

# WSUV RESEARCH SHOWCASE

## Color and the Cochlear Correlation

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## **TABLE OF CONTENTS**

Introduction .....	3
Literature Review .....	4
Methods .....	9
Data Analysis .....	13
Results & Conclusions .....	14
Appendix .....	17

## INTRODUCTION

Music and art are two of man's oldest pursuits. Throughout time, human beings have expressed themselves through whatever mediums have been available to them, from instruments fashioned out of wood to cave paintings and beyond. Today, artistic expression is increasingly taking place through digital media. And since research has shown that there are correlations between music and color, we chose to explore the relationship between music and color as expressed through the creation of digital art.

How do people choose to express themselves artistically when listening to music? Are color choices affected by what style of music they are listening to? As mentioned, research shows conclusive evidence for correlations people make between music and color. For example, the color red is associated with strong, vigorous music and pulsating beats. Yellow is associated with lively music. Slower, plodding music was associated with blue in one study.

However, previous research has not allowed subjects to actually create art while listening to music. We wanted to, rather than asking subjects to consciously choose colors, ask them to create art in a digital paint program, and watch the color choices they made as a part of the creative process. Subjects were allowed to paint whatever they wanted - from abstract doodling to pictures - and to choose whatever colors they wanted.

In addition we conducted a survey to find out what colors different genres of music bring to mind in separate subjects. This survey was similar to previous

research studies. We then compared the results of both of these experiments to see how they correlated with one another.

Results show that certain music pieces brought out strong tendencies in subjects to paint certain colors. For example, the classical and reggae pieces were strongly associated with blue, yellow and green when painting. These colors were sometimes also strongly associated with the colors people chose when asked to match a color to a genre. Other music pieces had less strongly correlated colors.

## **LITERATURE REVIEW**

Previous research has been done in the area of color/music correlation. This section describes four different studies or research articles in this area.

### **Color/Music Combinations**

At the University of Dayton, Ohio, 135 undergraduate students participated in a study on preferences of color and music. They were shown different colored lights while listening to different piano pieces. The objective of the study was to assess whether combinations of color and music can affect a person's experience.

Previously known is that people report imagining colors while listening to music, and that these colors are associated with attributes of the music. Alexander Scriabin even included a part for "light organ" in his symphony "Prometheus." When a note was played on this device, instead of hearing a tone, the audience would see a particular hue. Pitches were linked to hues according to a scheme devised by the composer. The organ projected colored lights on a screen while

the symphony was being played and the intensity of the lights changed to reflect melodic, harmonic, and rhythmic aspects in the music.

The 135 participants' task was to rank the lights according to how well they "matched" the music. Their preferences differed depending on whether the music was in a major or minor key. The participants' links are what might be expected: sounds that are loud and high in pitch tend to correlate with bright colors and sound that are soft and have a low pitch tend to correlate with darker colors.

Results from the study indicated that for major-key pieces, yellow and green were preferred over red and blue; and for minor-key pieces, green was preferred over all the other colors. Differences from this study to prior studies may be due to differences in the methodology of the experiments.

### **Color Music: Visual Color Notation for Musical Expression**

In this article by Michael Poast, a system of musical expression that uses color and shape in conjunction with sound to form a new language is discussed. The relationship of sound and color has been around since the time of Aristotle. Many famous composers have recognized color as a tool of expression for musical notation.

Colors have musical meaning, according to Poast. Color experiments have shown that colors can have a physical and emotional affect on us. One particular test from the book *The Luscher Color Test* notes that red, for example, is stimulating to the nervous system, increases blood pressure and increases the heart rate. Red is a "heavy" weight color. If one could associate this color with sound, red could be depicted as a pulsating rhythm. (An example of this can be

seen in *Figure 5* and *Figure 7* for experiments conducted with Pop and Techno genres of music. Red has a high percentage of use in each of these. Both of these genres of music have a more stimulating and pulsating rhythm. See Results and Conclusions section.)

Blue evokes different feelings depending upon whether it is light or dark. According to Poast, some hues of blue are associated with higher-pitched, flowing rhythms. An example of this holds true in experiments conducted for Jazz/Big Band and Classical music genres shown in *Figure 1* and *Figure 9*.

In the 1960s and 1970s, electronic music and poetry from Fluxus artists included visual scores that helped lead to many multimedia art forms. We now have diverse sensory stimulation in film, video, multimedia, television and computers.

Composers throughout history have used color and sound. A color organ was built in 1934 by Louis-Bernard Castel. The instrument was played by pressing down on a keyboard, which put a combination of colored lights onto a screen.

In reference to Color Music, Michael Poast poetically states, *“In our current era, we are weaving together complex expressions of our world. Our thinking and perceiving has broadened. In this increasingly visual society and intersensorial culture, it is a timely moment for the redefinition of notational systems.”*

### **A Comparative Study of Color Association with Music at Various Age Levels**

The purpose of Robert Cutietta and Kelly Haggerty’s study was to explore the development of the associations of color with music. 1256 subjects, ranging in age from 3 to 78, were asked to listen to three music excerpts and indicate the

color they associated with each. The excerpts consisted of three different classical pieces, each with unique and contrasting musical qualities.

The first piece, from Gustav Holst's *Suite No. 1 in E-Flat*, was majestic and energetic. The second piece, from Modest Moussorgsky's *Pictures at an Exhibition*, was slower and more laborious, and the third piece, from *Music for the Royal Fireworks* by George Frederic Handel, was light and lively.

Subjects were given six possible color choices to choose from. After age nine, the results were very consistent. Across the generations, the color choices tended towards red, orange, and yellow for the first piece. Blue was the favored color for the second piece, and for the third piece orange, yellow and green were all chosen, with yellow standing out the strongest. These results strongly support the existence of musical color associations.

Researchers sought to answer the question of how musical color associations are formed. Are people experientially conditioned by the entertainment and media industry to associate certain colors with certain musical styles? When the study showed that even senior citizens, who grew up without television, chose colors consistent with the choices of other age groups, the idea of experiential conditioning was rejected. Cutietta and Haggerty concluded that color associations to music must be the result of "*some sort of sensory processing of music that appears to be widespread and consistent across a wide age spectrum.*"

## **What is the Color of that Music Performance?**

In an article by Roberto Bresin, an experiment is conducted in which color is used to express emotions. The main goal of this experiment is to develop a computer system for teaching students to play expressively.

To rate each performance, colors were used with the hue, saturation, and brightness scheme where the hue is the actual color, saturation is the purity and brightness of the color is a percentage.

Each subject was instructed to rate each piece of music according to how well it matched a color palette given by the computer. Participants could listen to the piece of music for as long as they wanted and then rate it with the color sliders.

Significant correlations were found for the brightness of color and in the expressive performances that included love, pride, tenderness, contentment, sadness and fear. Another significant finding was the relationship between saturation, anger and shame.

For the saxophone and guitar, darker versions of the colors red, orange, blue and violet were preferred. Brighter versions of the same colors were preferred for the piano.

Music and art had a strong correlation with each other in this study. The purpose was *“to investigate if these differences could be explained in terms of expressive contents of music performances and consequently if we could use color as one indicator of expressivity in music performance.”*



A key part of the study was that individuals were not subjected to the music or the emotions that were being rated. Results showed “*significant correlations were found for brightness and the expressive performances performed with love, pride, tenderness, contentment, sadness and fear.*”

## **Discussion**

The above studies illustrate evidence for definite correlations between music and color. Although their methods vary, the common thread is that all of the studies asked participants to associate a color or colors with a piece of music. They did this either by showing colors and asking subjects to rate those colors according to how well they match the music, or by asking participants to choose a color that matches the music.

Research was not found that allowed subjects to freely paint or draw while listening to music and to choose colors as a spontaneous part of that experience. Our research team wanted to expand on the above studies by asking subjects to actually create art while listening to music. We wanted to see color choices made during the creative process, rather than ask subjects to consciously choose colors.

We then wanted to compare these colors with colors that other participants chose in a separate survey - one very similar to the above study by Cutietta and Haggerty.

## **METHODS**

### **Experiments**

We designed two experiments, one an interactive painting experiment and the other a simple six-question survey. Thirty-four interactive experiments were

conducted and 32 surveys were completed. Subjects either participated in the experiment OR the survey, but not both, so individuals who took the survey were not the same individuals who took part in the interactive experiments.

For the interactive experiment, we compiled a music file which consisted of six different 30-second tracks of music. Each track was a portion of a song from a unique genre of music. Subjects listened to the tracks while painting in a simple digital paint program (Microsoft Paint, standard on any PC). Between each track was a break of silence, allowing the subject time to save his or her painting and start a new file, beginning the next painting when the next track began. The experiment resulted in each subject having made six different paint files, one for each genre of music.

The subjects were allowed to paint using any color or colors they wished, using whatever brush stroke styles they wanted. They were also allowed complete freedom to draw pictures, or to simply doodle abstractly.

The interactive experiment consisted of the following music genres, which were represented by these specific selections:

1. Classical - *Appalachian Spring* by Aaron Copland
2. Reggae - *Three Little Birds* by Bob Marley
3. Pop - *If You Seek Amy* by Britney Spears
4. Techno - *I Wish* by Infected Mushroom
5. Jazz/Big Band - *Harlem Air Shaft* by Duke Ellington
6. Alternative - *Venus in Furs* by Velvet Underground

The survey listed the six music genres, in the above order, but without specifically naming the songs. Subjects were asked which color they thought of when they heard each type of music. They were asked to write down the first color that came to mind. Subjects were not limited to a predetermined list of colors; they were allowed to choose any color.

The following documents were use for the interactive experiment and the survey.

*Interactive Experiment Instructions*

**Instructions for Color/Music Test:**

As part of a research project for DTC 375 at WSU, we are conducting an experiment involving six genres of music and the Microsoft Paint program.

Six genres of music will be played while you create brushstrokes of your choice in the Microsoft Paint program. You may use any brushstrokes or colors and create whatever you wish. No artistic ability is necessary to take part in this experience.

After each genre of music has played, you will have time to save your file. Your files will be saved with your first name followed by a number matching the order of the music you hear. When you are finished with the experiment, you will have 6 files with your name completed.

Example: John-1.bmp

The most important thing about this experiment is to have fun and not think too hard – simply create whatever you feel.

Thank you for your participation.

*Survey*

**A Colorful/Musical Survey**

DTC 375 Showcase

If you could associate music with color, what color do you think of when you hear the following kinds of music? Please write down the first color that you think of for each type of music below.

1.	<b>Classical</b>	Color Choice: _____
2.	<b>Reggae</b>	Color Choice: _____
3.	<b>Pop</b>	Color Choice: _____
4.	<b>Techno</b>	Color Choice: _____
5.	<b>Jazz/Big Band</b>	Color Choice: _____
6.	<b>Alternative</b>	Color Choice: _____

## **Participants**

Subjects who participated in these experiments ranged in age and gender. Education levels ranged from high school through the PhD level. Most individuals who participated in the interactive experiment had some computer experience. The level of experience ranged from limited to advanced. Most were familiar with some form of digital paint program.

## **Hypothesis**

We hypothesized that while creating art - in this case digital art - a subjects' choice of colors would be affected depending on the style of music they were exposed to. We believed that the characteristics of their color choices would correlate with the characteristics of the particular music piece they listened to. We also thought that colors chosen for use while painting "under the influence" of music would correlate with the colors people think of when asked to match a color with a genre without musical influence.

## **Variables**

In the interactive experiment, our dependent (responding) variable was the resulting color choices. Our independent (manipulated) variable was the style of music (specifically six music genres). Our controlled variables were the Microsoft Paint program, the amount of time allotted to paint and the music file containing the six different genres of music (one music file containing the same six music selections, in the same order, for the same length of time).

For the survey, our dependent variable was the color choice for each genre. Our independent variable was the genre listed. Our controlled variable was the survey form – we used the same survey form for each participant which contained the same list of genres in the same order.

### **DATA ANALYSIS**

The data collected was analyzed for the following purposes:

- To determine if individuals correlate colors with music
- To determine if music directly affects color use
- To determine whether digital art is affected by the introduction of music

To determine which colors were used and how often colors were used for each genre, we looked at each painting and noted each color that was used. Each color received one point for that painting regardless of how much of that color was used. For example, a techno-influenced painting with a teal background, red, yellow and green solid boxes and six purple stars resulted in one point each for teal, red, yellow, green and purple.

We then added up the number of points for each genre and figured out the percentage of the time each color was used. In many paintings, some colors were not used at all. In others, only one or two colors were used. Each painting was unique and took some time to analyze.

For the survey, each subject was allowed to choose one color for each genre listed. Percentages were figured in the same way as the interactive experiments.

## **RESULTS AND CONCLUSIONS**

This section discusses the results of the surveys and interactive experiments that show how music affects color choice. Survey answers and interactive experiment results support the following conclusions:

- **Individuals correlate color with music.** In the simple, one answer survey where individuals were asked to note the first color they thought of when they read the name of a particular genre of music, certain colors were chosen more often than others. For example, in *Figure 2* for Classical music, blue was the choice for 25% of the surveys. In *Figure 4* for Reggae, green was chosen 26% of the time. These were the colors people thought of without ever hearing the music. When completely different individuals were exposed to the actual genres of music through the interactive experiment, not having been told which genre they were listening to, those same colors were chosen in high numbers as well. For Reggae, green was used 36% of the time and in Classical, blue was chosen 22% of the time. These colors still had high numbers regardless of whether the music was involved or not (See *Figure 1* and *Figure 3.*) Additionally, the Techno genre had a high percentage of black in both the survey and experiment and Jazz/Big Band had considerably high percentages of blue and green (See *Figures 7, 8, 9 and 10*)

Individuals correlated colors with music whether they actually heard the music or not. Oftentimes, similar colors were more prevalent than others.

- **Music directly affects an individual's color choices.** In addition to the survey, an interactive experiment was conducted with the same genres of music noted in the survey. The interactive survey required individuals to listen to the genres of music, without being told what they were, and express whatever they wished in the Microsoft Paint program. Similar colors were chosen for the same categories of music even though individuals that completed the written survey were different than those given the interactive experiment. In *Figure 9* and *Figure 10* for Jazz/Big Band, the colors red, yellow, green and blue were chosen over half the time with blue and green top choices at 41% in both the survey and experiment. However, red and yellow choices declined considerably from the survey to the experiments and the color purple increased from 8% to 19% in the interactive experiment. Similar changes can be seen in the Pop, Techno and Alternative genres in *Figures 5, 6, 7, 8* and *Figures 11* and *12*.
- **Digital art (or any art) may be affected by musical influence.** Color choice, while creating art, is affected when music is introduced as shown in comparisons of interactive experiments to written surveys in the pie chart figures. Some color choices remain notably constant while others change drastically. The following figures show a percentage of the time that each color was used. Oftentimes, color is automatically associated with certain music because of commercial advertising and stereotypical influences. In this research, surveys were conducted without music and individuals quickly associated a color with a certain genre of music. However, when

individuals were exposed to different genres of music while creating art in the Microsoft Paint program, many color choices were different than one might expect. In *Figure 12*, red, purple and gray were the predominant color choices for the survey. In the actual experiment, red continued to have high numbers compared to some, but gray, black and yellow were the predominant colors. Black moved from 13% in the survey to 17% in the experiment and yellow increased from 3% to 14% (See *Figure 11* and *Figure 12*.) Different pitches and sounds affect color choice, as described in “Color Music” by Michael Poast. Because higher notes and lower notes effect color choice in different ways, it is reasonable to see how art can be affected by musical influences. This can be seen in the Classical and Pop music pie charges on *Figures 1* and *2* and *Figures 5* and *6* of the Appendix. Yellow and pink were popular colors in the Classical and Pop music genres. Both of these musical choices had high notes and upbeat sounds.

The results of our research showed that while creating art, an individual’s choice of color is affected by music. Color choices are often associated with the characteristics of a particular genre of music. Individuals do correlate color and music. Color and the cochlear correlation of music does exist because our brains do interpret sound as color and color is additionally interpreted as sound.



## APPENDIX

Figure 1

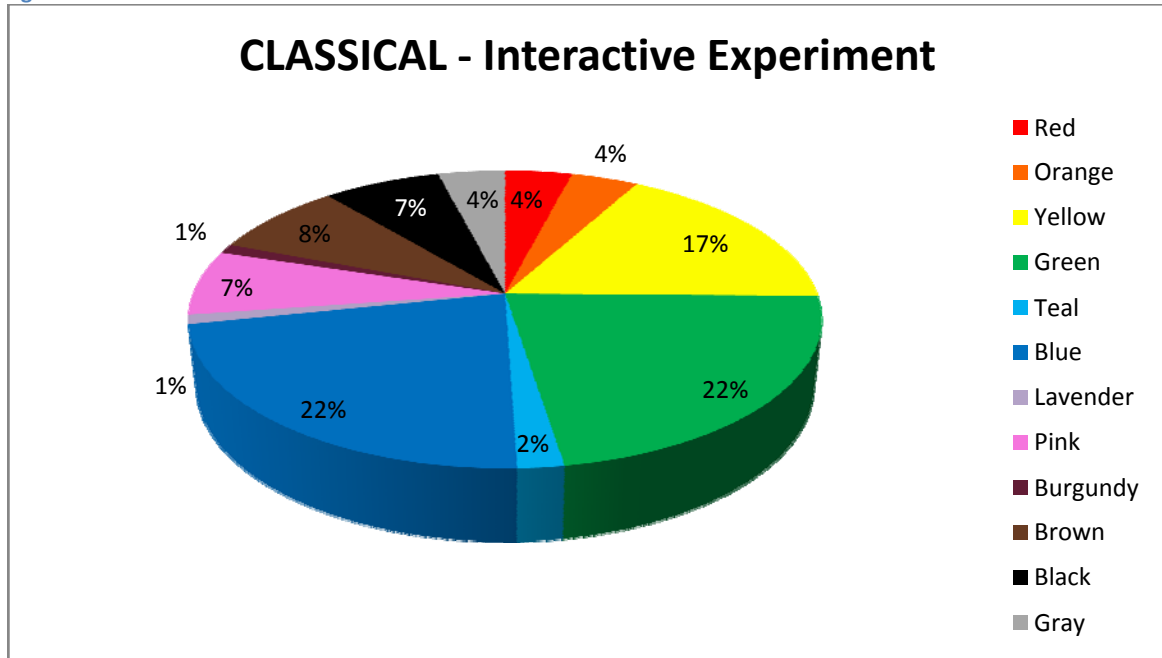


Figure 2

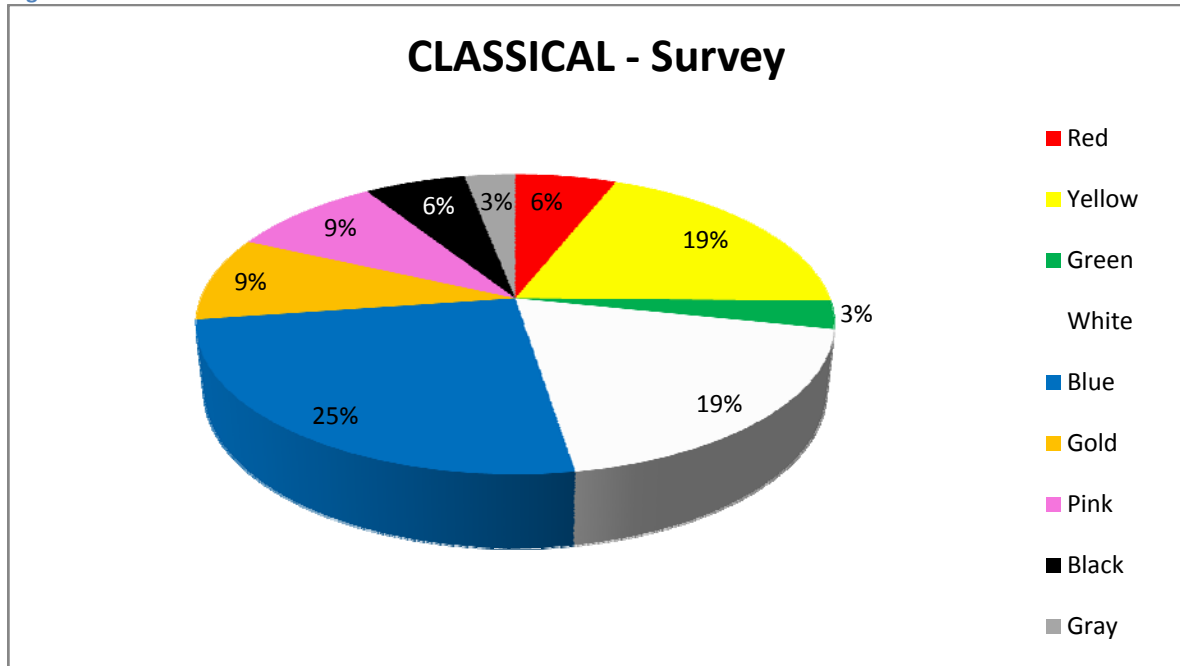


Figure 3

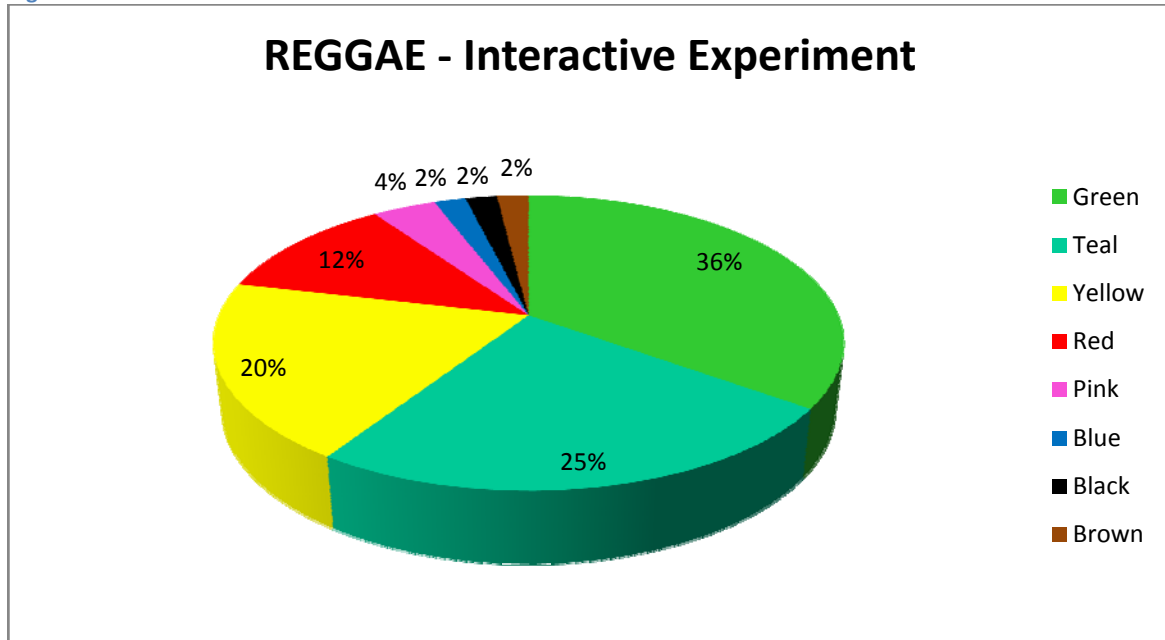


Figure 4

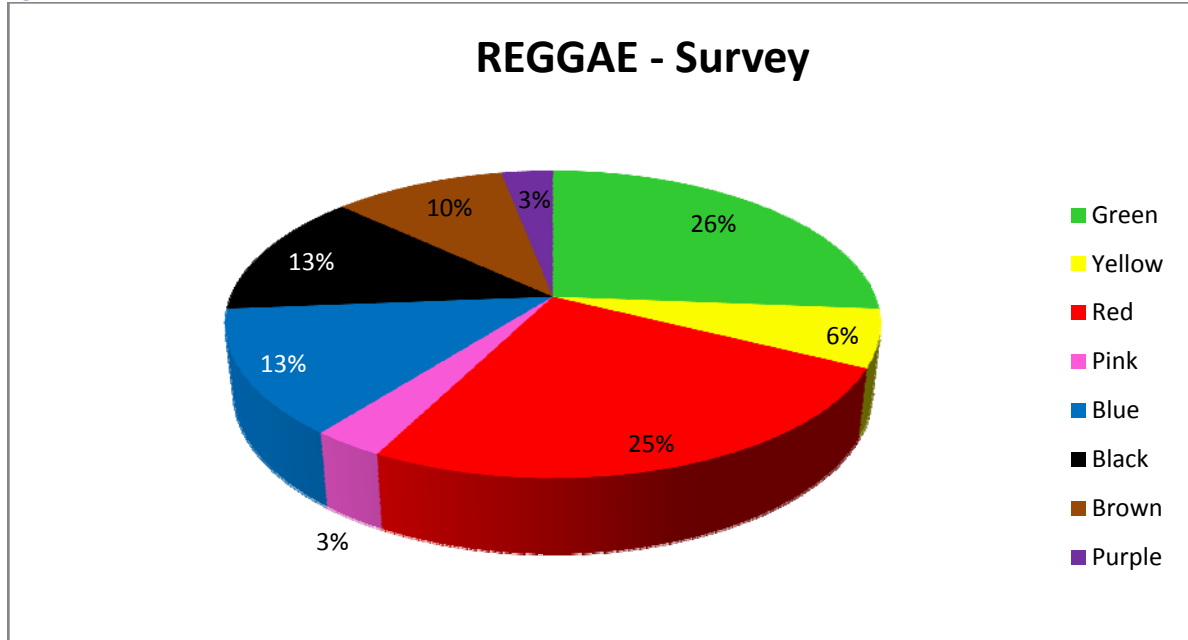


Figure 5

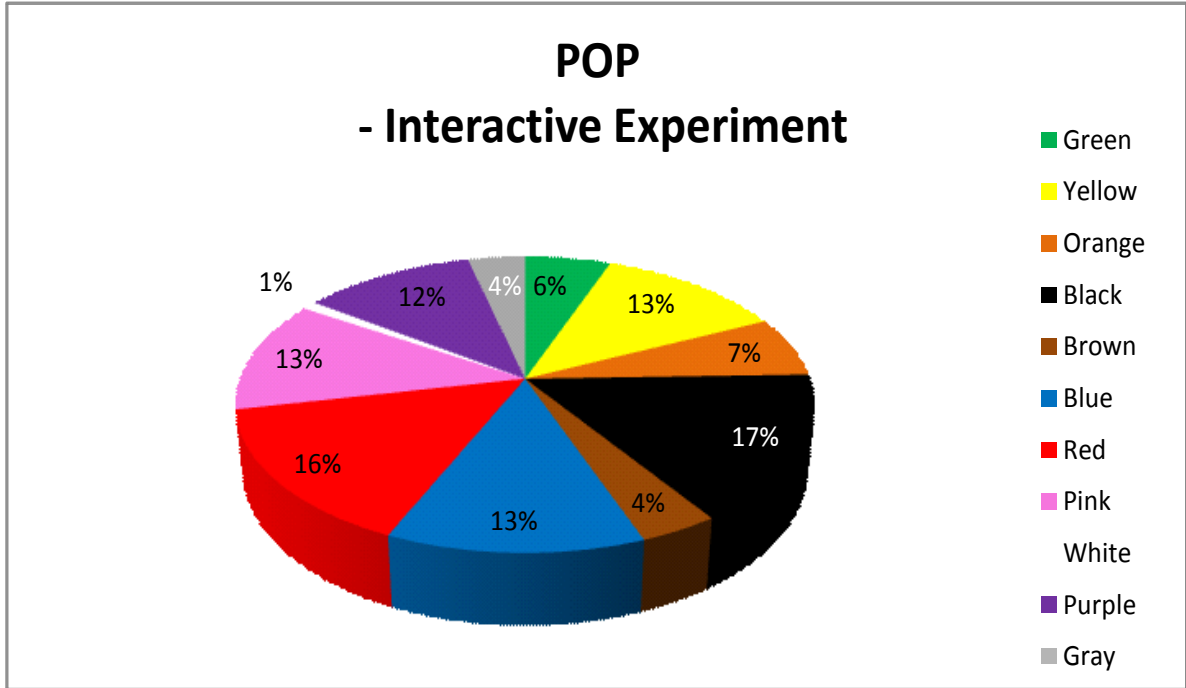


Figure 6

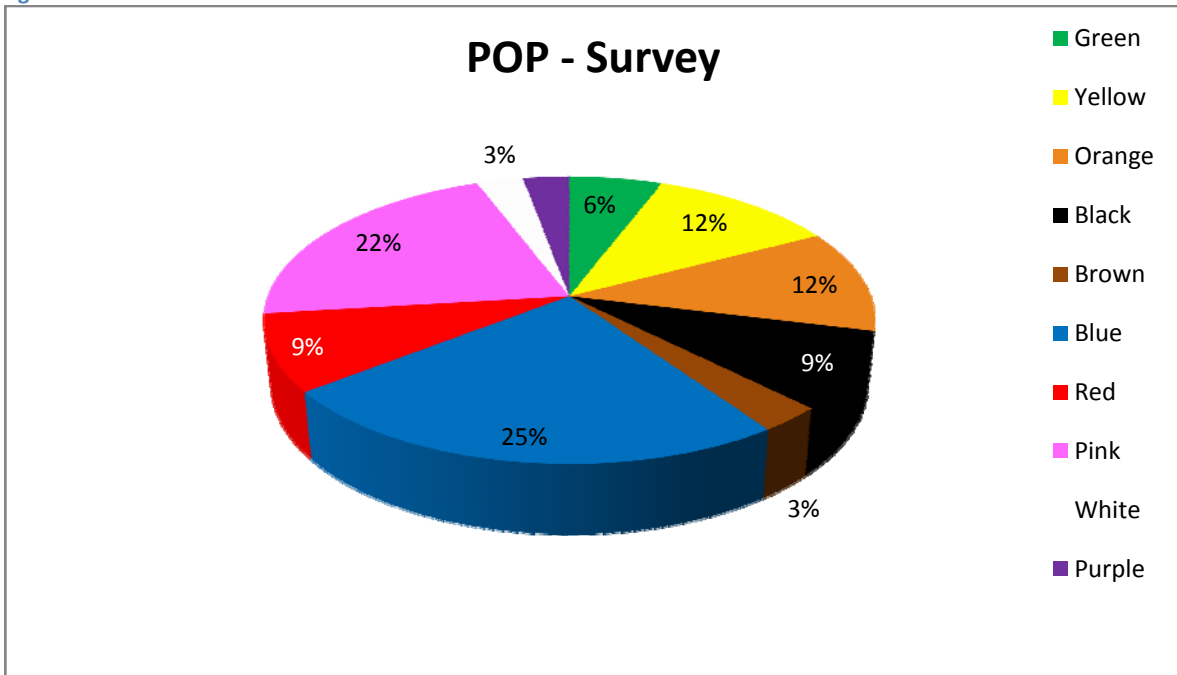


Figure 7

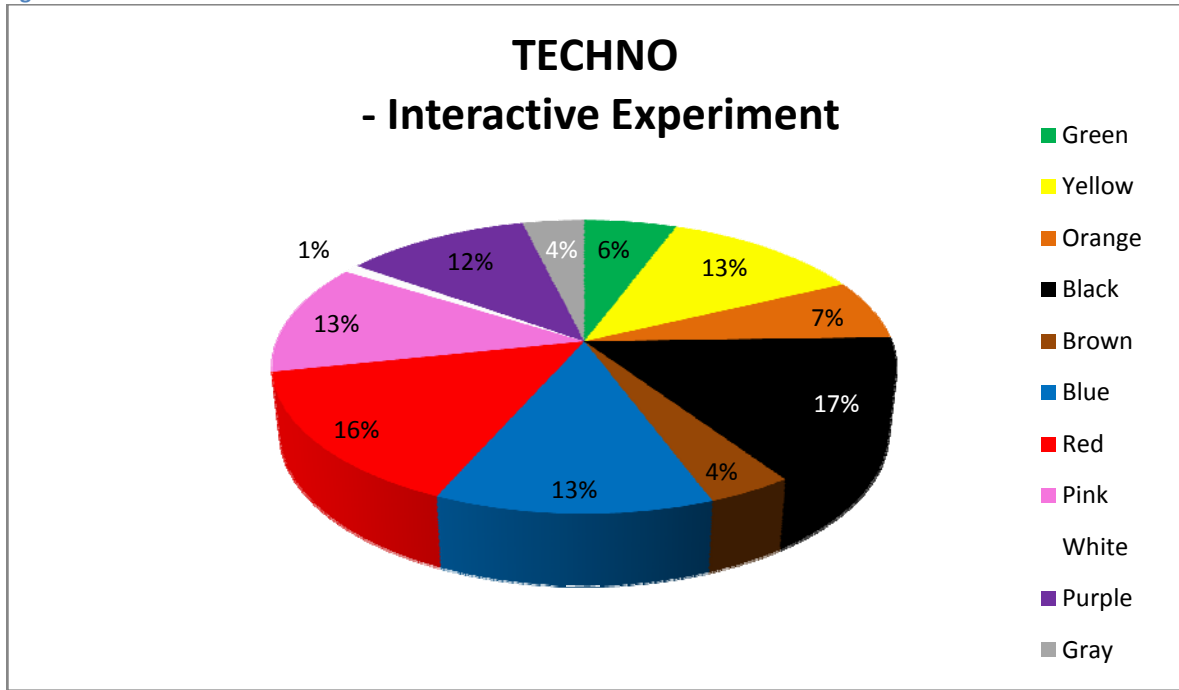


Figure 8

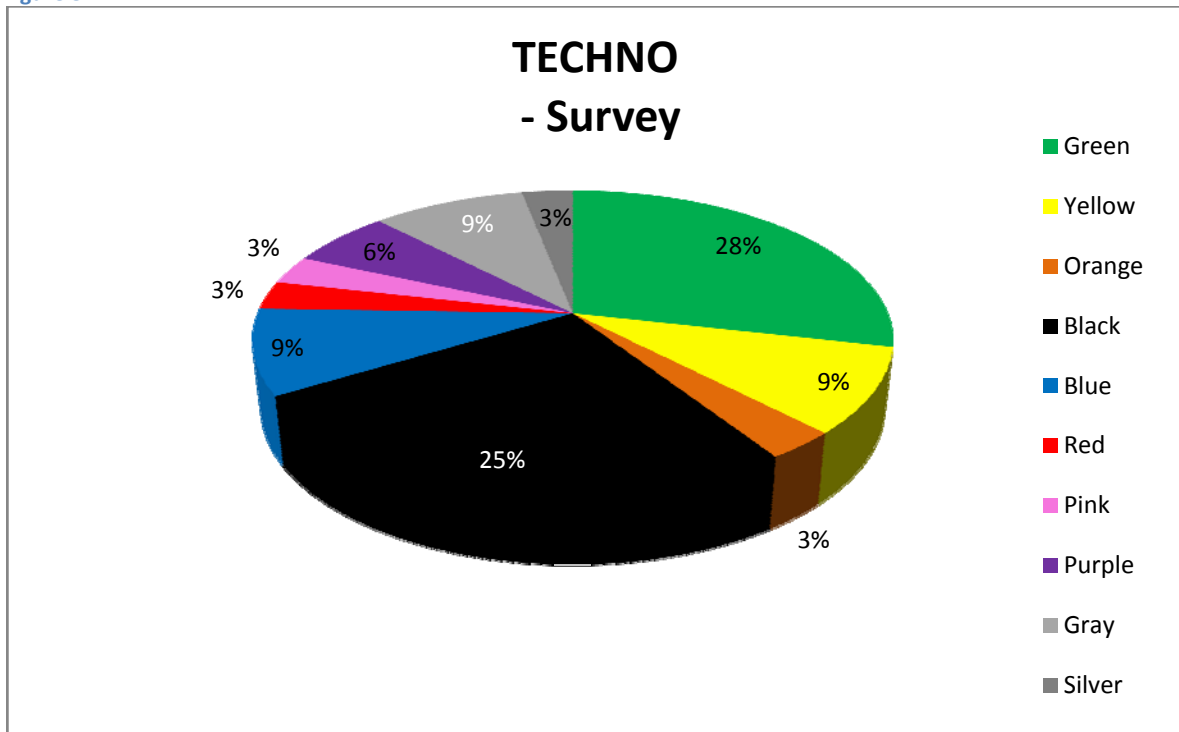


Figure 9

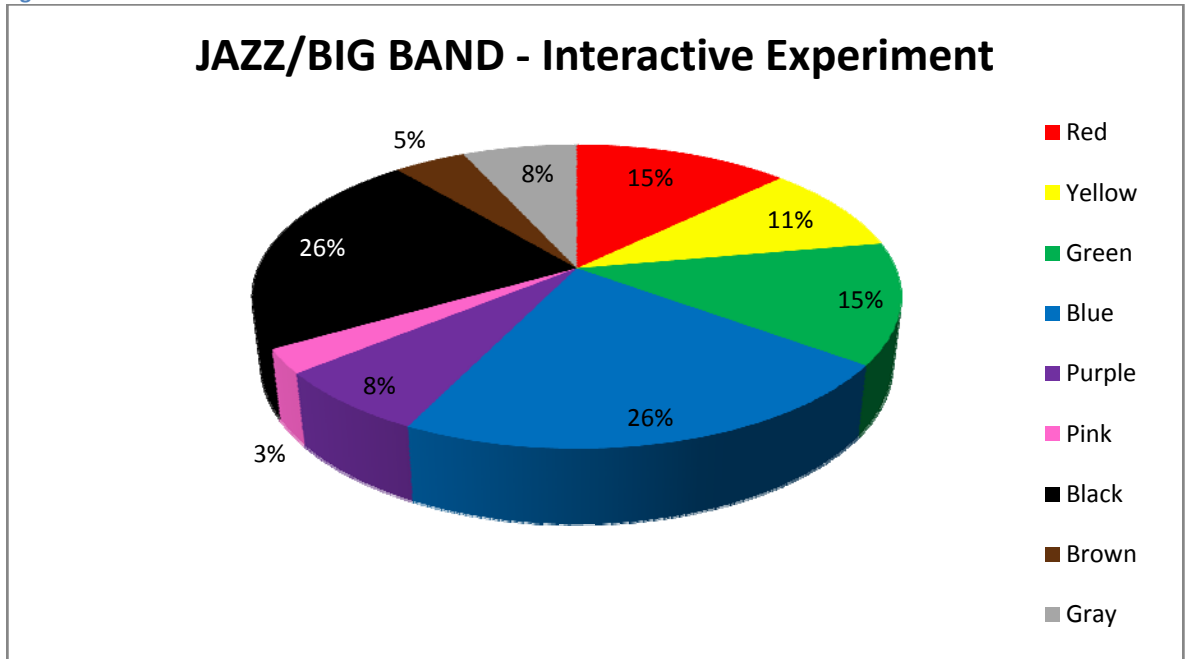


Figure 10

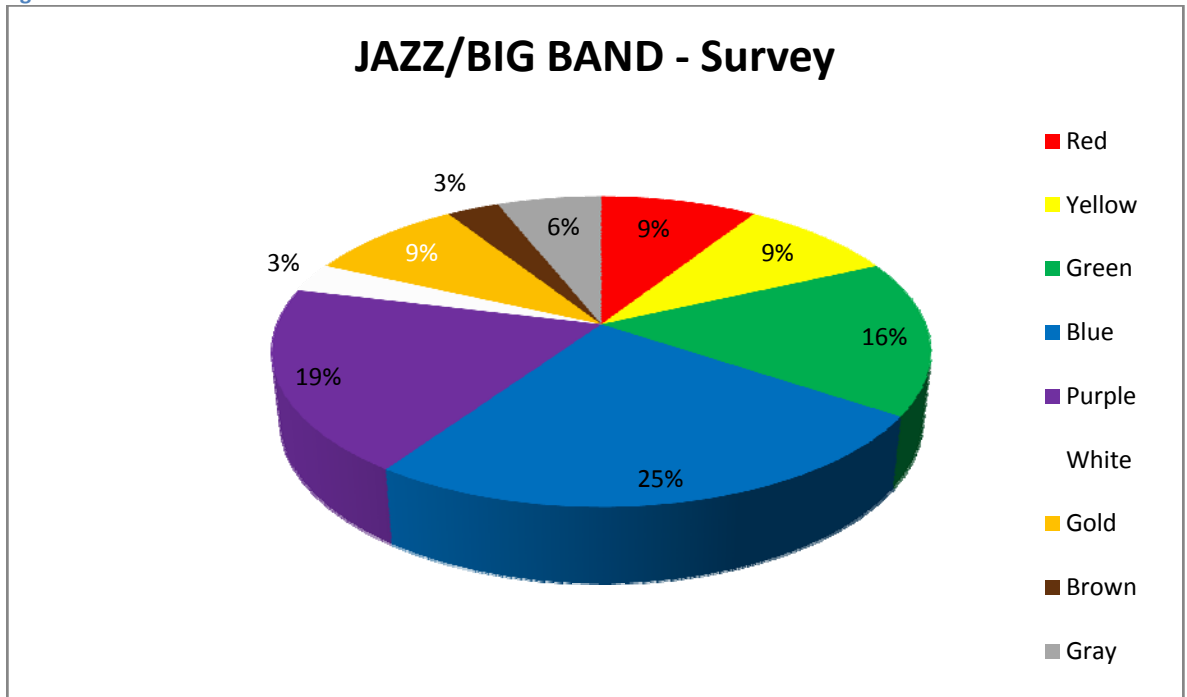


Figure 11

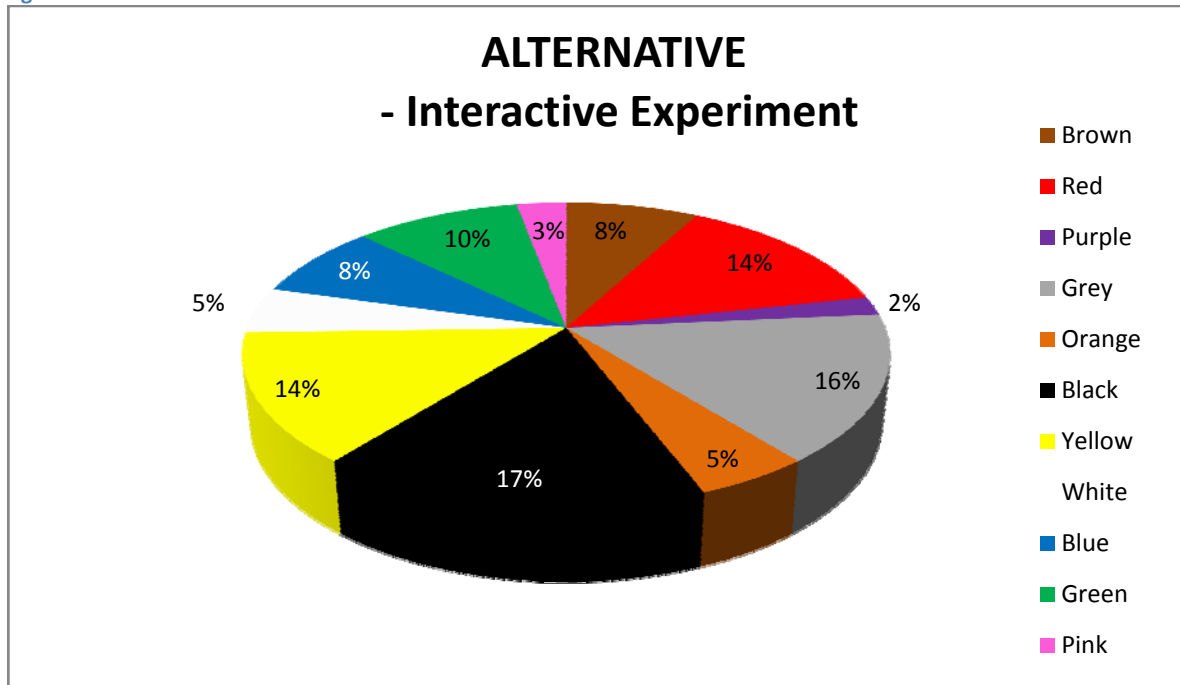
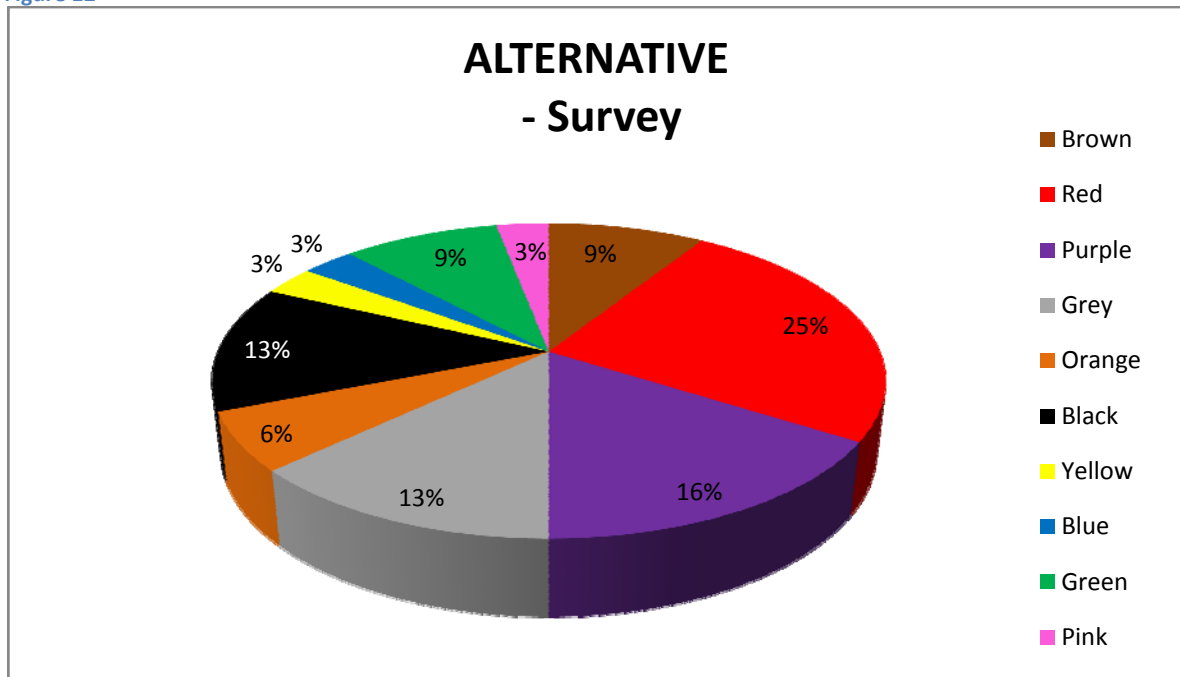


Figure 12



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