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Is Color Preference Affected by Age Difference

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Abstract: This study focuses on the age differences on the color preference. A psychophysical experiment was conducted. Eighty observers took part in the experiment, including 50 observers aged from 18 to 30 years old and 30 observers aged from 56 to 84 years old. Each observer was asked to arrange 11 color patches in order of preference. The color samples used in the experiment were selected from 11 basic color terms (red, orange, yellow, green, blue, brown, purple, pink, white, black and gray colors). Each basic color was produced according to their boundaries in CIELAB space. The results showed the elder's color preference differed from younger. The determinate for color preference were chroma and lightness attributes for elder and younger groups, respectively.

Key words: Color Preferences, age factor

1. Introduction

Many[1-6] color preference researches were studied. In these studies, the results showed the preferred colors were inconsistent. For example, light green and blue colors proposed by Lee and Luo[1], yellow and blue colors by Liou *et al.*[3], white, pink and red colors by Liu and Lee[4] and white, red, blue and pink colors by Chen *et al.*[5] But, in these studies[1-6], the dislike colors were consistent. They all agree that the brown and black colors were most disliked colors. It seems the color preference can draw the conclusion here. But, take look at the age of observers; it was found that the average age of observers were up to 33 years old. This implied that the elders' color preference remains unknown. This consequently raised a question, that has long been asked, whether color preference is affected by age levels.

Meanwhile, Lee[7] used the method of categorical judgment to conduct the experiment of affective feelings. His results showed that the data on preference scale were not significant, i.e. the variation on preference scale was centralized. It implied that the method of categorical judgment is not suitable for investigating the preference. Hence, the current study used the method of order to investigate the color preference. Also, the interview was carried out to see how observers make their preference judgments.

2. Experimental plan

A psychophysical experiment was carried out. It includes two sections, color preference order and interview sections. The interview section was prior to the color preference order section. In the interview section, the observers participated were required to answer 2 questions, 1) which color do you like most and why and 2) which color do you dislike most and why. In color preference order section, the observers were asked to place 11 color patches in order of color preference. The eleven colors used were selected from Berlin and Kay[8]'s 11 basic color terms, including red, orange, yellow, green, blue, brown, purple, pink, white, black and gray colors. These 11 colors were produced according to *Lin et al*[9-11].'s basic color boundaries. Each color was applied onto 8 cm × 8 cm square shape, as shown in Figure 2. The colors were measured by a GretagMacbeth® Eye-One. The CIELAB values were calculated under CIE D65 and 1964 standard colorimetric observers, as shown in Table 1 and Figure 1.

Eighty observers with normal color vision took part in the experiment. The observers were classified into two groups, elder and younger groups. The elder group has 30 observers (21 females and 9 males) with an average age of 70 years old (ranged from 56 to 84). They are from Taipei Shi-Lin Senior Center. The younger group has 50 observers (24 females and 26 males) with an average age of 23 years old (ranged from 18 to 30). They are students in the Department of Industrial Design at Tatung University.

In the experiment, the observers were invited to an office room, where near to windows, under the daylight illuminant, from late-morning to mid-afternoon daylight. The color temperature was measured before experiment by a GretagMacbeth® Eye-One. The color temperature ranged between 5057 and 6430 K.

Table 1:The CIELAB values for the eleven color samples

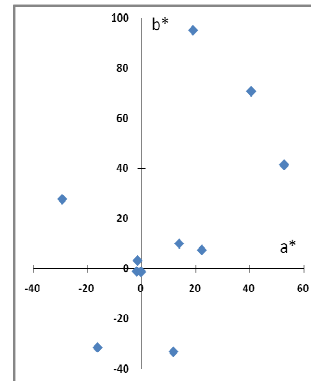|	L*	a*	b*	C*	hue angle
Red(R)	33	53	41	67	38
Orange(O)	57	40	71	82	60
Yellow(Y)	71	19	95	97	79
Green(G)	34	-29	28	40	137
Blue(Bl)	37	-16	-32	36	243
Brown(Br)	33	14	10	17	36
Purple(P)	31	12	-33	35	289
Pink(Pk)	67	22	7	23	18
White(W)	93	-2	-1	2	212
Black(Bk)	16	0	-1	1	260
Gray(Gy)	61	-2	3	4	116

Figure 1:The 11 colors in CIELAB *a*-b** diagram

Figure 2: The color samples used in the experiment.

The data collected from color preference order were converted into scores, i.e., the most preferred color was given 10, followed by 9, 8, 7, and until 0. Hence, the data collected from observers can be averaged to be visual results.

In prior to analysis, the observer accuracy were examined by RMS (root mean square) to see how well the individual observer agrees with the visual results. The RMS equation is give below：

$$RMS = \sqrt{\frac{(X_i - Y_i)^2}{n}}$$

where Xi and Yi are individual data and visual results, respectively. n is the number of data. For RMS of 0, it represents a perfect agreement between these two data arrays.
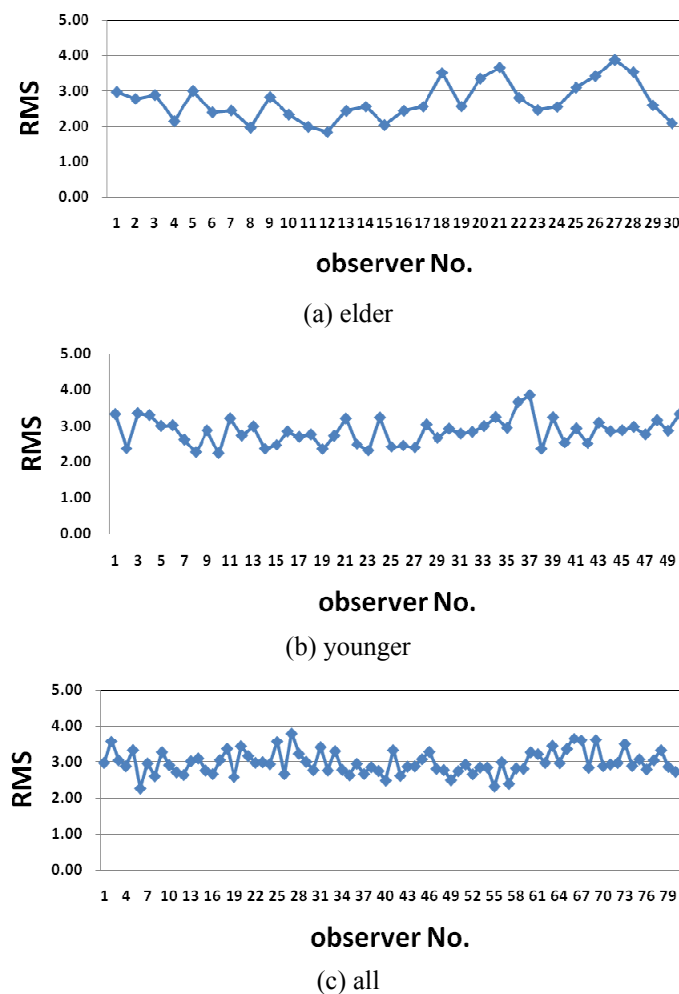

(a) elder

(b) younger

(c) all

Figure 3: Observers accuracy

The results are illustrated in Figure 3. From left to right is respectively for elder, younger and all observers. It can be seen that the observer accuracy was ranged between RMS of 2.0 and 4.0. In comparison with the previous studies[3-7], the RMS values for observer accuracy seem higher. But considering the method of collecting data, the method used here can be seen as 11-step categorical judgment. It is reasonable to have higher RMS here in comparison with previous studies, which used 7-step categorical judgment. It can be concluded that the each observer's judgments agree with the visual results.

3. Results of color preference older

To answer the main question, is color preference affected by age difference, the visual results were used to rank colors in order of color preference. The results are illustrated in Figure 4. The top row shows the results obtained from elder group, middle row from younger group and bottom row from all the observers. It can be seen that the elder group differed from younger group in color preference order. For elder group, pink color was appeared to be the most preferred color, followed by red, orange, yellow, and blue colors; the gray color was the most disliked color, followed by black, brown, green and white colors. For younger group, the white color was the most preferred color, followed by black, yellow, red, and blue colors; the brown color was the most disliked color, followed by purple, green, pink, and gray colors.
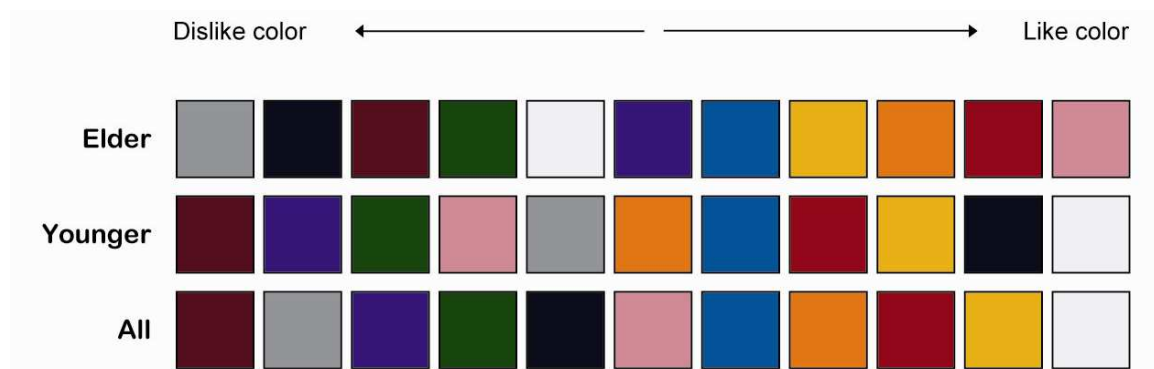

Figure 4: The color preference order for different age groups.

Furthermore, to understand how observers judged the color preference order, the bubble chart was used to observe the relationship between color preference and CIELab color space as shown in Figure 5. The CIELab a*-b* and L*-C* diagrams are illustrated; the bigger bubble shows more preferred color. Top three diagrams are from elder group, bottom three younger group. In Figure 5 (a) and (b), the small bubbles are located at the region of lower lightness and lower chroma, indicating that the black, gray and brown colors were disliked color; the colors having high lightness and high chroma were preferred. This reflected the elder's color preference order was likely to connect to chroma and lightness attributes. For younger group, the relationship between color preference and color attributes was insignificant.

(a) a*-b* (b) L*-C* (c) L*-hue
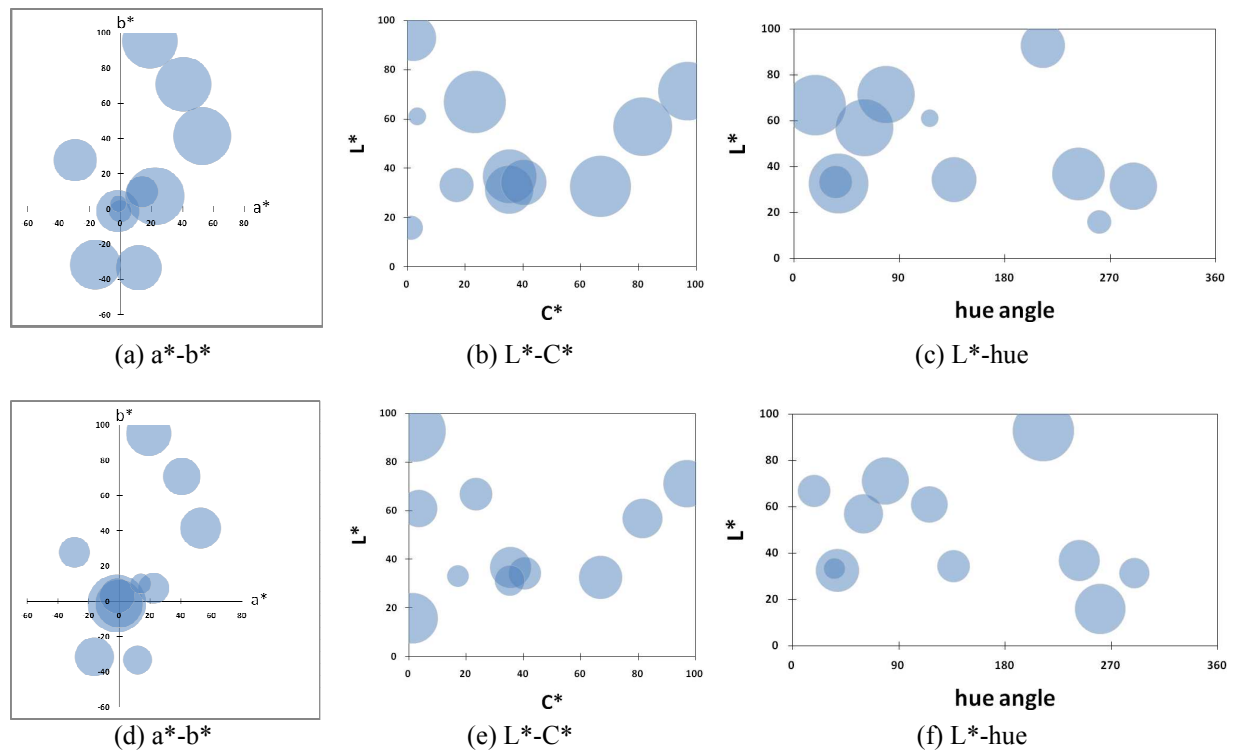
(d) a*-b* (e) L*-C* (f) L*-hue

Figure 5: The bubble chart of color preference. The top three diagrams are obtained from the results of elder group, the bottom three the younger group.

Furthermore, to see how well the relationship existed, the coefficient of correlation (r) was calculated to examine the relationship between the preference and the CIELab colorimetric values (L*, a*, b*, C*, and hue angle), as given in Table 2. The results showed that, for elder group, the C* had the highest r of 0.71, followed by a* 0.47, b* 0.38, hue angle -0.32, and L* 0.25, indicating that chroma had significant positive influence upon elder's color preference, i.e., more colorful more preferred. For younger group, the L* had the highest r of 0.43, followed by hue angle 0.34 and b* 0.15, indicating that lightness had medium positive impact on younger' color preference, i.e., light colors were more preferred than dark colors.

Table 2: The correlation coefficient (*r*) between CIELab colorimetric values and color preference order for elder and younger groups

|	Elder group	Younger group
L*	0.25	0.43
a*	0.47	-0.02
b*	0.38	0.15
C*	0.71	-0.01
hue angle	-0.32	0.34

In elder group, there was more significant tendency toward color preference in comparison with younger group. Hence, we furthermore discussed the other factors influencing the elders' color preference, including the gender, educational levels, annual salary before retirement and living expensive sources. Table 3 summarizes the elder observers' profile. Having made this distinction, we may further examine how elder observers' profile influenced the elder's color preference. The visual results obtained from different groups were plotted against each other, as shown in Figures 6, 7 and 8. The correlation coefficient and $45°$ line are also given in these diagrams to see how well they correlate with each other.

Table 3: The elder observer profile

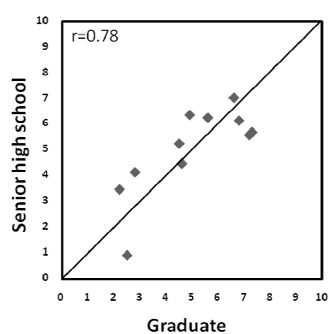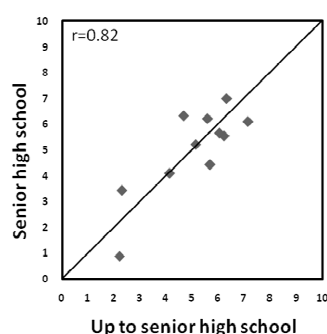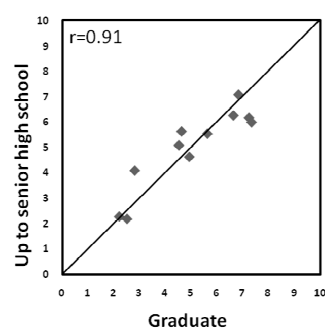| Sex		
male		female
9		21
Annual salary before retirement		
than NT600,000	More than NT600,000	Don't wish to answer
16	13	1
Educational level		
Graduate	Senior high school	Up to senior high school
10	9	11
Living expense source		
Pension	Supported by family member	Deposit
8	10	12
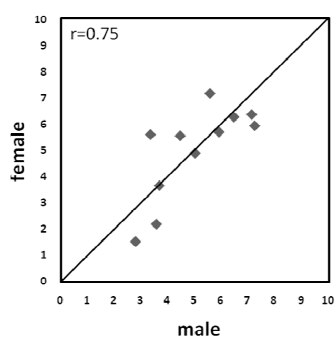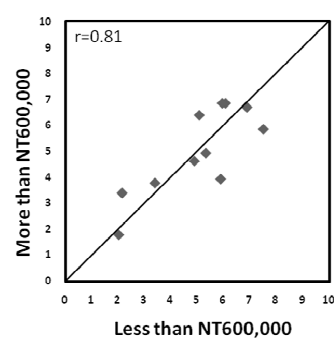
Figure 6: The elders' color preference between (a) different sexes and (b) different annual salary.

Figure 7: The elder's color preference for different salary groups were plotted against each other.

In Figure 6 and Figure 7, the data points are close to the 45° line and the correlation coefficients are greater than 0.75. This indicates that the elder's color preference was not affected by gender, annual salary before retirement and educational levels. However, it was found that the elders living expense sources had influence upon color preference, as indicated in Figure 8 (b) and (c) that the data points are deviated from the 45° line and the correlation coefficient were 0.57 and 0.68, respectively.
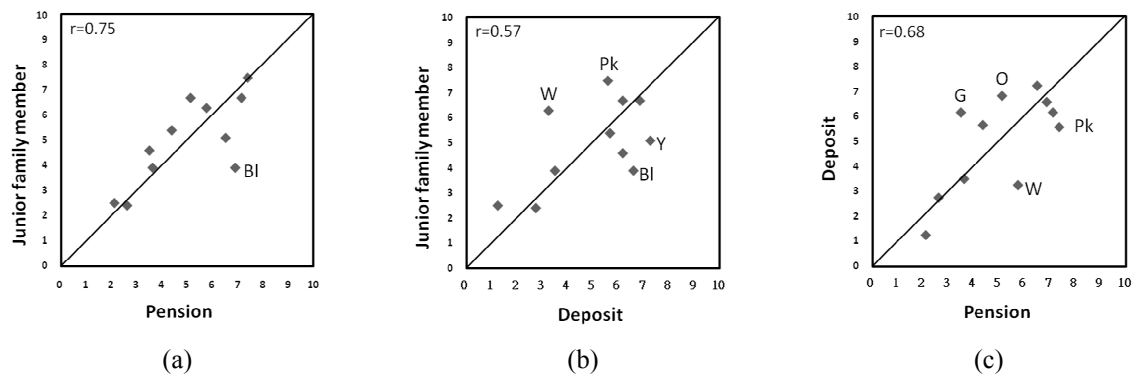

(a) (b) (c)

Figure 8: The elder's color preference for different living expense source groups were plotted against each other.

The elders' color preference order obtained from different living expanse sources are illustrated in Figure 9. It can be clear seen that the color preference trend toward chroma remained unchanged, i.e., the colorful colors are more preferred than the colorless colors. Only few colors had different rank in these three groups. For example, blue and yellow colors were ranked higher in "Pension" and "Deposit" than in "Family member"; white and pink colors were more preferred in "Pension" and "Family member" than in "Deposit"; green and orange colors were more liked in "Deposit" than in "Pension".
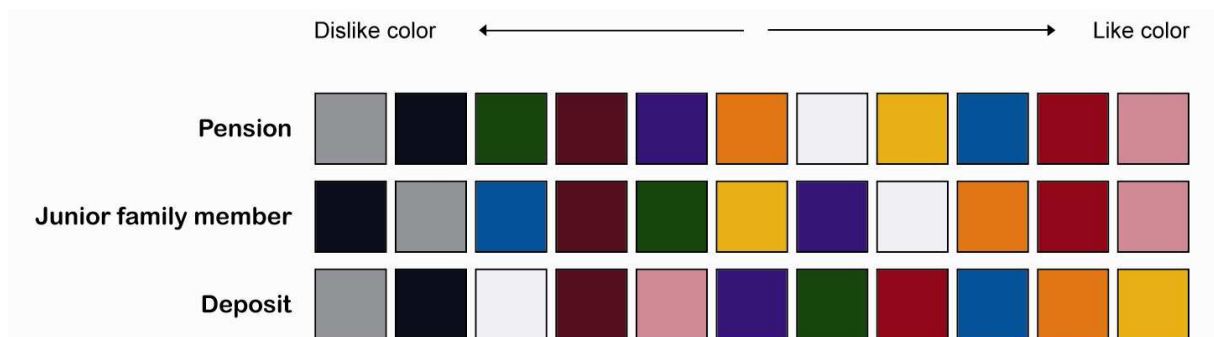

Figure 9: The elders' color preference order for different living expanse sources.

4. Results of interview

For the data collected from interview section, the results showed that the elder observers preferred red and yellow colors, disliked black and gray colors. In younger group, black and white colors were preferred, brown and purple colors were disliked. In the interview section, it was also found that the elder observers often mentioned their dress colors, i.e., they used their dress colors as the preferred colors. For younger observers, they often referred their preferred colors to their personality. Furthermore the reasons for color preference were summarized, as listed in Table 4. Note that the reasons for color preference are varied, only high frequently mentioned reason are listed.

For preferred colors, elder observers liked the colors related to joyful event (i.e., Taiwanese celebration for wedding, birthday and New Year); younger observers like the colors bringing the comfortable feeling to them. For dislike colors, both elder and younger observers agree that the dirty colors were disliked.

Table 4: The frequency of color preference reason.

Elder		Younger	
for preferred colors	for dislike color	for preferred colors	for dislike color
related to joyful events 4	dirty 6	comfortable 11	dirty 14
vivid 3	not appropriate for my age 5	clean 4	does not look good in dress 5
light 2	uncomfortable 4	natural 4	dull 3
bright 2	dull 3	pleasing to the eye 3	
soft 2	dim 3	lively 3	
lively 2	related to politics 2	fresh 3	
cheerful 2			
pleasing to the eye 2			

5. Conclusion

The purpose of this paper is to explore the color preference in different age levels. An experiment was carried out to find out the answer. The results showed that color preference was affected by different age levels. Elder observers' color preference was determined according to chroma attribute. Younger observers' color preference was connected to lightness attribute. Furthermore, the relationship between color preference and elder profile was examined. The results showed that only the living expense source had influence upon elder's color preference. The color preference trend toward chroma remained unchanged, only few colors' rank was changed. Additionally, the reason for color preference obtained from interview section revealed that the preferred colors were related to joyful events and comfortable feeling in elder and younger groups, respectively. Both younger and elder observers agree that the dirty colors were disliked colors.

In comparison with the previous studies, only the brown color remained dislike color in both younger and elder groups. For preferred colors, the current results revealed the chroma and lightness attributes were determinant in

elder and younger groups, respectively. But, the color preference order was not consistent with those found in the previous studies. The phenomenon of preferred colors needs more researches to find out.

The difficulty of this research is to invite the elder observers to take part in the experiment. Although the Taipei Shi-Lin Senior Center fully supported the current study, the elder' willingness is critical. Normally, the female elder had higher willingness than male elder. Hence, this led that the amount of elder observers was less than the younger observers and the amount of female elder observers was greater than male elder observers in the current study. If the future studies can invite more elder observers to do the experiment, the results would be very useful for product designers to do the color scheme for elder's products.

6. Acknowledge

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