Fifty shades of web design: A study on gender differences in color preferences regarding perceived aesthetics and usability in web design.

Abstract

Previous research has found evidence for the importance of color use in web design, the impact of color use on the perceived aesthetics of websites and the influence that both color use and aesthetics can have on the perceived usability of a website. Although there have been mixed results, research has also found differences between genders in their perception and preferences regarding websites. During this research, three studies have been conducted in order to examine the gender differences in color preferences regarding perceived aesthetics and perceived usability in web design. The first study has shown minimal differences between men and women regarding their color preferences. Interestingly, the second study showed that both men and women preferred the women-colors over the men-colors. Finally, the third study examined the effect of five color conditions and gender on the perceived aesthetics and perceived usability of a website. Little to no statistically significant effects were found, but it yielded some interesting findings nonetheless.

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1. Introduction

1.1 Color use, aesthetics, and usability in web design

Many visual stimuli we encounter as a human contain color information, which is subsequently processed by our visual and cognitive systems. This color information, such as hue, brightness, and saturation can, among other things, have an impact on our emotional reactions or behavioral intentions (Valdez & Mehrabian, 1994; Cyr, Head & Larios, 2010). This impact on emotional reactions or behavioral intentions manifests itself in user trust and engagement or buying behavior (Pieters, Warlop & Wedel, 2002). The influence of color use by brands on the attitude and expectations toward these brands by customers is well-known. Most research regarding color use by brands has focused on print or other media, with less regard to websites. However, various studies have found an influence of color use on a users' perception of the website (Simon, 2001; Coursaris, Swierenga & Watrall; 2008; Cyr et al., 2010). Besides being a determinant for website trust and satisfaction (Cyr et al., 2010), various studies found that color use also has an effect on the perceived aesthetic appeal of a website (Papachristos, Tselios & Avouris, 2005). Research has pointed out that on one hand, an objective screen-design-based approach, and on the other hand a subjective questionnaire-based approach, can be used to measure visual aesthetics of user interfaces (Seckler, Opwis & Tuch, 2015). The second approach is the most interesting regarding color use, since it focuses on the users' subjective perception of aesthetics and uses "colorfulness" as a facet which represents aesthetic impressions perceived from the selection, placement, and combination of colors (Altaboli & Lin, 2011).

Besides the overall impact of color use on the perception of a website, a few studies have given useful insights on which colors website users preferred. Overall, the color blue seemed to be the most preferred color, whereas green was the least preferred color (Fortmann-Roe, 2011). A study by Bonnardel, Piolat and Le Bigot (2011) has shown that users of a website mainly prefer the use of blue, orange or grey. It is interesting to see that the colors blue and orange were mostly preferred, since previous research found more favorable perceptions towards cool color combinations, as opposed to warm color combinations (Coursaris et al., 2008). To clarify, Coursaris and colleagues (2008) have defined warm colors as those that fall in the spectrum between red and yellow, with orange as the secondary by-product, and have defined cool colors as those that center around blue, with green and purple as the secondary by-products. In this current research, the same definition for both warm and cold colors will be used. Besides the overall information as to which colors users preferred the most, the study by Coursaris and colleagues (2008) has given more insight in the placement of specific color components on a webpage. They found that split-complementary color schemes which used a cool primary color for the top or global part of the page, and subsequently used either another cool color or a warm color for the secondary page components, resulted in a color balance that users found most aesthetically pleasing. Furthermore, they found that users found the combination of both a warm primary color and a warm secondary color least aesthetically pleasing.

Previous research not only shows an impact of color use on the perceived aesthetics of a website. Various studies have found that both color use and aesthetics can influence the perceived usability of a website. Usability is defined according to the International Standardisation Organisation as "the effectiveness, efficiency and satisfaction in which specified users can achieve specified goals in a particular environment" (ISO, 1998). Both effectiveness and efficiency comprise two different kinds of performance measures, while satisfaction can be seen as an attitude towards, for example, a product (Sonderegger & Sauer, 2010). Previous studies have shown a positive correlation between perceived aesthetics and perceived usability. For example, Tractinsky, Katz and Ikar (2000) found that users perceive and evaluate aesthetics quickly and early, subsequently develop an attitude towards a product, and that these evaluations may influence later perceptions of usability. On the other hand, De Angeli, Sutcliffe and Hartmann (2006) have shown that, when the context of use is less serious, participants preferred an interface evaluated as more attractive, despite an evident poor usability. This phenomenon is called the halo effect and states "what is usable is beautiful" (Tractinsky et al., 2000). However, this may not generalize to other, more serious, user contexts. Overall, previous research has found that the perceived usability is higher for appealing products or systems than for unappealing ones, even if there was no difference in the objective quality of usability (De Angeli et al., 2006; Sonderegger & Sauer, 2010).

1.2 Gender
Research focusing on gender differences regarding color use, perceived aesthetics or perceived usability appear to be scarce. Most studies focus on genders' preferences in the context of e-commerce, and these studies show opposite results. Some studies find a statistical difference between the two genders, especially in terms of overall design (Cyr & Bonnani, 2005), navigation, and even more specific, the use of a particular text color (Moss, Gunn & Heller, 2006). A research by Fortmann-Roe (2011) showed, within the context of customization of Twitter profile pages, that males preferred blues to a greater extent than females, whereas females preferred magentas to a much greater extent than males. On the other hand, some studies did not indicate that gender has an impact on perceptions of website aesthetics (Coursaris et al., 2008). The authors proposed one plausible explanation to be that women are more sensitive to situation-specific and associative cues, and that men pay less attention to the colors and details of information than women do (Kim, Lehto & Morrison, 2007). Djambasi, Tullis, Hsu, Mazuera and Osberg (2007) also found no significant difference between the genders regarding the number of fixations on elements with differing information, nor could they find any difference in the number of fixations on elements with different background color.

1.3 Outline current research

Previous research has found evidence for the importance of color use in web design, the impact of color use on the perceived aesthetics of websites and the influence that both color use and aesthetics can have on the perceived usability of a website. Although there have been mixed results, research has also found differences between genders in their perceptions and preferences regarding websites, and it is important to emphasize that the amount of studies on these differences is small. Furthermore, research that did take gender differences into account, rarely examined color use, perceived aesthetics, and perceived usability as constructs in one study.

In terms of research methods, previous studies mostly focused on researching how participants would construct their preferred web site based on (physically) buildable content (Chadwick-Dias, Tedesco & Tullis, 2004), or focused on researching separate elements of information and content instead of entire web sites (Djambasi et al., 2007). Moreover, studies that have examined differences in color use regarding website design, mostly manipulated one section or color within the web page (Djambasi et al., 2007; Coursaris et al., 2008; Reinecke et al., 2013). The websites used in these experiments also rarely consisted of more than one web page. In addition, it was also striking that eye tracking has rarely been used as a research method in order to explore any of above named constructs.

For the above stated reasons, more research seems to be needed to understand more about these constructs and consecutive differences between genders. This research will be conducted to supplement and extend the current knowledge on gender differences regarding color preference, perceived aesthetics and perceived usability in web design. In order to do so, the following research question has been stated: To which extent do men and women differ in color preferences regarding perceived aesthetics and perceived usability in web design?

In order to answer the stated research question, three studies will be conducted. The first study will explore which colors men and women prefer the most, using the Adobe Color Wheel as a reference. During the second study, men and women will be asked to rate the colors taken from the first study, in order to draw conclusions on how aesthetically appealing these colors are to both genders. Lastly, during the third study, these colors will be incorporated into a mock-up website, which will be tested on perceived aesthetics and usability using eye tracking and two questionnaires.
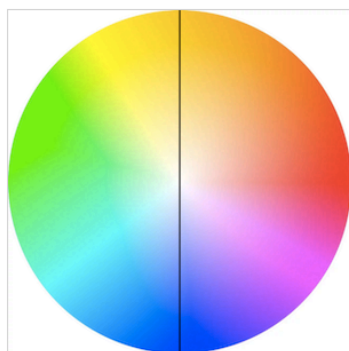
2. First study

2.1 Method
Objective
The first study is an exploratory study in order to determine which colors, of all colors in a color wheel, men and women prefer the most. For this study, it has been chosen to explore the color preferences of men and women by using the color wheel as a complementary color scheme. A complementary color scheme is a color scheme using one base color and its complement, the color on the exact opposite side of the color wheel. This will always create a combination of one warm and one cold color: Whenever a participant chooses a color to be the most preferable on one side of the color wheel, it will automatically yield a complementary color. Therefore, this study will result in one warm and one cold color for both men and women. At first, it will be interesting to see which colors men and women prefer the most; After further testing later on in this research, inferences can be made regarding whether a cold color indeed will be seen as more favorable as opposed to a warm color (Coursaris et al., 2008).

Experiment design
As stated in the previous section, a color wheel was used as a stimulus to conduct this experiment (*Figure 1*). First, the background image as its being used by the Adobe Color Wheel on the Adobe website (Adobe Color CC, 2018) was saved. TextWrangler was used in order to create a HTML page with this color wheel on it. This HTML page displayed a color wheel with a thin black line on top of it. With this line, participants indicated their preferred color. The page showed how many button clicks the line had been moved from its starting point. This amount of button clicks was converted to degrees on the color wheel itself. By computing every degree on the Adobe Color Wheel and its corresponding RGB-color, it was thus possible to determine the main color a person had chosen, and subsequently its complementary color.

Instructie: Druk op de knoppen met pijltjes om de zwarte streep rond te draaien. Draai deze streep totdat hij op een kleur(enspectrum) zit, die jij als mooiste ervaart.

Figure 1. The color wheel used in the first study, along with the buttons and instructions.

Participants
A group of 30 participants, consisting of 15 men and 15 women have partaken in this study. The average age within the groups of men and women was respectively 25 (*SD* = 3.79) and 23 (*SD* = 3.67).

Procedure
Every participant was asked to perform the task on a laptop. The instructions were fairly simple and were being communicated to the participant both verbally and textually, since the instructions of the task were presented beneath the color wheel on the webpage (*Figure 1*). The participant was asked to follow these instructions and whenever they were done with the task, they would get debriefed and the experiment was done. The participants received no compensation for participation.

2.2 Results

Overall, it was notable that both men and women on average moved the line on the color wheel for +94 steps, which means they moved the line 94 steps to the right from its starting point at 180 degrees. This resulted in a color combination of a green and red color (*Figure 2*). After determining the median of the outcomes of men and women, the results showed four colors: One 'cold' and one 'warm' color for both men and women. These colors can be found in *Figure 3*.

Cold color   Warm color

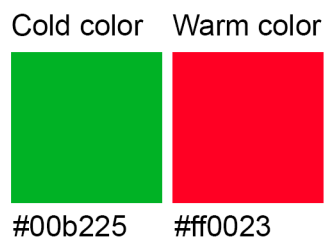#00b225   #ff0023

Figure 2. The median complementary color preference for all participants.

Cold color   Warm color

Men

#3ab200   #ff00f6

Women

#00b218   #ff0044

Figure 3. The median complementary color preference for men and women.

2.3 Conclusion

This study has found that both men and women chose a greenish color (#3ab200 and #00b218, respectively) to be the most preferred cold color. Regarding the warm color, however, the results show a difference between the genders. Men have chosen a color closer to blue (#ff00f6) on the color wheel to be the most aesthetically pleasing, while women have chosen a color closer to red (#ff0044) on the color wheel to be the most aesthetically pleasing.

3. Second study

3.1 Method

Objective

The second study consisted of an online questionnaire and this study had two purposes. The first purpose of this study was to explore whether men and women will rate the colors taken from the first study in line with their gender. In short, will men give the two colors related to men a higher score than the two colors related to women? The second purpose of this study was to look into the strength of preference men and women had for these colors. In order to determine this strength of preference, participants were asked to rate all four colors that emerged from the first study. The choice for a questionnaire was made because a subjective questionnaire-based approach can be used to measure visual aesthetics of user interfaces (Seckler et al., 2015), and to measure the users' subjective perception of aesthetics (Altaboli & Lin, 2011).

Experiment design

Google Forms was used in order to construct an online questionnaire, which can be found in *Appendix 1* of this paper. The questionnaire consisted of five sections. All five sections contained instructions regarding the experiment and the task located at the top of the screen, so that participants could easily reread their tasks in case they forgot it. Participants first had to fill in the questions regarding age and gender, and subsequently had to rate the four colors. In each section, the color was presented as a square with that color, with beneath it a clickable scale from one (least aesthetically pleasing) to ten (most aesthetically pleasing). An answer on every consecutive question of this questionnaire was required for the participant to continue to each next section.

Participants

A total of 74 participants filled in the questionnaire, divided into 25 men and 49 women. The average age within the groups of men and women was respectively 28 (SD = 11.17) and 30 (SD = 11.91).

Procedure

Since the questionnaire was online, using Google Forms, it was distributed through Facebook, and all people that were interested could fill it in. At the end of the questionnaire, the participant saw an end screen with an acknowledgement of receipt. The participants received no compensation for participation.

3.2 Results

Overall, the participants gave the four colors that derived from the first study an average rating of 5.95 on the scale from one (least aesthetically pleasing) to ten (most aesthetically pleasing). An overview of the average rating men and women both together and separately gave all four colors, can be found in *Table 1* to *3*.

	Mean rating	Standard deviation
Men cold color	6.03	1.91
Men warm color	4.84	2.24
Women cold color	6.16	1.92
Women warm color	6.77	1.80

Table 1. The average rating men and women together gave all four colors, and its standard deviation.

	Mean rating	Standard deviation
Men cold color	6.52	2.24
Men warm color	5.12	2.51
Women cold color	6.52	2.29
Women warm color	6.80	2.16

Table 2. The average rating men gave all four colors, and its standard deviation.

	Mean rating	Standard deviation
Men cold color	5.78	1.69
Men warm color	4.69	2.10
Women cold color	5.98	1.69
Women warm color	6.76	1.61

Table 3. The average rating women gave all four colors, and its standard deviation.

3.3 Conclusion

The results of this study show that overall, the women-colors were rated higher (6.16 and 6.77) than the men-colors (6.03 and 4.84). The highest rating was given to the women warm color (6.77), while the lowest rating was given to the men warm color (4.84).

Thereafter, the results of the ratings men gave to all four colors show that men rated both green colors, the men cold color and women cold color, equally since both colors received a rating of 6.52. Besides that, there is a greater difference between the ratings of the men warm color, which got the lowest rating (5.12), and the ratings of the women warm color, which got the highest rating (6.80).

It is interesting to see that the results of the ratings women gave to all four colors show a resemblance to the results previously reported regarding the ratings by men. The results show that women also rated the men cold color (5.78) and women cold color (5.98) approximately the same. Also, a greater difference was found between the ratings of the men warm color, which got the lowest rating (4.69), and the ratings of the women warm color, which got the highest rating (6.76).

To summarize, the two women-colors were rated higher than the two men-colors. The highest rating was given to the women warm color, while the lowest rating was given to the men warm color. Interestingly, these findings applied for both the entire group in general and the two genders separately. The ratings of the men warm color show to be spread out the most, with the standard deviations for the rating of this color being the highest in the entire group and the two genders separately. Also, the ratings given by men to all four colors appear to be more spread out than the ratings given by women.

4. Third study

4.1 Method

Objective

During the third study, the four colors found and tested in the previous studies are incorporated into multiple versions of a fairly simple mock-up website. The aim of this study is to extensively investigate whether the colors preferred by men and women have an influence on the perceived aesthetics and perceived usability of a website. In order to determine the perceived aesthetics, the questionnaire from the second study will be used, which can be found in *Appendix 1* of this paper. By using this questionnaire, it is possible to make inferences on how aesthetically pleasing men and women find these four colors to be. The perceived usability of the website will be measured using the System Usability Scale (SUS) (Brooke, 1996). The SUS is a questionnaire consisting of ten items measuring attitude through a Likert scale, and its results give a global view of subjective assessments of usability. It yields a score between 0 and 100, which should be interpreted similar to a percentile rank (Bangor, Kortum & Miller, 2009). Ultimately, the influence of color use on both perceived aesthetics and perceived usability will be measured by comparing the outcomes from

the aesthetics questionnaire and the SUS to the results from an eye tracker. The Tobii Pro Glasses 2 will be used in order to measure the number of dwells and duration of dwells on various assigned regions of interest (ROI) on the website. Dwells are defined as consecutive fixations on the same ROI. These dwells will be used as a measure of attention to task-relevant elements, which can be used to examine the usability of the website. The Tobii Pro Glasses 2 is a wearable eye tracker, which shows exactly what a person is looking at as they move freely in a real-world setting. The advantages of using a mobile eye tracker over a static eye tracker, are the freedom of movement and the possibility to conduct the experiment in an environment similar to the surroundings in which the participant would usually use a website.

Experiment design
The mock-up website was shown on a 27-inch ASUS computer screen. A simple Logitech computer mouse was used to navigate through the website, the participants either had to scroll or click through elements on the website. As for the two questionnaires used: The aesthetics questionnaire from the second study was duplicated, and the SUS was adapted and translated to Dutch.

As stated above, a total of seven ROI's were assigned to certain parts of the website (*Figure 4)*. These ROI's made it possible to specifically make inferences as to if and how long participants had looked at relevant locations during the experiment. In order to gather this information, Tobii Pro Glasses 2 were used. The data was analyzed using GazeCode, a program specifically designed to easily and quickly convert gaze data derived from the Tobii eye tracker, and to classify fixations (Benjamins, Hessels & Hooge, 2018). These fixations were then calculated to dwells. A HTML website was constructed using TextWrangler. The website consisted of nine unique web pages. The home page contained links, which lead the participant to eight other pages.

The four colors from the previous studies were incorporated into four color versions of the website. Also, a fifth, grayscale, version of the website was constructed. The grayscale color condition functioned as a 'control' condition. In two color conditions, the colors consisted of men- or women-colors for both the 'background' color and the 'highlight' color. In two other color conditions, the colors consisted of a mix of men- or women-colors for the 'background' color and the 'highlight' color. In the grayscale color condition, grays with differences in lightness were used. *Figure 5* shows which regions of the webpage were manipulated, *Table 4* shows which color manipulations were used in the five color conditions.

All participants were asked to perform three tasks, which can be found in *Appendix 2* of this paper. Each task required clicking a link on the home page, which led the participants to another page that contained information they needed to accomplish each task. In order to perform all three tasks, participants had to click on three different links. The first task involved a neutral colored link, consisting of black text on a white background. The second task involved a 'background' colored link, consisting of black text on a background of either the men cold color or women cold color. The third task involved a 'highlight' colored link, consisting of text with either the men warm color or women warm color on a white background.
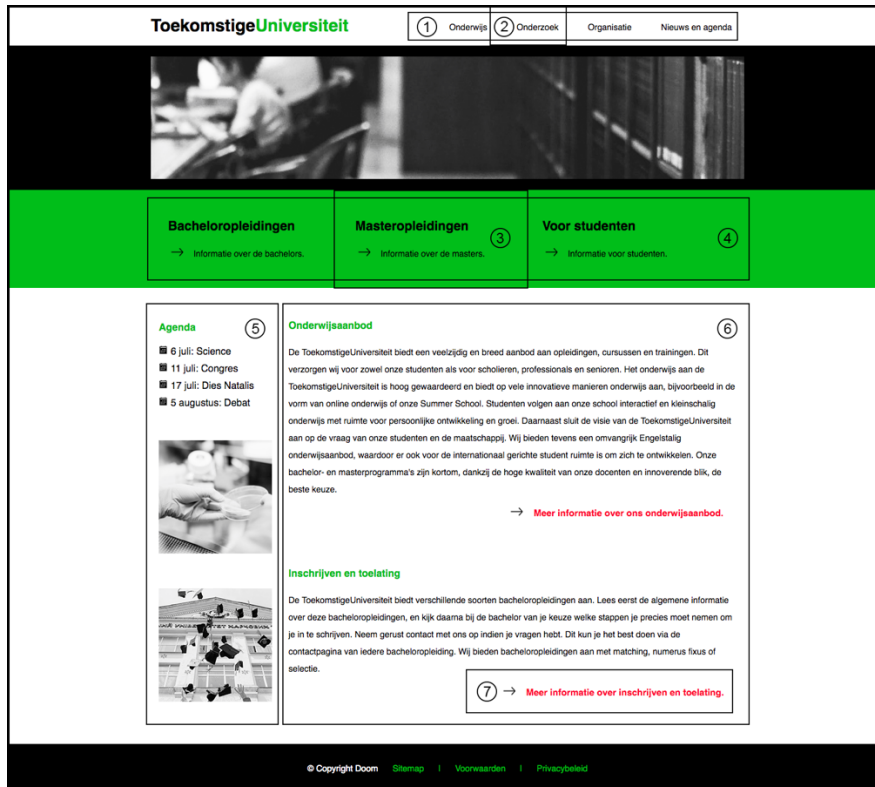
Figure 4. The seven regions of interest (ROI) that were used to measure if and how long participants had looked at relevant locations during the experiment. These regions consisted of the menu bar (1), an action link to the page 'Onderzoek' (2), an action link to the page 'Masteropleidingen' (3), the middle menu (4), the side content (5), the main content (6), and an action link to the page 'Inschrijven en toelating' (7).
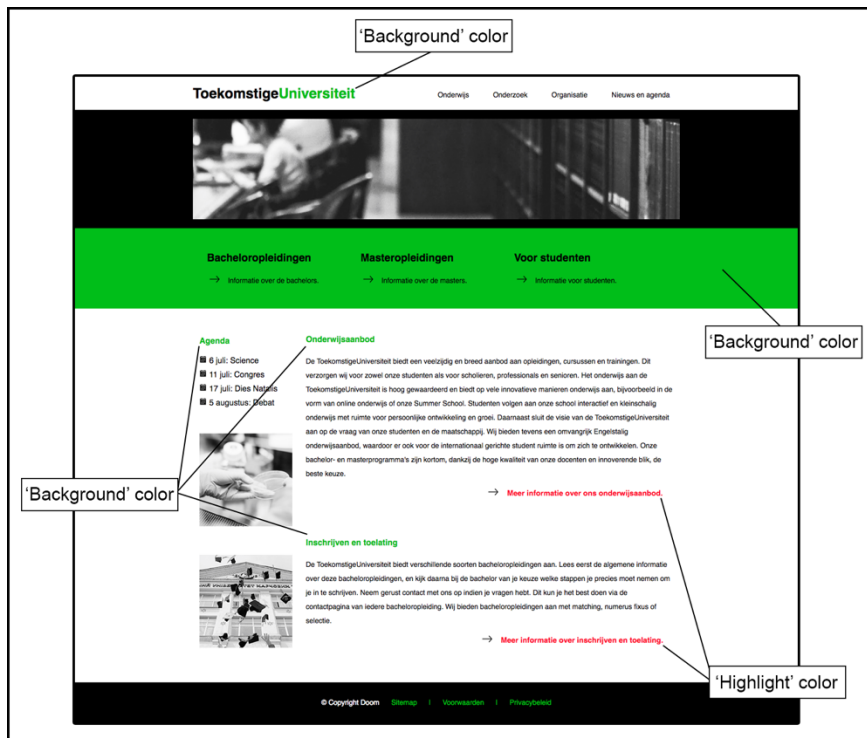
Figure 5. An overview of the regions on the webpage that were manipulated, and which kind of color it involved.

Color condition	'Background' color	'Highlight' color
1	Women cold color	Women warm color
2	Women cold color	Men warm color
3	Men cold color	Men warm color
4	Men cold color	Women warm color
5	Grayscale	Grayscale

Table 4. Five color conditions as used in this study, with their color manipulations regarding the 'background' color and the 'highlight' color.

Participants
A group of 18 men and 22 women have partaken in this study, with a sum of 40 participants. The average age within the groups of men and women was respectively 24 (*SD* = 5.37) and 23 (*SD* = 5.95).

Procedure
All participants had to perform the same three tasks and had to fill in both the SUS and the aesthetics questionnaire. The condition that was manipulated, however, was which one of the five versions of the website the participant had to use. The versions of the website were assigned to the participants based on their sequence: Participant 1 had to use the website with color condition 1, participant 2 had to use the website with color condition 2. Subsequently, participant 6 had to use the website with color condition 1, participant 7 had to use the website with color condition 2, and so forth. No distinction was made between the gender of the participant in assigning a version of the website.

The experiment was set up in the hall of a building at Utrecht University. Participants could simply walk by and immediately partake in the experiment. First, participants got verbal instructions regarding the experiment, and were then asked to fill in an informed consent form. Next, they were asked to put on the Tobii eye tracker after which the manufacturer method of single-point calibration took place. Then the participant received a sheet with the tasks on it and were asked to thoughtfully read the question and then perform the task on the screen using the computer mouse. The participants were asked to report whenever they had completed a task, after which they could continue with reading and performing the next task. When they were done with all three tasks, they could take off the eye tracker, and were then asked to fill in the SUS and base their answers on the website they had just used. Subsequently, the participants were asked to complete the aesthetics questionnaire. At the end of the questionnaire, the participant saw an end screen with an acknowledgement of receipt. The participants received no compensation for participating in this experiment.

4.2 Results
Descriptive results

Since the amount and proportion of dwells will be used as a measure of attention to task-relevant elements, the results will focus on dwells instead of fixations. On average, 185 dwells occurred during the experiment. With an average of 84 dwells on ROI's, this results in a proportion of dwells on ROI's of 0.45.

It took the participants an average time of 122.95 seconds to perform all three tasks of the experiment. During the experiment, participants fixated an average time of 43.23 seconds on the ROI's, which is a proportional duration of fixations of 0.35. The proportional duration of dwells on each separate ROI, however, turned out to be the same for all seven ROI's: 0.025.

Table 5 and *Table 6* summarize information regarding the proportions of dwells and durations of dwells for all seven ROI's. Additionally, the outcomes from the System Usability Scale can be found in *Table* 7, and the outcomes from the aesthetics questionnaire can be found in *Table 8* to *10*.

	Mean	Minimum	Maximum
ROI 1: Menu bar	0.03	0.00	0.08
ROI 2: Action link – 'Onderzoek'	0.002	0.00	0.01
ROI 3: Action link – 'Masteropleidingen'	0.004	0.00	0.01
ROI 4: Middle menu	0.007	0.00	0.02
ROI 5: Side content	0.006	0.00	0.06
ROI 6: Main content	0.20	0.04	0.55
ROI 7: Action link – 'Inschrijven en toelating'	0.003	0.00	0.02

Table 5. Mean proportion of dwells on the seven ROI's of the website.

	Mean	Minimum	Maximum
ROI 1: Menu bar	4.31	0	11.40
ROI 2: Action link – 'Onderzoek'	0.39	0	3.84
ROI 3: Action link – 'Masteropleidingen'	0.89	0	2.84
ROI 4: Middle menu	1.02	0	3.22
ROI 5: Side content	1.44	0	10.52
ROI 6: Main content	34.55	4.44	100.80
ROI 7: Action link – 'Inschrijven en toelating'	0.66	0	3.50

Table 6. Mean duration of dwells, in seconds.

	Mean	Lowest	Highest
Score	73.125	40	100

Table 7. Overall mean, lowest and highest score on the System Usability Scale (SUS).

	Mean rating	Standard deviation
Men cold color	6.23	2.04
Men warm color	4.35	1.87
Women cold color	6.58	1.78
Women warm color	6.53	1.69

Table 8. Overall results on the aesthetics questionnaire.

	Mean rating	Standard deviation
Men cold color	6.33	2.11
Men warm color	3.83	1.50
Women cold color	6.50	1.86
Women warm color	5.83	1.65

Table 9. Results of men on the aesthetics questionnaire.

	Mean rating	Standard deviation
Men cold color	6.14	2.03
Men warm color	4.77	2.07
Women cold color	6.64	1.76
Women warm color	7.09	1.54

Table 10. Results of women on the aesthetics questionnaire.

Analysis

For the purpose of further analysis of these outcomes, a two-way ANOVA was conducted in order to examine the effect of the five color conditions on the proportion of dwells and duration of dwells during the experiment. Additionally, a two-way ANOVA was conducted in order to examine the effect of gender on the proportion of dwells and duration of dwells during the experiment.

There was no statistically significant effect of the five color conditions on the proportion of dwells on the menu bar, $F(4,33) = 1.055$, $p = .394$, action link 'Onderzoek', $F(4,33) = .544$, $p = .705$, action link 'Masteropleidingen', $F(4,33) = 2.579$, $p = .055$, middle menu, $F(4,33) = .958$, $p = .443$, side content, $F(4,33) = 1.758$, $p = .161$, main content, $F(4,33) = .643$, $p = .636$, or the action link 'Inschrijven en toelating', $F(4,33) = .472$, $p = .756$. Also, there was no statistically significant effect of the five color conditions on the duration of dwells on the menu bar, $F(4,33) = .552$, $p = .699$, action link 'Onderzoek', $F(4,33) = 1.053$, $p = .395$, action link 'Masteropleidingen', $F(4,33) = 1.102$, $p = .372$, middle menu, $F(4,33) = .918$, $p = .465$, side content, $F(4,33) = 1.174$, $p = .340$, main content, $F(4,33) = .388$, $p = .816$, or the action link 'Inschrijven en toelating', $F(4,33) = .503$, $p = .734$.

Looking at the effect of gender on the proportion of dwells and duration of dwells, a statistically significant effect of gender on the proportion of dwells on the side content, $F(1,33) = 4.753$, $p = .036$, was found. Besides that, there was no statistically significant effect of gender on the proportion of dwells on the menu bar, $F(1,33) = .1.060$, $p = .311$, action link 'Onderzoek', $F(1,33) = .675$, $p = .417$, action link 'Masteropleidingen', $F(1,33) = .193$, $p = .663$, middle menu, $F(1,33) = .993$, $p = .326$, main content, $F(1,33) = 1.632$, $p = .210$, or the action link 'Inschrijven en toelating', $F(1,33) = 1.076$, $p = .307$. In addition, there was no statistically significant effect of gender on the duration of dwells on the menu bar, $F(1,33) = 1.095$, $p = .303$, action link 'Onderzoek', $F(1,33) = .530$, $p = .472$, action link 'masteropleidingen', $F(1,33) = .636$, $p = .431$, middle menu, $F(1,33) = .292$, $p = .593$, side content, $F(1,33) = .978$, $p = .330$, main content, $F(1,33) = .985$, $p = .328$, or the action link 'Inschrijven en toelating', $F(1,33) = .294$, $p = .591$.

Subsequently, a two-way ANOVA was conducted in order to examine the effect of the five color conditions on the scores on the SUS and aesthetics questionnaire. Additionally, a two-way ANOVA was conducted in order to examine the effect of gender on the scores on the SUS and aesthetics questionnaire.

There was no statistical significant effect of the five color conditions on the scores on the SUS, $F(4,34) = 1.497$, $p = .225$, or the aesthetics questionnaire, $F(4,34) = 1.438$, $p = .243$. Lastly, there was no statistical significant effect of gender on the scores on the SUS, $F(1,34) = .050$, $p = .825$, or the aesthetics questionnaire, $F(1,34) = .481$, $p = .493$.

4.3 Conclusion

Analysis of the outcomes show no statistically significant results regarding the effect of the five color conditions on the proportion of dwells and duration of dwells during the experiment. Also, no statistically significant effect of the five color conditions on the scores on the SUS and aesthetics questionnaire were found. Although results show a statistically significant effect of gender on the proportion of dwells on the side content of the website, gender seemed to have no statistically significant effect on the proportion of dwells and duration of dwells on the other ROI's.

The results that derived from the eye tracker show that participants made the highest proportion and longest duration of dwells on the main content. This ROI was located at the middle portion of the website and contained the greatest portion of semantic information. On the other hand, the ROI's that contained the three color manipulations within the tasks (action link 'Onderzoek', action link 'Masteropleidingen', and action link 'Inschrijven en toelating'), had the lowest proportion and shortest duration of dwells of all ROI's.

Furthermore, the website received a mean rating of 73.125 on the System Usability Scale (SUS), which indicates that the usability of the website is 'OK' (Bangor et al., 2009). Finally, the results from the aesthetics questionnaire are overall similar to the results from the second study in this research. The results show that overall, the 'women'-colors were rated higher (6.58 and 6.53) than the 'men'-colors (6.23 and 4.35). The highest rating was given to the first 'women'-color (6.58), while the lowest rating was given to the second 'men'-color (4.35). Besides that, both men and women gave the second 'men'-color the lowest rating (3.83 and 4.77 for respectively men and women). It is notable, however, that in this study men and women differed as to which color they gave the highest rating. While men gave the highest rating to the first 'women'-color (6.50), women gave the highest rating to the second 'women'-color (7.09).

5. Discussion and implications

During this research, three studies have been conducted in order to examine the gender differences in color preferences regarding perceived aesthetics and perceived usability in web design.

The first study found that both men and women chose a greenish color to be the most preferred cold color, as opposed to previous research, which found that blue is overall the most preferred cold color (Coursaris et al., 2008; Bonnardel et al., 2011; Fortmann-Roe, 2011). Besides that, this study found that men chose a color on the color wheel closer to blue to be the most aesthetically pleasing, while women chose a color on the color wheel closer to red to be the most aesthetically pleasing. The choice made by men is more in accordance with previous research than the choice women made, since Coursaris and colleagues (2008) have found that overall a cold color is seen as a more favorable color as opposed to a warm color. To summarize, this study yielded results that opposed previous research and their findings in color preferences

for men and women. The current study, however, limited the itself to exploring the color preferences of men and women by using a complementary color scheme. A complementary color scheme might show what cold and warm color people like, but participants in the first study mainly chose a certain position of the line on the color wheel because they liked one of the two complementary colors. It is uncertain whether you might assume that, whenever participants chose a warm color to be most favorable, the complementary cold color would actually be their most favorable cold color. For future research, it might be interesting to conduct more explorative research on color preferences, whether or not between men and women, by using more or more diverse types of color schemes.

Thereafter, the findings from the second study indicated that little to no difference can be found in color preferences between men and women. The first purpose of this study was to explore whether men and women will actually give the colors that derived from the first study, and were related to their gender, a higher rating than the colors that belonged to the other gender. The results showed that both men and women gave higher ratings to the two women-colors than to the two men-colors. This raises the question whether men and women differ in color preferences at all. Besides that, the second purpose of this study was to look into the strength of preference men and women had to these colors. Results show that the ratings given by men to all four colors appeared to be more spread out than the ratings given by women to all four colors. This might indicate that men show a weaker preference for these colors, while women show a stronger preference for these colors.

Finally, the third study examined the effect of five color conditions and gender on the perceived usability of a website. This was measured using an eye tracker in order to see if and how long participants had looked at relevant locations on the website during the experiment. The proportion of dwells and duration of dwells on these ROI's were used as a measure of attention to task-relevant elements on the website, and thus its usability. Although results from the SUS show that the website was rated 'OK' by the participants regarding usability, analysis using a two-way ANOVA has shown that not many conclusions can be drawn regarding the effect of the five color conditions and gender on the perceived usability of a website. This was also the case for the effect of the five color conditions and gender on the perceived aesthetics of a website. Results only show a statistically significant effect of gender on the proportion of dwells on the side content. An explanation for this finding might be that women are more attracted to pictures on a website than men do (Moss et al, 2006), and women also include more images in their web design than men (Chadwick-Dias et al., 2004). However, a limitation of this study was its low number of participants. Future research on this topic might consider including a higher number of participants, since it might yield more reliable or even more interesting results.

This study, however, yielded interesting results as to which ROI's participants looked at the most, least, shortest and longest. First, participants made the highest proportion and longest duration of dwells on the main content. An explanation for the highest proportion and longest duration of dwells, is that participants might needed the most time to read the semantic information located at this ROI (Bonnardel et al., 2011).

The three tasks all participants had to do, asked them to search for specific substantive information, which participants could find by reading the middle portion of the website containing this information. On the other hand, the ROI's that contained the three color manipulations (action link 'Onderzoek', action link 'Masteropleidingen', and action link 'Inschrijven en toelating'), had the lowest proportion and shortest duration of dwells of all ROI's. One possible explanation has two sides: On the one side, the relatively smaller size of the ROI's could possibly made them harder to gaze at by chance alone, which explains the lowest proportion of dwells. On the other side, these ROI's were small compared to the size of the other ROI's, which might cause the durations of dwells to be relatively short.

Regarding the experimental approach of this research, it might be interesting for future research to construct a website with certain elements of which the color is adjustable during the experiment. This way, participants can not only tell which colors they find most aesthetically appealing for certain elements on a website, but a combination with eye tracking in a consecutive study might yield interesting results regarding the usability and color use on a website. It has not yet become clear whether gender differences regarding these constructs can be established. However, foundations have been laid for future research to build an understanding on gender differences regarding color preference, perceived aesthetics and perceived usability in web design.

Appendix 1: Aesthetics questionnaire

Kleuren

In deze korte vragenlijst wordt per vraag een kleur getoond. Bepaal voor jezelf hoe mooi je deze kleur vindt en geef deze kleur vervolgens een cijfer tussen 1 en 10. Hierbij betekent een 1 dat je deze kleur helemaal niet mooi vindt en betekent een 10 dat je deze kleur heel mooi vindt.

*Vereist

1. Wat is je leeftijd? *

_____

2. Wat is je geslacht? *
Markeer slechts één ovaal.

◯ Man
◯ Vrouw

Vraag 1 van 4

Bepaal voor jezelf hoe mooi je deze kleur vindt en geef deze kleur vervolgens een cijfer tussen 1 en 10. Hierbij betekent een 1 dat je deze kleur helemaal niet mooi vindt en betekent een 10 dat je deze kleur heel mooi vindt.

3. Hoe mooi vind je deze kleur? Geef deze kleur een cijfer. *

Markeer slechts één ovaal.

	1	2	3	4	5	6	7	8	9	10	
Helemaal niet mooi	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Heel mooi

Vraag 2 van 4

Bepaal voor jezelf hoe mooi je deze kleur vindt en geef deze kleur vervolgens een cijfer tussen 1 en 10. Hierbij betekent een 1 dat je deze kleur helemaal niet mooi vindt en betekent een 10 dat je deze kleur heel mooi vindt.

4. Hoe mooi vind je deze kleur? Geef deze kleur een cijfer. *

Markeer slechts één ovaal.

	1	2	3	4	5	6	7	8	9	10	
Helemaal niet mooi	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Heel mooi

Vraag 3 van 4

Bepaal voor jezelf hoe mooi je deze kleur vindt en geef deze kleur vervolgens een cijfer tussen 1 en 10. Hierbij betekent een 1 dat je deze kleur helemaal niet mooi vindt en betekent een 10 dat je deze kleur heel mooi vindt.

5. Hoe mooi vind je deze kleur? Geef deze kleur een cijfer. *

Markeer slechts één ovaal.

	1	2	3	4	5	6	7	8	9	10	
Helemaal niet mooi	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Heel mooi

Vraag 4 van 4

Bepaal voor jezelf hoe mooi je deze kleur vindt en geef deze kleur vervolgens een cijfer tussen 1 en 10. Hierbij betekent een 1 dat je deze kleur helemaal niet mooi vindt en betekent een 10 dat je deze kleur heel mooi vindt.

6. **Hoe mooi vind je deze kleur? Geef deze kleur een cijfer.** *

Markeer slechts één ovaal.

	1	2	3	4	5	6	7	8	9	10	
Helemaal niet mooi	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Heel mooi

Appendix 2: Three tasks participants had to perform during the third study

1. Je bent mogelijk geïnteresseerd in het volgen van een opleiding aan een universiteit genaamd de ToekomstigeUniversiteit. Je bevindt je op de homepagina van hun website. Allereerst wil je rondkijken om erachter te komen wat er vanuit deze universiteit zoal wordt gedaan op het gebied van onderzoek. Vind de pagina met informatie over het onderzoek dat gedaan wordt vanuit de ToekomstigeUniversiteit.

2. Je interesse is gewekt en je gaat weer terug naar de homepagina van de website. Vervolgens zoek je de pagina met informatie over de masteropleidingen aan de ToekomstigeUniversiteit, om erachter te komen wanneer de eerstvolgende open dagen zijn. Vind de pagina met informatie over de masteropleidingen en vind de data van de eerstvolgende open dagen.

3. Nu je weet wanneer de eerstvolgende open dagen zijn, wil je meer weten over wanneer je je uiterlijk dient in te schrijven en hoe de toelating werkt. Ga terug naar de homepagina. Vind de pagina waar je deze informatie kunt vinden en zoek uit wat voor de meeste masteropleidingen de deadline is om je aan te melden.

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