1. INTRODUCTION

The sensibility on colors has been improving through the development of modern life. Color is everywhere in our daily life as an important element. People’s preference, opinion, taste, understanding on color are becoming more and more subtle, various, dynamic in different culture, contents, and situations. There is a large body of literature on the psychology of color [1]. The research on color is a topic that will never get old.

Color-emotion and color-preference are two most popular topics for color research (e.g. [1-4]). Our past experiences influence our emotion and preference on colors, and individual experiences, cultural conventions and stereotypes also provide subtle connotation and multiple meanings of the same color to people [5].

Color plays an important role in our dining experience. The color of the food, tableware, table sheet, will always be in our sight while having the food. Research on the color of food is the majority in the field of color-dining research. There are various studies on the color of tableware as well, however, most of the study conducted the experiment with only a small sample of colors (red/blue or black/white, e.g. [6-8]). A few research focused on a wider range of tableware colors [9]. One previous study involved a wide range of tableware colors showed that when Jelly was used as the target food, dull color schemes were not liked as the color of the tableware (black and cool colors were the most disliked), but warm scheme colors were mostly liked by participants [9]. Little is known about how the colors of non-edible items such as tableware affect people’s perception of food, emotional responses and mood in dining activities. Previous research on the color of tableware mainly aimed to only investigate the influence of the color of plate ware on appetite, or the flavor perception of the food placed on it. For instance, a research group in Oxford University provided sweet and salty popcorn in containers with different color to the participants. The results showed that the flavor perception of sweet and salty popcorn changed when switched to red or blue containers [6]. Another study on the color of dining tray showed that the color of the tray affected not only the appetite of the diner, but also some other emotional responses such as “brightness” and “peacefulness” [10]. Moreover, some other research took place in United States and Japan indicated that warm colors increase appetite and cold colors do the opposite [11, 12].

Although color contrast between plate ware and food was considered as the key factor in some studies, the explanations for the fact that the color of the plate were
impacts flavor perception have not been fully developed yet. On the other hand, emotional responses and mood during dining, which are considered more easily affected by colors, have become very important and noticeable.

Previous research on dining atmospherics indicated that the indirect effect of perceived atmospherics on behavioral intentions through perceived quality was greater than the direct effects like services and food themselves, which means in some cases, the environment might have bigger influence on customers than the food or service [13]. Different dining environment and interaction around the dining table (which are various situations or scenes) should also be taken into consideration as an important factor in the evaluation of dining experience.

2. OBJECTIVE

Factors like mood, emotional responses, and harmony, which are not being paid attention on fairly, are as important as flavor or appetite in the modern dining experience. On the other hand, by knowing that the cultural factors and gender effects influence color preference and emotions in different ways, Japanese female was taken into consideration as the target because of a higher market share as tableware customers in Japanese retail stores. Therefore, in this study, we intend to explore the role of colors in dining experience, understanding how Japanese females interpret colors into dining experience, what kind of mood and emotion Japanese females feel on different color and dining scenes, and color preference in different dining situations. Our study aims to understand the interaction between user and colored tableware, provide knowledge to designers and consumers and help them choose colors depending on specific situation and demand in dining activities.

3. METHOD

We conducted an experiment to collect people’s understanding about different colors and dining experience by showing simple color samples and sketches of different dining scenes. The experiment indicated participants to rate their preference of the shown colors, evaluate their emotional responses against presented different sketches of dining scenes, and required participants to pick one or multiple color samples from the colors as their preferred colors for tableware to use in each dining scene. Participants were indicated to describe the reason why they chose certain color for the dining scene.

3.1 Participants

We invited 30 Japanese female students in University of Tsukuba, with the average age of 24.6 (M=24.6, SD=2.96) and major in medical science, sports, comprehensive human sciences. All the participants passed color vision test using Ishihara PseudoIsochromatic Plates [14].

3.2 Color

In previous study, blue and red were chosen as the target color of tableware [6]. In this study, instead of using only 2 colors, we intended to expand the color hue range in order to explore more detailed relationship between color of tableware and dining scenes. At first, 5 designers were presented with pictures and real product of colored tableware for reference. After brainstorming and discussing on the meaning and association of colors considering various aspects such as lifestyle, seasons and culture, we selected 4 colors: pink, green, orange and blue. In previous study on colors and emotions, it was found that the saturation of color evidenced strong and consistent effects on emotions [1]. Therefore, in addition, to understand the effect of not only the hue of color, but also the saturation of color, we included two versions of the 4 colors: light and dark (low and high saturation). In total, 8 colors were selected as the stimuli of the experiment. The color code was decided by 5 designers based on CMYK color model system, considering the process of making colored tableware with these colors and how they really look like on a real product. The color code was recorded for reproducing and re-printing in the future study (Figure 1).

3.3 Dining scenes

After brainstorming and internet browsing, a list of Japanese dining activities was made based on combinations of all possible time, location, people relationship
and social meaning. After eliminating similar and non-sense combinations, we concluded 6 typical dining situations, which are: 1. “dinner dating with partner (lover)”, 2. “Dinner with family members”, 3. “Drinking alone at home”, 4. “Breakfast at home”, 5. “Picnic with family at park”, 6. “Hot pot party with friends”. Afterwards, we collected internet pictures by using these keywords. Based on the pictures, we simplified the elements in the picture and designed a group of black-and-white illustrations representing the 6 dining scenes (Figure 2).

3.4 Experimental procedure

Firstly, all color samples were presented to participants in random order. After gazing at each color stimulus as indicated, participants were handed over a questionnaire to rate their preference of the colors. Afterward, all dining scene illustrations were presented in random order too, and the emotional responses against dining scenes were evaluated by questionnaire. The questionnaires included 0-4 scale assessment for preference rating and adjective words rating. The adjective words rating scale was made according to the extracted factors in a research on the mood in various dining scenes by Hirai (2005) [15]. In addition, the questionnaire for dining scenes required participants to select their favorite colors as many as they want for each dining scene.

3.5 Analysis

Firstly, analysis of variance was needed to determine whether there were significant differences between the preference of colors. Afterwards, the color selection under different dining scenes was listed to observe the tendency of participants’ choice of color in dining situations. Finally, we conducted correlation analysis to explore the relationship between mood assessment and color selection of each dining scene.

4. RESULT

4.1 Color preference

Test of normality using Kolmogorove-Smirnov method showed that the preference rating scores data set was non-parametric (p = 0.001). Therefore, we conducted Friedman test to determine if there were significant differences between the preference of color samples. Friedman test yielded a significant difference (p = 0.001) that indicates there are significant difference between preference of color samples.

Following up the Friedman test, we carried out post-hoc analysis using Wilcoxon signed-rank test. The preference rating score of light pink was rated significantly lower than most of the other colors: dark pink ($\Delta = 0.80$, $p = 0.001$), light green ($\Delta = 0.67$, $p = 0.012$), light orange ($\Delta = 0.60$, $p = 0.034$), light blue ($\Delta = 1.14$, $p = 0.001$) and dark blue ($\Delta = 0.57$, $p = 0.019$). The second relatively less preferred color is dark orange, which is rated significantly lower than dark pink ($\Delta = 0.53$, $p = 0.002$) and light blue ($\Delta = 0.87$, $p = 0.002$). light blue was rated as the most preferred color in the chart, showing significant differences from all the other color samples except dark pink ($\Delta = 0.34$, $p = 0.082$) (Figure 3).

4.2 Color selection in different dining scenes

Figure 4 shows the number of selected colors by the participants in each dining scene. The length of horizontal column represents the total number of selected colors in the dining scene. The number in different colors shows the number of people who selected that color.

Dining scene No. 1 “dinner dating with partner” shows a very balanced color selection result with majority of pink (light pink with 10 & dark pink with 9 participants) and blue colors (light blue with 9 & dark blue with 10 participants) being selected. In dining scene No. 2
“dinner with family members”, light orange was apparently the favorite color with 15 out of 30 participants selected, followed by light green. Dining scene No. 3 “drinking alone at home” has the least overall number of selected colors (40), and 18 out of 30 participants chose dark blue as their favorite color in this situation. No. 4 “breakfast at home” also has the least overall number of selected colors (40), and light green was the most preferred color (with 14 participants selected) in this situation alongside light blue (with 14 participants selected). No. 5 “picnic with family at park” has the most selected number of colors (66), with dark blue being the only color that was not chosen in this situation. Dark pink was the most liked color (with 18 participants selected), followed by light blue (with 11 participants selected) and light pink (with 10 participants selected). Orange dominated dining scene No. 6 “hot pot party with friends” with 21 out of 30 participants selecting light orange and 13 participants selecting dark orange.

4.3 Correlation between color selection and adjective words in different dining scenes

Based on adjective words rating scale, we collected participants’ mood assessment in different dining experiences. Following color selection’s result, we conducted correlation analysis to explore the relationship between mood assessment and color selection.

Tables 1 to 6 show the correlation strength and direction between mood assessment words and specific color selection in each dining situation. In dining scene No. 1 “dinner dating with partner”, the result shows that the Pearson correlation between selection of light pink and the mood of feeling empty is moderate positive (Pearson $r = 0.446$, $p = 0.014$). The relationship between feeling of refreshing is also moderate positive with dark orange (Pearson $r = 0.488$, $p = 0.013$). On the other hand, the feeling of quiet and selection of dark pink showed moderate negative relationship (Table 1).

In dining scene No. 2 “dinner with family members”, there are 4 pairs of moderate positive relationships: feeling of cramped with dark pink (Pearson $r = 0.394$, $p = 0.031$), peaceful with light green (Pearson $r = 0.410$, $p = 0.024$), boring with light blue (Pearson $r = 0.402$, $p = 0.027$) and lonely with dark blue (Pearson $r = 0.489$, $p = 0.006$). On the other hand, the result revealed 3 pairs with moderate negative relationships: joyful with light pink (Pearson $r = -0.402$, $p = 0.027$), feeling of warm with light pink (Pearson $r = -0.363$, $p = 0.049$), and feeling of peaceful with dark green (Pearson $r = -0.362$, $p = 0.049$) (Table 2).

**Figure 4:** Color selections in different dining scenes. The numbers in each color bar represents the number of selected colors by participants. For example, in dining scene 1, the number 10 in light pink indicates that there were 10 people selected light pink.

**Table 1:** Correlations between mood assessment and color selections in dining scene No. 1 (dinner dating with partner)

<table>
<thead>
<tr>
<th>Mood assessment</th>
<th>Color selection</th>
<th>Pearson r</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling empty</td>
<td>Light pink</td>
<td>0.446</td>
<td>0.014</td>
</tr>
<tr>
<td>Feeling quiet</td>
<td>Dark pink</td>
<td>-0.377</td>
<td>0.040</td>
</tr>
<tr>
<td>Refreshing</td>
<td>Dark orange</td>
<td>0.488</td>
<td>0.013</td>
</tr>
</tbody>
</table>

**Table 2:** Correlations between mood assessment and color selections in dining scene No. 2 (dinner with family members)

<table>
<thead>
<tr>
<th>Mood assessment</th>
<th>Color selection</th>
<th>Pearson r</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joyful</td>
<td>Light pink</td>
<td>-0.402</td>
<td>0.027</td>
</tr>
<tr>
<td>Warm</td>
<td>Light pink</td>
<td>-0.363</td>
<td>0.049</td>
</tr>
<tr>
<td>Feeling cramped</td>
<td>Dark pink</td>
<td>0.394</td>
<td>0.031</td>
</tr>
<tr>
<td>Peaceful</td>
<td>Light green</td>
<td>0.410</td>
<td>0.024</td>
</tr>
<tr>
<td>Peaceful</td>
<td>Dark green</td>
<td>-0.362</td>
<td>0.049</td>
</tr>
<tr>
<td>Boring</td>
<td>Light blue</td>
<td>0.402</td>
<td>0.027</td>
</tr>
<tr>
<td>Lonely</td>
<td>Dark blue</td>
<td>0.489</td>
<td>0.006</td>
</tr>
</tbody>
</table>
In the dining scene No.3 “drinking alone at home”, there were only 2 pairs of significant correlation relationships. The feeling of weird and selection of dark pink showed moderate positive relationship (Pearson \( r = 0.364, p = 0.048 \)), and the joyful was significantly correlated with selection of light green with a moderate negative relationship (Pearson \( r = -0.379, p = 0.039 \)) (Table 3).

In the dining scene No.4 “breakfast at home”, there were only positive relationships between color selections and mood adjective words, and all words were only correlated to the color selection of dark orange. The mood assessment adjective words are: feeling cold (Pearson \( r = 0.371, p = 0.043 \)), feeling weird (Pearson \( r = 0.615, p = 0.001 \)), boring (Pearson \( r = 0.399, p = 0.029 \)), lonely (Pearson \( r = 0.494, p = 0.006 \)) and feeling cramped (Pearson \( r = 0.576, p = 0.001 \)) (Table 4).

In dining scene No.5 “picnic with family at park”, the color selection tendency of dark green showed positive relationships with 3 mood assessment adjective words: feeling weird (Pearson \( r = 0.421, p = 0.020 \)), feeling quiet (Pearson \( r = 0.464, p = 0.010 \)) and feeling empty (Pearson \( r = 0.417, p = 0.022 \)). For negative relationships, dark pink was the only color showed lower preference for light orange showed positive relationship (Pearson \( r = 0.364, p = 0.048 \)) and feeling cramped (Pearson \( r = -0.379, p = 0.039 \)) (Table 3).

In dining scene No.6 “hot pot party with friends”, dark orange showed the only positive relationships with feeling cramped (Pearson \( r = 0.462, p = 0.010 \)). Light orange showed only negative relationships respectively with boring (Pearson \( r = -0.385, p = 0.036 \)), feeling empty (Pearson \( r = -0.385, p = 0.036 \)) and feeling cramped (Pearson \( r = -0.485, p = 0.007 \)). Light green also revealed negative relationship with feeling of being together (Pearson \( r = -0.429, p = 0.018 \)) (Table 6).

5. DISCUSSION

5.1 Color preference

The results showed that in general, when comparing the light version and dark version between the same color hues (e.g., comparing light blue with dark blue), there was a tendency that light colors were rated higher in preference than dark colors. Pink was the only color that showed lower preference for light pink than dark pink.

The color preference test revealed participants’ taste that when presented by colors with high saturation (dark color) and low saturation (light color), participants tend to prefer colors with low saturation. The dark colors used in this experiment are relatively close to primary colors, and the light colors are faded colors with low saturation or mixed with grey color. One observation is that colors with low saturation or grey tone are perceived as colors with better taste in society. According to Global Automobile 2016 Color Popularity Report, 77% people prefer white, black and grey colors [16]. More and more products designed with low saturation color or mixed with grey tone are perceived as more expensive and refined, refer to the traditional color of Japan (e.g., the traditional color of kimono in Japan) [17]. Unlike products in primary colors that often seen in cheap product retailers, those with grey tone colors are sophisticated and well arranged in Japanese society. The beloved traditional Japanese color which are a collection of colors with grey tone, are recognized and used widely in fashion design, product design and culture from prehistoric time to present day [17].

However, regardless of the tendency observed above, pink was the only color showed lower preference for light color than dark color. Considering all the participants are female, and the fact that females are biologically...
programmed to prefer color pink, or redder shades of color than man [18], the color of pink or other redder shades of colors might make exception from the observation that low saturation colors are better accepted. This indicates that although colors with grey tone or low saturation are preferred by customers and suggested for designers in general, when it comes to pink color, a more saturated pink could be a better choice for female customers. On the other hand, the experiment did not involve male participants, but a hypothesis could be proposed that the dark blue (high saturation) would be preferred to light blue (low saturation) in male participants.

5.2 Color selection in different dining scenes

Despite being the least preferred colors in all 8 colors, light pink and dark orange were chosen by many participants in some dining scenes. For example, when participants imagine that they are having a diner date, they obviously prefer pink and blue as the color of their tableware in this situation, despite light pink was the least liked color. According to the descriptive answer of participants on why they chose the color, we found that it is likely because that in this situation, more than half of participants consider pink and blue are the appropriate colors to represent male and female.

Light pink was also chosen by 33% of the participants in the situation of "picnic at park with family". In Japanese culture, "picnic at park" is always associated with "Hanami", which is the traditional custom of enjoying the transient beauty of the bloom of cherry blossom. As the color of cherry blossom, pink is the key color to every event and festival related to cherry blossom and spring season. Therefore, it makes sense that people would like to choose pink to match the beautiful color of the nature. This explains the reason why green was selected by many participants in the same dining scene as well. This dining scene has the most total amount of chosen colors, which means that participants prefer multiple colors to make the event more colorful.

13 out of 30 participants selected dark orange in the dining scene of "hot pot party with friends". Similar with light pink, although dark orange was not the liked color, participants tend to choose it because it matches the vibe of the event. According to participants’ comments at the end of the experiment, many participants responded that the reason of choosing orange is because orange matches the feeling and vibe of "hot" and "crowd". 21 out of 30 participants made their decision to choose light orange in this dining scene. The dominance of orange (light and dark combined) showed that the vibe in this dining scene matches orange much better than other colors. “Having a party with friends” was associated with words such as “lively”, “loud” and “crowded” according to correlation analysis, and “hot pot party” also create the feeling of “hot”, which is always associated with orange or red. Similarly, light orange is also the most chosen color in the dining scene of “dinner with family at home”, which indicates that light orange is a color associated with the feelings of warm and happy, suitable for both situations. However, “dinner with family” was considered as an event with a more peaceful mood, dark orange is not popular in this situation.

Dark blue clearly matches the situation of drinking alone at home and people tend to use less color in this situation. According to the descriptive answer in the interview, dark blue is a perfect color for a quiet “home alone moment” for more than half of the participants. In contrast to “picnic with family at park”, “drinking alone at home” and “breakfast at home” have the least total amount of chosen colors. This indicates that participants’ preferred colors are more limited in this situation from the given color samples.

The selected colors in dining scene “breakfast at home” are all light colors (except for only one participant selected dark orange). Furthermore, light green and light blue dominated the selection. According to the answer in the interview, participants tend to seek for a refreshing feeling in the morning and light green or light blue are their best answer to provide a clean and refreshing ambient environment.

5.3 Correlation between color selection and adjective words in different dining scenes

The correlation analysis revealed some insights and implication to help us understand the reason behind the color selections and the Kansei of the participants on colors. For instance, in dining scene No. 2 “dinner with family”, the selection of light green (11 out of 30) is much more than dark green (1 out of 30). Light green and dark green both showed relationships with the adjective word “peaceful”, however, light green presented a moderate positive relationship (Pearson $r = 0.410$, $p = 0.024$) but dark green presented a moderate negative relationship (Pearson $r = -0.362$, $p = 0.049$). This indicates that as the rating of mood assessment adjective word “peaceful” increases, the selection of light green increases but the selection of dark green decreases. The situation of having a dinner with family clearly gives participants a peaceful mood and led to a gap between the amount of the selection of two colors. This also suggests that light green might
have an implicit meaning of “peaceful” rather than dark green in this situation.

In the situation of “breakfast at home”, the selection of dark orange showed correlations with multiple mood assessment words, however, there are two correlations showed greater strength than others: “feeling weird” (Pearson $r = 0.615$, $p = 0.001$) and “feeling cramped” (Pearson $r = 0.576$, $p = 0.001$). Since dark orange is only selected by 1 participant, the possible connection here based on the result is that the color dark orange is associated with “feeling cramped”, and “feeling weird” in this dining scene, therefore most people don’t consider this color as a fit. Most users would not choose tableware with dark orange because it gives them a feeling of “weird” or “cramped”.

For the last dining scene “hot pot party with friends”, as the most selected color, light orange showed 3 negative relationships respectively with boring (Pearson $r = -0.385$, $p = 0.036$), feeling empty (Pearson $r = -0.385$, $p = 0.036$) and feeling cramped (Pearson $r = -0.485$, $p = 0.007$). This indicates that situation of a hot pot party with friends are unlikely to connect to negative feelings such as “boring”, “empty” or “cramped”, and light orange is the perfect color to decorate in this situation. As the observation above, orange dominated the selection, however, dark orange (13 out of 30) is less selected than light orange (21 out of 30). Different from light orange, dark orange revealed a positive relationship with “feeling cramped” (Pearson $r = 0.462$, $p = 0.010$). This might explain the reason why dark orange is selected less than light orange: dark orange was likely associated with a negative feeling of “cramped” or “crowded”, therefore we suggest that when designers or users decide to deliver the feeling of “lively”, “hot”, “joyful” and so on, light orange is a more acceptable better choice because of the negative implications from dark orange such as “cramped” in specific situations.

6. CONCLUSION

Color plays an important role in culture, society and our daily life, and color preference is always a factor that continues changing through different time, place, culture and personality. Capturing the trend of customers’ color preference and choice in different situations is essentially useful for designers and researchers in this area.

In this research, we explored color preference and relationship between the perception of color and different dining situations. The results showed a gap of color preference between colors with low saturation and high saturation. On the other hand, it is found that colors with low preference might still be chosen as a better fit to the situation over those with higher preference. Colors with different hues represent various meanings to people. Moreover, colors with same hues but different value or saturation could be associated with different meanings and concepts that affect the choice of colors.

It is suggested that colors contain a lot more implications and implicit information that worth digging. Understanding the deep perception of customers on colors and categorize the dining experience into different situations help designers and retailers improve the user experience of products and the marketing potential.

ACKNOWLEDGEMENTS

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