STA160 Final Project

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Abstract

Andy Warhol's five "Shot Marilyn" paintings (1964) used various colored backgrounds: red, orange, light blue, sage blue, and turquoise. In 1964, just as Warhol was finishing a set of "Marilyn" canvases, Dorothy Podber (a performance artist) arrived at Warhol's studio and asked Warhol if she could photograph them. Warhol agreed but was uncertain about Podber's use of the word "shoot," at which point Podber removed her white gloves, grabbed a small handgun from her purse, and fired a bullet into the stack of four "Marilyn" paintings, which became known as "The Shot Marilyns." It is a series of silkscreen paintings with 5 different colors.

1 Introduction

The "Shot Marilyn" series, which was released in 1964, pays tribute to the mysterious Hollywood actress and cultural icon Marilyn Monroe, who tragically died in 1962. Each painting in the series represents Marilyn in a vibrant, larger-than-life manner, emphasizing her eternal beauty and appealing allure. The works of art pay tribute to the famous star while also commenting on the brief duration of fame and celebrity. The vibrant color palette utilized in the "Shot Marilyn" paintings is a unique characteristic of Warhol's artwork. Warhol constructed a visual impact that both captivates and challenges viewers by using bold, eye-catching colors. He enhanced the impression of Marilyn Monroe as an omnipresent figure in popular culture by using vibrant colors and repeating the image several times. In this project, we will look at the "Shot Marilyn" paintings using density plots, a visual tool that lets us examine the distribution and intensity of colors and shapes inside each piece of artwork and more analysis using hierarchical clustering and scatterplots.

2 Method

To begin our exploration of Warhol's images and understanding his choices for specific color patterns across his five different images, we processed his images into pieces of data that can be accessed and manipulated. Each image's resolution is 750 x 750 pixels. The image would become an array consisting of columns of red, green, and blue channels that indicate the specific color channels that make up each pixel in the image. These sets of data would then allow us to perform analyses and transformations in the forms of plots, color changing, clustering, and more. Specifically, we will be performing color changing for regions of interest, analysis of density of CMYK (Cyan, Magenta, Yellow, Key) values, hierarchical clustering, and analysis of density scatterplots of RGB values for regions of interest.

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2.1 Hierarchical Clustering

By applying hierarchical clustering to a sample of R, G, B values of each image, we hope to gain an understanding of the color distribution of each image. Specifically, by looking at the hierarchical clustering plot, we'd like to pinpoint the dominant color and the specific color pattern profile that stands out for each image. With this, we can guess Warhol's approach for color selection regarding the various different backgrounds of the Marilyn Monroe image.

2.2 Color Changing for Regions of Interest

One way of understanding how to analyze Warhol's shots of Marilyn Monroe is being able to pinpoint specific regions of interest. In this section, we isolate the regions for which we are interested, for example the lips, and change the color profile of the lips, creating a unique image that retains the other features but only changes the color for the region of interest.

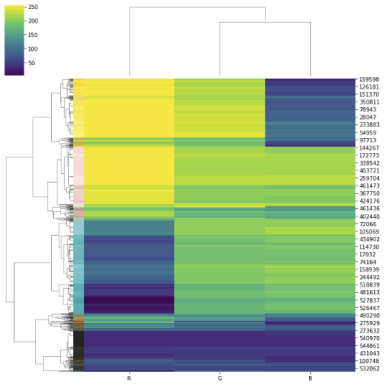
2.3 Analysis of Density Scatterplots of RGB Values for Regions of Interest

In observing the density scatterplots of RGB values for regions of interest, we hope to analyze the specific patterns and gradients that occur in regions of interest across images. In comparing the difference in patterns for the scatterplots across the different images, we can analyze Warhol's thought process behind selecting specific colors for parts of the image. For example, a question that we are interested in answering is why Warhol prefers a specific color profile for a region of interest in one background color, say blue, versus another color.

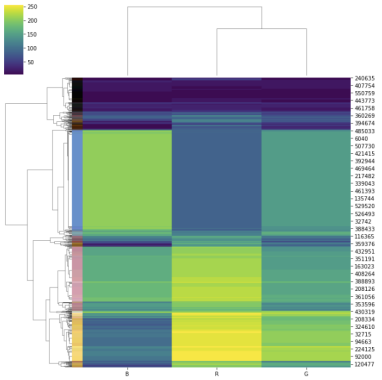
2.4 Analysis of Density of CMYK Values

Focusing on the density of CMYK values allows us to understand the importance of layering in Warhol's images. In this section, we explore a little bit of background regarding how Warhol operates in terms of his process of creating images and how that might in turn affect the turnout of the images. We use CMYK to visualize the dominant colors for each variation of the images and are able to generate insights on the layering aspects through the density plot.

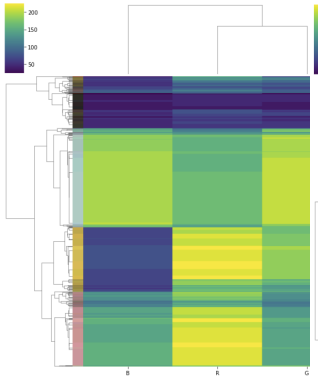
3 Hierarchical Clustering



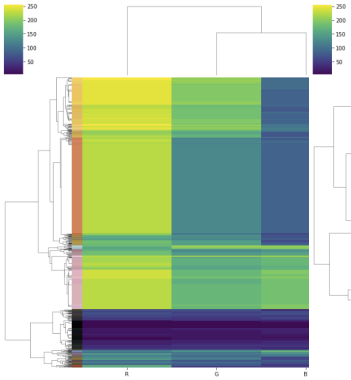
(a) Aqua Cluster Map



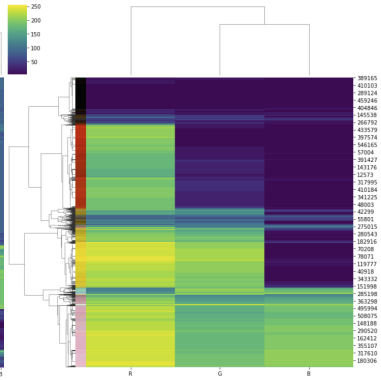
(b) Blue Cluster Map



(c) Green Cluster Map



(d) Orange Cluster Map



(e) Red Cluster Map

Here we have the hierarchical cluster charts of a sample(n=1000) of pixels of the 5 images. The most left colors of the charts showcases the corresponding color of the respective R,G,B values. From this, we get the color spectrums of the images. When looking at each of the charts, we see that the background, hair, and face color stick out the most for each of the image's color spectrums. This is due to these colors taking a majority of the pictures. Another part that sticks out is the black/dark color which is due to the eyebrows/shadow that Marilyn Monroe produces. We also can see the tiny slivers of teal which represent the collar, earrings, and eyeshadow color. Moving on from the color, we can see the individual R,G,B coordinates of the color spectrum. This will be useful when creating the Regions of Interest(ROI). Furthermore, we can see looking at the R,G,B columns, the distribution of values of each of them. When looking the Red Image cluster chart, we can see that there were a lot of higher values of red compared to the green and blue. This is the complete opposite in the aqua and green image cluster charts, where there are more higher values of green and red. When we look at the blue and orange cluster maps, we see that the R,G, and B columns are similarly distributed in value. However, overall among all the five cluster charts, Warhol tends to use higher values of the R,G,B color spectrum, creating more lighter colors than dark. This is representative of the pop art genre where vibrant colors are used. Looking at the color spectrum, we can see the contrast of these colors such as the pinkish skin and the vibrant background color(red, orange, green, blue, aqua).

4 Color Changing for Regions of Interest

In exploring Warhol's five shots of Marilyn Monroe, one thing that stood out to us was his choice of giving the images different background colors and different shades for specific parts of the body, for example, earrings and eyebrows. The five images above are organized in the format of ABGOR (Aqua Blue Green Orange Red) format, where the colors represent the background color.

Across the five images, there are various examples of artistic choice that Warhol demonstrates, for example opting for a paler face in one image and electing for a darker shade in another. These examples speak a lot about Warhol's tendency and preference to play with colors. In this section, we'd like to try our hands at manipulating the images of Warhol's image. In doing so, hopefully, it would give us a perspective into how Warhol felt in altering the original image and putting his own inspiration. In our case, we manipulated the lips for each image such that the image itself stayed the same, but the lips turned into a bright shade of purple. Note that in the images altered above, even though the lips all changed colors that there are still many distinct aspects that differentiate each image from the other. However, despite their differences, there are also many similarities that linger. For example, note how the eyeshadow keep their tint of blue, albeit a different shade for each image. However, in performing the alterations that we did, it became clear that it is possible to change an image's profile simply by changing its RGB colors. In changing the colors, the meaning and definition behind the image also change. Perhaps this is one of Warhol's intentions behind creating the so similar yet different images of Marilyn Monroe.

5 Density Scatterplots of RGB Values for Regions of Interest

Figure (2) Face: Five Regions of Interest(Order: Aqua, Blue, Green, Orange, Red)

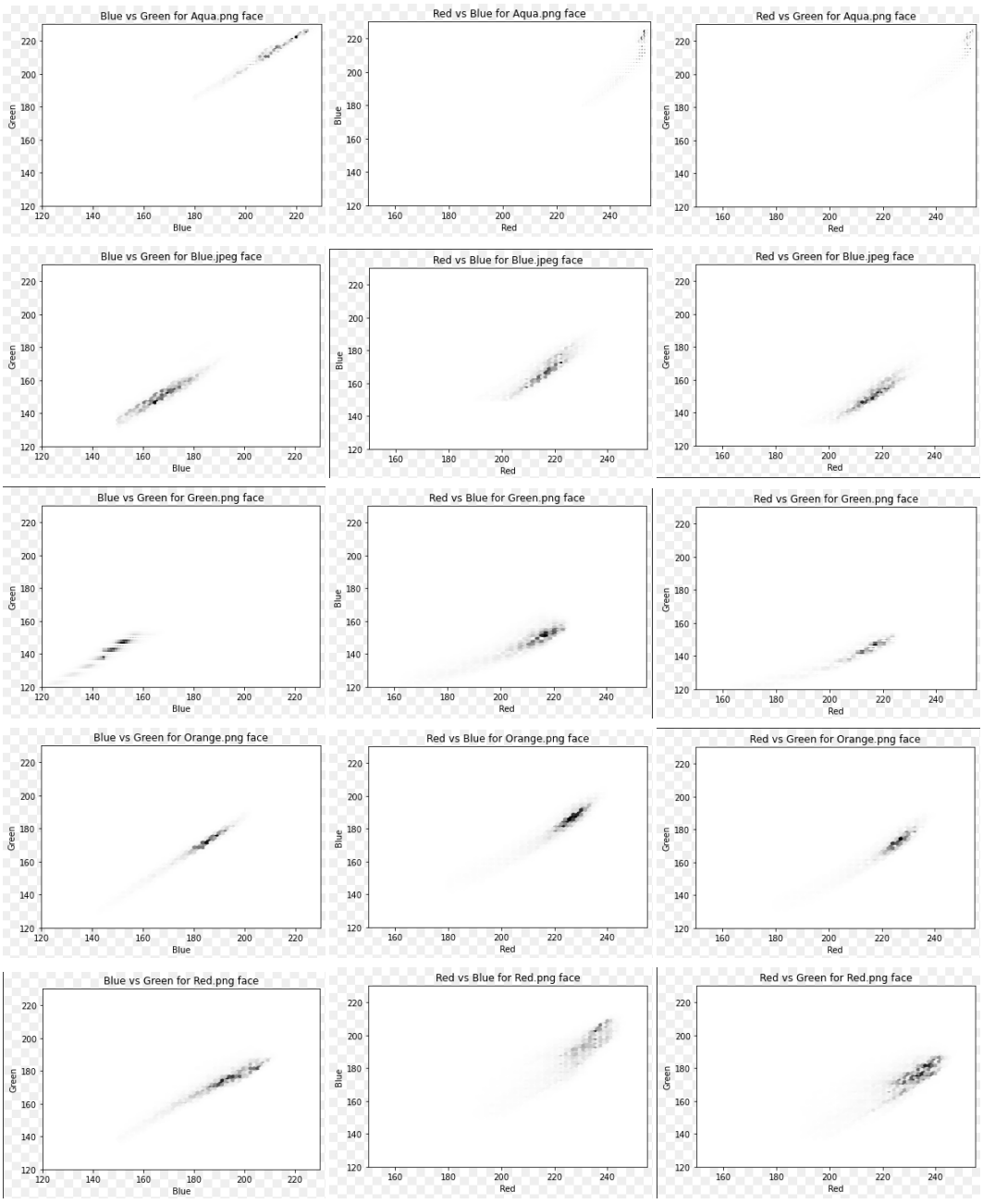


Figure (3) RGB space Density graphs of Face

When we look at the five pictures, we notice each of the faces has a pinkish tone that is different from each others. Going further in-depth, here we have the different RGB spaces of each face for the five different images. These are hexagonal binning plots that show the density of where the points(RGB coordinate) are allocated. From looking at all the plots, we can see that the plot that differentiates the most is the Aqua Marilyn Monroe picture. The plots for the Aqua picture show that the face takes an RGB space with significantly higher values than the other four pictures. This would mean that the color of the skin that the RGB produces would be a lighter tone since all three R, G, and B values are collectively higher. This can also be seen visually in the blue image as it looks paler than the others. On the other hand, when looking at the other four images, we can see that the orange Marilyn Monroe face RGB space is similar to the RGB space of the red Marilyn Monroe, while the Green one is similar to the Blue one. The values for the Orange and Red appear to be higher than the Green and

Blue, meaning that the latter would have a darker shade than the prior. While the Orange and Red have a lighter tone, it is not as light as the aqua one.

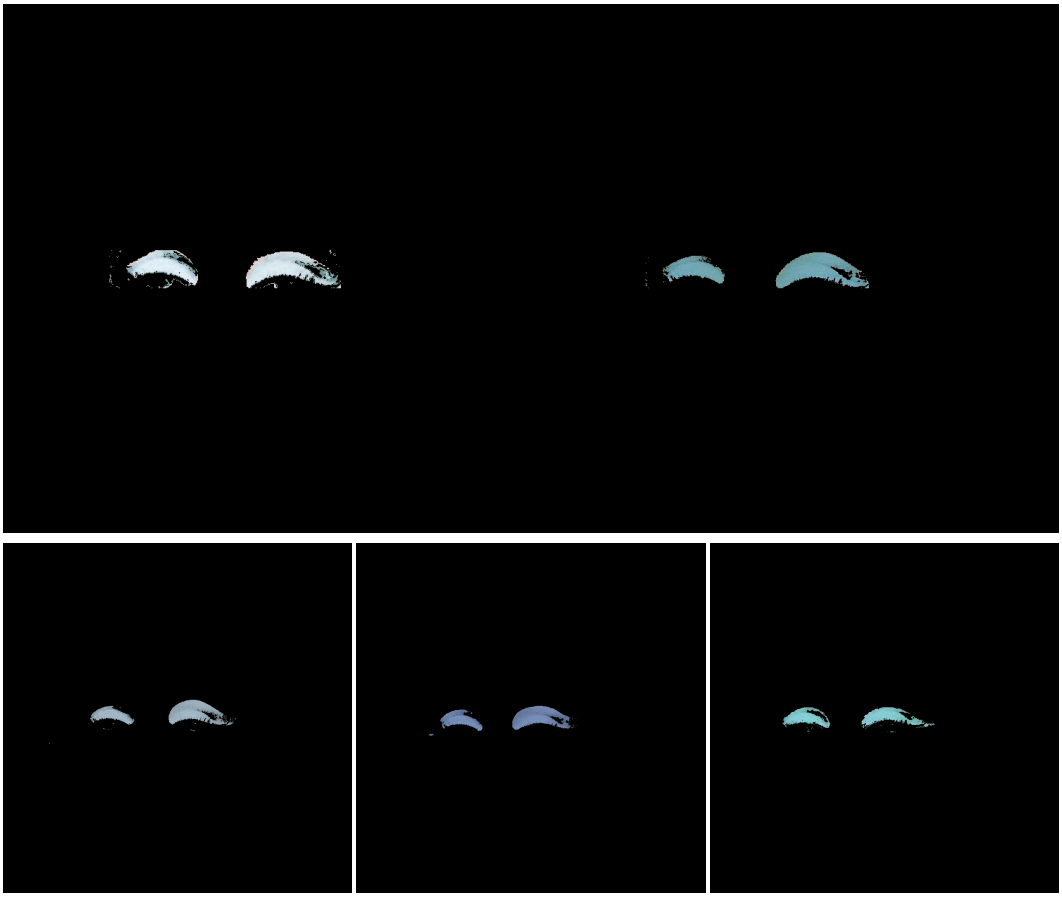


Figure (4) Eyeshadow: Five Regions of Interest(Order: Aqua, Blue, Green, Orange, Red)

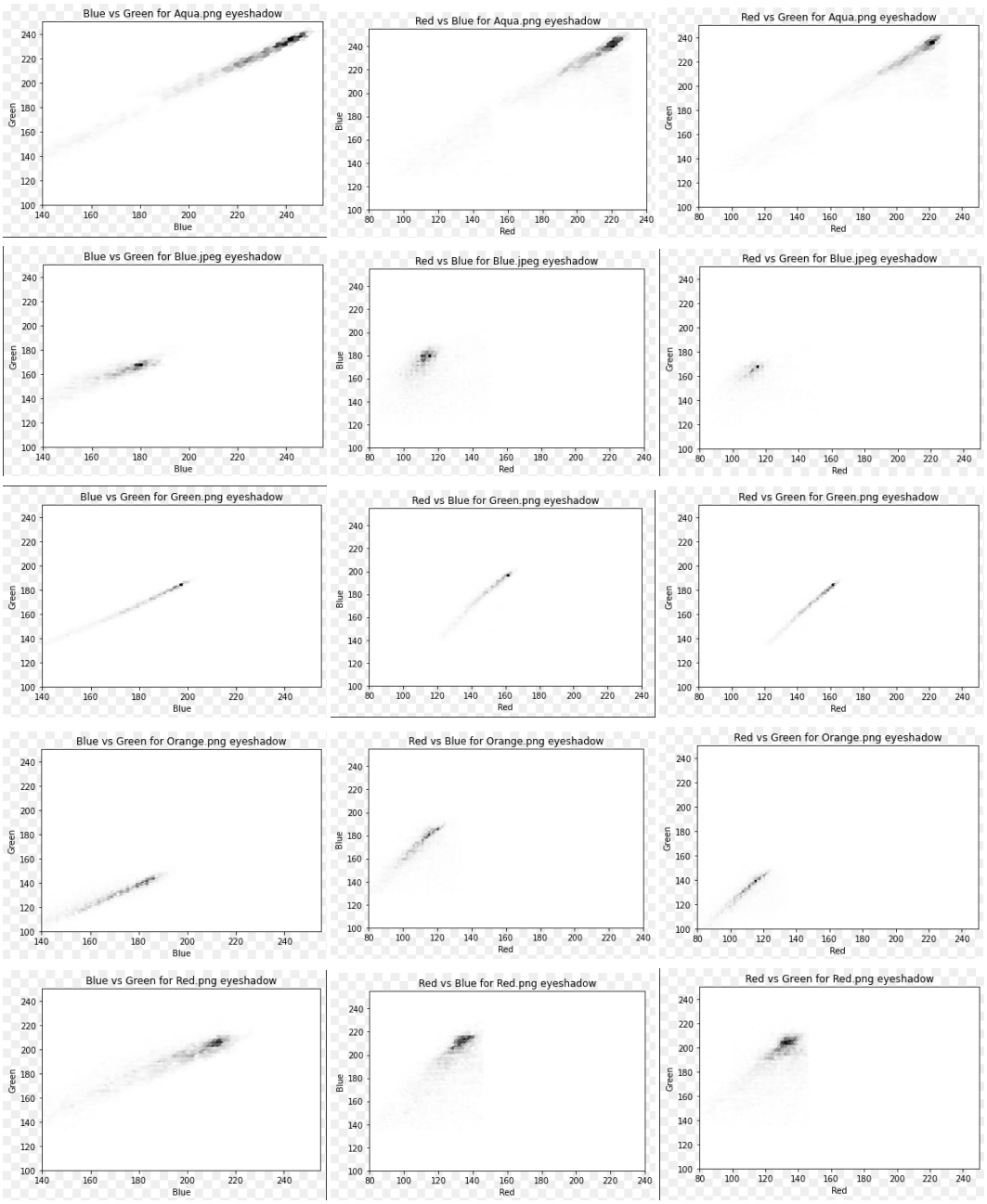


Figure (5) RBG space Density graphs of Eyeshadow

Next, we have the RGB color space of the eyeshadows. Just looking at the images alone, we see that the five eyeshadows range from a light blue to a teal-ish color. When looking at the plots, we notice that most of them are similar in the space that they take up. The plots that stand out the most are the Aqua ones since they have higher values for R, G, and B collectively than the other plots. This is similar to the face color where Aqua also had higher values than the rest. Likewise, this would mean that the aqua eyeshadow would be a lighter tone than the rest of the eyeshadows. On the other hand, the four other eyeshadows show a similar range of color. This is interesting since two of them(red and blue) have a tealish tone while the orange and green showcase a light blue color.

6 Density of CMYK values

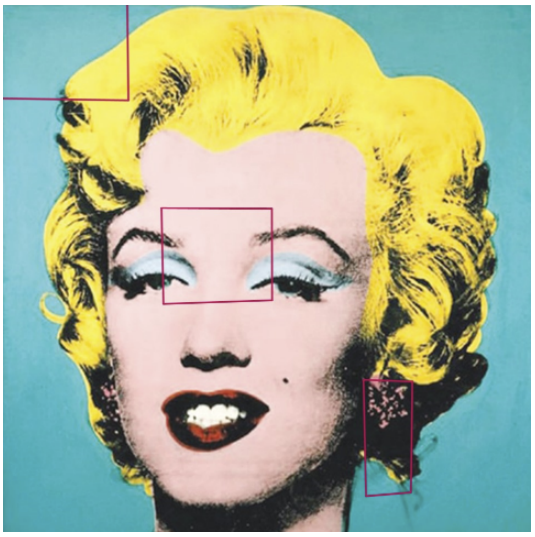
One of the things that immediately stood out when beginning to research Andy Warhol was his fascination with screen printing, or silk-screening more specifically. Upon looking into the screen printing process, it was clear that using RGB might not be the best way to analyze what was happening in the painting process. Screen printers usually apply 4 layers of paint to one painting: a cyan layer, a magenta layer, a yellow layer, and a black layer, represented by CMYK[5]. This is a similar principle to RGB, but instead of mixing light, Warhol was mixing ink. This is why the primary colors, CMY, are necessary. These colors are not reproducible by combining any other two colors of ink, but are capable of creating all other colors via some combination of the three. Conveniently, there is a way to switch RGB files to CMYK files with Adobe Photoshop. I conducted a similar analysis as earlier, but with CMY instead of RGB.

These are the densities of the CMY values of each respective image, with CMY each being on the same 0-255 scale as RGB.

It is worth noting that screen printers determine the intensity of each of the primary colors before the print, and can opt to have very opaque or more transparent ink [2]. This is effectively what determines the 0-255 value of each CMY, while the relative height of each density is what determines the visible color.

As you can see, the densities seem to form themselves into much neater 'peaks', with the turquoise and red paintings still towards the extremes. You can also see that some plots seem to have multiple peaks. This goes against the standard practice of screen printing, as one usually can usually make enough color with a single layer of CMYK. This prompted us to further study the color properties of each of the major colors in the painting, to see which colors might have different 'peaks' in their density graphs, indicating that they were painted with their own set of CMY, each at different intensities than before.

To do this, we sectioned off 3 rectangles of each of the paintings, visualized below:



This was in an attempt to get most of the main colors of the image: Using the same clustering methods as before over these subsets of image data, we were able to get separate color samples of the hair, the background, the face, the makeup, the earring, and the collar. After doing this clustering, we were able to graph densities of the CMY values of each color, much like we did before with each image. This gave us the results below:

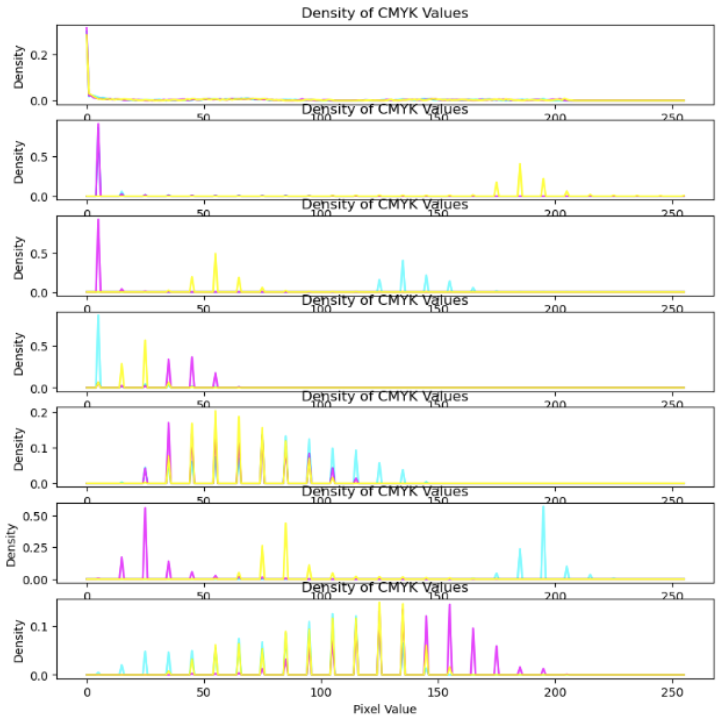


Figure (6) Density of CMYK Values

Because the data is centered, the density acts more like a histogram, but the peaks and distributions are still clear. As you can see there are clearly different peaks corresponding to different colors/locations of the painting, meaning Andy Warhol almost definitely had to have used multiple layers of CMY. For example, we can see the first plots of the background and hair have low (but nonzero) values of magenta, and the last plot of the earrings shows a completely different set of magenta values. Also note that the colors of the hair, face, and background all have large peaks towards 0, suggesting that CMY color was barely used at all for that portion of the painting. Since these are the biggest areas of the painting, it is clear why the details of the lower graphs are not noticeable in the full graph.

We did notice an increase in variance of color for the more intricate shapes, like the eyeshadow, earring, and the collar. This is likely attributable to the artistic process, as applying layers while the previous layers are still wet can lead to unpredictable mixtures of the colors[1]. It is easy to see that this might be the case, as normally a layer must sit for 24 hours to dry. With multiple layers on multiple paintings, this would be highly efficient, especially given the amount of Marilyn paintings Warhol produced within such a short time after her death. Smaller sample sizes of pixels and increased proportion of shaded pixels might also cause this increased spread, but the shift in intent is undeniable.

A full plot matrix with these layers broken down for each of the images is attached in the appendix below. There we can see that the orange, blue, and egg blue paintings form 3 much clearer peaks, and even the more intricate shapes show markedly less variance. This further suggests that Warhol used 3 different layers of CMY for each painting, making a total of 9 color layers and a 10th black layer. This also suggests that he likely let the layers dry completely before applying the next one for these 3 paintings in particular. It is also worth noting that the respective peaks of each component line up well for the blue and orange paintings. That is, if the CMY value changed from layer to layer, it seemed to take on an intensity that matched other colors in other layers.

The red painting follows a very similar pattern as the turquoise, but with dominance at the 255 side of the graph instead of 0. The variance is also much higher for the colors of the smaller areas, suggesting that Warhol could have initially been simply testing the difference between mixing heavily transparent and heavily opaque sets of CMY when wet. This would also explain why the paintings were laying in a stack in Warhol's studio before they were 'shot' and made famous[4].

Overall, this is a testament to who Andy Warhol is as an artist, who would often go to unusual lengths to get the visuals he wanted, He was never afraid to test new techniques on what were thought to be simple processes [3], and that was a large part of how he put Pop Art on the map.

7 Conclusion

In our exploration, we set out to understand some of the reasoning behind Warhol's specific application of colors across his five different pieces of "Shot Marilyn" series artwork. Some of the questions we sought to answer were the reasoning behind the unique differences between images. For instance, if the five pieces of artwork were modeled based on the same photo, why are there distinct differences between each? There are obvious differences in for example the shade of the eyeshadow or the skin tone of Marilyn across images. Were these artistic choices by Warhol or were they products of circumstances, i.e. differences due to the availability of materials to produce the paintings. Through performing our various methods of color transformation, hierarchical clustering, analysis of CMYK and RGB for areas of interest, we discovered some interesting observations as well as hypotheses about why some features came to be. In color transformation, we realized the availability as well as ease of application of changing one color to another. In performing the task, we also compared the process that it may have taken Warhol to create the five different images. Since Warhol didn't have computer processing at hand to generate the images exactly each time, it's likely due to circumstances that the images are different in distinct areas. In RGB, we noticed that the distributions of each R,G,B column varied depending on each different image. Furthermore, we hypothesize that Warhol has a tendency to use higher values of the RGB color scale (0-255), creating lighter and more vibrant colors for his art. In applying CMYK density analysis, we approached the problem from the point of view of Warhol and his constraints, i.e. his need for use of screen printing and how that has an effect on layering in his images. From observing the density plots, we believe that much of Warhol's color selection in this "Shot Marilyn" series had to do with experimentation using opaque and transparent colors while the painting was wet. Though we don't know for sure whether there are any conclusive truths in our observations, the analysis of colors as well as Warhol's artistic process provides us with a perspective into both his artistic color preferences and his style for creating art.

References

[1] Wedman, Jacelyn. "A Beginner's Guide to Wet-on-Wet Printing." ScreenPrinting.Com, 9 Feb. 2022, www.screenprinting.com/blogs/news/print-wet-on-wet-water-based-ink.

[2] "Color Theory - from Monitor to Print." Avient, pt.avient.com/color-theory-monitor-print. Accessed 11 June 2023.

[3] "Warhol's Blotted Line." Howard Steenwyk, www.howardsteenwyk.com/warhols-blotted-line. Accessed 11 June 2023.

[4] "Shot Marilyns." Wikipedia, 12 May 2023, en.wikipedia.org/wiki/Shot_Marilyns.

[5] "Screen Printing." Wikipedia, 30 May 2023, en.wikipedia.org/wiki/Screen_printing.