

An Eye-tracking Study: Investigating the Impact of Website Theme Colors on Viewer Engagement

Chao Hsuan, YU

Abstract:

The Internet's rapid evolution has transformed the media landscape, prompting brands and companies to transition from traditional print and TV to online media. Enhancing website design has become a focal point for effectively conveying information and capturing users' attention. Among the various elements involved, the choice of web page theme color stands out as a crucial visual component in web navigation, significantly impacting the viewer's user experience. Investigating the influence of web page colors on viewer attention is imperative. This study employs eye-tracking technology to delve into the impact of diverse web page colors on participants' attention, particularly on news websites. An eye tracker was employed to meticulously record participants' gaze patterns while browsing by experimenting with new pages featuring distinct theme colors. Data analysis revealed that red and blue colors garnered the most attention from viewers, followed by yellow, while gray-themed sites performed the least effectively in this regard. These findings offer valuable insights for web design improvement. In the context of news websites, red and blue are particularly effective in capturing and guiding people's attention. When emphasizing or conveying breaking news, incorporating blue or red icons or relevant elements can be a powerful means of communication; however, it is equally important to be mindful of the potential for viewer visual fatigue when using highly saturated colors over a significant area. Therefore, designers must exercise care in determining the color balance when employing high-contrast and high-saturation hues.

Keywords: eye-tracking, website design, theme color, attention, user experience

Introduction:

In the ever-evolving digital landscape, websites have seamlessly woven themselves into the fabric of our daily existence (Waykar, 2020). In the 21st century, propelled by rapid technological advancements and the information age, the Internet, a quintessential product of high-tech and interactive information media, has established itself as a fundamental and irreplaceable element of human life. The expansion of network technology has effectively bridged the digital divide, giving birth to intricate systems and structures of online communication, thus solidifying its status as the fourth medium in the evolution of media, following in the footsteps of newspapers, radio, and television (Yi Qing & Li Jing, 2020). As websites continue to flourish, website design demands have reached new heights. Countless endeavors have been undertaken to enhance various aspects of websites, encompassing functionality, aesthetics, and more. Yet, the paramount question that media companies and website owners ponder revolves around attracting and guiding users while navigating websites (Li, 2005). Using color on a website transcends mere aesthetics; it is a pivotal factor influencing user perceptions, emotions, interactions, and overall engagement with the content. Colors can evoke specific feelings (JIN Design, 2023), establish brand identity, and significantly shape user decision-making

processes. Investigating the psychological ramifications of font color in web design can thus yield invaluable insights into creating websites that captivate, inform, and retain users.

In the growing emphasis on user experience and human-computer interaction, eye-trackers have gradually emerged as indispensable tools for web designers to evaluate the effectiveness of their designs (Ding, 2014). Using eye trackers to trace users' visual journeys across websites equips designers with the ability to tailor designs to cater to consumer preferences more precisely. The current body of research comprises numerous studies employing eye trackers to assess various aspects of web design, from page layout to the positioning and form of advertisements (Shi, 2008; Bai, 2008; Cheng, 2007). This study deviates its focus towards a distinct facet of website design – theme colors. This study endeavors to identify which theme colors effectively capture users' attention. Furthermore, theme colors, essential messages, or key elements are typically employed in the navigation bar. By comparing the allocation of attention across different colors, this study also seeks to unveil whether webpages can effectively leverage colors to guide users' attention toward delivering essential messages. Utilizing an eye tracker, it can meticulously document users' gaze patterns as they navigate news websites featuring a

spectrum of theme colors. The eye-tracking data will yield quantifiable insights into users' attention allocation, while subsequent statistical analyses will illuminate how users distribute their attention in the context of varying theme colors. This study has the potential to facilitate website design by offering valuable insights, especially for news websites, where attracting and guiding users' attention is of paramount importance, with colors serving as a potent tool in this endeavor.

Methods

2.1 Participants

A total of 20 individuals, consisting of 10 males and 10 females, with an average age of 30.15 years ($SD=15.08$), were randomly recruited for this study. They were divided into two groups to observe web pages featuring distinct theme colors. All participants were presented with and read the informed consent form, subsequently providing their voluntary participation consent.

2.2 Stimuli

To maintain the blind nature of this experiment, participants were categorized into two groups, namely Group A and Group B. Group A was presented with two web pages featuring red and blue theme colors, respectively. At the same time, Group B was exposed to two web pages showcasing yellow and gray theme colors. Each web page exhibited similar content and layout. Additionally, an unrelated webpage was included between the two stimuli in each group to introduce an element of distraction during the trials. Consequently, four stimuli were utilized, each representing the red, blue, gray, and yellow theme colors.

2.3 Design and Procedure

Participants were randomly assigned to either Group A or B, with each group instructed to explore web pages displaying the designated theme colors. The initial step involved presenting participants with the informed consent form for their review. Upon voluntary agreement to participate, participants provided their signatures. Subsequently, they were seated in front of a screen equipped with an eye-tracking device (Tobii 4C), connected to a laptop overseeing the experimental process.

During the experiment, Group B sequentially viewed web pages featuring gray and yellow theme colors, while Group A was exposed to web pages highlighting red and blue themes. The eye-tracking device diligently recorded participants' eye movements throughout the process. Demographic information was gathered after the experiment concluded, and participants received gifts as expressions of gratitude. The entire experimental session

took approximately five to ten minutes. The regions featuring different theme colors were identified as Areas of Interest (AOIs). Post-experiment, eye movement data pertaining to these AOIs were extracted for all participants, encompassing First Fixation Duration (FFD), Total Fixation Duration (TFD), and Fixation Count (FC).

2.4 Data Analysis

A single-factor analysis of variance (ANOVA) for FFD, TFD, and FC was conducted across the four sites to ascertain the impact of site color on viewer browsing behavior. Furthermore, pairwise t-tests were performed to elucidate specific differences between the sites. These analyses aimed to delineate the influence of theme color on viewer browsing patterns.

Results

3.1 Analysis of Total Fixation Duration

As shown in Table 1, the results of a single-factor ANOVA analysis indicate that there are significant differences in participants' Total Fixation Duration (TFD) when exposed to web pages of different theme colors ($F = 3.06$, $p < 0.05$). Subsequent T-tests reveal that TFD between the red and blue web pages ($M = 1.79$, $SD = 1.37$) shows no significant difference ($t = 1.73$, $p > 0.05$). Similarly, the TFD between the gray web page ($M = 0.61$, $SD = 0.93$) and the yellow web page ($M = 1.04$, $SD = 1.09$) also exhibits no significant difference ($t = 1.73$, $p > 0.05$). However, it's worth noting that the TFD for the red and blue web pages is significantly higher than that for the gray and yellow web pages ($t = 1.75$, $p < 0.05$; $t = 1.74$, $p < 0.05$; $t = 1.73$, $p < 0.05$).

3.2 Analysis of Fixation Count (FC)

As indicated in Table 1, a single-factor ANOVA analysis demonstrates that participants exhibit significantly different Fixation Counts (FC) when viewing web pages with different theme colors ($F = 1.94$, $p < 0.05$). Subsequent T-tests reveal that there is no significant difference ($t = 1.72$, $p > 0.05$) in FC between the red web page ($M = 6.18$, $SD = 4.49$) and the blue web page. Similarly, the FC between the gray web page ($M = 3.00$, $SD = 2.83$) and the yellow web page ($M = 4.20$, $SD = 3.58$) also displays no significant difference ($t = 1.74$, $p > 0.05$). However, it's essential to highlight that the FC for the red and blue web pages is significantly higher than that for the gray and yellow web pages ($t = 1.73$, $p < 0.05$; $t = 1.74$, $p < 0.05$; $t = 1.74$, $p < 0.05$).

3.3 Analysis of First Fixation Duration (FFD)

Table 1 presents the outcomes of a single-factor ANOVA analysis, which indicates that participants have significantly different First Fixation Durations (FFD)

when exposed to web pages with varying theme colors ($F = 2.60, p < 0.05$). Subsequent T-tests reveal that there is no significant difference ($t = 1.73, p > 0.05$) in FFD between the red web page ($M = 0.25, SD = 0.14$) and the blue web page ($M = 0.24, SD = 0.11$). Similarly, the FFD between the gray web page ($M = 0.13, SD = 0.15$) and the

yellow web page ($M = 0.14, SD = 0.10$) also exhibits no significant difference ($t = 1.75, p > 0.05$). However, it is important to note that the FFD for the red and blue web pages is significantly higher than that for the gray and yellow web pages ($t = 1.73, p < 0.05$; $t = 1.74, p < 0.05$; $t = 1.73, p < 0.05$; $t = 1.75, p < 0.05$).

Table Result of TFD and FC for Red, Gray, Blue, and Yellow

	RED	GRAY	BLUE	YELLOW
TFD(s)	1.86	0.61	1.79	1.04
FC(freq)	6.18	3.00	6.55	4.20
FFD(s)	0.25	0.13	0.24	0.14

Discussion

This study aimed to investigate how webpage theme colors influence people’s viewing behavior, using red, blue, gray, and yellow as stimuli. Two participants were involved, with Group A viewing webpages featuring red and blue themes and Group B viewing yellow and gray themes. The eye tracker recorded participants’ viewing process, providing quantitative results. The first Fixation Duration indicates how the theme color could capture viewers’ initial attention. Total Fixation Duration and Fixation Counts reveal viewers’ overall attention allocation during the process. The analysis revealed that red and blue theme websites initially captured participants’ attention with the highest First Fixation Duration (FFD) values. In contrast, gray and yellow themes did not attract much initial attention. This pattern continued throughout the viewing process, with red and blue themes accumulating more Total Fixation Duration (TFD) and Fixation Counts (FC) than yellow and gray. Heat map data also support the results.

Color psychology posits that different colors stimulate various responses in the brain, affecting emotions, attitudes, behaviors, attention, and cognition (Wang, 2023). For example, red is associated with strong emotions, passion, love, and vitality, making it eye-catching and attention-grabbing. In contrast, blue conveys calmness, trust, and professionalism, appealing to those seeking reliability and stability. Yellow represents happiness, creativity, and optimism, while gray is often associated with dullness and sadness (Chen, 2023). Red and blue are prevalent colors on news pages, with over 80% of news websites employing them as primary hues (Gu, 2018). News sites opt for these colors to maintain an authoritative and reliable image while avoiding reader disinterest due to excessive rigidity. Red is a suitable choice for official websites in China as it exudes a sense

of national authority. Dark blue imparts a solemn and calm ambiance. At the same time, blue could reduce visual fatigue caused by excessive red. Hence, it fits the official police bulletins’ background color (Li, 2021). The findings from this study align with these color choices, confirming that red and blue effectively capture viewer attention and are well-suited to news websites. Color combinations influence reading efficiency, and different colors suit distinct purposes. Zhang (2006) discovered that black and white contrasts strongly and is eye-catching but can lead to reader fatigue. Red enhances memorization, and blue is conducive to teaching. In this context, red and blue are well-suited for news pages as they draw the reader’s eye. Despite this, certain websites adopt yellow or gray themes. However, gray and yellow news webpages did not engage participants significantly in this experiment. The likely reason is that gray and yellow fall within the light color spectrum, making them less distinct compared to white backgrounds and providing lower contrast. Red and blue against a white backdrop create high-contrast color combinations that are more effective at capturing viewers’ attention (Daktronics, 2014).

Despite this, certain websites choose to implement yellow or gray themes for their web pages. However, the experimental results revealed that gray and yellow news webpages failed to engage the participants significantly. This diminished engagement could be attributed to the fact that gray and yellow are situated within the light color spectrum, causing them to blend less conspicuously with white backgrounds and resulting in a lower degree of contrast. In contrast, when set against a white backdrop, red and blue evoke high-contrast color combinations, which have proven to be more adept at capturing and retaining viewers’ attention, as suggested by previous research findings (Daktronics, 2014). The choice of webpage theme color plays a significant role in grabbing attention and affects the user’s overall experience.

Designers should thus take into account the potential impact of color choices on visual appeal and readability when designing webpages for different purposes.

Conclusion

This study investigated how different web page theme colors impact viewers' attention, yielding quantitative insights into color preferences. The findings indicate that viewers tend to be more attentive to webpages with blue and red themes, reflected in higher First Fixation Duration (FFD), Total Fixation Duration (TFD), and Fixation Count (FC). Meanwhile, these colors can effectively guide viewers' attention during their navigation. On the other hand, gray and yellow themes appear less appealing in comparison. These results offer valuable design considerations. Red and blue favor webpage theme colors, particularly for news websites. It is essential to be mindful of color saturation, as excessive use of highly saturated colors across a large area can lead to viewer visual fatigue. Therefore, designers should carefully balance color proportions when employing high-contrast and high-saturation hues.

Reference

Bai Xuejun, Gong Zhun, Yang Haibo and Tian Jin (2008). Eye Movement Assessment of the Impact of Location and Content on Web Advertising Effectiveness Applied Psychology (03), 208-212+219

Chen, Hu & Zong, Xiaomeng. (2023). Refining the application of color in cognitive psychology based on color psychology. Popular Color (03),57-59.

Cheng Li, Yang Zhiliang&Wang Xinfu (2007). Eye Movement Research on Web Advertising with Different Presentation Methods Psychological Science (03), 584-587+591. doi: 10.16719/j.cnki.1671-6981.2007.03.016

Daktronics. (2014). Choose High-Contrast Colors So Your Messages Get Read. Daktronics.com.

Ding Yi, Guo Fu, Hu Mingcai,&Sun Fengliang (2014) A review of research on user experience both domestically and internationally Industrial Engineering and Management, 19 (4), 7

Gu Yan (2018) Visual design of news web pages News Front (12X), 2

JIN Design. (2023, March 25). The Role of Emotion in Web Design: Designing Websites That Evoke Positive Emotional Responses From Users | JIN Design. Jin Design. <https://jin-design.com/role-of-emotion-web-design/>

Li Runtong (2012) Design of a visual recognition system for news web pages Technology Communication (8), 2

Li Zhuo (2005) Cognitive psychology and artistic design concepts in web design (Doctoral dissertation, Jilin University)

Sengupta, A., Halder, A., Biswas, S., Saha, S., & Dutta, T. (2020). International Journal of Scientific Advances Impact of Age on Color Choice/Preference. <https://pdfs.semanticscholar.org/82d2/e015442770a819e5dfa05b4d044959b5aea0.pdf>

Shi Jinfu, Cao Xiaohua, Wang Gang&Qu Bin (2008). Eye Movement Study on the Impact of Web Page Layout on Visual Search Ergonomics (04), 1-3. doi: 10.13837/j.issn.1006-8309.2008.04.008

Wang, Hua Lei. (2023). Application of color psychology in graphic poster design. Textile Report (07), 61-63.

Waykar, S. (2020, July 27). Importance of Website. Infidigit - SEO Company in India; Infidigit. <https://www.infidigit.com/blog/importance-of-website/>

Yi Qing & Li Jing (2020) The Fourth Wall: The Integration Process of Traditional Media from a Media Perspective Press (04), 57-64. doi: 10.15897/j.cnki.cn51-1046/g2.20200513.006

Zhang Xiaoman (2006) Eye Movement Research on Color Matching of Web Page Text (Doctoral dissertation, Zhejiang Normal University)