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Final Research Paper

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**Preferences of Usability in Web-Based Platforms**

**Introduction**

Color is a complex topic. Everyone sees color differently. It all depends on the cones in their eyes and the processing of that information in their brains [12]. These different experiences with color can affect a person’s preferences in many things - for example food, environment, or clothing. It could even affect the way that someone reacts to an interface and technology. The goal of this research is to see how different color schemes implemented in websites affect preferences in platform usability.

We created two different websites with identical structure and different color schemes. Each subject will use both websites and after each one is explored, the subject will complete a short survey about the websites. Subjects with different knowledge levels and skills, as well as subjects with visual deficiencies, such as colorblindness, are included in the study. The surveys can be used to analyze how color schemes affect user’s learning curve with respect to their performance. In addition to the survey, we want to observe how the user uses the website and extract some conclusions based on their interaction.

In the following section we will discuss some other works that have referenced color and color schemes and their impact on user interfaces. We will then describe our complete experimental design. The last section will talk about our next steps and some potential future research.

**Background**

The effects of how color schemes affect the usability of different interfaces have been greatly studied under different circumstances. How does the aesthetic of websites color schemes affect usability? In Aesthetics and Usability: A Look at Color and Balance, Laurie Brady and Christine Phillips expand on the idea that the visual experience can influence how the viewer interacts with a website [1]. Although, in their study there was not a statistical difference between the different sites that supported their idea that “user satisfaction is related more to successful navigation than aesthetic appearance” [1]. Participants thought that the color scheme was a factor for aesthetic appeal for the site [1].

In “Chameleon: a color-adaptive web browser for mobile OLED displays” Mian Dong and Lin Zhong [2] did an experiment where they explored how different lights affect which colors can be first seen better. OLED is organic light-emitting diode which appear on many mobile devices, but displays are inefficient for showing bright colors. Using OLED technology requires on average less system power consumption for web browsing and is able to reduce display power consumption [2]. Although OLED is not the most aesthetically pleasing, users were still well accepted by users [2]. The type of light being used affects the usability of an interface, but for those who have different visual disabilities are impacted even more.

In “Color Monitoring and Analysis for Color Vision Deficient Individual,” by Heidi Steele, Steele presents the problem that “the reliance on color to indicate critical information may prevent people with color vision deficiencies from effectively appropriately using certain tools.” [3] Steele proposes the use of an application that teaches a display system to use a special color scheme that is more visible for people who have color deficiencies. This system has different kinds of color schemes which can be easily differentiated by all different types of color blind people. [3] Steele also gives examples of the different color schemes and how different elements would be displayed to fit the user needs. [3]

Similar to Steele’s work, Korneluk [4] worked on an invention for people with colorblindness. In his work, ‘Method and Apparatus for Self Adjusting Color Scheme’, he describes his invention, in which people with colorblindness can either specify their type of blindness or take a test that will determine their type of blindness for them [4]. Korneluk’s work is interesting because it focuses not just on red-green colorblindness, which the most common, affecting about 5% of the male population. His work also includes tritanopia and monochromacy. The idea is that this invention can be implemented through hardware, software, or a combination of both [4] to supplement all devices with colored displays. Once a type of colorblindness is discovered or specified, the invention will have the ability to store that data and adjust the color scheme of the displays on the device to suit the user’s needs. A device like this, that could self-adjust the color scheme of a display would be a huge help to people with visual deficiencies.

Picking an appropriate color scheme, however, can be very difficult - especially if one is considering visual deficiencies as they should. Visme, a site that helps customers with visualization, wrote on article entitled “50 Gorgeous Color Schemes From Award-Winning Websites.” As it says in the title, these color schemes were adapted from Awwwards winning sites and provided by Visme to help those who struggle to find the right color scheme for the right design project they are conducting [6]. Awwwards is considered one of the most prestigious awards that can be given to web developers, which is why Visme collected these color schemes to share with those looking to use their services. Because Visme is a company that specializes in visualization, they understand the importance of color and how it can affect the way that people perceive the information placed in front of them [6]. Their emphasis on finding the right color of the right project supports the idea that color schemes can determine whether a user will find an interface usable or not.

As we stated before, it is important to remember that colors hold relative characteristics [12]. These characteristics can influence a user’s impression of the color and the action that may follow because of it [12]. In “Affect of color interface on accuracy and speed of operations,” Suto et al. examined the relationship between color and simple operations on electronic devices. They conducted two experiments to test the speed and accuracy of participants, using only variations of the primary subtractive colors [12] - red, blue and yellow. The first experiment asked participants to select the correct translation of a simple word on the screen. This test was conducted with 4 different sets of colored buttons. The end results showed that when the buttons were colored blue participants selected the correct answer more often [12].

In the second experiment, Suto et al. looked at the way that coloration, basically color scheme, affected the way that participants complete a simple math problem [12]. For this experiment, 6 colorations were created, each with 3 colors. From these tests, it was found that participants answered correctly when presented with what they classified as the formal coloration - consisting of a neutral color, a purple-blue color, and a blue-green color [12]. The interesting find in both of these experiments is that the color blue, which is supposed to represent calm, out performed the other subtractive colors.

Another important factor to consider is if users have different types of disabilities. In “Good Background Colors for Readers: A Study of People with and without Dyslexia”by Luz Rello, Rello explains the effectiveness of different background colors can affect the readability of interface[11]. Rello’s results show “that using certain background colors have a sig­nificant impact on people with and without dyslexia” [11].

There are physical properties that affect how users interact with computers, but another important factor to consider is one’s emotions. In “A Review on the Role of Color and Light in Affective Computing,” by Marina V. Sokolova and Antonio Fernández-Caballero, they study the “importance of light and color from demographic, gender and cultural perspectives” [8]. The different considerations about background of users can help create an interface that is more widely accepted and have a broad user population. Although, there is dispute if “there exists universal emotions shared by all humans, independently of their cultural background” [10]. Effective computing relates to how effectively computers can influence our emotions [9]. These different perspectives mean that interactions with computers are not solely based on the usability of the interface, but also computers can influence our behavior which can change how a user interacts with an interface. When we were designing our project, we tried to take all these different factors into account.

**Experimental Design**

There are many factors in considering what is affecting usability of websites and other interfaces. In our experiment, we will be using the same computer to minimize external factors such as different lights used for computers, and we will also be using the same lay out for each website. Since we used the same layout for our websites, we will be able to see more directly if different color schemes affect usability of website interfaces.

The experimental design is rather simple. As stated in the introduction, the goal of the experiment is to test how color schemes directly affect a user’s sense of usability when it comes to the UI they are interacting with. We hypothesize that color schemes directly affect whether or not a user finds an interface usable and prefers to keep using it. To test our theory, we centered the experiment around a user’s interaction with two websites. In addition to the home page, we added an about page, a contact page, and a team page for the users to navigate. The websites were created using a third party application and editor, [wordpress.com](http://wordpress.com), which allowed us to guarantee that the base layout of both websites would be identical in all aspects, except for their designated color schemes. Because we were concerned with identical content, as well as identical layout, we stuck with the provided company information on the layout pages that we used from wordpress.com.

Looking at just some basic color scheme information found online, we were able to determine which color schemes we wanted to work with for this project. We also found an interesting article that talked about designing a display for those with colorblindness [7]. This article was helpful in choosing both of our color schemes, because we did not want colorblindness to be a factor that could skew the data. Based on Visme’s research [6], we grabbed what is to be considered a “good” color scheme for the first website. Entitled “Blue and Refreshing”, we went for a color scheme that had complimentary shades of blue and grey in which we could represent our selected website data. As for the “bad” color scheme, we were able to find some articles [5][7] online that gave suggestions on colors not to use together when building user interfaces or advertisements. From this we adapted an interface that used one or more of these “bad” color combinations in the website to see if the user experience would be different.

During the experiment, a participant was randomly assigned to interact with one of the two websites first. We made this assignment random to help eliminate bias that could arise if we showed the websites in the same order to every participant. All participants, also, did the experiment on the same computer so that measurements such as screen quality and resolution would not cause variability in the results. The participant was asked to interact with the website for 10 minutes. Interactions were times to guarantee equal interacting with the websites. After their session, the participant was asked to complete a paper survey that asked them questions about their interaction with the website. The last question asks them to rate the overall usability of the site. The participants were then given a 15-20 minute break where they could walk around, use their mobile devices, etc. This break was intended to help the user forget about the website that they had just interacted with, in the hopes that they would not realize immediately that the sites were exactly the same. After the break, the participant was then asked to interact with the second website for 10 minutes, and again complete the paper survey about usability. Once they completed the second survey, the participants were allowed to leave and their survey answers were used to see whether or not color scheme has a direct correlation to interface usability.

**Next Steps and Future Work**

The next step would be to conduct the study as planned. We hope that the collection of data from this study will be able to tell us whether or not color schemes really do affect how a user feels about the overall usability of a website or other application. By repeating this study many times, with different color schemes, we could eventually understand what color schemes are preferred among most people. To get the best understanding of universal preferences, this study should be done with a larger pool of participants. Because we are on a university campus, our target audience, for participants, was college students, roughly ages 18-25. The outcome of performing this study more times could be a shareable color guide to help developers create user interfaces that are best received by users, helping to promote the usage of their applications or websites.

Besides repeating this study, other future work could be done to see how color schemes and layout overlap, when it comes to the preferred user interfaces for devices. For our study, we used a pre-generated layout that we thought was “user friendly” and focused on changing the color scheme. This was so that we could be sure the color scheme was the only thing swaying the opinion of participants. It would be interesting, however, to see if using a more “user friendly” layout with a poor color scheme would be preferred to a less “user friendly” layout with an optimal color scheme. It is also worth noting that this study was only intended to be conducted on a web-based platform and should be studied on other platforms to see if the theory holds for different interface sizes and designs.

The color scheme, although it may not seem like it, is a very complex part of the development of a user interface. Just the slightest of changes could mean that more people are using and suggesting one platform over another. While the suggested future works above are interesting, and important, they are not the only studies that can be done. There is so much more to understand about color schemes, people, and platform preferences that should be explored and we hope that our work contributes to the knowledge of this fascinating subject.

**References**

[1] Chaparro, Barbara S., et al. *Aesthetics and Usability: A Look at Color and Balance*. 2003.

[2] Dong, Mian, and Lin Zhong. “Chameleon: A Color-Adaptive Web Browser for Mobile OLED Displays.” *Proceedings of the 9th International Conference on Mobile Systems, Applications, and Services*, ACM, 2011, pp. 85–98. *ACM Digital Library*, doi:[10.1145/1999995.2000004](https://doi.org/10.1145/1999995.2000004).

[3] Steele, Heidi, and Hekmatpour To. “COLOR VISION DEFICIENT INDIVIDUALS.” 13. Print.

[4] Korneluk, Jose Eduardo. *SELF-ADJUSTING COLOR SCHEME*. p. 8.

[5]“10 Troublesome Colors to Avoid In Your Advertising.” *SitePoint*, 8 May 2013,<https://www.sitepoint.com/10-troublesome-colors-to-avoid-in-your-advertising/>.

[6]“50 Gorgeous Color Schemes From Award-Winning Websites.” *Visual Learning Center by Visme*,<https://visme.co/blog/website-color-schemes/>. Accessed 26 Nov. 2019.

[7] “How to Design for Color Blindness.” *The Latest Voice of Customer and CX Trends | Usabilla Blog*, 17 Jan. 2017,<https://usabilla.com/blog/how-to-design-for-color-blindness/>.

[8] Sokolova, Marina, and Antonio Fernández-Caballero. “A Review on the Role of Color and Light in Affective Computing.” *Applied Sciences*, vol. 5, no. 3, Aug. 2015, pp. 275–93. *DOI.org (Crossref)*, doi:[10.3390/app5030275](https://doi.org/10.3390/app5030275).

[9] Picard, R.Affective Computing; The MIT Press: Cambridge, MA, USA, 1997

[10] Ekman, P.; Friesen, W.; O’Sullivan, M.; Chan, A.; Diacoyanni-Tarlatzis, I.; Heider, K.; Tzavaras, A.Universals and cultural differences in the judgment of facial expressions of emotion.J. Personal.Soc. Psychol.1987,53, 712–717.

[11] Rello, Luz, and Jeffrey P. Bigham. “Good Background Colors for Readers: A Study of People with and without Dyslexia.” *Proceedings of the 19th International ACM*

*SIGACCESS Conference on Computers and Accessibility - ASSETS ’17*, ACM Press, 2017, pp. 72–80. *DOI.org (Crossref)*, doi:[10.1145/3132525.3132546](https://doi.org/10.1145/3132525.3132546).

[12] Suto, Hidetsugu, et al. “Affect of Color of Interface on Accuracy and Speed of Operations.” *2009 International Conference on Biometrics and Kansei Engineering*, 2009, pp. 201–04. *IEEE Xplore*, doi:[10.1109/ICBAKE.2009.23](https://doi.org/10.1109/ICBAKE.2009.23).

**Appendix**

Unfortunately, we were not able to conduct our research study, because we were not able to complete the Institutional Review Board (IRB) form process before the end of the semester. The Research Administration Offices at our school were almost unreachable during the time when we were trying to compile all the necessary paperwork for our IRB form. The web-based administration system that they use, Cayuse, was also hard to use and provided inefficient information for first time applicants. The inaccessibility of the Research Offices prevented our team from getting access to the proper Financial Conflict of Interest forms as well as prevented on of our team members from being able to sign up for a required training course. These two limitations prevented us from being able to submit our IRB form for review and ultimately hindered us from completing our research all together. In the future, if working with the Research Offices, our team will know to get on top of the process as soon as possible, and hopefully find a reliable contact in the office who will be able to get us the help we need when we need it.