of time. However, if it occurs with sufficient density, navigating a site becomes mere guesswork and meaningful access to content ceases. The same can happen with auto-playing content or pop-up windows. Their mere presence obscures content on a site, as VI visitors are delayed and must figure out how to bypass them. When they occur on every page, or multiple times within the same page, navigation again comes to a halt until they are resolved.

#### *Blind Users - Unique Issues*

There were six different issues reported that were unique to blind participants and not mentioned at all by LV participants. All told, they accounted for 12.6% (15) of the total number of issues reported by the blind participants overall.

Many of these issues may not have been reported by LV participants as the issues are more disruptive to visitors solely using screen readers with no visual access to fall back on. Missing headers or landmarks are problematic when you need them to navigate through a

**TABLE 8. Issues Unique to Blind Participants**

<b>Issue</b>	<b>Participants</b>	<b>Participant %</b>
Missing or Misused Headers	4	21.1%
Carousel Ads or Banners	3	15.8%
Missing Landmarks	3	15.8%
Slow Operation (site or SR)	2	10.5%
Visual-only Notifications	2	10.5%
Reputation or Word of Mouth	1	5.3%
Total Unique Issue Reports	15	

***For blind participants, n = 19***

website on a basic level. However, a visitor with a small amount of vision can still see text on the page that a sighted visitor would recognize as a header, even though it is not coded properly as such on a base level within the site. Similarly, carousel ads and visual notifications can cause serious disruptions to blind visitors, with carousel ads possibly reading out through the SR's speech or redirecting the SR focus each time the banner changes. Visual-only notifications, such as incorrect entries highlighted in red when filling out a form, may not be picked up by a SR at all, meaning that a blind visitor may not proceed without assistance while a LV visitor may merely be slowed down as they comb through the site for the source of the issue. Thus, these issues present larger problems for blind users and are only stumbling blocks for LV ones.

The remaining two issues, slow operation and website reputation, may prove to be problems more for blind visitors than LV ones because of the increased inconvenience involved with them. When a screen reader malfunctions or crashes, a blind user must halt all navigation until it reloads or restarts, causing a delay that LV visitors may not experience. With word of mouth, an unknown site poses an even larger potential time sink because a blind visitor has no idea in advance if there will be even rudimentary attempts at accessibility on the site.

## Low Vision Users

The issues experienced by LV visitors were relatively balanced between content and structure. Content- and structure-related problems both had an equal number of issues types present (3), but the number of participants mentioning content issues was 15 (40.5%), with structure being reported 14 times (37.8%). Ads were reported the least at two issues and 8 occurrences (21.6%).

**TABLE 9. Low Vision Participants' Most Frequent Website Issues**

Issue	Participants	Participant %	Issue Category
Layout	6	50%	structure
Poor Color Schemes	6	50%	content
Security or Scam Concerns	5	41.7%	structure
Auto-playing Content	4	33.3%	ads
Labeling	4	33.3%	structure
Excessive Amounts of Ads	4	33.3%	ads
Information - Overt Bias	4	33.3%	content
Text & Font	4	33.3%	content
Total Issues Reported	37		

***For LV participants, n = 12***

Immediately apparent from the most frequent issues for LV browsers are problems with locating content through one means or another. As mentioned with the blind participants, excessive amounts of ads and auto-playing content makes locating valid information on a site more difficult, even if you have some sight to augment your browsing. Additionally, layout and labeling make finding the content within a site harder by removing easy-to-locate milestones. Some LV visitors are only able to view small portions of the screen at a time, so sites with

inconsistent layouts or those that lack regular placement of headings may impair user navigation. Poorly chosen color schemes, text, and font issues compound each others' issues. A poor choice of font, be it too fancy or stylized, combined with the text being small, on a background that it does not stand apart as distinct from the text, means that LV visitors may have an extremely difficult time even noticing the content is there, let alone parsing it easily.

The low vision participants were also more concerned about the inherent trustworthiness of a site, citing different issues they felt made a site seem misleading. When a site's content held obvious, strong biases, the participants did not feel like they could view the site as presenting information in an even-handed manner. When it came to e-commerce sites in particular, those lacking in security functions like two-factor authentication, https addresses, or unreasonable requests for personal information appeared suspect. The participants did not want to continue using them because they could not judge the legitimacy of the site.

#### *Low Vision Users - Unique Issues*

There was only a single issue reported solely by low vision participants: poor color schemes. It represents a unique challenge to them as the color scheme used on a site is something often manipulated to evoke a particular sentiment from the visitor. When done poorly, it can also effectively hide content from LV visitors. If, for example, a website places light grey text on a white background, that may be intended to have a soothing or relaxing effect, but it also results in the text blending into the background for a LV viewer. Blind users with a screen reader would not encounter this issue as the SR can read text regardless of its appearance. For LV visitors, the content is effectively concealed and the information lost. When discussing color schemes, these participants also mentioned that some color schemes actively required more effort to decipher, or were genuinely painful to interact with. The common combinations were light text on light-colored backgrounds or dark text on dark backgrounds. Also, uncomfortable color combinations were not always consistent across the LV participants reporting this issue.



For some, staring at a white screen with black text for an extended period of time was excruciating. For others, the brightness of light or white text on a dark screen was overpowering. Whenever the offending color combination arose, it required more effort from the LV visitor to browse the site. This was an important point for this group. During the interviews, the LV participants indicated that when it was worth the energy to continue browsing a site, they felt they became fatigued more quickly than would a normally-sighted viewer. So, even with ideal coloration conditions, LV browsers were not able to browse as long as normally-sighted ones, and this effect became more pronounced if the color combinations were worse. One participant described it this way:

*People like me who have some sight, but not much, also experience vision fatigue very quickly, which contributes to this frustration about having to just page through result after result after result. Because you're looking for something and the only way you can filter down is visual. I mean, I can only go through like maybe two or three pages of Google search results and my eyes are just burning, you know? So, that's, I think, something that maybe people with visual limitations experience that the sighted population doesn't necessarily. I mean, I've seen my daughter sit here and run through like hundreds. She'll go on Etsy and browse inspirations for an hour and I'm sitting there thinking "Oh my god! My eyes would be in flames!" But she can just look at one after another after another and she said, "No, that's no big deal." I hate that, you know?*

**TABLE 10. Issues Unique to Low Vision Participants**

<b>Issue</b>	<b>Participants</b>	<b>Participant %</b>
Poor Color Schemes	6	50%
Total Unique Issue Reports	6	

***For LV participants, n = 12***

## WCAG COMPARISON

To address the final aim of this thesis, the question of how well the current WCAG guidelines address the issues encountered by VI visitors during their initial visits to websites, it may be helpful to briefly revisit what those guidelines seek to achieve. The short answer is that these guidelines are intended for those who are creating content on the internet (web designers or content creators themselves), developers creating tools intended for online use, and developers specialized in creating tools for assessing the accessibility of online accessibility (W3C, 2021a). The guidelines themselves follow the four “POUR” principles: perceivability, operability, understandability, and robustness. This means that a website should be presented in ways that any visitor can perceive the contents of the site with the senses they have available. Visitors should be able to navigate the website in the ways available to them at a speed of their own choosing. The contents of the site should be intelligible to them as well as *the ways* they need to interact with the site to access its contents. Finally, the site should be able to be interpreted with as many different types of assistive technologies as possible. All of the guidelines listed in WCAG also have an associated compliance level from A to AAA, indicating how easy each particular criterion is to meet. Keeping this brief refresher in mind, let’s take a look at how well the most current WCAG guidelines cover the issues reported by the participants in this study.

As noted in Tables 3 through 5, many of the 31 issues examined in this study were actually comprised of multiple different problems in a similar vein. For example, the graphics issues contained 4 separate, but similar problems: missing alt-text, poor quality alt-text, pictures of text, and excessive amounts of graphics. Each of these is similar enough to each other to be grouped together, but not so similar as to say that they are the same issue. So, when examining the WCAG guidelines, each individual sub-issue within the 31 primary issues was considered separately.

Ultimately, coverage by the WCAG 2.2 guidelines fell into four categories. Of the total of 80 sub issues, 33 were issues covered by at least one guideline, 16 were issues that did not appear to be covered by any guidelines, 11 were out of scope for the guidelines, and 20 were subjective to visitors. Included in this section are tables of each category of issue. For cross-referenced listings of these issues, please reference the additional tables in Appendix F.

#### Covered Issues

These sub-issues had clear guidelines addressing them, meaning that these were issues that the WAI were aware of causing issues for VI visitors to websites. It is also possible that some of these issues may be addressed by multiple guidelines. Looking again at the Graphics family of issues, problems with graphics are brought up multiple times within the WCAG guidelines in different contexts, so a problem with graphics may be addressed in different ways by different guidelines. The guideline listed for each sub-issue is one selected for being the most representative of the issue as it was described by both the participants and what issue a particular guideline is meant to address.

**TABLE 11. WCAG Covered Issues**

<b>Issue</b>	<b>Description</b>	<b>WCAG Correlation</b>	<b>Compliance Level</b>
<b>STRUCTURE</b>			
Layout	(1) inconsistent layout	(1) 3.2.3 Consistent Navigation	AA
	(2) inconsistent placement of menu buttons	(2) 3.2.3 Consistent Navigation	AA
Labeling	(1) unlabeled or mislabeled buttons	(1) 2.4.6 Headings and Labels	AA
	(2) unlabeled or mislabeled links	(2) 2.4.4 Link Purpose (In Context)	A
	(3) unlabeled or mislabeled fields	(3) 3.3.2 Labels or Instructions	A
	(4) unlabeled or mislabeled menus	(4) 3.3.2 Labels or Instructions	A
CAPTCHAs		1.1.1 Non-text Content	A
Navigation	(1) elements cause SR to move unexpectedly (to the end, to random locations)	(1) 2.4.3 Focus Order	A
	(3) keyboard traps	(3) 2.1.22 No Keyboard Trap	A
	(5) page refreshes and moves SR cursor to top	(5) 2.2.2 Stop, Pause, Hide	A
Security or Scam Concerns	(1) missing "About" information	(1) 3.2.6 Consistent Help	AAA
Missing or Misused Headings		2.4.10 Section Headings	AAA
Inconsistent Dialogue Boxes	Difficulty closing a pop-up dialogue box because the close button is:		
	(1) not always in an obvious or consistent place (upper right)	(1) 3.2.3 Consistent Navigation	AA
Missing Landmarks	(1) large spaces without or absence of landmark headings	(1) 2.4.10 Section Headings	AAA
Visual-Only Notifications	(1) using color to highlight error fields	(1)1.4.1 Use of Color	A
	(2) representing things via color only	(2)1.4.1 Use of Color	A
	(3) dialogue box popped up without notification of an error	(3) 3.3.1 Error Identification	A

	(4) new message appeared at bottom of page with no notification	(4) 3.3.1 Error Identification	A
<b>CONTENT</b>			
Graphics	(1) missing alt-text	(1) 1.1.1 Non-text Content	A
	(2) poor quality alt-text	(2) 1.1.1 Non-text Content	A
	(3) pictures of text	(3) 1.4.9 Images of Text (No Exception)	AAA
Poor Color Schemes	(1) bad color combinations	(1) 1.4.11 Non-text Contrast	AA
	(2) bad text/background color combos	(2) 1.4.11 Non-text Contrast	AA
	(3) bad backgrounds	(3) 1.4.11 Non-text Contrast	AA
Information - Hard to Find Contact Details	(1) absent or hard to access contact information	(1) 3.2.6 Consistent Help	A
Text & Font	(2) small fonts	(2) 1.4.4 Resize Text	AA
	(3) AJAX content	(3) 1.4.9 Images of Text (No Exception)	AAA
Transcripts for Non-voiced Videos	videos with only music and embedded (non-readable) text	1.2.1 Audio-only and Video-only (Prerecorded)	A
<b>ADS</b>			
Auto-playing Content	automatically playing ads, music, or video	1.4.2 Audio Control	A
Pop-up Ads or Windows	(1) pop-ups that are not announced	(1) 3.3.1 Error Identification	A
	(2) pop-up ads that pull the cursor away from the main content	(2) 3.2.1 On Focus	A
	(3) pop-ups that occur every time at a certain point on a website	(3) 3.2.1 On Focus	A
Carousel Ads or Banners	ad or site content banners that periodically change appearance	2.2.2 Stop, Pause, Hide	A

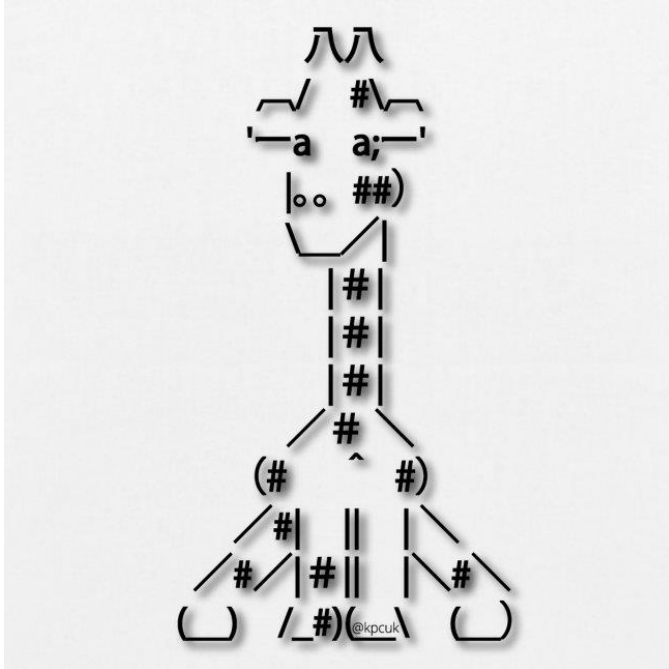
Covered issues constituted the largest portion of the 80 sub-issues reported by participants and also contained all three categories of issues outlined in this paper. What stood out among these issues, however, was the number of A-level compliance issues brought up by participants. Of the 33 sub-issues covered by WCAG guidelines, 60.6% (20) of them were A-level. The AA- and AAA-level issues combined were only 39.4% of the remaining covered issues. This means that the A-level issues, the ones that should be both the most straightforward and simplest to remedy, were the ones the participants were most frequently encountering. This supports the findings in previous papers that the most basic levels of accessibility are not being met within commonly-used websites. It is not surprising to find this confirmation. It is, however, disappointing that websites are not meeting these basic levels of compliance.

#### Not Covered Issues

In this category were issues that seemed as though they ought to be covered by a WCAG guideline, but did not have one appearing to correspond to the issue in the way the participants reported it. These issues were largely structural in nature, which falls within the general goals of the WAI, making the absence of coverage even more unusual. For instance, a website containing a large number of ASCII characters was reported by the participants. This would be difficult for a screen reader user to understand, violating the understandability principle. However, the understandability principles largely relate to things such as translations of a webpage into different languages being available or a website using plain language to make sure that its message is clear. Usage of non-language ASCII characters to convey a meaning, such as ASCII art or complex emojis, is not addressed, even though this is something that occurs on sites.

**TABLE 12. Issues Not Covered by WCAG**

Issue	Description	WCAG Correlations
<b>STRUCTURE</b>		
Navigation	(2) menu expands without notification, causing SR to get lost	(2) none
	(4) headings don't focus and user has to hit KB shortcuts repeatedly	(4) none
	(6) removing functional tables	(6) none
Overlays	(1) changes hotkeys for navigation	(1) none
	(2) may move content to different locations	(2) none
	(6) deposits tracking cookies	(6) none
Broken Links or Buttons	(1) clicking on a link and nothing happens	(1) none
	(2) clicking on a menu and it doesn't load	(2) none
	(3) clicking on a radio button in a menu and there's no dropdown	(3) none
Inconsistent Dialogue Boxes	Difficulty closing a pop-up dialogue box because the close button is:	
	(2) appears to be missing	(2) none
	(3) non-functional	(3) none
Missing Landmarks	(2) placement of important elements not near any landmark elements	(2) none
No Attempt at Accessibility		none
<b>CONTENT</b>		
Text & Font	(1) lots of ASCII characters	(1) none
<b>ADS</b>		
Interstitial Ads or Elements	dynamic content inserted into text blocks such as ads, video, embedded Twitter links, or live feeds	none



**Image 3. ASCII Art of a Giraffe**

The flip side of these findings is that non-covered issues have the potential to be the most helpful category of issue because they identify the strongest areas for possible improvement within the existing WCAG guidelines. Since the issues are largely structural, falling within areas that WAI is already attempting to improve, they may also be the easiest to incorporate into future revisions of the WCAG guidelines.

#### Out of Scope Issues

Out of scope issues are problems for VI visitors, but are also things that may not be realistic for the WCAG guidelines to address. In one case, the participants mentioned multiple different issues with the support teams supporting websites. It was reported that they often lacked accessibility training, denied there being problems with the websites, and did not listen to VI visitors trying to describe their issues when trying to get assistance.



*I was looking for a refrigerator that has an electric cooktop, that is preferably white in color on the outside and has a white cooktop as well. Now, it's very specific what I was looking for. I talked to somebody. I did the same chat on Lowe's and Home Depot. The one lady says, "Oh, we have 10 different models." She sent me the link. I'm like, "Did you look at the link you sent me?" They were white stoves, but they had a black cooktop on it, which for me it's harder to see... If people just like actually read what you're saying, what you're typing in there, because many times you type exactly one thing and they give you a standard random answer back. Almost has nothing to do what you're asking.*

**TABLE 13. Out of Scope Issues**

<b>Issue</b>	<b>Description</b>	<b>WCAG Correlations</b>
<b>STRUCTURE</b>		
Security or Scam Concerns	(4) lacking two-factor authentication (TFA)	(4) out of scope
Slow Operation (site or SR)		out of scope
<b>CONTENT</b>		
Solicitation	(1) paywall pop-ups	(1) out of scope
	(2) prompts to sign up for emails/newsletters	(2) out of scope
	(3) requiring an account before being able to access information	(3) out of scope
Inconsistent Support	(1) support without accessibility training	(1) out of scope
	(2) support denying problems	(2) out of scope
	(3) support not listening	(3) out of scope
	(4) communication issues	(4) out of scope
Information - Burying the Lede	burying pertinent information or making it otherwise hard to find	out of scope
Information - Unprompted Information Presentation	irrelevant information presentation	out of scope
Reputation or Word of Mouth		out of scope

It is not realistic for the WAI to have guidelines relating to how websites train their support staff regarding accessibility, no matter how sound a business practice it may be. Other examples included websites not requiring two-factor authentication and paywall pop-ups preventing access to content. This first is considered to be a sound security measure, but it is not within the purview of the WAI to recommend security protocols to websites within the guidelines. Regarding paywall messages, visitors may prefer that these not be present, but it is, again, not something that the WAI can recommend sites cease doing as it has no authority over their subscription practices. So, issues in the out of scope category are problems, but not ones that are reasonable to expect guidelines to cover. Instead, these exist as persistent negative interactions that decrease VI visitors' perceptions of the websites that contain them.

#### Subjective Issues

The final category, subjective issues, shares some aspects of the out of scope issues in that it may not be feasible for the WAI to create guidelines for them. In some situations, there is no objective way of measuring them currently. How do we determine how many ads constitutes too dense or too frequent an amount on a webpage? It is clearly a problem, but there is not a definitive point at which a web developer can say, "We can't add another ad on this page because then we would have too many." The same could be said of odd or suspicious domain names. A visitor in the United States or the UK might be suspicious of a .ru web address, but a Russian visitor would not be. These are subjective issues that can vary from one person to the next, making creation of any guidelines for them problematic.

**TABLE 14. Subjective Issues**

Issue	Description	WCAG Correlations
<b>STRUCTURE</b>		
Layout	(3) too many different sections on the page	(3) subjective
	(4) too many clickable elements	(4) subjective
	(5) poor page structure	(5) subjective
Security or Scam Concerns	(2) suspected unnecessary information gathering/asking for unusual PPI	(2) subjective
	(3) alarming messages/pop-ups	(3) subjective
	(5) odd domain names	(5) subjective
	(6) unexpected/unusual file downloads	(6) subjective
Overlays	(3) promotes feelings of segregation	(3) subjective
	(4) implies website doesn't know anything about accessibility ("participation trophy")	(4) subjective
	(5) implies website is lazy	(5) subjective
<b>CONTENT</b>		
Graphics	(4) excessive amounts of graphics	(4) subjective
Information - Poor Information Quality	(1) unverifiable claims	(1) subjective
	(2) unreliable sources	(2) subjective
	(3) hyperbolic or overinflated claims	(3) subjective
	(4) no information sources listed	(4) subjective
Information - Overt Bias	(1) inflammatory speech	(1) subjective
	(2) over politicizing	(2) subjective
Poor Grammar or Spelling		subjective
<b>ADS</b>		
Excessive Amounts of Ads	(1) high density of ads	subjective
	(2) high frequency of ads	subjective

*Obviously, I'm being hyperbolic, but if you have a hundred different clickable aspects, keywords. Like, I'm just annoyed because now I have to again scan through. I have to read each thing. What does each thing say? Which one of these things is relevant to what I'm looking for? Because it's not like I can just read it and scan it at a distance.*

On the other hand, some issues in this category perhaps cannot have recommendations for them. Language and grammar classes are taught the world over and yet, poor grammar and spelling persist in every single language on the planet. It is similarly infeasible to attempt to guide the different types of overt bias in information sources some participants reported. Research related to inflammatory speech has been prevalent for many years, indicating that it may be causing problems, but accessibility guidelines related to its inclusion on websites is again something that the WAI cannot reasonably be asked to produce.

## CONCLUSION

### Recommendations for Practice

The findings in this research highlight the continuing trend of websites failing to include basic accessibility functionality. Making sites accessible is a time-consuming task that keeps increasing in volume and complexity, commensurate with the increase of website creation. Unless measures are taken to slow down the creation of inaccessible content, this is never likely to change.

One angle to approach the problem would be an evaluation of the reported issues in this thesis that are not currently covered by the WCAG guidelines. Those issues could provide some additional directions for future versions or revisions.

The most direct way of addressing the problem would be for developers to begin including these functions on all websites moving forward, while gradually retrofitting sites that are missing them. While difficult, it could be achievable with a concerted effort on the part of web developers via a multi-pronged approach.

First, findings such as these should be shared with web developers currently working in the field in a format that they could integrate into discussion plans with prospective clients, perhaps in summary form. This would increase awareness of accessibility issues in those spheres moving forward. This would also include providing these findings to accessibility specialist organizations that work with organizations to remediate pre-existing websites that are currently lacking accessibility features.

For a longer-term solution, accessible design should have increased coverage in web design curricula. Several studies in the last decade (Rughiniş & Rughiniş, 2014; Shinohara et al., 2018; Cao & Loiacono, 2022) have found that this topic is either under-incorporated or not taught at all. In part, this is caused by a lack of coverage in web design textbooks. In others, lack of awareness with faculty. In either case, increasing the coverage of accessible design in web design courses will increase the awareness of the importance of accessible design in new web designers entering the workforce.

This long-term approach to changing web developer attitudes towards accessibility is, like many things related to accessibility, not at all straightforward. There are, however, some methods that could be used in the nearer term in order to begin increasing overall accessibility rates. One method may be greater implementation of graceful degradation on pre-existing websites, making them easier to access for differing versions of screen reader technologies. Another could be the creation of a toggle for ads to switch them to a screen reader-friendly format. Both of these methods of simplifying the content included on websites would create experiences that are more straightforward for VI visitors while also addressing some of the concerns they have voiced in this thesis.

Ultimately, the largest changes will come from the overall change in mindset for web developers. One of the study participants framed the approach perfectly.

*It's like the story about the janitor outside the high school and it had been snowing. He's brushing off the steps from the snow and someone in the wheelchair comes along. He says, "Oh, I'll do the ramp when I've done the steps," and the wheelchair user says, "Well, if you did the ramp first, everybody could get in."*

## Recommendations for Research

One goal of this research was to provide a foundation for future research into accessible design and improved VI experiences online. As mentioned earlier in the discussion of skewed results, a future study could evaluate the level of importance for the issues presented in this study. By providing VI participants with the complete list and having them evaluate the seriousness of each issue, additional information on the priority of what to improve on websites could be obtained. Going even further, once some sort of ranking has been established, additional testing can be conducted to verify that that indeed influences VI visitors' decisions to leave or stay on webpages. This information can be applied to the practitioner side of web design to improve overall design schemes, thus improving VI UX.

The subjective issues experienced present a potential line of research in the future as well. At earlier stages of development for the Internet, researchers did not yet know how long visitors needed to make a decision about a website. It wasn't until the Lindgaard and Tractinsky studies that we found out websites have a mere 50ms to create a positive impression on visitors. In a similar vein, studies could be conducted to determine if there is a tipping point for how many ads can be included on a page before visitors begin to become too frustrated and leave. For example, studies by McCoy and colleagues found that users' intentions to return to a

site were diminished by intrusive ads (2007; 2017), especially those that interfered with accessing the site's content (2008). Similar studies could be conducted for VI visitors.

Another route could be to branch out and examine what aspects of websites are truly most important to VI visitors and then delve into what websites best representing those features would be like. There is a definite opportunity to examine in the same level of depth and specificity for VI users what researchers have studied for sighted ones.

An interesting line of inquiry might be the degree to which specific device platforms (for example, PC versus Mac or iOS vs. Android) used to access the internet influence the experiences of VI users. Many of the participants in the study had access to multiple different devices and could freely switch between them. They often had different reports of what they experienced when using a mobile device versus a laptop or desktop. These devices generally have slightly different functionalities, which may lead to differing experiences online.

When designing VI studies in the future, it will be important to consider the question of where to focus research: If it should be directed primarily towards blind or LV users specifically, or whether studying them separately is appropriate at all. As found in this study, there are definitely overlaps in experiences between LV and blind web visitors. Would it be more appropriate to focus early studies on LV participants and later apply those findings to blind participants? Then again, it may prove more useful to study blind visitors first, then see how well those findings translate to LV users. Yet another route may be to continue to include them both in studies moving forward. The question does not yet have a definitive answer and there are benefits and consequences to any particular choice. This is something that future researchers in this field will need to consider when designing their own studies.

It may also be valuable to further consider experiences based on time. There is likely a fruitful line of research exploring the differences of experience between visitors who have developed a VI at a later point in life and comparing them to those who have always had a VI. Even within this study, several participants who had become VI later in life remarked upon how

different their conceptualization of the world was because they had at one point had a visual frame of reference for it.

*There's a guy that works here who's about 28 years old and he's been blind since he was like nine. So, he doesn't even try to orient himself visually. Everything is audible for him. He doesn't care where something lives on a screen. ...but for me, I can't completely shake those paradigms of sight because they worked for me for most of my life.*

Taking this difference of experience into account may lead to additional useful findings for improving the experiences of both groups of users.

Beyond that, this study created a potential template of inquiry for future studies of a similar nature for website visitors with other abilities. Visual impairments are not the only barriers that a person could face when using a website. Learning from those with motor or attention impairments would likely involve a unique set of issues but such studies could be just as rich and important. The inclusion of these different perspectives can only serve to enrich our understanding of how humans interact with the online world.

## Limitations

It is important to acknowledge that there were limitations within the design. This study was limited to English-speaking participants only, and also those most often from North America and the UK. While the study had participants from around the globe, it would be interesting to see if the findings would be similar from an entirely African group or participants, or a group from eastern Asian countries.

Another potential limitation is that the participants in this study were all routine internet users. There is the possibility that people in the VI community that only occasionally use the internet may have differing experiences than those who use it every day for multiple hours.



## In Closing

The purposes of this study were to create a baseline of information regarding the online experiences of two groups of people with visual impairments, those who are blind and those with low vision. It aimed to find out what problems were being encountered by both of these groups, compare them to each other, then see to what degree those problems were covered by the current WCAG accessibility guidelines. 31 participants from both groups around the world were interviewed to obtain their experiences and thoughts about those experiences.

Ultimately, over 80 different problems in 31 different categories were identified. The issues reported by blind and LV participants had many similarities, but each group had separate issues that were unique only to them. WCAG covered some of the primary problems they were encountering, but by no means addressed all of them.

The end goal is for all websites to be accessible to all. It is an issue that affects people in every country and requires our attention. It requires our attention not just because it may someday affect us as well, but because it is the altruistic thing to do. The first step in changing our current course is learning more about the problem in order to formulate a plan to rectify it. This paper seeks to be a stone in that path.

## Appendix A: WCAG 1.0-2.1 Guidelines

### Full List of WCAG 1.0 Guidelines (W3C, 2021)

- Guideline 1: Provide equivalent alternatives to auditory and visual content
- Guideline 2: Don't rely on color alone
- Guideline 3: Use markup and style sheets, and do so properly
- Guideline 4: Clarify natural language usage
- Guideline 5: Create tables that transform gracefully
- Guideline 6: Ensure that pages featuring new technologies transform gracefully
- Guideline 7: Ensure user control of time sensitive content changes
- Guideline 8: Ensure direct accessibility of embedded user interfaces
- Guideline 9: Design for device independence
- Guideline 10: User interim solutions
- Guideline 11: Use W3C technologies and guidelines
- Guideline 12: Provide context and orientation information
- Guideline 13: Provide clear navigation mechanisms
- Guideline 14: Ensure that documents are clear and simple

### Full List of WCAG 2.0 Guidelines (W3C, 2008; W3C, 2012)

#### Perceivable

- Guideline 1: Provide text alternatives for non-text content.
- Guideline 2: Provide captions and other alternatives for multimedia.
- Guideline 3: Create content that can be presented in different ways, including by assistive technologies, without losing meaning.
- Guideline 4: Make it easier for users to see and hear content.

## Operable

- Guideline 5: Make all functionality available from a keyboard.
- Guideline 6: Give users enough time to read and use content.
- Guideline 7: Do not use content that causes seizures.
- Guideline 8: Help users navigate and find content.

## Understandable

- Guideline 9: Make text readable and understandable.
- Guideline 10: Make content appear and operate in predictable ways.
- Guideline 11: Help users avoid and correct mistakes.

## Robust

- Guideline 12: Maximize compatibility with current and future user tools.

### **Changes from WCAG 2.0 to 2.1 (W3C, 2018)**

5th guideline added under Operable: Make it easier to use inputs other than a keyboard.

Guideline 7 amended to read: “Do not use content that causes seizures or other physical reactions.”

### **Changes from WCAG 2.1 to 2.2 (W3C, 2023c)**

Nine additional success criteria introduced, five within Operability and four within

Understandability

## Appendix B: Screening & Interview Questions

### Screening questions

1. Are you 18 years old or older?
2. Do you use the internet on a daily basis?

This study is focusing on individuals who have experienced significant vision loss that would be considered as low vision or blindness. For the purposes of this study, low vision is defined as "...vision loss that cannot be corrected by medical or surgical treatments or conventional eyeglasses." Affected activities include being able to "...read, drive, recognize people's faces, tell colors apart, or see your television or computer screens clearly."

Blindness, in the study, is defined as including the previous description as well as complete, or almost complete, lack of the perception of light.

3. Would your level of vision be classified as falling within the spectrums of low vision or blindness?
4. Do you own, or have access to, a computer with a microphone, camera, and steady internet connection for taking part in a Zoom meeting?

*(if yes to above)*

5. Do you have any objections to an interview being audio and video recorded for transcription and research purposes?
6. Do you have any questions for me about the study right now?

*(If yes to 1-4 and no to 5)*

7. Could I please have your name, email address, a preferred telephone contact number, and times of day you are usually available?

## Interview questions

(italicized questions indicate some, but not all, possible follow-up questions for the main question)

### Demographics:

1. What is your: name, age, gender, ethnicity?
2. Please tell me about the level of vision you have.

### Internet Usage:

3. How long have you been using the internet?
4. What does your daily Internet usage look like?
  - *Tell me about the types of activities you go online to do. (shopping, news, social media, information, entertainment, communication, etc.)*
  - *Are there any of those activities that are more difficult to complete than others?*
    - *Would you say it's more stressful for you to complete these kinds of activities?*
5. What devices do you usually use to browse the internet? (phone/desktop/tablet)
  - *If you had to estimate, what percentage do you use each of those devices that you mentioned?*
  - *What is your preferred method of going online?*
    - *Why?*
6. Do you use any assistive technology to browse online?
  - *If so, which one/s?*
  - *How long have you been using it?*
  - *What does this technology do to assist you?*
  - *How do you feel about this technology?*
    - *Does this technology help you?*
    - *How could it do its job better?*
7. Do you have a job that requires Internet usage?
  - *If yes, what kinds of activities does your job require you to do online?*
  - *How long have you had this job?*

### Accessibility:

8. What does a site being accessible mean to you?
9. What are your opinions about the levels of accessibility you encounter on websites you frequent?
  - Can you give me an example of a site that you find to be easy to use and useful?
    - *What is it about this one that makes it particularly easy to use or useful?*
    - *Why?*
  - Can you give me an example of a site that you find to be challenging to use?
    - *What is it about this one that makes it particularly challenging to use?*
    - *Why?*

### Internet Searches:

10. Walk me through the process you use when searching for something online. Start with the first step after you realize you would like to look something up.
  - *(Ask follow-up questions to clarify unclear steps)*
11. When you get search results, how do you choose which search result to click on first?
  - (alternate wording) How do you decide which result is the most likely to have the information you want?

- *Are there any parts of the search results that stand out to you?*
  - *Are there any aspects that you pay more attention to than others?*
  - *Of the things you've told me (mention them),*
    - *Which one of them is the most important to you?*
    - *Which one is the least important to you?*
    - *How would you rank those in importance?*
12. *Is there anything that would make it easier for you to decide whether a search result is worth clicking on?*
13. *Tell me about the most negative internet search experience you've had in recent memory.*
- *What was the website?*
  - *What type of content was displayed?*
  - *What was the purpose of accessing the website?*
  - *What was it about this experience that makes it a negative one?*
    - *How often had you visited the site before this incident happened?*
    - *Would you say that you distrust this website?*
      - *If yes, what was it about the site that you distrusted? (site operation, site interface/design, owner of site, visited it before, previous positive experience, etc.?)*
14. *Tell me about the most positive internet search experience you've had in recent memory.*
- *What was the website?*
  - *What type of content was displayed?*
  - *What was the purpose of accessing the website?*
  - *What was it about this experience that really stood out to you to make it a positive one?*
    - *How often had you visited the site before this incident happened?*
    - *Would you say that you trust this website?*
      - *If yes, what was it about the site that you trusted? (site operation, site interface/design, owner of site, visited it before, previous positive experience etc.?)*

**Initial Trust:**

15. *When you visit a website for the first time, what about it makes you decide to continue using the site?*
- *When visiting a site for the first time, are there aspects of the site that help you trust the site or feel more comfortable using it?*
    - *What makes it seem trustworthy?*
      - *What are they?*
        - *Tell me more about that. (Thing they mentioned)*
      - *Of the things you've told me (mention them) ...*
        - *Which one of them is the most important to you?*
        - *Which one is the least important to you?*
        - *How would you rank those in importance?*
16. *When you visit a website for the first time, are there any aspects of the site that make you distrust the site or feel uneasy about using it?*
- *What are they?*
    - *Tell me more about that. (Thing they mentioned)*
  - *Of the things you've told me (mention them) ...*
    - *Which one of them is the most important to you?*
    - *Which one is the least important to you?*

- *How would you rank those in importance?*

*Closing*

Are there any questions you would like to revisit or any answers you would like to elaborate on?

Is there anything else you would like to share or that you think would be relevant that I haven't asked you about?

Do you have any questions for me about anything we've discussed or about the research in general?

If I need to clarify any of your answers in the future, do I have your permission to contact you?

## Appendix C: Participant Demographics

**TABLE C1. Detailed Participant Demographics**

ID	Age	Gender	Vision	Employment	Assistive Tech	Online Activity
P1	19	male	B	student	VoiceOver, (NVDA)	iPhone
P2	20	male	B	IT/student	NVDA, VoiceOver, (TalkBack)	PC, iPhone
P3	21	male	B	student	NVDA, VoiceOver	PC, iPhone
P4	22	female	B	accessibility	NVDA, VoiceOver, (Braille display), (JAWS)	PC, iPhone
P5	26	male	B	student	NVDA	PC, iPhone
P6	26	male	B	unemployed	JAWS, NVDA, TalkBack, VoiceOver	PC, Android
P7	27	male	LV	unemployed	ZoomText, monocular	PC, Android
P8	28	female	LV	education	Voice Dream Reader, VoiceOver, ZoomText	PC, iPhone
P9	29	female	B	IT/student	Braille display, VoiceOver, (JAWS), (Narrator), (NVDA)	Mac, iPhone
P10	30	male	B	art & music	NVDA, VoiceOver, (JAWS)	PC, iPhone
P11	31	female	LV	government/accessibility	magnification, Fusion	Mac, iPad, Android
P12	32	male	B	IT/accessibility	ChromeVox, JAWS, NVDA, Orca, TalkBack, VoiceOver, (Window Eyes)	PC, Mac, Android, iPhone
P13	34	female	B	administration	JAWS, VoiceOver	PC, iPhone
P14	34	female	B	accessibility	Aira, JAWS, NVDA, VoiceOver	PC, Mac, iPhone
P15	34	male	B	education/IT/accessibility	NVDA, VoiceOver, (JAWS)	PC, iPhone
P16	34	male	B	unemployed	TalkBack	Android
P17	35	male	B	IT	JAWS, NVDA, TalkBack	PC, Android
P18	38	male	LV	unemployed	VoiceOver	Mac, iPad, iPhone
P19	39	male	B	unemployed	JAWS, NVDA, VoiceOver	PC, iPad, iPhone
P20	40	male	B	accessibility	EasyReader, Narrator, NVDA, (JAWS)	PC
P21	40	non-binary	LV	art & music	JAWS, NVDA, VoiceOver	PC, iPad, iPhone
P22	42	female	B	administration	JAWS, NVDA, VoiceOver, (Window Eyes)	PC, iPhone
P23	50	female	LV	unemployed	VoiceOver	PC, iPad, iPhone
P24	54	male	LV	retired (education/engineering)	NVDA	PC
P25	61	female	LV	IT/student	physical magnification, telescopic glasses, ZoomText	PC, iPhone



P26	62	female	LV	retired	Siri, (JAWS), (ZoomText)	PC, iPad, iPhone
P27	66	female	LV	retired (IT)	Fusion	PC, iPhone
P28	68	female	LV	retired (accessibility)	Alexa, VoiceOver	iPad, iPhone
P29	69	male	LV	retired (government)	JAWS, VoiceOver	PC, iPhone
P30	71	male	B	retired (art & music)	VoiceOver, (JAWS)	Mac, iPhone
P31	73	female	B	art & music/government	JAWS, VoiceOver, (Windows Eyes)	PC, iPhone

**Parentheses under Employment indicate career field prior to retirement.**

**Parentheses under Assistive Tech indicate prior experience with a technology that is not currently being used.**

## Appendix D: The Problems with Websites

Website examples were provided by participants during interviews.

**TABLE D1. Expanded Summary of Structure-Related Website Issues (All Participants)**

Issue	Participants (n = 31)	Description	Participant Examples	Site Examples
Layout	15	(1) inconsistent layout, (2) inconsistent placement of menu buttons, (3) too many different sections on the page, (4) too many clickable elements, (5) poor page structure	<p>I noticed this particularly on Reddit, but it also happens on other sites. Reddit is laid out in sections. There's a section where the main body is, but then there's also a heading where options are. There are sidebars on the side where information is given. When I zoom in to the point where things are readable to me, those sidebars and menu options up at the top fall out of my field of vision. They're no longer on the screen.... I guess my problem here, my complaint, is that there's no standard protocol for this. Some websites do it, some websites don't.</p> <p>Some are organized so that my text-to-speech reader can cope with them easily. Some are not. Like, some of them do stupid things where they put, like they don't even use multiple columns - which is a little tough for my text-to-speech to cope with - but like, they'll just have different blocks of text in different places on the screen. So, I'm kind of having to fish around and find text and then turn on the text-to-speech reader.</p>	TikTok, Facebook, WCAX.com, Reddit
Labeling	11	(1) unlabeled or mislabeled buttons, (2) unlabeled or mislabeled links, (3) unlabeled or mislabeled fields, (4) unlabeled or mislabeled menus	<p>If you have a label for a field that you need to put something in on a form, it needs to be associated with that field properly. Like, if your order has been, the label is above the field for the whole form until halfway through and now the label's below the field? Well, that intersection point is going to be very confusing. I'm going to put the text in the wrong place. And if you have the label above the field and the field itself is labeled? That's kind of redundant. Not as big of a deal, but it's like, you don't need to do both.</p>	Reddit, Gog.com, YouTube website, TikTok, Amazon website, Insomnia Cookies

			I've seen a site where it'll be something like they'll have a submit button and a cancel button, but both buttons are unlabeled. So, you have to guess which one is the right button.	
CAPTCHAs	10		<p>CAPTCHAs are just really, they're not very well designed. I have accessibility issues with them. Like last night when I wanted to register to the website for job offers, I was asked to enter a CAPTCHA, which was an image. I had to calculate the numbers and add and subtract, but they were only an image. They were not plain text and I could not complete that.</p> <p>Or you have this three-by-three thing of pictures. "Find the one with the mountain" or "Find all the ones with the mountains." And it's just kind of frustrating because, like, there has to be an easier way than trying to click all of them and you miss one, you have to do it over again. So, that's kind of frustrating.</p>	Jumia.com.ng, Discord
Navigation	10	<p>(1) elements cause SR to move unexpectedly (to the end, to random locations),</p> <p>(2) menu expands without notification, causing SR to get lost,</p> <p>(3) keyboard traps,</p> <p>(4) headings don't focus and user has to hit KB shortcuts repeatedly,</p> <p>(5) page refreshes and moves SR cursor to top,</p> <p>(6) removing functional tables</p>	<p>I was looking at an Adobe website, I think it was, and we were looking at the main navigation menu. Which is obviously a vital part of navigating through a website, and it was completely broken... Their headings are alright, but they're not always clear and their navigation menu is literally one of the worst I've ever seen in my life. So, basically what happens is, it automatically expands out when you're trying to navigate through it with a screen reader and then you just get lost and you can't like, ugh. It's just really annoying and takes time to actually navigate... When I try to navigate through this, sometimes I'll click on a link and it will do nothing. Expand out a sub-menu thing without telling me and then I'll click on another link and it will just take me to a new page. And it's so confusing.</p> <p>They've taken away the semantic html because they think it's making life inaccessible for blind people. That's annoying because it means if it were in the table, I could run my screen reader down the column. So, if I'm looking for a transaction from a certain company, I could be in the description in the name column and I can just run down the column really quickly. Just by scrolling. You know, like you would scroll your eye down one part. Because it's not in the table anymore, that ability is lost.</p>	Facebook, Amazon website, robbobrainle.org, YouTube mobile, Adidas.com, Victoria's Secret, WCAX.com

			The screen reader sees the whole statement as a paragraph of text, or as paragraphs of text.	
Security or Scam Concerns	9	(1) missing "About" information, (2) suspected unnecessary information gathering/asking for unusual PPI (3) alarming messages/pop-ups, (4) lacking two-factor authentication (TFA), (5) odd domain names, (6) unexpected/unusual file downloads	<p>If I have to give them credit card information or private information, I like things like two-factor authentication. Things that tell me that they take my security and my privacy seriously.</p> <p>If I'm trying to download a program or something that I need or want to try out, a lot of times it can be on a website with a download link, but the ads also have a download link. And it's like, I don't know which one to click. I did that the other day and installed something that was not what I had intended to download and I can't remember what it was now. I removed it as soon as it was downloaded and realized that it wasn't what I was looking for. But that's one of those things that's like scary, you know? It could be a virus, it could be a hacker. I mean it could be anything like that that could basically remove your whole operating system.</p>	WCAX.com
Overlays	5	(1) changes hotkeys for navigation, (2) may move content to different locations, (3) promotes feelings of segregation, (4) implies website doesn't know anything about accessibility, "participation trophy", (5) implies website is lazy, (6) deposits tracking cookies	<p>Having an overlay is a bigger offender because usually, sometimes a site can be perfectly accessible and it didn't even need one in the first place.</p> <p>I don't like websites that have special modes for blind people. I don't like websites that have special, "This is a special version made just for screen reader users." Like, if your site's not good enough for me, I'm not going to give you my business.</p>	
Missing or Misused Headings	4		Everything's laid out in a long column for screen readers. So, you get everything and without stuff to fix, to skip to, which is why it sucks, when websites don't include things like that. Like headings and landmarks. When you don't do that, you don't have that option, everything just kind of sucks. It's way slower	TikTok, WCAX.com

			<p>and you can't compete with sighted people at all.</p> <p>I've come across some people that will just put headings in there, as we say in the South, willy-nilly all over the place. Makes no sense.</p>	
Broken Links or Buttons	3	<p>(1) clicking on a link and nothing happens,</p> <p>(2) clicking on a menu and it doesn't load,</p> <p>(3) clicking on a radio button in a menu and there's no dropdown</p>	<p>Combo boxes that don't just sit there when you hit down arrow. Down arrow is supposed to cycle through a combo box with the screen reader and if it just sits there for whatever reason, it's broken. That's a big problem because you can't select anything now.</p>	
Inconsistent Dialogue Boxes	3	<p>Difficulty closing a pop-up dialogue box because the close button is:</p> <p>(1) not always in an obvious or consistent place (upper right),</p> <p>(2) appears to be missing</p> <p>(3) non-functional</p>	<p>One thing I hate about pop-ups, and you never know where there is the little X you have to click on to get out of it. It's never in the same spot. I mean, it's nice if it's like in the top right corner or something like that and it was always there, but sometimes like hidden like between "Close," "No thank you," or whatever. Such as an X or something you can click on. So whenever you have something popping up, it's like you have to scan the whole stupid screen. Where is the thing to get out of there?</p>	
Missing Landmarks	3	<p>(1) large spaces without or absence of landmark headings,</p> <p>(2) placement of important elements not near any landmark elements,</p>	<p>Another thing is like when you want to go to the next page or the previous page, it's not really near any element. So, it's just pretty much smack dab right between two elements and pretty far away from both of them. So, it's not in a convenient place. They could have put it below the second element.</p>	Reddi, WCAX.com
No Attempt at Accessibility	3		<p>If all they do is sort of make it inaccessible, or haven't even tried to put accessibility features in, then I'll be less likely to go back there.</p>	
Slow Operation	2		<p>In some apps, some websites, are some files. Maybe it's the way they format it, but you know you swipe, you get half a sentence.</p>	Amazon website

(site or SR)			You swipe, you get another half a sentence. That's not good.	
Visual-Only Notifications	2	(1) using color to highlight error fields, (2) representing things via color only, (3) dialogue box popped up without notification of an error, (4) new message appeared at bottom of page with no notification	Things that use red as a highlighter to say, "Oh, you didn't fill this field," but they won't use anything else. So, it's like, "Oh, you have two fields that are missing." Okay, which ones? Oh, well they're highlighted in red. I'm like, well that's great.  I'll click on something and nothing will happen, and I'm like, "Okay, what's going on here?" But I don't realize that something did happen. It's just at the bottom of the page and it didn't go to a new page.	
	80	Total Category Mentions		

**TABLE D2. Expanded Summary of Content-Related Website Issues (All Participants)**

Issue	Participants (n = 31)	Description	Participant Examples	Site Examples
Graphics	12	(1) missing alt-text, (2) poor quality alt-text, (3) pictures of text, (4) excessive amounts of graphics	<p>Anything where the link doesn't have a name and it's just a picture. It's like, especially when the picture's name among all the crap it's also saying is not even descriptive. It's like, that doesn't help me at all. Like thecon3.jpg or png. I'm like, "Cool. What does it do?"</p> <p>One of the things that's highly frustrating for me is when people take images of text. Because, okay, so now I know that I'm talking about a cell phone booster here, but I can't read any of the specifications because they're not actually words there.</p>	Instagram.com, Pinterest, Etsy, Old Navy, deviantart.com, Bing
Information - Poor Information Quality	9	(1) unverifiable claims, (2) unreliable sources, (3) hyperbolic or overinflated claims, (4) no information sources listed	<p>Things that make some unsubstantiated claims and then things that kind of fall into the yellow journalism school. Like, "You may be feeding your child toxins right now!"</p> <p>Exaggerated claims. Clearly inaccurate information, conspiracy theories that are based on beliefs that are widely held but provably not true.</p>	
Solicitation	8	(1) paywall pop-ups, (2) prompts to sign up for emails/newsletters, (3) requiring an account before being able to access information	<p>Paywalls and things like paywalls are a terrible idea on any website. I think the amount of money that you earn from a paywall is nothing compared to the people that you hemorrhage by having one.</p> <p>I find it annoying that I have to set up an account just to get a phone number for somebody or I don't really want to sign up. I just want to know.</p>	
Poor Color Schemes	6	(1) bad color combinations, (2) bad text/background color combos, (3) bad backgrounds	<p>So you can read something and all of a sudden, the picture, the color changes to black or really dark and you have black text. So, the text all of a sudden disappears almost in the picture, if you know what I mean. So that's, like, don't ever do that. That's not helpful.</p> <p>Like neon green or yellow with white writing, or if it's a busy pattern with black or white, right? Or if it's very pastel. So, if we're doing like mint or baby pink with white writing.</p>	
Information -	6	(1) inflammatory speech,	As soon as they start politicizing anything I can tell right then, it's not	

Overt Bias		(2) over politicizing	trustworthy.  If I'm looking for a clear political view on the topic, whether it's for I want to get what people are thinking about this, or I want to look up what people are thinking about this for me to never even get close to them. I'll find some blogs or usually smaller websites have clearer political views and stuff. Usually, for example, if I see something I'm really not into I won't keep using the website just for, life's already bad enough, I don't need this.	
Poor Grammar or Spelling	6		If it looks poorly written or not formatted well? It's sloppy. I guess then I'm going to leave.  Poorly written text is the big red flag. It's like grammatical and spelling. Yeah, those types of things. That would be a flag.	
Inconsistent Support	5	(1) support without accessibility training, (2) support denying problems, (3) support not listening, (4) communication issues	Very rarely do you actually talk to somebody who knows their stuff. And most of the time you, and I'm very specific now, I mean, get to the point! I don't want to hear about how your day is going, I don't want to be asked if I'm having a good day today when I'm on a chat for technical advice.  I don't have anything against giving work to other countries, but when those other countries are very hard to understand over the phone, it's so aggravating... I was trying to tell this guy that I wanted the smallest screen that they have because I don't use a screen. He was not understanding what I was saying and he was trying to give me the bigger screen.	Steam.com, Virgin Media, Lowe's, Home Depot
Information - Hard to Find Contact Details	5	(1) absent or hard to access contact information	I think how they label their options. It's kind of how frequently asked questions on websites almost always lead you to questions that nobody ever actually asks. It's more just a chance and here's our chance to repeat our mission statement.  Sometimes, it's really hard to find a phone number or an email address for a company, even if you're on their website, to find a phone number or an email address if you want to get in touch with somebody.	Florida Department of Education
Text & Font	5	(1) lots of ASCII characters,	Small print in general is just hard. If the font is small, I want to say.	Reddit, Canvas



		(2) small fonts, (3) AJAX content	It was something called AJAX and it was very popular with programmers for a while because it allowed them to put a lot of information on a page by somehow as they say "floating it on the page" so that you could have several different levels of information using the same amount of space. Now I really haven't got a clue how that would work, but for a blind person you might as well not even bother because none of those levels of information were accessible and it was a total waste of time even looking.	
Information - Burying the Lede	3	burying pertinent information or making it otherwise hard to find	News articles, for instance, are t-top trash to me and I hate them so much because they're, not all of them, not all, I'm being a little hyperbolic trying to be funny, but there is a rhythm to them. They will put up in their headline this big awesome click-baity thing that you want to know and then five paragraphs down is the thing that's related to that.	
Information - Unprompted Information Presentation	2	irrelevant information presentation	Like I was looking for a certain Norelco razor one time and I thought I had narrowed my choices down to the particular one that I wanted. All of a sudden, I saw all these other choices! They just popped up and like wait a minute! Nope. And so, it made it more difficult to actually find that particular razor again and make that choice.	
Transcripts for Non-voiced Videos	2	videos with only music and/or embedded (non-readable) text	If you're giving me an instructional video and all it is is music and text, you need a transcript. I can't do anything with that. It's nice music maybe, but that's about it. It's not gonna help me put my dishwasher back together.	TikTok
Reputation or Word of Mouth	1		I ask about different experiences other people have on the specific website, specific topic. It's very important.	
	70	Total Category Mentions		

**TABLE D3. Expanded Summary of Ad-Related Website Issues (All Participants)**

Issue	Participants (n = 31)	Description	Participant Examples	Site Examples
Auto-playing Content	11	automatically playing ads, music, or video	<p>The web pages that you'll click on and say the like music or a commercial or advertisement immediately starts playing. I'm not sure how frustrating that is for somebody who can see, because they're really frustrating because I mean you can still see to read the text. But somebody who has to listen to JAWS? And those videos are always at 100% volume, I swear.</p> <p>You've ever gone to a website and it immediately starts playing background music? I will back right out of that because I need my audio bandwidth for this thing to tell me important information about the site. I do not want to be hearing "Nearer, My God, to Thee" in the background, you know?</p>	
Excessive Amounts of Ads	10	(1) high density of ads, (2) high frequency of ads	<p>Advertisements, of course, they're aggravating to people that are sighted too, but when you're using a screen reader, it tries to read the ads and sometimes it can't. You have to stop and kind of try to arrow through them and pass them and that can be annoying.</p> <p>I particularly have a lot of gripes about unnecessary amounts of ads, usually the worst offenders are news sites.</p>	
Pop-up Ads or Windows	10	(1) pop-ups that are not announced, (2) pop-up ads that pull the cursor away from the main content, (3) pop-ups that occur every time at a certain point on a website	<p>Basically, if I click anywhere on the screen and I just have a random pop-up, I was like, "Oh well!" And that's my cue to leave. Specifically, the ones that like appear from you just clicking anywhere on the screen. You didn't have to click on a link, just the entire experience is an ad.</p> <p>The stupid "Would you like to join our newsletter? Even though this is the very first time you've seen our site and you don't even know if they're any good yet?" Sometimes it won't close and those aren't seen as pop-ups by most pop-up blockers.</p>	Adidas.com, Victoria's Secret, WCAX.com, Twitter
Interstitial	5	dynamic content	It says, "Advertisement frame" and then you get a bunch of text.	WCAX.com

Ads or Elements		inserted into text blocks such as ads, video, embedded Twitter links, or live feeds	<p>A bunch of links. Most of which are just pictures with the whole link text in there and the JavaScript and all that crap. And then, you get advertisements in the middle of your article and you have to scroll through all of that and there is no element to skip it, of course. So, that sucks.</p> <p>Because like with a news article, you'll have paragraph, paragraph, link, ad, link, maybe another link, and then the rest. Then the next part of the article and you have to shuffle through that, I assume. Which sounds really annoying for certain screen readers.</p>	
Carousel Ads or Banners	3	ad or site content banners that periodically change appearance	<p>So, say I'm on a website and they've got a, there's like sort of carousel things that go round and round. And it's just sort of like automatically moving. What happens sometimes with them, is that my screen reader will just continuously read out all of them at once and just will interrupt everything that I'm doing. And it is so annoying and I hate that! They would just auto-play everything and that's a massive problem because I can't stop it. I can't get out of it. Like, it won't stop.</p>	WCAX.com
	39	Total Category Mentions		

## Appendix E: Separated Group Issues

**TABLE E1. Complete List of Ranked Issues Reported by Blind Participants**

<b>Issue</b>	<b>Participants</b>	<b>Participant %</b>
Graphics	10	52.6%
Layout	9	47.4%
Navigation	9	47.4%
Auto-Playing Content	7	36.8%
Labeling	7	36.8%
CAPTCHAs	7	36.8%
Pop-up Ads or Windows	7	36.8%
Excessive Amounts of Ads	6	31.6%
Information - Poor Information Quality	6	31.6%
Solicitation	5	26.3%
Security or Scam Concerns	4	21.1%
Poor Grammar or Spelling	4	21.1%
Overlays	4	21.1%
Missing or Misused Headings	4	21.1%
Interstitial Ads or Elements	3	15.8%
Carousel Ads or Banners	3	15.8%
Missing Landmarks	3	15.8%
Information Issues - Overt Bias	2	10.5%
Inconsistent Support	2	10.5%
Information - Hard to Find Contact Details	2	10.5%
Broken Links or Buttons	2	10.5%
Inconsistent Dialogue Boxes	2	10.5%
No Attempt at Accessibility	2	10.5%

Slow Operation (site or SR)	2	10.5%
Visual-only Notifications	2	10.5%
Text & Font	1	5.3%
Information - Burying the Lede	1	5.3%
Information - Unprompted Information Presentation	1	5.3%
Transcripts for Non-voiced Videos	1	5.3%
Reputation or Word of Mouth	1	5.3%
Poor Color Schemes	0	0%
Different Issue Types Reported	30	
Total Issues Reported	119	
Issues Reported per Participant	6.3	

***For blind participants, n = 19***

**TABLE E2. Complete List of Ranked Issues Reported by Low Vision Participants**

<b>Issue</b>	<b>Participants</b>	<b>Participant %</b>
Layout	6	50%
Poor Color Schemes	6	50%
Security or Scam Concerns	5	41.7%
Auto-Playing Content	4	33.3%
Labeling	4	33.3%
Excessive Amounts of Ads	4	33.3%
Information Issues - Overt Bias	4	33.3%
Text & Font	4	33.3%
CAPTCHAs	3	25%
Pop-up Ads or Windows	3	25%
Information - Poor Information Quality	3	25%
Solicitation	3	25%
Inconsistent Support	3	25%
Information - Hard to Find Contact Details	3	25%
Graphics	2	16.7%
Poor Grammar or Spelling	2	16.7%
Interstitial Ads or Elements	2	16.7%
Information - Burying the Lede	2	16.7%
Navigation	1	8.3%
Overlays	1	8.3%
Broken Links or Buttons	1	8.3%
Inconsistent Dialogue Boxes	1	8.3%
No Attempt at Accessibility	1	8.3%
Information - Unprompted Information Presentation	1	8.3%
Transcripts for Non-voiced Videos	1	8.3%

Missing or Misused Headings	0	0%
Carousel Ads or Banners	0	0%
Missing Landmarks	0	0%
Slow Operation (site or SR)	0	0%
Visual-only Notifications	0	0%
Reputation or Word of Mouth	0	0%
Different Issue Types Reported	25	
Total Issues Reported	70	
Issues Reported per Participant	5.8	

***For low vision participants, n = 12***

## Appendix F: WCAG Correlations

**TABLE F1. WCAG Coverage for Structural Issues**

Issue	Description	WCAG Correlations	Compliance Level
Layout	(1) inconsistent layout	(1) 3.2.3 Consistent Navigation	AA
	(2) inconsistent placement of menu buttons	(2) 3.2.3 Consistent Navigation	AA
	(3) too many different sections on the page	(3) subjective	
	(4) too many clickable elements	(4) subjective	
	(5) poor page structure	(5) subjective	
Labeling	(1) unlabeled or mislabeled buttons	(1) 2.4.6 Headings and Labels	AA
	(2) unlabeled or mislabeled links	(2) 2.4.4 Link Purpose (In Context)	A
	(3) unlabeled or mislabeled fields	(3) 3.3.2 Labels or Instructions	A
	(4) unlabeled or mislabeled menus	(4) 3.3.2 Labels or Instructions	A
CAPTCHAs		1.1.1 Non-text Content	A
Navigation	(1) elements cause SR to move unexpectedly (to the end, to random locations)	(1) 2.4.3 Focus Order	A
	(2) menu expands without notification, causing SR to get lost	(2) none	
	(3) keyboard traps	(3) 2.1.22 No Keyboard Trap	A
	(4) headings don't focus and user has to hit KB shortcuts repeatedly	(4) none	



	(5) page refreshes and moves SR cursor to top	(5) 2.2.2 Stop, Pause, Hide	A
	(6) removing functional tables	(6) none	
Security or Scam Concerns	(1) missing "About" information	(1) 3.2.6 Consistent Help	AAA
	(2) suspected unnecessary information gathering/asking for unusual PPI	(2) subjective	
	(3) alarming messages/pop-ups	(3) subjective	
	(4) lacking two-factor authentication (TFA)	(4) out of scope	
	(5) odd domain names	(5) subjective	
	(6) unexpected/unusual file downloads	(6) subjective	
Overlays	(1) changes hotkeys for navigation	(1) none	
	(2) may move content to different locations	(2) none	
	(3) promotes feelings of segregation	(3) subjective	
	(4) implies website doesn't know anything about accessibility ("participation trophy")	(4) subjective	
	(5) implies website is lazy	(5) subjective	
	(6) deposits tracking cookies	(6) none	
Missing or Misused Headings		2.4.10 Section Headings	AAA
Broken Links or Buttons	(1) clicking on a link and nothing happens	(1) none	
	(2) clicking on a menu and it doesn't load,	(2) none	
	(3) clicking on a radio button in a menu and there's no dropdown	(3) none	

Inconsistent Dialogue Boxes	Difficulty closing a pop-up dialogue box because the close button is:		
	(1) not always in an obvious or consistent place (upper right)	(1) 3.2.3 Consistent Navigation	AA
	(2) appears to be missing	(2) none	
	(3) non-functional	(3) none	
Missing Landmarks	(1) large spaces without or absence of landmark headings	(1) 2.4.10 Section Headings	AAA
	(2) placement of important elements not near any landmark elements	(2) none	
No Attempt at Accessibility		none	
Slow Operation (site or SR)		out of scope	
Visual-Only Notifications	(1) using color to highlight error fields	(1)1.4.1 Use of Color	A
	(2) representing things via color only	(2)1.4.1 Use of Color	A
	(3) dialogue box popped up without notification of an error	(3) 3.3.1 Error Identification	A
	(4) new message appeared at bottom of page with no notification	(4) 3.3.1 Error Identification	A

**TABLE F2. WCAG Coverage for Content Issues**

<b>Issue</b>	<b>Description</b>	<b>WCAG Correlations</b>	<b>Compliance Level</b>
Graphics	(1) missing alt-text,	(1) 1.1.1 Non-text Content	A
	(2) poor quality alt-text,	(2) 1.1.1 Non-text Content	A
	(3) pictures of text,	(3) 1.4.9 Images of Text (No Exception)	AAA
	(4) excessive amounts of graphics	(4) subjective	
Information - Poor Information Quality	(1) unverifiable claims,	(1) subjective	
	(2) unreliable sources,	(2) subjective	
	(3) hyperbolic or overinflated claims,	(3) subjective	
	(4) no information sources listed	(4) subjective	
Solicitation	(1) paywall pop-ups,	(1) out of scope	
	(2) prompts to sign up for emails/newsletters,	(2) out of scope	
	(3) requiring an account before being able to access information	(3) out of scope	
Poor Color Schemes	(1) bad color combinations,	(1) 1.4.11 Non-text Contrast	AA
	(2) bad text/background color combos,	(2) 1.4.11 Non-text Contrast	AA
	(3) bad backgrounds	(3) 1.4.11 Non-text Contrast	AA
Information - Overt Bias	(1) inflammatory speech,	(1) subjective	
	(2) over politicizing	(2) subjective	
Poor Grammar or Spelling		subjective	

Inconsistent Support	(1) support without accessibility training,	(1) out of scope	
	(2) support denying problems,	(2) out of scope	
	(3) support not listening,	(3) out of scope	
	(4) communication issues	(4) out of scope	
Information - Hard to Find Contact Details	(1) absent or hard to access contact information	3.2.6 Consistent Help	A
Text & Font	(1) lots of ASCII characters,	(1) none	
	(2) small fonts,	(2) 1.4.4 Resize Text	AA
	(3) AJAX content	(3) 1.4.9 Images of Text (No Exception)	AAA
Information - Burying the Lede	burying pertinent information or making it otherwise hard to find	out of scope	
Information - Unprompted Information Presentation	irrelevant information presentation	out of scope	
Transcripts for Non-voiced Videos	videos with only music and embedded (non-readable) text	1.2.1 Audio-only and Video-only (Prerecorded)	A
Reputation or Word of Mouth		out of scope	

**TABLE F3. WCAG Coverage for Ad Issues**

<b>Issue</b>	<b>Description</b>	<b>WCAG Correlations</b>	<b>Compliance Level</b>
Auto-playing Content	automatically playing ads, music, or video	1.4.2 Audio Control	A
Excessive Amounts of Ads	(1) high density of ads,	subjective	
	(2) high frequency of ads	subjective	
Pop-up Ads or Windows	(1) pop-ups that are not announced,	(1) 3.3.1 Error Identification	A
	(2) pop-up ads that pull the cursor away from the main content,	(2) 3.2.1 On Focus	A
	(3) pop-ups that occur every time at a certain point on a website	(3) 3.2.1 On Focus	A
Interstitial Ads or Elements	dynamic content inserted into text blocks such as ads, video, embedded Twitter links, or live feeds	none	
Carousel Ads or Banners	ad or site content banners that periodically change appearance	2.2.2 Stop, Pause, Hide	A

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