

Country Differences in E-commerce App Logo Color

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INTRODUCTION

As an entry point for users to interact with apps, app logos play an important role in visual search efficiency and user experience(Cao et al., 2019; Lin & Chen, 2019; Trapp & Wienrich, 2018). Color is especially considered as one of the key features in logo design which influences visual retention and preference of logo design(Liu, W. et al., 2021; Alexander, A. T., 2019). It is also a key visual clue related to other marketing elements of the product(Labrecque et al., 2012) and sometimes may even affect consumer's judgments (Sundar & Kellaris, 2017). In view of the importance of color in logos, this project intends to analyze app logo color features with data approaches. While most related research compared differences between east and west countries, the color differences among eastern countries is not widely discussed. Therefore, we compare the logo color differences among 4 east Asian countries: Korea, Japan, Taiwan and China in this project.

RELATED WORKS

Some research has been done to understand logo color features. According to Qingbin, W's research(2009) on Global top 500 enterprise's logo, most of them use 1 to 2 colors in their logo—43% use a single color, 43.8% use two colors, 10.8% use three colors, only 2.4% use more than three colors. However, white color is excluded in this research. They also tried to find out color features by analyzing the saturation and brightness value, and concluded that highly saturated and moderated brightness is preferred in overall logo color. Another research intended to see if bank logo colors are culture-specific or universal(Gross, A. M., 2019). The result showed that blue and gray colors are universally used in bank logos, but Chinese bank logos have preference in using red color.

METHODOLOGY

To understand the logo color features in different countries, we decided to focus on the top 50 most-downloaded iOS apps in the

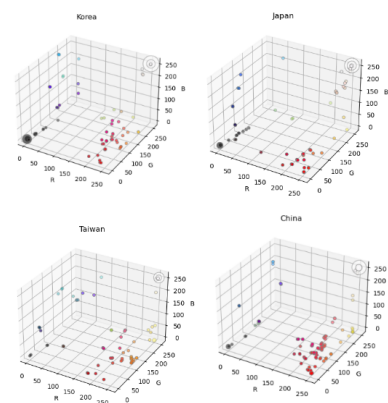
shopping category in each country. Shopping apps have a relatively stronger connection with the local, compared to other apps such as game or social network apps. Hence we assumed they could better reflect the cultural differences between countries than other types of apps.

First, we used AppAnnie, an app market data analytic platform, to get the download ranking and logo images from each country, and then tried to eliminate some non-local apps from the list(i.e., Amazon). Therefore, we got 47 logos for Korea, 40 logos for Japan, 31 logos for Taiwan and 45 logos for China for further analysis. Second, we determined dominant colors for each logo by extracting colors from each pixel and concluded the top 3 mostly used colors in each logo. The following logo color analysis will be based on these dominant colors. The data analysis is conducted with Python and R programming language in this project.

Preliminary analysis

The color data we used in this project includes RGB values (Red, Green, Blue color) and HSB values (Hue, Saturation, Brightness), which are the most common ways to research color features. We can see from Figure1 that Korea and Japan have preferences in using black and white colors compared with others. Korea has more black colors, while Japan has more white colors especially. Another preliminary finding is that except for black and white colors, red colors are the most commonly used color in all four countries.

Figure 1. RGB color 3D scatterplots



We also conducted a principal component analysis (PCA) to identify the characteristics of these logo colors. The scree plot(Figure 2.1) is to determine the number of principal components to keep in a principal component analysis. According to the Kaiser rule, all components with eigenvalues under 1.0 are dropped. By observing the two principal components selected, the result implies red color, hue and brightness and saturation are important features in the components(Figure 2.2.). Viewing that the red colors seems to be the key element in shopping app logo colors, we decided to do further analysis focusing on red colors.

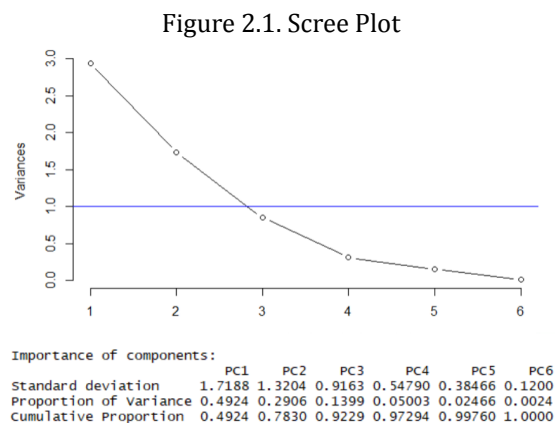
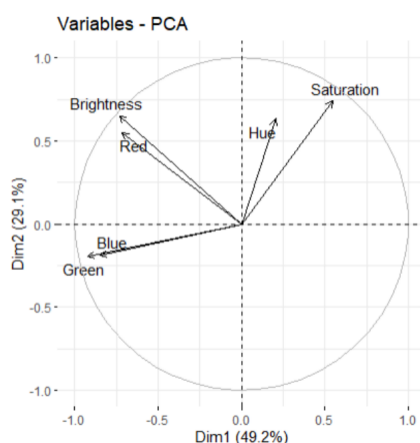


Figure 2.2. Principal component analysis



Analysis focusing on red color features

To tell “red colors” from a group of colors efficiently, we used the hue range to determine the colors. The “red colors” include red(10°-355°), red-pink(346°-355°) and red-orange(11°-20°). We also observed the colors close to red on the hue range map, which includes pink(331°- 345°) and orange(21°-40°), in order to have a more holistic view of red-color distribution. However, black and white colors are meaningless in the hue range map. We get rid of them by filtering out the colors with brightness lower than 0.4 and also the colors whose saturation is lower than 0.4.

The distribution of red colors and colors close to red shows the differences among four countries. The violin chart(Figure 3) shows that all the distributions concentrate on the red colors. In China and Japan, the red color is mostly composed of red(10°-355°) and red-pink(346°-355°), while Korea and Taiwan's red color concentrates on red(10°-355°) only. There are also differences in the distribution of colors close to red. Compared to China and Korea, Japan barely has colors close to red, while Taiwan has obviously more orange colors(21°-40°). If we take a closer look at the red colors, we can also see the differences in brightness and saturation among countries(Figure 4, 5). Japan's red colors have higher saturation than other countries. In China, red colors are mostly with high brightness, while red colors in Taiwan are less bright. The observations are concluded in the table below(Figure 7).

Figure 3. Violin plot of the distribution of red colors and colors close to red

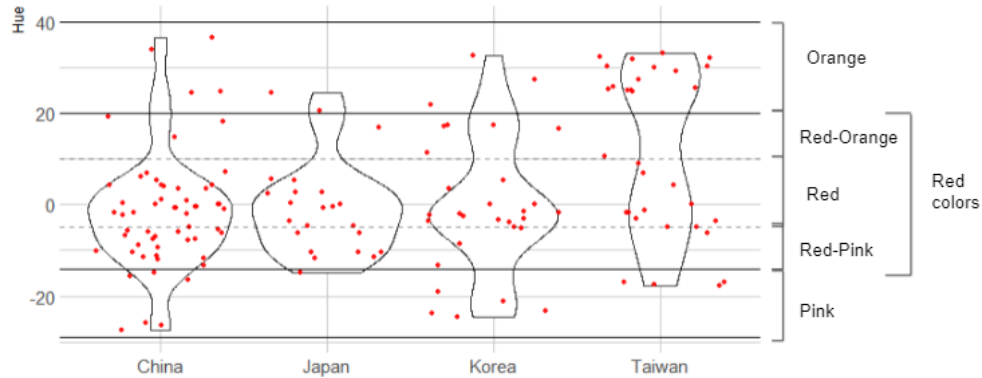
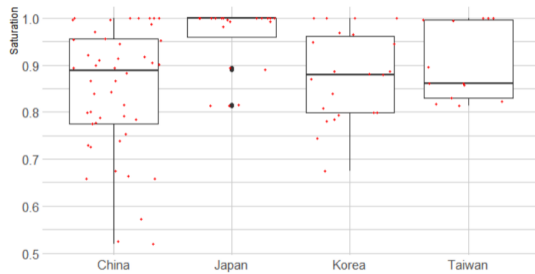


Figure 4. Saturation of red colors



Taiwan	- Red, low brightness - Many orange color
China	- Red & Red-Pink, high brightness - Some orange and pink color

Logo color combinations

From the analysis above, we can know that red colors are important factors in all four countries. Also, black and white colors are features of Korean and Japanese logos. However, we don't know how these colors combined with each other in logos. To observe the combinations among the dominant colors, first of all we linked the colors by logo. Colors from the same logo are linked to each other. Second, we grouped up the colors by the main colors we focus on: Red colors(10°-355° & 346°-355° & 11°-20°), Back colors, White colors. The black and white colors here are actually colors close or equal to black and white colors. Colors close to red such as pink(331°- 345°) and orange(21°-40°) are grouped up as well. To see the color proportions in color combinations, we also visualized the proportion by node size in the network plot. An example is shown in Figure7.

Figure 5. Brightness of red colors

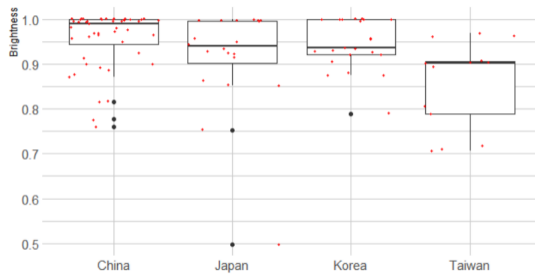
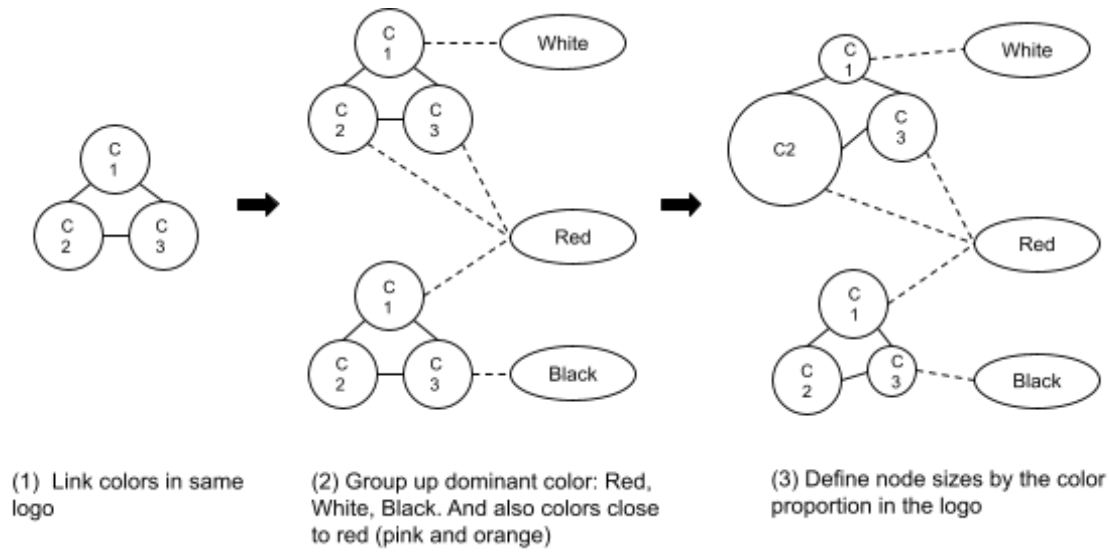


Figure 6. Observations on red color features

Korea	- Red - Some orange and pink color
Japan	- Red & Red-Pink, high saturation - Barely no orange or pink color

Figure 7. Example of the color combination analysis process



According to the color combination network plots(Figure 8,9,10,11), we can see that in all four countries, red colors are mostly combined with white color or red colors. Korea and China have a few combinations of red colors and colors close to red, but no such combinations are found in Taiwan and Japan. At first, we intended to analyze the color combination by the proportions as well. However, it seems that we couldn't really observe the combinations in this way. In some logos, there are only small proportions of colors linking to each other, which are not representative to the overall color proportion of the logo. For example, logos with complicated gradients or having many small elements in the logo image could lead to this outcome. Even though the three dominant colors extracted still present the mostly seen colors in the logo, regarding the color combination analysis, this might not be a good way to get the answer. In China and Taiwan, there are many logos like this. Most node sizes are very small, which implies logos could not be composed of "pure" colors or have more elements in the image. In Korea and Japan, we can see more logo colors with bigger proportions. It implies logos in these countries are composed of "purer" colors or with less elements in the logo image. Among the colors with big proportions, there are more white colors in Japan while more black colors are found in Korea. The big proportions could

probably represent the background color of the logo.

Figure 8. Color combination network (Korea)

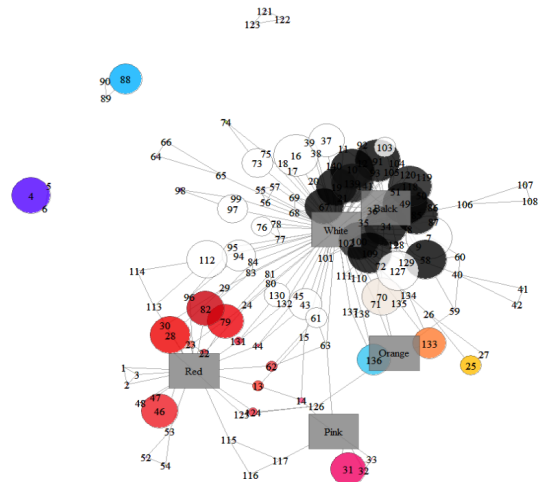


Figure 9. Color combination network (Japan)

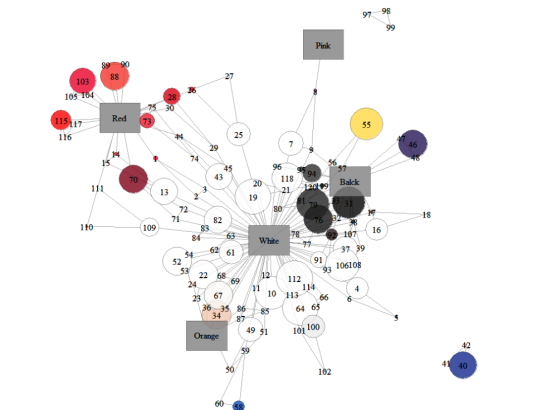
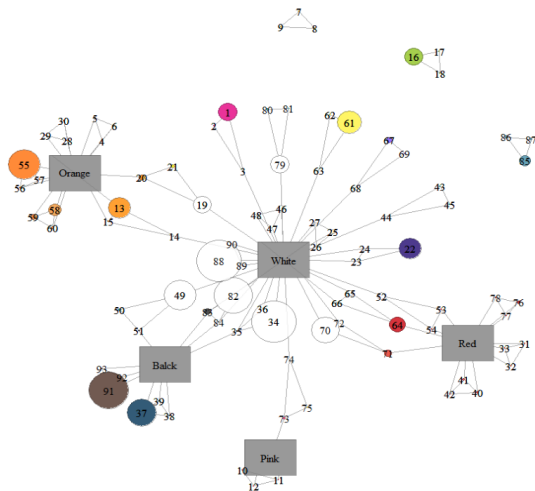


Figure 10. Color combination network (Taiwan)



CONCLUSIONS

Executive summary

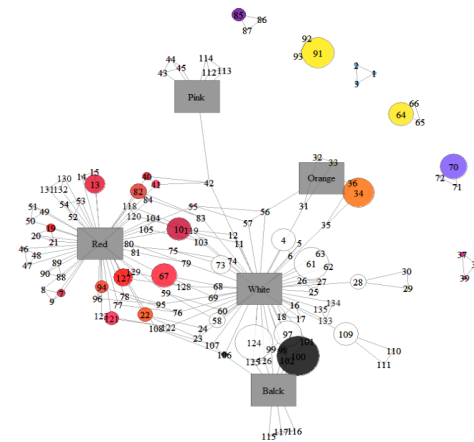
The project intended to explore the logo color differences among countries in east Asia with data approaches. Result shows the common important elements in shopping app logos and some differences, such as brightness and saturation, could be found in different countries. Meanwhile, the author found limitations in the present approach when observing color combinations if there're complicated gradient colors or many elements in the logo image. The composition of the logo image should be considered when analyzing logo color combinations.

Limitations and future works

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Figure 11. Color combination network (China)



The project has several limitations. First of all, the representativeness of the determined dominant logo colors is unknown. Even if a color takes up most pixels in a logo image, it's possible that it doesn't equate to the most important color to human eyes. Second, content of the logo image, such as gradients and the number of elements, affects the analysis when observing logo color combinations. Also, the current approach is not applicable to logos composed of photos. New approaches that consider logo content should be developed in further studies.

In addition, this project focused on analyzing the color elements and didn't discuss the possible reasons that made the differences. Cultural background of the logo color selections could be discussed in future works.

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