Perception of Colors in Games as it Applies to Good and Evil

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ABSTRACT

Context. Color can be used to convey allot of information but in particularly when it comes to telling who is good and who is evil. The most common color to use when displaying good and evil is blue for good and red for evil.

Objectives. This study will take a look at what colors people automatically associated with good and evil respectively.

Methods. The two methods that are used in this paper is a survey in the form of a questionnaire and the second method is a statistical hypothesis testing that was done on the data collected in the survey. The statistical hypothesis testing was done in the form of a chi-square test. From the chi-square test you get a chi-square value and a p-value.

Results. The result of the survey was that most participants thought of green, white and blue as good colors, while black and red where thought of as evil. The statistical hypothesis testing revealed that there where a significant statistical difference when comparing two colors in all but two cases. Those cases where white vs. blue and orange vs. purple.

Conclusions. The conclusions that can be drawn are that there is a significant statistical difference between how a color is perceived as good or evil. The perceived convention for what a good character should have, as a color is that it should be green and the perceived convention for an evil character is that it should be either red or black.

Keywords: Perception of Color, Games, Chi-Square Testing, Survey.
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1 INTRODUCTION

Computer games have been around for a long time now and the easiest and most powerful way to influence the player is by using colors [1][2]. Nowadays games have many different colors in them, most games use the same colors to relay the same message. The following strategy games, Age of Empires III, Empire Earth, Tzar: The Burden of the Crown, Command & Conquer: Red Alert 2, Company of Heroes 2 and StarCraft II: Wings of Liberty. Have something in common. In particular when it comes to which characters are good and which are evil. What these strategy games have in common is that the good characters are in the color blue and the evil or bad characters are in the color red, this occurrence can be seen in Figure 1.1 which is a screenshot from Age of Empires III: War Chiefs and in Figure 1.2 that is a screenshot from Command & Conquer: Red Alert 2. This is something that Anhut (2011 b) have remarked on “A widely understood but kinda silent convention established in fiction is to equal red with evil and blue with good”.

This is something that is common in games and has always been common. Especially in strategy games since it is very important in them to see the difference between friend and foe. In these games the player especially see these colors as good and evil when they are playing them in singleplayer mode, while in multiplayer mode the colors might still be considered good and evil but are more used to see the difference between friend and foe. How come that it is blue and red that are used, they are two of the three color that are used in games to create all other colors with RGB and they are very different which creates a good contrast. So why is it that when we see a character in a game with the colors blue or red we think that they are good or evil? It is not like in real life when we see a person in blue clothing we think that person is our friend and when we see a person dressed in red we don’t think they are our enemy. The two research questions that this thesis is trying to answer is:

• What is the perceived convention for a game characters color when it comes to good and evil?

• Is there an apparent difference in the perception of good and evil based on a game characters color?

This paper will put our perceived conventions to a test to see if there are any colors that we automatically think of as good or evil. Also it will challenge our perception of what colors a game character should have if we are going to think of it as good or evil. There are not many articles or papers about how a color is perceived in games when it comes to good and evil, that have been published so this paper could help the industry to find another combination then red and blue to use to represent good and evil. There might be a color combination that people automatically think of the colors as one good and one evil. It might also confirm that red and blue are the best combination possible. This paper will also look at if a person’s favorite color affects how they see that color as good or evil.
Figure 1.1. This is a screenshot that shows a battle sequence from Age of Empires III: War Chiefs, in which you can see the traditional blue vs. red. In this instance blue soldiers are attacking a red village and its settlers.

Figure 1.2. This is a screenshot from Command & Conquer: Red Alert 2, in which you can see the blue forces attack a red base.
There are not many articles or papers about how a color is perceived as good or evil in games but there have been studies and papers about how colors are perceived and papers about the usage of colors in games. There has been a lot of research about color in areas such as Color Psychology, with Whitfield & Wiltshire (1990) doing a critical review on the topic and also there have been a lot of research in the field of Color Symbolism [3].

A color isn’t simply a color; there can be many variations on a color in aspects such as lightness, saturation and hue. That is why Anhut (2011 a) divides up colors in two levels, distinct colors and color situations. Color situations is when you have a lot of variations of a color, this is demonstrated in Figure 2.1. While distinct colors are colors that can be named because they have commonly known names such as red, blue, purple and orange. We use these names because when all the color variations that are seen in Figure 2.1 hits our eyes we sum up the complexity in one manageable color and that would be red in this case. This is done because can process all the colors of Figure 2.1 subconsciously but we can’t keep track of all the colors at the same time so we sum them up to red. So in games color situations are used to affect the player mood and emotions by letting the subconscious process the color situations and since the subconscious is connected to our primal instincts it can affect our mood and emotions. Anhut (2011 a) also brings up that players know that sometimes things have a specific color for as specific purpose. Like a traffic light have a red light for stop and green for go.

“From boardgames, over sports, companies and nations to political parties and back to the days of tribes and caves, color labels are used to mark group affiliation. A clear and consistent color language helps the player separate friend from foe.” This is a quote from Anhut (2011 b). In this article Anhut (2011 b) talks about what happens when distinct colors are added to the different game characters, by doing this it becomes easier for the players to see a difference between characters and by having different distinct colors the characters are separated into fractions or groups which makes it clearer for the player who is good and who is bad. Anhut also brings up that the player have already learned that certain colors have certain meanings, take red as an example. Red can have many different meanings and that it is up to the creators of the game to trigger the right conventional meaning of that color. So in games if a player sees a red cross, that usually means medical supplies, while a red flashing light often means danger or malfunction and a red traffic light means stop.

Hallock (2003) published a survey on his website, the survey was about peoples favorite colors and least favorite colors. The most favored color in their survey was blue with 42%; second place was split at 14% by green and purple, all the favorite color from Hallock (2003) can be seen in Figure 2.2. For female participants of the survey the most favored color was blue with 35% and the second most favored color was purple with 23%. Blue was also the most favored color for male participants the only difference was that males favored it more since it got a 57% of the male participants votes. Second place for favorite color was green at 14%. The least favorite color for both male and female was orange at 30% followed by brown at 23%; all the least favorite colors from Hallock (2003) can be seen in Figure 2.3.
Women disliked orange the most with 33% followed by brown at 20% and grey at 17%. For men the most disliked color was brown with 27% followed by orange and purple at 22%.

Figure 2.2. This graph shows the result of both male and female’s favorite colors from the survey done by Hallock (2003).

Figure 2.3. This graph shows the result of both male and female’s least favorite colors from the survey done by Hallock (2003).

Lambrant (2015) is trying to determine which color setting that is most preferred on a game character. He uses color theory to get the color that he applies to a game character and a cube. In this experiment Lambrant found out that split complementary red was the most favored color combination and that anything with the color green, as a base was not liked at all.

In The Impacts of Colours in Character Concepts Johansson (2012) brings up how good and evil can be illustrated in color. In her experiment she tries to find out how a character is perceived based on its color. This she does by changing the color of the character and then doing a survey on how people perceive the character. Johansson comments on that an
observers emotions are changed by the color and how their perception of the character as good and evil changes with different colors.
3 METHODOLOGY

The methodology that was chosen for this thesis was a survey. A survey was chosen because it is the best fit for the project since the research questions are about how people perceive colors; it is logical to do a survey of what people think about colors as it applies to good and evil. There was a second methodology chosen for this thesis that was a statistical hypothesis testing; this was chosen to be able to prove or disprove that there aren’t any difference in perception of the colors as good or evil.

3.1 Survey

The survey was done by sending out a questionnaire for people to answer some questions about what they think about colors as it relates to good and evil. The whole questionnaire can be found in the appendix of this paper. The questionnaire was designed and aimed at a demographic for young people with a lot of experience with games. A minimum of 30 participants was the goal for the survey, because with that many the statistical hypothesis testing would yield a believable result. The goal for the number of participants was more than reached since the total number of participants that took part in the questionnaire was 90 participants. The questionnaire was sent out to people living in Sweden.

As Anhut (2011 a) describes it there are two levels to colors; distinct and situation. In this experiment only distinct colors where used and that is for the benefit of the participants of the questionnaire since a color situations such as in Figure 2.1 would have complicated the questions. When all that is wanted from the questionnaire is what color they prefer and not the variation of the color.

To select the colors for the questionnaire, the survey by Hallock (2003) was used as a base to select some of people’s favorite and least favorite colors, since these colors would bring out the most intense opinions for the participants. Blue and red where already selected since they are the colors used, in the games that was used as examples in chapter one, to depict good and evil. From the survey the following colors where selected; green since it was favored highly by both men and women, purple was chosen because of the high score it got by women and it was tied with green for the second most favored color when both genders favorite colors where put together. Orange was chosen since it scored high in least favored color by both men and women, the same thing applies to the color brown. Yellow was selected for being consistently disliked by everyone. Grey was chosen since it got a high score in least favorite color for women. Black and white where also chosen even though they where either liked or disliked in the survey by Hallock (2003). The reason they where chosen is that black and white have always symbolized opposites, it is the two most common colors when it comes to chess pieces, it is the representation of good and evil in the common phrase “It’s not black and white” and it is the two halves in yin and yang.

When all colors that where going to be used in the questionnaire had been selected, the construction of the questionnaire began. The questionnaire was created on Google Drive with Google Forms. The questionnaire consists of four parts. The first part of the questionnaire handles three basic questions; they are as follows, age of the participant, level of gaming experience expressed in eight different choices where the participant have to chose one and the participants favorite color, so that their favorite color can be analyzed too see if it affects how they see the color as good or evil. The second part handles individual colors; the participant was asked to rank a color in a scale from 1 to 5 of how evil or good they think the color was, where 1 is evil, 3 is neutral and 5 is good. This is done for all ten colors. The third part of the questionnaire consists of 30, two alterative forced choice
questions. There the participant get a choice between two characters, that each have a
different color and the participant have to chose which they think is the good one. An
example of this choice can be seen in Figure 3.1. All the characters can be seen in Figure 3.2
and it was decided that a robot character would be the most optimal in order to not get any
biased from a human characters appearance. The author of this paper created the robot
character that was used in the questionnaire. The robot for each color consists of three sub
colors, which are the original color that was used in the second part of the questionnaire, one
lighter color and one darker color the exact RGB values can be seen in Table 3.1. Not all the
color combinations where used in the questionnaire since the creator of the questionnaire
wanted to keep the questionnaire small so that people would not get tired of the
questionnaire and quit before finishing the questions. All colors appear the same number of
times and all colors appear as the first and the second color the same number of times. This
is done so that the questionnaire becomes a little more tamperproof because if a participant
decides to always check the first color all the colors gets a equal amount of votes. The fourth
part gives the participant the chance to choose the color that they associate the most with
good and the one they associate the most with evil, the choice is between the ten colors that
was used for the questionnaire. All questions in the questionnaire are mandatory, the
participants where not able to skip any of the questions. The participants could end the
questionnaire at anytime, which would negate their answers.

<table>
<thead>
<tr>
<th>Color</th>
<th>Type</th>
<th>R</th>
<th>G</th>
<th>B</th>
<th>Color</th>
<th>Type</th>
<th>R</th>
<th>G</th>
<th>B</th>
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<td>0</td>
<td>255</td>
<td>Yellow</td>
<td>Original</td>
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<td>80</td>
<td>255</td>
<td>Light</td>
<td>255</td>
<td>255</td>
<td>80</td>
<td></td>
</tr>
<tr>
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<td>Dark</td>
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<td>0</td>
<td>155</td>
<td>Dark</td>
<td>205</td>
<td>205</td>
<td>0</td>
<td></td>
</tr>
<tr>
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<td>0</td>
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<td>Original</td>
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<td>255</td>
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<tr>
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</tr>
<tr>
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<td>155</td>
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<td>Dark</td>
<td>205</td>
<td>0</td>
<td>205</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>Original</td>
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<td>0</td>
<td>0</td>
<td>Brown</td>
<td>Original</td>
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<td>25</td>
<td>25</td>
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<td>97</td>
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<td>255</td>
<td>Orange</td>
<td>Original</td>
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<td>152</td>
<td>49</td>
<td></td>
</tr>
<tr>
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<td>Dark</td>
<td>205</td>
<td>205</td>
<td>205</td>
<td>Dark</td>
<td>235</td>
<td>118</td>
<td>0</td>
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</tr>
<tr>
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<td>Grey</td>
<td>Original</td>
<td>128</td>
<td>128</td>
<td>128</td>
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<tr>
<td></td>
<td>Light</td>
<td>80</td>
<td>255</td>
<td>80</td>
<td>Light</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dark</td>
<td>0</td>
<td>155</td>
<td>0</td>
<td>Dark</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1. This table shows the colors that were used on the robot character that can be seen
in Figure 3.2. Every robot consists of three colors the original color that was used in the
second part of the questionnaire, a lighter color and a darker color. The background colors
of the table are in the RGB colors that are on the same row.

All the questions in the questionnaire were checked against Etikkommittén Sydost own
ethical self-evaluation [4].
Figure 3.1. This is an example of a questionnaire question. The participant have to chose which one of these characters they think of as the good one.

Figure 3.2. This picture shows all the alternative characters that the participants where choosing between. The colors are from top left to right: Yellow, Red, Green, Brown and Blue. Bottom left to right: White, Purple, Orange, Grey and Black. The author of this paper created the robot character.

3.1.1 Limitations

This section will go through the limitations of the survey. One of the limitations of the survey is that the survey do not take into consideration color blindness, the survey does not check participants for color blindness in anyway. Since the questionnaire was sent out to the participants, there was no controlled environment when the participants answer the questionnaire, which means that they could have been influenced by thing like sound and object in the room they where in when they answered the questionnaire. Also since they answered the questionnaire on different monitor they might not have seen the same shade of
the colors, but this is not a major problem since the questionnaire only wants the answer of which color they prefer not the specific shade of the same color they prefer. One limitation is that the gender of the participants where not a data point that was kept track of. Another aspect that weren’t tracked was the cultural background of the participants, since different cultures have different symbolisms for different colors [3]. The comparison in the questionnaire was only done with one type of mesh, this could be considered a limitation since having different meshes might have produced a different result.

3.2 Statistical Hypothesis Testing

To preform a statistical hypothesis test, a comparison between the statistical relationships of two data sets have to be examined, this is usually done by using a formula to test the null hypothesis. For this experiment a chi-square test was used to test the null hypotheses. There was two null hypothesizes for this experiment and their alternative hypothesizes:

- Null hypothesis 1 = there is no difference between red, blue, black, purple, green, orange, yellow, brown, grey and white when it comes to being thought of the good guy color in games.
- Alternative hypothesis 1 = there is a difference between red, blue, black, purple, green, orange, yellow, brown, grey and white when it comes to being thought of the good guy color in games.
- Null hypothesis 2 = there is no difference between red, blue, black, purple, green, orange, yellow, brown, grey and white when it comes to being thought of the bad guy color in games.
- Alternative hypothesis 2 = there is a difference between red, blue, black, purple, green, orange, yellow, brown, grey and white when it comes to being thought of the bad guy color in games.

These null hypotheses are tested each against its own alternative hypothesis to see if there is a significant statistical difference. To be able to say that there is a significant statistical difference, a p-value have to be calculated. The p-value is between 0 and 1, the higher the p-value is the higher probability it is that the null hypothesis is true. In order to be able to reject the null hypothesis there have to be a significant statistical difference and in order to confirm that there have to be a significance level. In this experiment the significance level was at 1%. That means if a p-value is lower than 0.01 there is a significant statistical difference. The equation that makes up the chi-square test can be seen below.

$$\chi^2 = \sum \frac{(o - e)^2}{e}$$

The chi-square test was chosen because it is often used when trying to disprove the null hypothesis in order to be able to confirm independence. Independence is when it is possible to say that there is a significant statistical difference.
4 RESULTS

In this chapter the results of the survey and the statistical hypothesis testing will be presented.

4.1 Result of Survey

The survey was done by a questionnaire that 90 participants took part in, the average age of the participants where 23.6 years. The youngest participant was 19 years old and the oldest participant was 52. The most common age of the participants was 23 years old with 20 participants.

On the question on favorite color, the color blue was the most popular with 26 answers. In second place came black with 15 answers, followed by purple and green with 13 answers each. Red received 11 answers, orange and pink, the only color that was added by the participants, got 5 answers each. The last two color to received any answers where white and yellow with 1 each. Grey and brown did not get any answers as the favorite color of the participants. The distribution of favorite colors can be seen in Figure 4.1.

![Figure 4.1](image)

*Figure 4.1. This pie chart shows the distribution of the 90 participants favorite colors. The number in the chart is the number of participants that had that as their favorite color.*

In the second part of the questionnaire the participants where asked to rank all ten colors in a scale from 1 to 5, where 1 was evil, 3 was neutral and 5 was good. Those answers where converted from a scale of 1 to 5 into a point system. In this point system 1 and 2 that represents the evil spectrum was converted so that a 1 became -2 points and 2 became -1 point. Since 3 represented neutral all 3s where converted into 0 points. 4 and 5 that represented the good spectrum where converted so that 4 became +1 point and 5 became +2 points. This resulted in what can be seen in Figure 4.2. What is clear from Figure 4.2 is that there are three colors that scored high in the point system and those color are blue, white and green. What is also clear from Figure 4.2 is that red and black scored low.
Figure 4.2. This graph shows the result of the point system for how good or evil the colors where perceived. The colors where ranked in a scale of 1 to 5 which was converted into a point system of -2 to +2. The y-axis show the number of points the color scored, the maximum number of points possible where either -180 or +180 point depending on if it is evil or good.

The third part of the questionnaires result was used to do the statistical hypothesis testing in the form of a chi-square test. That result can be found in chapter 4.2. For the result of the color against color comparison that was done in the third part of the questionnaire, that result of the individual color against color comparison can be found in Table 4.1 in the columns Value 1 and Value 2. Value 1 holds the number of participants that found Color 1 as the good color; the same thing applies to Value 2 for Color 2. The combined result of the third part of the questionnaire is found in Figure 4.3. The maximum numbers of votes a color could get was 540 votes. The color that scored the highest number of votes was green with 441 followed by blue with 407 and white with 386. On the lower end, black was the one with the least number of votes with 72. Two other colors also scored low were brown with 116 votes and red with 160 votes.
Figure 4.3. This diagram shows the total result of all questions asked in the third part of the questionnaire, the diagram shows how often the color was chosen as the good color when compared to another color. The maximum under of votes a singular color could receive was 540.

The first question in part four of the questionnaire, the participants are asked which color they associate the most with good, the result of this question can be found in Figure 4.4. What is clear from the results shown in Figure 4.4 is that there are clearly three colors that the participants thought of as good and those colors are green, white and blue. Green and white are the top scorers with 32 and 28 participants choosing them respectably.

The second question in the fourth part of the questionnaire was about which color the participants associate the most with evil. That result can be seen in Figure 4.5. What is clear from Figure 4.5 is that there are two colors that the participants associate with evil and those are red and black. With red getting 46 of the 90 participants votes as the evil color and black receiving 33 votes that is one more vote than the highest color received in being thought of as good in Figure 4.4.
Figure 4.4. This diagram shows the color that the participants associate the most with good when asked, which out of the ten colors they thought of as the good color. The scale is in number of participants that chose that color.

Figure 4.5. This diagram shows the color that the participants associate the most with evil when asked, which out of the ten colors they thought of as the evil color. The scale is in number of participants that chose that color.
4.2 Result of Statistical Hypothesis Testing

The results of the third part of the questionnaire were used to perform a chi-square test and the result of that test can be seen in Table 4.1. What is clear from the result is that there where a significant statistical difference in all but two cases. The two cases in which there where no significant statistical differences are highlighted in Table 4.1 and they are white vs. blue and orange vs. purple.

<table>
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<th>Color 1</th>
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<th>Value 2</th>
<th>Chi-Square</th>
<th>P-Value</th>
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<td>74</td>
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<td>Purple</td>
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<td>Yellow</td>
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<td>63</td>
<td>27</td>
<td>14,4</td>
<td>0,000148</td>
</tr>
<tr>
<td>Yellow</td>
<td>Black</td>
<td>75</td>
<td>15</td>
<td>40</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>White</td>
<td>Blue</td>
<td>44</td>
<td>46</td>
<td>0,044444</td>
<td>0,833029</td>
</tr>
<tr>
<td>Black</td>
<td>Grey</td>
<td>10</td>
<td>80</td>
<td>54,444444</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>Blue</td>
<td>Brown</td>
<td>73</td>
<td>17</td>
<td>34,844444</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>Green</td>
<td>Orange</td>
<td>77</td>
<td>13</td>
<td>45,511111</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>Grey</td>
<td>Red</td>
<td>65</td>
<td>25</td>
<td>17,777778</td>
<td>0,000025</td>
</tr>
<tr>
<td>Orange</td>
<td>Purple</td>
<td>46</td>
<td>44</td>
<td>0,0444444</td>
<td>0,833029</td>
</tr>
<tr>
<td>Brown</td>
<td>Yellow</td>
<td>23</td>
<td>67</td>
<td>21,511111</td>
<td>0,000004</td>
</tr>
<tr>
<td>Red</td>
<td>Blue</td>
<td>9</td>
<td>81</td>
<td>57,6</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>White</td>
<td>Black</td>
<td>86</td>
<td>4</td>
<td>74,711111</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>Purple</td>
<td>Blue</td>
<td>28</td>
<td>62</td>
<td>12,844444</td>
<td>0,000338</td>
</tr>
<tr>
<td>Yellow</td>
<td>Green</td>
<td>19</td>
<td>71</td>
<td>30,044444</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>Black</td>
<td>Purple</td>
<td>10</td>
<td>80</td>
<td>54,444444</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>Green</td>
<td>Grey</td>
<td>77</td>
<td>13</td>
<td>45,511111</td>
<td>&gt;0,000000</td>
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<tr>
<td>Blue</td>
<td>Black</td>
<td>86</td>
<td>4</td>
<td>74,711111</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>Grey</td>
<td>Orange</td>
<td>31</td>
<td>59</td>
<td>8,711111</td>
<td>0,003163</td>
</tr>
<tr>
<td>Brown</td>
<td>White</td>
<td>14</td>
<td>76</td>
<td>42,711111</td>
<td>&gt;0,000000</td>
</tr>
<tr>
<td>Orange</td>
<td>Yellow</td>
<td>28</td>
<td>62</td>
<td>12,844444</td>
<td>0,000338</td>
</tr>
</tbody>
</table>

Table 4.1. This table shows the result of the chi-square test for all the questions in the third part of the questionnaire. The two results that did not show any significant statistical difference are highlighted in yellow. All the results in the chi-square and p-value columns have been rounded to 6 decimals. The numbers in the value 1 column are the number of participants that chose the color in the color 1 column. The same thing applies to value 2 and color 2.
5 ANALYSIS AND DISCUSSION

In the following chapter the results will be analyzed and discussed.

5.1 Favorite Colors

How does our favorite color affect us when we think of good and evil? All participants where asked what their favorite color was in the beginning of the questionnaire, so when ever a participant got the choice between their favorite color and any other color, what they chose can be seen in Figure 5.1. So the participants thought of their favorite color as good in 61% of the times and evil in the other 39%. If a participant thinks of their favorite color as good or evil will depend on what their favorite color is, so all participants with the same favorite color and how often they chose it as the good color can be seen in Figure 5.2. In Figure 5.2 it is possible to see that participants that had blue, white, yellow and green as their favorite color often thought of that color as good. While participants with the colors red and black as their favorite colors, often thought of them as evil. Participants with the favorite colors orange and purple didn’t have a clear preference; we can see that it is leaning towards the good side.

![Figure 5.1. This diagram show the result of how often a participant chose their favorite color as the good color, when given the choice between their favorite color and any other color. This diagram only contains 85 of the 90 participants since the other 5 participants wrote in their favorite color as pink and because pink wasn’t a choice in this experiment they hade to be excluded.](image-url)
Figure 5.2. What is shown in this graph is how often a participant chose their favorite color as good or evil. When they had the choice between their favorite color and any other color, sorted by favorite color. This graph only contains 85 of the 90 participants since the other 5 participants wrote in their favorite color as pink and because pink wasn’t a choice in this experiment they had to be excluded.

In the survey by Hallock (2003) the five color that where the most peoples favorite color where; Blue with 42%, Purple with 14%, Green with 14%, Red with 8% and Black with 7%, this can be seen in Figure 2.2. The results from this survey produced the same top five colors as in Hallocks (2003) survey. The result of this survey was; Blue with 29%, Black with 17%, Purple with 14%, Green with 14% and Red with 12%. What is interesting with this result is that they have the same top five colors and that purple and green got the same percentage of likeness. In this survey blue was not as liked as in Hallocks (2003), while black and red where more liked than in Hallock (2003). It is my opinion that people tends to have the same favorite colors and that favorite colors don’t affect our opinions on how we perceive a color as good or evil.

5.2 Good Colors

The color that where preferred more than half of the all times when compared with another color; are as follows green, blue, white, yellow, orange and purple. That is what we can see in Figure 4.3. That means that all these colors are on the half that can be said are considered the good colors. Do people actually think of these colors as good? When the participants got to choose what color they associated the most with good, as seen in Figure 4.4, it is clear that there are three colors that can be said that people associate with good and those are green, white and blue. When ranked on a scale from 1 to 5, which was converted into a point system that can be seen in Figure 4.2, green, white and blue all scored high towards good. With this data it is clear that these three colors are contending for the title of color most associated with good. Why do people associate these colors with good? Colors have symbolisms that they are associated with [3]. Blue is often associated with water, sky and cold it is also a calming color [5][6]. The reason why I think blue is thought of, as a good color is because blue is common in game when represent something as good and that is why people associate it with good. Green is often associated with nature, environment and healthy. The reason I think green is thought of as good is because green is used as a symbol.
for on and go, but also because it is used for environment friendly and healthy products. White is associated with cleanliness, purity, snow and winter. I think the reason people think of white as good is because it is a light color that repels darkness.

When we look at Lambrants (2015) result we can see that anything that have green as its color base where not liked at all and that color harmonies with the base in blue was preferred on the character. Green is considered good but according to Lambrant (2015) people do not like green on game characters. Does this mean that a green game character would be received badly or would it not be considered good or would it just be a disliked good character? Blue was liked on a game character in Lambrants (2015) experiment and according to this papers survey blue is considered good. Which would mean that a blue game character would be thought of as good and be liked or does it just play into the silent convention that Anhut (2011 b) describes?

5.3 Evil Colors

The color that scored in the bottom half of Figure 4.3 it can be said that they are considered evil when compared with another color; the colors that are in the bottom half are black, brown, red and grey. When the participants where asked what color they associated the most with evil, the result in Figure 4.4 shows that there are two colors that are considered evil and those are red and black. In the point system that was created from the 1 to 5 scale in Figure 4.2 it is clear that it is black and red that are the colors associated with evil. How come people associate these colors with evil? All colors have some symbolisms that they are associated with [3]. Black is often associated with mourning, mystery and depth. It is my opinion that black is thought of as evil because black is darkness and in the dark people can’t see what is hiding and that people usually finds that scary. Red is associated with love, fire and blood. The reason that I think red is thought of as evil is it is common in game to portray enemies as red and also because red is used in symbols for stop and off. Another reason can be because the devil is often portrayed as red.

When comparing to Lambrant (2015) that got the conclusion that complementary red was the most preferred color for a game character, complementary red have its basis in red, with red being its primary color. Considering that it is surprising to see that red, which most people prefer to see on their game character, is considered evil. Does this mean people want to play as an evil character?

5.4 Color vs. Color

When it comes to color vs. color there are three cases that are interesting Red vs. Blue, White vs. Blue and Orange vs. Purple. The last two cases are interesting because there where no significant statistical difference in how they where perceived. While Red vs. Blue is interesting since it is the classical colors used in games to portray good and evil.

White vs. Blue was one of two cases where there was no significant statistical difference between the colors when the participants where asked which they thought of as the good color. 44 participants preferred white while 46 participants preferred blue. What could the reason be for there not being any difference? As seen in Figure 4.2 and Figure 4.3 both white and blue are thought of as good. So the likely scenario is that people think of them both as good and they think of them as equally good.
Orange vs. Purple is the second case in which there was no significant statistical difference. 46 participants preferred orange as the good color and 44 participants thought that purple was the good color. It can be seen in Figure 4.3 that both orange and purple are not seen as particular good or evil, since they both scored just above half of the possible 540 votes. In Figure 4.2 both orange and purple are in the middle ground of the diagram, which is considered neutral, with purple scoring 17 points towards good and orange scoring 1 towards evil. This is interesting because in Hallock (2003) survey we can see that orange is very disliked by both genders, while purple is liked by women and disliked by men. This means that theoretically purple should have an advantage over orange, because purple is liked by women and orange is disliked by both genders. Since this papers survey do not keep track of genders it is possible that women preferred purple and that it was more even between the men if they preferred orange or purple. There could have been a significant statistical difference if the number of male and female participants had been equal. But looking at the data that was collected it is clear that people perceived both orange and purple as neutral.

Red vs. Blue is the classical color used in games to portray evil and good. As seen in Table 4.1 blue got 81 participants votes as the good color, while 9 participants thought red was the good color. Blue is seen as the good color and red is seen as the evil color, this is clearly the statistic as seen in Figure 4.2, Figure 4.3, Figure 4.4 and Figure 4.5. Should this color combination still be the standard for good and evil? Well there are according to this experiment only four color combinations that had a larger difference between them then Red vs. Blue. These color combinations where; White vs. Grey, white with 82 votes and grey with 8 votes, Yellow vs. Red, yellow with 84 votes and red with 6 votes, White vs. Black, white with 86 votes and black with 4 votes, Blue vs. Black, blue with 86 votes and black with 4 votes. To use White vs. Grey or Black as good and evil might not be visually appealing since they are on the same brightness scale when dividing up a color in brightness, saturation and hue. It might also lack the colorfulness of bright colors like yellow, red and blue. If a new standard color for good and evil would be created it should take the colors that most people considered good and the one that most people considered evil. According to this experiments result, that would mean green and either red or black. But choosing green and red would bring a big problem since people with color blindness usually have problems with seeing the difference between red and green. That would eliminate red in this case and make green the good color and black the evil color. This would statistically be the best possible color combination to replace red and blue as they represent good and evil in games. But the combination of green and black are not fault free them self, because games that uses minimaps would have problems with green if they would have to represent a lot of nature on the minimap, which is normally done with green. Also black would cause a problem since on minimaps unexplored terrains are usually covered up with black.
6 CONCLUSION

The research questions asked in this paper was:

- What is the perceived convention for a game characters color when it comes to good and evil?

- Is there an apparent difference in the perception of good and evil based on a game characters color?

<table>
<thead>
<tr>
<th></th>
<th>Good</th>
<th>Evil</th>
<th>Point System</th>
<th>Color vs. Color</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>0,36</td>
<td>-0,01</td>
<td>0,66</td>
<td>0,63</td>
<td>1,64</td>
</tr>
<tr>
<td>White</td>
<td>0,31</td>
<td>-0,02</td>
<td>0,52</td>
<td>0,43</td>
<td>1,24</td>
</tr>
<tr>
<td>Blue</td>
<td>0,19</td>
<td>0</td>
<td>0,50</td>
<td>0,51</td>
<td>1,20</td>
</tr>
<tr>
<td>Yellow</td>
<td>0,06</td>
<td>-0,08</td>
<td>0,07</td>
<td>0,25</td>
<td>0,30</td>
</tr>
<tr>
<td>Purple</td>
<td>0,03</td>
<td>-0,01</td>
<td>0,09</td>
<td>0,07</td>
<td>0,18</td>
</tr>
<tr>
<td>Orange</td>
<td>0</td>
<td>0</td>
<td>-0,01</td>
<td>0,08</td>
<td>0,07</td>
</tr>
<tr>
<td>Grey</td>
<td>0</td>
<td>0</td>
<td>-0,12</td>
<td>-0,16</td>
<td>-0,27</td>
</tr>
<tr>
<td>Brown</td>
<td>0,01</td>
<td>0</td>
<td>-0,04</td>
<td>-0,57</td>
<td>-0,60</td>
</tr>
<tr>
<td>Red</td>
<td>0,03</td>
<td>-0,51</td>
<td>-0,61</td>
<td>-0,52</td>
<td>-1,61</td>
</tr>
<tr>
<td>Black</td>
<td>0</td>
<td>-0,37</td>
<td>-0,55</td>
<td>-0,73</td>
<td>-1,65</td>
</tr>
</tbody>
</table>

Table 6.1. This table shows all the results converted into a scale of -1 to +1, where -1 is evil, 0 is neutral and +1 is good. The results are then combined into a total value of how good or evil a color is.

To answer the first research question we have to split the question into two parts what color is perceived as good and what color is perceived as evil. So what color are thought of as good, by looking at all the data in Figure 4.2, Figure 4.3, Figure 4.4 and Figure 4.5 it is not possible to say anything conclusive since they are not in the same scale. In Table 6.1 all the results of Figure 4.2, Figure 4.3, Figure 4.4 and Figure 4.5 have been converted into the same scale, which makes it possible to see the larger picture. The colors are that could be considered good would be blue, white and green. What is clear from the Table 6.1 is that green is the clear winner when being perceived as good. The second part of this question is harder to answer, because when looking at what color is perceived as evil in Table 6.1 we get a tight race between red and black. Since there is only a small difference between red and black in Table 6.1, it makes it a to close a case to be able to say that one is perceived as more evil than the other. So the perceived convention for a game characters color is that a good character is green and an evil character is either red or black.

The second research question can be answer by looking at the statistical hypothesis testing, because the result of the statistical hypothesis testing shows that in all but two cases people perceive a game characters color as good or evil. That means that in only 2 out of 30 comparisons people had a clear perception of what color they thought was the good and evil colors. With this result there is an apparent difference in if a game character is perceived as good or evil based on color.
7 Future Work

In the future I would like to extend on this research to include more colors, or at least one, and that would be pink since that was the only color the participants in this experiment added as their favorite color. Different characters would also be added to eliminate any possible inaccuracies in having only one character. The experiment should also compare all the color combinations. This since I found that green and black had not been compared against each other and that this combination might be the most optimal. I would also like to add gender to the questionnaire, so that analyzes could be done to see if there are any differences between men and women when it comes to perceiving a color as good or evil.
REFERENCES


APPENDIX

Perception of Colors

In this questionnaire you will answer some questions about how you perceive colors. By doing this you will help me with my thesis project.

*Obligatorisk*

1. Age *

2. Gaming experience *
   Which of the following best describes how often you play any games on any platform (PC, Xbox, PlayStation, Nintendo, etc.)
   Markera endast en oval.
   - I play every day
   - I play a couple of times a week
   - I play one or two times a week
   - I play a couple of times a month
   - I play one or two times a month
   - I rarely play anymore but I used to play a lot
   - I rarely play
   - I never play

3. Favorite Color *
   Markera endast en oval.
   - Blue
   - Green
   - Red
   - Yellow
   - Black
   - White
   - Grey
   - Purple
   - Brown
   - Orange
   - Övrigt:

In the following questions you will be shown a color and you will have to answer if you thing of that color as Good or Evil in a scale of 1 to 5 where 1 is Evil, 3 is Neutral and 5 is Good.
4. Blue *

Markera endast en oval.

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<tbody>
<tr>
<td>Evil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good</td>
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5. Green *

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<tbody>
<tr>
<td>Evil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good</td>
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6. Yellow *

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<tbody>
<tr>
<td>Evil</td>
<td></td>
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<td></td>
<td></td>
<td>Good</td>
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</tbody>
</table>
7. Red

Markera endast en oval.

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<th>Good</th>
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8. Black

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<th>Good</th>
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<td>2</td>
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9. Purple

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<th>Good</th>
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<td>2</td>
<td>3</td>
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<td>5</td>
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</table>
10. Brown *

Markera endast en oval.

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<th>Good</th>
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<td>2</td>
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<td>4</td>
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</table>

11. White *

Markera endast en oval.

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<th>Good</th>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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12. Grey *

Markera endast en oval.

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<th>Good</th>
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<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
13. Orange *

Markera endast en oval.

<table>
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<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the following questions you will be shown two robots which you have to choose the one that you think of as the Good one if they were to fight each other.

14. Which of these two do you think is the good one? *

Markera endast en oval.

- Red
- White
15. Which of these two do you think is the good one?

Markera endast en oval.
- Purple
- Green

16. Which of these two do you think is the good one?

Markera endast en oval.
- Yellow
- Red
17. Which of these two do you think is the good one? *

Markera endast en oval.

- White
- Grey

18. Which of these two do you think is the good one? *

Markera endast en oval.

- Black
- Red
19. Which of these two do you think is the good one? *

- Blue
- Yellow

20. Which of these two do you think is the good one? *

- Green
- White
21. Which of these two do you think is the good one? *

Markera endast en oval.
- Orange
- Brown

22. Which of these two do you think is the good one? *

Markera endast en oval.
- Grey
- Purple

https://docs.google.com/forms/d/1NgX1ixJp6aVvnlv6sVhSzd7b7tX63X068v67yX7h12wWBgfjQ/edit
23. Which of these two do you think is the good one? *

Markera endast en oval.

- Brown
- Green

24. Which of these two do you think is the good one? *

Markera endast en oval.

- Red
- Orange

https://docs.google.com/forms/d/1NxWIXhB96xkWy0CnnHd7b5jD2Jsvb0yWZ6h20WggQ/edit
25. Which of these two do you think is the good one? *

![Robot Option 1](Purple)

![Robot Option 2](Brown)

Markera endast en oval.

- Purple
- Brown

26. Which of these two do you think is the good one? *

![Robot Option 1](Yellow)

![Robot Option 2](Black)

Markera endast en oval.

- Yellow
- Black
27. Which of these two do you think is the good one?  *

Markera endast en oval.

☐ White
☐ Blue

28. Which of these two do you think is the good one?  *

Markera endast en oval.

☐ Black
☐ Grey
29. Which of these two do you think is the good one? *

![Image of two robots, one blue and one brown.]

Markera endast en oval.

- Blue
- Brown

30. Which of these two do you think is the good one? *

![Image of two robots, one green and one brown.]

Markera endast en oval.

- Green
- Orange
31. Which of these two do you think is the good one? *

Markera endast en oval.

- Grey
- Red

32. Which of these two do you think is the good one? *

Markera endast en oval.

- Orange
- Purple
33. Which of these two do you think is the good one? *

- Brown
- Yellow

34. Which of these two do you think is the good one? *

- Red
- Blue
35. Which of these two do you think is the good one? *

Markera endast en oval.

☐ White
☐ Black

36. Which of these two do you think is the good one? *

Markera endast en oval.

☐ Purple
☐ Blue
37. Which of these two do you think is the good one? *

Markera endast en oval.

☐ Yellow
☐ Green

38. Which of these two do you think is the good one? *

Markera endast en oval.

☐ Black
☐ Purple
39. Which of these two do you think is the good one? *

Markera endast en oval.
- Green
- Grey

40. Which of these two do you think is the good one? *

Markera endast en oval.
- Blue
- Black
41. Which of these two do you think is the good one? *

Markera endast en oval.

- Grey
- Orange

42. Which of these two do you think is the good one? *

Markera endast en oval.

- Brown
- White
43. Which of these two do you think is the good one?

Markera endast en oval.

☐ Orange
☐ Yellow

In the following two questions you will have to choose the color that you associate the most with Good and the most with Evil.
44. Which one of these colors do you think of as Good? *

Markera endast en oval.

- Black
- Blue
- Brown
- Green
- Grey
- Orange
45. Which one of these colors do you think of as Evil? *
Markera endast en oval.

- Black
- Blue
- Brown
- Green
- Grey
- Orange