

Differences Between Males and Females on Color Perception

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Gender and color perception: humans have a lot of similarities, but they do have their own differences on a biological level. The perception of colors might differ from gender to gender based on a lot of different factors. Social norms, stereotypes, and cultural differences are considered outside factors, but on a biological level, such as hormones, sensitivity, and color ranges, studies have shown some interesting results for both males and females. Acknowledging different insights from the research findings may lead to more user-centered designs and a better understanding for designers.

The field of human-computer interaction has been developing for a long time. The user experience of digital interfaces has a strong connection with color perception. Colors are a crucial factor in how humans understand what they perceive. It can drive attention, change emotions, and influence actions. HCI designers always try to find the best combination to achieve the goal of user satisfaction. The more they understand how users perceive and react to it, the closer they get to their goal, which is always to fulfill the user's needs by giving an equitable design to everyone.

The impact of understanding color perception on the user experience is huge. It can influence how users interact with digital interfaces in many different ways, provide better accessibility when it comes to contrast and readability, and provide a better hierarchy to organize the importance of elements for users. All of these were just a few of the many benefits of understanding how genders perceive colors. The goal at the end for designers is to have an equitable design that adds more inclusiveness and satisfaction to the users.

Literature Review

Gender Differences in Color Perception

There are many studies about gender differences in color perception that agree and disagree on the results of each. Most people say females are better at dealing with colors, and some say that there are no differences. Most of the time, our color choices are influenced by our cultural backgrounds or experiences, but will some of them be related to biological factors? The following research has different answers, and hopefully it can provide an insight on how these complex choices of colors are shaped to enhance the experience of the users in the future.

Investigation of gender perception differences in color combinations

In today's world, everyone uses digital interfaces either at work, home, or school. The field of human-computer interaction is growing to increase and understand the users in order to build better interfaces overall. According to (Yaying et al., 2023) They have done a study on driving head-up displays (HUDs), testing them in six different scenarios on both males and females to explore their cognitive abilities. The purpose of this study was to help designers understand how genders perceive colors and improve the safety of color systems in HUD.

Eye-tracking technology in simulated driving scenarios.

Eye-tracking technology was deployed in the simulated driving scenarios to investigate the eye reaction and cognitive behavior while doing the task. Participants were asked a couple questions, like what the current speed on the HUD is based on the different scenarios for the first experiment. For the second experiment, they were tested using six different color combinations related to the original color scheme; after that, they were asked to rate the speed to record the results.

Different focus of men and women on color ranges.

The results of the experiments did not show a hugely significant difference. In some scenarios, like weather and geographic locations, there were some differences in visual search performance and cognitive efficiency between genders, as males tend to focus on colors in a range between green and orange, while females are more focused on colors between red and yellow (Yaying et al., 2023).

Exploration of color choices for Visual Stress treatment

Visual stress (VS) is a real thing, and the answers to help patients who suffer from it can be complex based on different factors. As in psychology, there are colors that help us calm and some that make us more active. A study on VS was conducted to see if gender is a factor in the selection of color treatment for VS. They used colored overlays and precision-tinted lenses (PTLs) to see how different genders would react (Conway et al., 2016).

Influence of gender on overlay and tinted lens color preference

Based on previous research on color preference, the study categorized colors as male, female, and neutral. The study found that gender does not influence color choice in the treatment, as there were no significant differences in color choice between male and female participants, suggesting that gender may not be a factor in choosing color for lids or PTLs to reduce visual stress symptoms. However, the study found that some patients choice of PTL was based on gender influence (Conway et al., 2016).

Gender differences in blog user satisfaction and visual design

As everything revolves around the web these days, user satisfaction is important. A study was conducted by (Cho, & Hong, S.-J, 2013) from Korea University on blog user satisfaction and gender differences. There were no huge differences in the information quality, as everyone

seemed to navigate through the blogs normally. However, there were some gender differences in the responses to the visuals. It was suggested that web design should focus on the end-user, while in the case of gender-related products, they can separate them with different content.

Selective attention to colors by females

The results of the study found that females have the tendency to get more attracted to blogs with more colors and decorations, as they find them more useful that way, while males prefer more casual, minimal designs, as they find them more useful that way. Overall, the study agrees that the satisfaction of the user for the blog's visual design is affected by the visual design and gender (Cho, & Hong, S.-J, 2013).

Focus on peripheral color vision differences between sexes

Peripheral vision is the vision that is outside the area of our vision field, away from the center of focus. The human peripheral vision has fewer details and is more about detecting motions. A study was done on peripheral vision between sexes by testing their color vision deficiency through the Farnsworth-Munsell 100-Hue test and a color matching paradigm (Murray et al., 2012). The study found that females had less saturation loss than males ($p < 0.003$) in the green-yellow levels, which resulted in females having better color perception ability than males in the peripheral visual field.

Analysis of cross-cultural data

A world survey study on colors was done by (Fider et al., 2019) about human color preferences, color perception, and color lexicon. The study used cross-cultural data from the

World Color Survey (WCS) and accurate mathematical methods to analyze the way males and females categorize color stimuli.

Differences in color categorization between males and females

The cross-cultural data that was provided showed a significant difference between the genders in categorizing colors. Females isolate green and/or blue, and males tend to use the grue (Green-Blue) category. The study says that these differences might be related to different factors, such as physiological, with women having lower macular pigment levels. It was suggested that gender plays a role in color perception and language and that these findings could have implications for fields such as marketing, design, and psychology. However, the exact reasons for the differences in color categorization between males and females are still not fully understood and require further research (Fider et al., 2019).

Gender Preferences in Lighting and Color Temperature

As it was mentioned earlier in the article, gender differences in color perception can be influenced by a variety of factors. This section analyzes how males and females perceive colors in different temperatures and lighting conditions. Different research was done to examine whether weather lighting and color temperature influence decision-making and whether these reactions reveal underlying biological reasons for gender-based differences.

Investigation into gender preferences in LED light color temperature

An autopilot study (Huang et al., 2022) was conducted on the LED light in the cabin. Male and female participants were involved in order to analyze the behavior of both to reduce visual fatigue. According to the study, both genders showed different results based on the color

temperature in connection with LED lights in the cabin. “Women preferred 3500K white light, and men preferred cooler than 5000K light during daytime in summer, while women preferred 3000K warm white light and men preferred 4000K cool white light during nighttime” (Huang et al., 2022). The results provide new ideas and implications for differences in light and gender preferences in specific conditions, as well as new ideas to customize the autopilot cabins.

Exploration of color appearance in monochromatic lights

Monochromatic lights are lights with only one or a specific wavelength of light. It is of interest to examine how gender differences affect color perception in response to monochromatic lights. It shows that males generally need longer wavelengths to perceive colors, while females need shorter wavelengths across the spectrum (Abramov et al., 2012).

Differences in hue sensation based on testosterone receptors

Single hues' locations don't line up with anomaloscope data (a color vision testing method in the study) matches, indicating influences beyond L- and M-cones. Wavelength discrimination functions show males have broader but worse discrimination in the middle spectrum. Based on the evidence, it was suggested that testosterone likely plays a role in shaping human neurons, and this may impact how individuals process and perceive colors (Abramov et al., 2012).

Study of biological components of sex differences in color preference

In the study of biological components (Hurlbert & Ling 2007), there was an investigation about the differences in color preferences between genders. Data from British and Chinese subjects was analyzed, and based on that, there were some gender preferences on the hue. Females preferred a more reddish contrast, but males did the opposite.

Influence of neural dimensions and personal experiences

A method of a forced-choice color task influenced the neural dimensions and experience of the preferred color. By analyzing controlled stimuli, the research identifies two key physiological weights representing blue-yellow and red-green contrast components in individual hue preferences. Especially, a consistent sex difference emerges in the red-green weights, with females favoring reddish contrasts and males the opposite, as mentioned earlier. The study suggests that these preferences may relate to sex-specific reasons and the role of color vision. This highlights the complicated relationship between neural dimensions, biological factors, and cultural influences in shaping color preferences (Hurlbert & Ling 2007).

Conclusion

Summary of Findings

Gender differences in color perception do exist on a biological level, influenced by factors such as hormones, sensitivity, and color ranges. Despite cultural influences such as social norms and stereotypes, research suggests that males and females have a noticeable difference. These differences could lead to more user centered designs in human-computer interaction. The impact of understanding color perception on user experience is important, influencing interactions with digital interfaces, enhancing accessibility, readability, and providing a better hierarchy of elements. Studies exploring genders color preferences reveal different insights, contributing to a broad understanding of the complex relationship between biological factors and cultural influences in shaping color preferences. Finally, even though the research field about genders and colors might show some promising results. On the other hand, it still needs further research and experiments to determine weather or not these results should be considered.

Implications for user experience and HCI design

Understanding gender differences in color perception has great implications for user experience and HCI design. HCI designers have an important role in optimizing the user interface by considering gender specific color preferences. The findings suggest that making digital interfaces to accommodate diverse color perceptions can significantly enhance user satisfaction. From color choices in blog design to the development of driving head-up displays to enhancing safety in autopilots cabin, recognizing and accommodating gender specific differences in color preferences can lead to more inclusive and equitable designs.

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