Understanding the Prevalence of Color-Blind Accessibility in Websites

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

Chloe Tran
Spring, 2021

On my honor as a University Student, I have neither given nor received
unauthorized aid on this assignment as defined by the Honor Guidelines
for Thesis-Related Assignments

Signature _____ Date _____
       Chloe Tran

Approved _____ Date _____
       Professor Sharon Tsai-hsuan Ku, Department of Engineering and Society

Introduction

Web accessibility practices aimed towards people with color-blindness is a topic that is often ignored. Around 1 in 12 men and 1 in 200 women world-wide are affected by color-blindness (Color Blindness Awareness, n.d.). This statistic includes Mark Zuckerberg, the CEO of Facebook. Facebook is blue because of his color-blindness - it is the color that he sees the clearest (Sutter, 2021). Despite color-blindness affecting a significant part of the population, color contrast errors were present on 86.3% of website home pages in 2020 (WebAIM, 2020).

Web accessibility refers to practices and guidelines that are implemented to make websites accessible for people with disabilities (W3C, 2019, para. 1). In this paper, the term "color-blind accessibility" will be used to refer to web accessibility guidelines that are related to color-blindness.
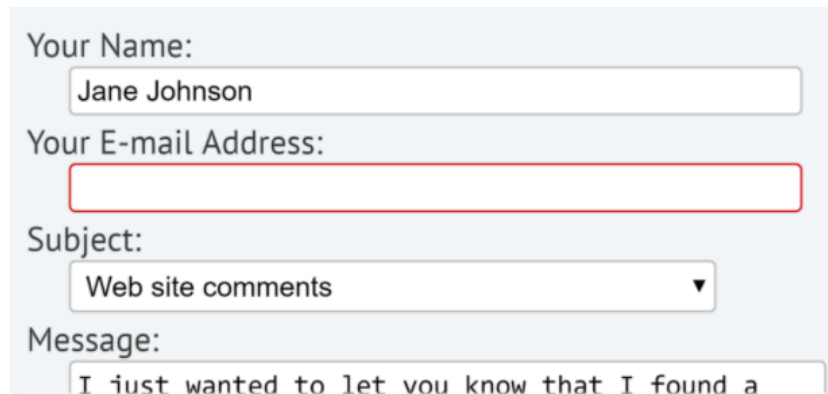
There are two color-blind accessibility guidelines, the first being color contrast errors. The World Wide Web Consortium (W3C) is the organization that develops internet web accessibility standards. They state that a color contrast error is an element on a website that does not meet their WCAG (Web Content Accessibility Guidelines) guideline 1.4.3 - contrast minimum (W3C, 2019). Guideline 1.4.3 states that normal sized text must have a contrast ratio of at least 4.5:1 and that large text must have a contrast ratio of at least 3:1 (W3C, n.d. -a).

Figure 1 shows text examples that do not meet this contrast ratio. These color combinations are inaccessible to those with color-blindness.

Figure 1. Color combinations that fail the 4.5:1 color contrast ratio guideline. (WebAIM, 2021).

The second indicator in color-blind web accessibility is guideline 1.4.1 – use of color. This guideline states that color cannot be the only way to communicate information (W3C, n.d. - b).

Figure 2. A form where there is a "use of color" failure in indicating a required input field. (WebAIM, 2021).

Figure 2 shows a form where a required input field is marked in red. However, the color red is the only way that the user would know that the field is required, making it inaccessible. This form would be more color-blind accessible if there was informative text placed near the red outline.

These two color-blind web accessibility guidelines are well defined. Yet, the application of these guidelines is not widespread. Therefore, this research seeks to understand:

- *What are the reasons for the low prevalence of color-blind web accessibility?*

- *Can the status of color-blind web accessibility improve?*

To answer these questions, Pinch and Bijker's (1987) Social Construction of Technology (SCOT) approach will be used to examine interpretations of web accessibility (p. 199). In consequence, insight into color-blind web accessibility is attained as well since it is an embedded area of web accessibility. Additionally, an ethical framework, called technology

mediation can characterize how the low-prevalence of color-blind accessibility impacts color-blind users.

Literature Review

Color-blind web accessibility is not well researched in literature. What was found were methods that adjust colors combinations to make them more accessible. For example, Jefferson and Harvey (2006) have proposed an algorithm that takes colors of an image, compares their color contrast, and optimizes them so that they can be seen by color-blind users (pp. 5-7). Huang, Chen, Jen, and Wang (2009) proposed a faster algorithm with the same goal to optimize color contrast computationally (p. 1162). While both these researches can aid color-blind users browsing on the web, they do not address socio-technical reasons why additional assistance is needed.

Since there is not much research directly on color-blind web accessibility, research related to general web accessibility was reviewed as well. This helped garner views on the varying motivations, challenges, and awareness of web accessibility. This background on general web accessibility is necessary as the it provides context for color-blind accessibility.

Regarding web accessibility, previous research indicated that there are conflicting motivations in adopting it. A survey of 300 people interested in accessibility administered by Yesilada, Brajnik, Vigo, and Harper (2012) revealed that the desire to be more inclusive was the primary reason why respondents wanted to adopt web accessibility (p. 6). Financial and legal incentives were not chosen regardless of if the respondent's background was in engineering, business, or another field (Yesilada, Brajnik, Vigo, & Harper, 2012, p. 7). In contrast, Leitner, Strauss, and Stummer (2014) found that web accessibility motivations for businesses are not

purely social but also financial and technical (p. 254). Applying web accessibility raises a company's image and brings better economic results. The technical motivation was that the businesses wanted higher quality websites which applying web accessibility promotes intrinsically.

Previous research also indicated that there are challenges in implementing web accessibility. In a survey of website creators, Lazar, Dudely-Sponaugle, and Greenidge (2004) noticed that creators lacked technical expertise, time, and business support when trying to execute web accessibility (p. 279). Balancing client demands with practical accessibility was a hard task. Trewin, Cragun, Swart, Brezin, and Richards (2010) also surveyed 49 web developers working at the company IBM and noticed that there was a common sentiment that accessibility was technically challenging (p. 2). IBM developers reported that accessibility tools did not work as intended and that accessibility grows more complex as websites become increasingly modern (pp. 3-4). Craven (2008) also supported the idea that accessibility will become more intricate in the future since there are emerging technologies that allow other methods of accessing websites such as smart TVs and music players (p. 6).

Furthermore, a large barrier in the diffusion of web accessibility is a lack of awareness. Brown and Hollier (2015) reviewed recent accessible technology, laws, and guidelines and found that government laws on web accessibility are slow to enact and that the web is still largely inaccessible (p. 7). They suggest that more awareness on how accessibility benefits all users and not just those with disabilities is needed for it to become further established (Brown & Hollier, 2015, p. 8). In a survey of 630 Brazilian people involved in web development, Freire, Russo, and Fortes (2008) support that increased awareness can be achieved through education (p. 91). They found that 56.38% of those surveyed did not have web accessibility training and were not aware

5

of accessibility laws and practices (Freire, Russo, & Fortes, p. 93). General mainstream awareness and instruction on the topic would promote better practices. Moreover, Brophy and Craven (2007) reviewed studies done by various groups on levels of web accessibility awareness and found that awareness is increasing overall but that more education is needed (p. 969).

In this paper, I aim to use and build on top of the web accessibility perspectives synthesized above to unpack the reasons behind the low prevalence of color-blind accessibility in particular. Since color-blind accessibility is a part of web accessibility, it is expected that there is substantial overlap in perspectives between the two topics.

STS Framework/Research Method

Pinch and Bijker's (1987) Social Construction of Technology (SCOT) framework is a tool that can unravel why color-blind accessibility prevalence is low (p. 199). Since color-blind accessibility is a part of web accessibility, the general concept of web accessibility can be used as the central artifact.
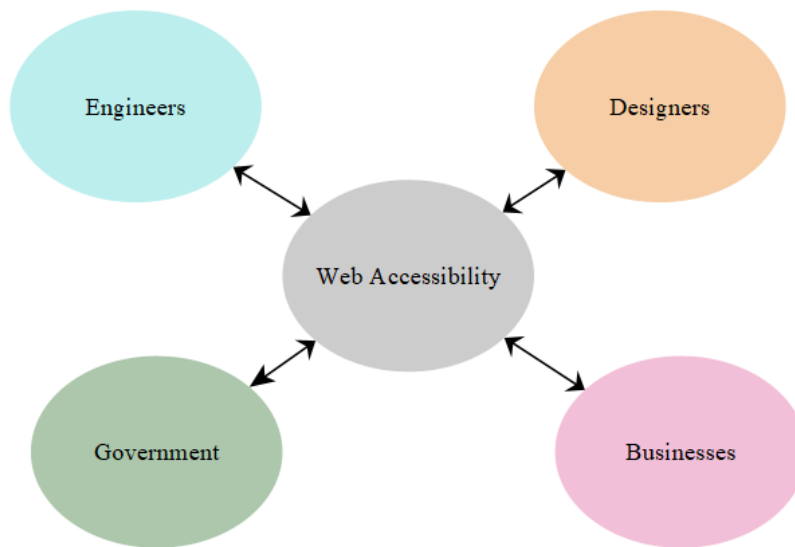

Figure 3. SCOT Model for web accessibility.

6

Figure 3 shows the relevant social groups that can shape the concept of web accessibility: engineers, designers, government, and businesses. The arrows towards the term web accessibility represent this. Each of these groups also have interpretive flexibility on their perceptions of web accessibility. In SCOT, "different interpretations of social groups about the concept of an artifact indicates different problem definition, and thus a diverse range of developed solutions" (Yousefikhah, 2017, p. 37). The arrows back towards each social group represents this interpretive flexibility.

While they are not part of the SCOT framework as a relevant social group, color-blind users themselves are also impacted by these differing interpretations. Color-blind users' relationship with color-blind accessibility can be understood with the technology mediation ethical framework. Technology mediation views technology as an active source of influence that "shape[s] human experiences and practices" (Verbeek, 2015, p. 30). In this case, the version of a website that color-blind users see is different based on the mediation that happens through the computer screen due to the prevalence of color-blind accessibility. Website creators often forget about color-blind users, thinking that the mediation will result in the same interpretation for all users. However, color-blind users leave a website with a different understanding of the content provided than non-color-blind users have since what they see might be improperly conveyed color-wise.

In this paper, two types of research were conducted to gain more understanding of each relevant social group. The first research method is the document analysis and synthesis of various online sources. These sources included blog posts, blog comments, and web articles. These documents provided numerous viewpoints from people who are a part of the relevant social groups. The second research method was compiling accessibility statements from the top

forty most popular United States (U.S.) websites as listed by Alexa Internet (n.d.). Accessibility statements are corporate statements that publicize a companies' viewpoint on accessibility. These statements provided first-hand insight into how web accessibility is socially viewed by businesses. The second research method was added to supplement the first research method. The combination of these two methods helped attain a fuller understanding of how web accessibility is interpreted from a variety of perspectives. As a result, these interpretations of web accessibility also uncover the reasons behind the low prevalence of color-blind accessibility.

Data Analysis

Data collected from the two research methods can be organized and analyzed for each of the relevant social groups: designers, engineers, businesses, and government. The succeeding sections delves into each of these groups.

A Designer's Empathy

Designers are often the group that have the most direct access to apply accessible practices in web design. They directly choose the features of a website. However, designers are often unempathetic to impairments such as color blindness because of a lack of awareness to web accessibility.

In a blog post titled "Going Colorblind: An Experiment in Empathy and Accessibility", Novak (2018), an experience designer, documents the process of understanding her color-blind co-worker's experiences (para. 3). She used a browser extension to simulate color-blindness on websites and was shocked at how difficult tasks such as online shopping was when she could not see some content due to improper color contrast (Novak, 2018, para. 18). Through direct

exposure to how her colleague experienced websites, her empathy grew. The ending of the blog post showcased WCAG (Web Content Accessibility Guidelines) guidelines such as the 1.4.3 Contrast (minimum) rule for color contrast, indicating that Novak urges other designers to apply accessible web practices.

Novak had contact with someone with an impairment and gained awareness and empathy towards accessibility. However, this awareness might not be widespread among designers. Another web designer commented on a blog post titled "Why Are Accessible Websites So Hard to Build?" that, "I've been a web designer for almost two decades, and I know for a fact that [a] company without a compliant website is almost 100% caused by lack of knowledge instead of malice… you never hear it [web accessibility] discussed about …" (Shea, 2019). Shea's experience reveals that web accessibility awareness is low among designers.

Designers perceive the meaning of the web accessibility differently among their own group. For many designers, web accessibility is something that they are not even conscious of. Designers with awareness towards accessibility gain empathy towards those with disabilities. If more designers were to gain more empathy to how those with disabilities including those with color-blindness experience the web, then the prevalence of general web accessibility and color-blind web accessibility could be higher. Empathy seems to be a strong force that drives designer decisions.

Engineers and Technical Implementation

Engineers are the developers who implement websites. To engineers, web accessibility is often seen as an obstacle. This is because there is a lack of education in web accessibility and that accessibility is challenging to implement in practice.

Engineers can struggle with web accessibility because they were not taught about the topic and how it incorporates into their field of work. A commentor on the blog post "Why are Accessible Websites so Hard to Build?", announced that "I have written some pretty inaccessible code, and it's not because I didn't care. Actually, when I started to try and write accessible code, I made things even worse" (Boone, 2019). Another commentor says that "…to be honest I don't have the knowledge of all the different ways of testing accessibility" (JP, 2019). These comments and other similar stories from developers written in the comment section highlights that there is not emphasis placed onto how to write code and fabricate website architecture that translates to an accessible interface during the process of learning to be a developer. There is also the concern about continually integrating web accessibility into the engineering process as shown by JP's reference to testing. These engineers do not yet have the education to technically implement accessible practices.

There are also additional challenges in implementation. Engineers often use third party services and components when creating websites. Another commenter on the same blog post indicates that "…it's not easy to just switch them [third party services] out when they are tied to legacy POS [point of sale] and the like." (Zach R, 2019). A dependence on existing systems makes transitioning to accessible practices difficult since businesses and third parties might not be aligned on an accessibility stance. Additionally, changing a dependency in the code of a

website is challenging since other components will have been built on top of the legacy site over time.

Engineers interpret web accessibility from a more technical perspective. Those engineers with awareness towards web accessibility may be unable to apply it properly due to lack of knowledge on accessible web methodology and existing technological barriers. Making a website accessible inclusive of color-blind accessibility practices could involve much more work than just simply applying defined web accessibility guidelines.

The Complexity and Contradictions of Business Interpretations

Several sources in the data collection provided information about businesses regarding web accessibility. Business interpretations on the concept of web accessibility can be broken into four perspectives: change in processes, financial cost, legal action, and public accessibility stance.

Change in Processes

The first business perspective on web accessibility is process changes. Many businesses do not alter their existing business processes to include web accessibility because they believe that they do not have any incentives. Groves (2011), an accessibility consultant and trainer, wrote in his personal blog that:

> Unfortunately, I can't say that any person I know has ever chosen to do business with a website explicitly because the company does (or does not) have an accessible website apart from the obvious cases where a friend with disabilities cannot use a site (para. 4).

The belief exhibited from his experience is that businesses do not have pressure from their clients to pursue accessibility. They will receive the same number of clients anyway, so they do not feel any need to change their well-working processes.

Financial Costs

The second business interpretation of web accessibility is from the financial perspective. Ameilucha (2019), a web developer, commented under a blog post titled "Why It's Important for Web Developers to Focus on Web Accessibility" that the agency he works for "…only bother[s] with accessibility testing if the client is paying for it. Usually they don't." (Ameilucha, 2019). He implies support of Grove's (2011) idea that businesses are complacent unless motivated by their clients. Ameilucha (2019) adds on that cost is a key factor as well. Transitioning a website to be accessible could be a costly business expense. The price varies from "a few thousand dollars to upwards of a million dollars" due to the differences in the complexity of websites (Avila, 2020).

In contrast, web accessibility could be a worthwhile investment. For instance, Ron Packard Jr., the CEO of an app development company called CloudBurst, disclosed that after his company implemented the accessible feature of making their font size larger, he found that "... [this] single adjustment improved our revenue by a whopping 50%!" (para. 6). Financial cost of web accessibility is a contradictory business consideration – there is the upfront price tag but there is also the potential financial reward.

Legal Action

The third business interpretation of web accessibility is from the legal perspective. Businesses in the U.S. can be sued for not having an accessible website. In the U.S., the Americans with Disabilities Act (ADA) can be applied in website accessibility lawsuits (Sapega, 2020, para. 4). This is because it broadly covers all forms of disability discrimination, which has grown to include websites. However, the ADA's domain on web accessibility particularly relating to color-blindness is not clear (Riverburgh, 2018, para. 17-18). Rivenburgh, who is the Chief Accessibility and Legal Officer at Essential Accessibility illustrates a color contrast example:

> Let's say my text color contrast ratio is 4.4:1 and doesn't meet the 4.5:1 guideline set in WCAG, does this mean I'm violating the ADA? No…. [since] public accommodations have flexibility in how to comply with the ADA's general requirements (para. 37).

ADA requirements are not explicit which makes accessibility legalities blurry. This is especially the case with color-blind web accessibility since it is also not well-defined whether color blindness is considered a true disability applicable to the ADA or just an impairment (Larson, 2018).

Accessibility Stances

	Percentage [%]
Businesses with a general accessibility statement on their website	80%
Businesses that address web accessibility in their accessibility statement on their website	65%
Businesses that address color contrast in their accessibility statement on their website	7.5%

Table 1. Accessibility Statement Differences Among the Top 40 U.S. Websites

The final interpretation of web accessibility from businesses is revealed through the second research method. Web accessibility statements from the top forty most popular U.S. websites was collected. This data revealed that accessibility interpretations among businesses are not uniform. Table 1 displays that a majority of sites (80%) declare they are dedicated to general accessibility which includes websites and other technologies. Some sites mention web accessibility distinctly (65%) and three websites (8%) mentioned color contrast, one of the color-blind accessibility guidelines.

The variance in accessibility statements indicate that businesses do not have the same depth of awareness on what accessibility means. Accessibility is a vast topic that includes accommodating for many categories of disabilities. Accessibility encompasses web accessibility and web accessibility encompasses color-blind accessibility. Categories of accessibility include auditory, speech, cognitive, neurological, physical, and visual disabilities (W3C, 2019). Color blindness is a specific impairment that belongs in the visual category. Only a small percentage of businesses highlighted color in their statements showing that many businesses might not recognize that designing for color-blindness is a part of general accessibility.

Ultimately, each business decides whether to apply web accessibility on the organizational level based first on their awareness of accessibility and how they interpret it. If that awareness is obtained, then businesses may then take into consideration process changes, costs, legal action, and public statements related to web accessibility.

The United States Government – A Regulation Provider

Government interprets the concept of web accessibility from a regulation provider perspective. The U.S. government can provide laws and policies regarding how web accessibility should be applied. Although they hold this power, the government's influence is currently not fully utilized to enforce web accessibility.

Currently, the only federal regulation in the U.S. that mandates web accessibility is Section 508, a part of the Rehabilitation Act of 1973 (Stemler, 2018, para. 1). Section 508 states that all technology funded by federal agencies must be accessible (Stemler, 2018, para. 2). Section 508 are legal mandates that apply explicitly to websites. Thus, federal agencies are pressured to be more accessible than private businesses overall. Businesses are only subject to the less clear and legally hazy American with Disabilities Act (ADA) (Sapega, 2020, para. 5).

<div align="center">

Discussion

</div>

Overall, SCOT provided a framework to explore how various social groups interpret the concept of web accessibility. A range of differing interpretations were identified. Designers are often unempathetic towards web accessibility. Engineers lack education and proficiency in applying web accessibility due to technological barriers. Businesses juggle a variety of considerations such as existing process modification, financial risk or reward, and lawsuit potential. Governments provide regulation but are not influential outside of their sphere.

The common theme among these groups is that there is an extensive lack of awareness on web accessibility. This lack of awareness manifests in several ways. There can be a complete lack of knowledge in the existence of the concept of web accessibility, a lack of awareness on knowledge on how to implement web accessibility, a lack of knowledge on the depth of the term

web accessibility, or combinations of these. Businesses in particular might want to show their users that they care about accessibility through corporate accessibility statements presented on their websites. However, they might be unaware of the wide domain that accessibility covers. For instance, they might not recognize that accessibility encompasses accommodating for people with color-blindness as well.

One can understand why color-blind accessibility prevalence is currently low. Differences in interpretations and awareness of web accessibility makes effective adoption complicated. Due to this, it is expected that color-blind accessibility, an area with less exposure, suffers from the same problems. Moreover, businesses have even less of an incentive to accommodate for color-blindness since color-blind accessibility guidelines such as color contrast errors alone are not large enough of an accessibility issue to be held legally accountable for.

Conclusion

The prevalence of color-blind accessibility can be more solidified in the U.S. if laws such as Section 508 were expanded to businesses. Another route would be adapting the current ADA laws to become clearer on color-blindness. This would apply greater pressure over businesses legally. Increased government enforcement is not unlikely. Canada, another democratically governed country, has passed legislation requiring all public and private websites to be accessible by January 2021 (James, 2020). Furthermore, Section 508 has influenced ten U.S. states to pass technology accessibility legislation at the state level (U.S General Services Administration, n.d.).

The prevalence of color-blind accessibility could also increase if there was more awareness and empathy towards those with color-blindness. As mentioned previously, Novak

16

(2018), who is a designer, had exposure to someone with color-blindness (para. 3). This allowed her to be aware of an experience that she could not comprehend because she was not living every day with a disability or impairment herself. She adopted a more empathetic design approach because of it. I propose that this kind of direct exposure to and resulting empathy towards those with disabilities and impairments is needed among all relevant social groups to advance color-blind accessibility and general web accessibility forward more holistically.

It is easy to consider accessibility as just a concept and detach it from those actually affected by disabilities and/or impairments such as color blindness. In doing so, we lose the empathy needed to drive forward more accessible practices. From this paper, my aim is to spread knowledge about and expand empathy towards color-blind accessibility. Hopefully, the results of increased empathy will bring the mediated versions of websites that color-blind users experience closer to reality.

Works Cited

Alexa Internet. (n.d.). Top sites in the United States [Informational web page]. Retrieved from

    https://www.alexa.com/topsites/countries/US

Ameilucha, S. (2019, May 1). Re: Why it's important for web developers to focus on web

    accessibility [Blog comment]. Retrieved from https://dev.to/flippedcoding/why-it-s-

    important-for-web-developers-to-focus-on-web-accessibility-37n3

Avila, Marc. (2020, January 30). The cost of making your website accessible [Web blog].

    Retrieved from https://www.3mediaweb.com/blog/the-cost-of-making-your-website-

    accessible/

Baritaud, C. (2020, September 19). Bijeker, W. & Pinch, T.J. (1987). The social construction of

    facts and artifacts. [Class reading material]. Retrieved from

    https://collab.its.virginia.edu/access/content/group/832630af-ee03-4e53-9a33-

    88eb585868e8/CDBReadings/Pinch_Bijker_2008.pdf

Boone, R. (2019, October 23). Re: Why are accessible websites so hard to build? [Blog

    comment]. Retrieved from https://css-tricks.com/why-are-accessible-websites-so-hard-to-

    build/

Brophy, P., & Craven, J. (2007). Web accessibility. *Library Trends, 55*, 950-972.

    doi:10.1353/lib.2007.0029

Brown, J., & Hollier, S. (2015). The challenges of Web accessibility: The technical and social

    aspects of a truly universal Web. *First Monday*, *20*. doi: 10.5210/fm.v20i9.6165

Color Blind Awareness. (n.d.) Color blindness [Informational web page]. Retrieved from

    https://www.colourblindawareness.org/colour-blindness/

Crave, J. (2007). Web accessibility: what we have achieved and challenges ahead. *World Library and Information Congress: 74th IFLA General Conference and Council,* 10-14. Retrieved from http://archive.ifla.org/IV/ifla74/papers/086-Craven-en.pdf

Freire, A.P., Russo, C.M., & Fortes, R.P. (2008). A survey on the accessibility awareness of people involved in web development projects in Brazil. *Proceedings of the 2008 international cross-disciplinary conference on Web accessibility.* doi:10.1145/1368044.1368064

Groves, K. (2011). The social factors of website accessibility [Web blog]. Retrieved from https://karlgroves.com/2011/11/04/the-social-factors-of-accessibility

Huang, J., Chen, C., Jen, T., Wang, S. (2009). 2009 IEEE International Conference on Acoustics, Speech and Signal Processing. doi:10.1109/ICASSP.2009.4959795

James, G. (2020, March 31). Why the private sector needs to plan for digital accessibility [Web blog]. Retrieved from https://siteimprove.com/en-us/blog/why-the-private-sector-needs-to-plan-for-digital-accessibility/

Jefferson, L. & Harvey, R. (2006). Accommodating color blind computer users. Proceedings of the 8th International ACM SIGACCESS Conference on Computers and Accessibility. doi:10.1145/1168987.1168996

JP. (2019, October 24). Re: Why are accessible websites so hard to build? [Blog comment]. Retrieved from https://css-tricks.com/why-are-accessible-websites-so-hard-to-build/

Larson, A. (2018, May 8). Is color-blindness a disability for employment under the ADA [Legal web article]. Retrieved from https://www.expertlaw.com/library/employment-and-labor-law/color-blindness-disability-employment-under-ada

Lazar, J., Dudely-Sponaugle, A., & Greenidge, K. (2004). Improving web accessibility: a study of webmaster perceptions. *Computers in Human Behavior, 20,* 269-288. doi: 10.1016/j.chb.2003.10.018

Leitner, M.L., Strauss, C., & Stummer, C. (2014). Web accessibility implementation in private sector organizations: motivations and business impact. *Universal Access in the Information Society*, *15,* 249-260. doi: 10.1007/s10209-014-0380-1

Novak, S. (2018, April 2). Going colorblind: an experiment in empathy and accessibility [Web blog]. Retrieved from https://blog.prototypr.io/going-colorblind-an-experiment-in-empathy-and-accessibility-98b7003737ca

Rivenburgh, K. (2018, November 7). The ADA checklist: website compliance guidelines for 2021 in plain English [Web blog]. Retrieved from https://medium.com/@krisrivenburgh/the-ada-checklist-website-compliance-guidelines-for-2019-in-plain-english-123c1d58fad9

Sapega, M. (2020, March 21). The history of digital accessibility and why it matters [Web log post]. Retrieved from http://www.tpgi.com/the-history-of-digital-accessibility-and-why-it-matters/

Stemler, S. (2018, October 9). Everything you need to know about Section 508 compliance for websites [Web article]. Retrieved from https://www.accessiblemetrics.com/blog/everything-you-need-to-know-about-section-508-compliance-for-websites/

Sutter, J. (2021, April 30). Why Facebook is blue – six facts from Mark Zuckerberg. *CNN*. Retrieved from http://www.cnn.com/

Trewin, S., Cragun, B., Swart, C., Brezin, J., & Richards, J. (2010). Accessibility challenges and tool features: an IBM web developer perspective. *Proceedings of the 2010 international cross-disciplinary conference on Web accessibility.* doi: 10.1145/1805986.1806029

U.S. General Services Administration. (n.d.). State policy [Informational web page]. Retrieved from https://www.section508.gov/manage/laws-and-policies/state

Verbeek, P. (2015). Beyond interaction: a short introduction to mediation theory. *ACM Interactions.* Retrieved from https://core.ac.uk/download/pdf/31151236.pdf

W3C. (2019, June 5). Introduction to web accessibility [Informational web page]. Retrieved from https://www.w3.org/WAI/fundamentals/accessibility-intro/

W3C. (n.d. -a). Guideline 1.4.3 Contrast (Minimum) – Level AA. In How to meet WCAG (quick reference). Retrieved from https://www.w3.org/WAI/WCAG21/quickref/?versions=2.0&currentsidebar=%23col_overview&levels=aaa#contrast-minimum

W3C. (n.d. -b). Guideline 1.4.1 Use of Color – Level A. In How to meet WCAG (quick reference). Retrieved from https://www.w3.org/WAI/WCAG21/quickref/?versions=2.0&currentsidebar=%23col_overview&levels=aaa#use-of-color

We are Colorblind. (n.d.). Interview with Ron Packard Jr, creator of Castle Breakout [Web article]. Retrieved from https://wearecolorblind.com/articles/interview-with-ron-packard-jr-creator-of-castle-breakout/

WebAIM. (2020, March 30). The WebAIM million, an annual accessibility analysis of the top

    1,000,000 home pages [Informational web page]. Retrieved from

    https://webaim.org/projects/million/

WebAIM. (2021, January 9). Contrast and color accessibility [Informational web page].

    Retrieved from https://webaim.org/articles/contrast/

Yesilada, Y., Brajnik, G., Vigo, M., & Harper, S. (2012). Understanding web accessibility and its

    drivers. *Proceedings of the International Cross-Disciplinary Conference on Web*

    Accessibility. doi: 10.1145/2207016.2207027

Zach R. (2019, October 23). Re: Why are accessible websites so hard to build? [Blog comment].

    Retrieved from https://css-tricks.com/why-are-accessible-websites-so-hard-to-build/