

Senior User's Color Cognition and Color Sensitivity Features in Visual Information on Web-Interface

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Abstract. At seeing from the viewpoint of HCI, the problems relevant to the use of smart devices like mobile phone, tablet PC are not limited to young people. Each user experiences smart devices with respectively different use abilities. When senior generations use smart devices, the color environment on a device's screen may take an important role in their usability. We conducted a survey targeting some senior generations with an application program for this experiment in various color environments on a tablet PC's screen. From the survey, we found that male and female senior generations preferred for larger text size and more distinctive brightness contrast between the text's color and the background color, and also preferred for opposite color combinations. Color arrangement commonly being preferred for by seniors was clear, dynamic high-chromatic color combinations, and unfavorable arrangements were dull, static low-chromatic color combinations. However, there were gender differences in 2nd and 3rd preferring color combinations. While female seniors preferred soft-feeling color combinations, but male seniors did hard-feeling color combinations. From this survey, we identified the existence of gender differences in the preferred color combinations as well as the senior people's general visual ability.

Keywords: Smart device, Aging Society, Senior Generation, Color Cognition, Color Combination.

1 Introduction

Recently from the HCI viewpoint, there are developing some studies for the efficient usability of smart devices targeting various user classes [1]. Of the web graphic user interface's factors, the visual information like texts, images, icons and menu are visual factors requiring a senior user's intuitive understanding, and they take important roles in information cognition [6, 13, 14]. It is know that for information to senior users having low visual-perceptual abilities, the most efficient way to deliver information should clearly use the color application to visual factors as well as should increase a text's explicitness and readability [10, 11, 12]. However, currently most interface designs are being developed around young generations, so it needed some researches

to experiment senior people's visual abilities [3]. So, this study set following hypotheses and conducted an experiment in a tablet PC environment.

H1: Senior generations will prefer for larger text sizes.

H2: Senior generations will prefer for more distinctive brightness contrast between the background color and the text's color.

H3: Senior generations will prefer for more distinctively contrasting color arrangements in graphic factors like menu and icons.

H4: Senior generations will prefer for harder-feeling, clearer color combinations rather than soft-feeling, dull color combinations.

2 Composition of Experiment Materials for Color Cognition

Through a previous survey, we selected 6 senior people, and then conducted the FGI(Focus Group Interview), and collected necessary color information for solving web-usability relevant problems. Experiment sample was based on Korea I.R.I's 'Hue & Tone 120 System', and was produced according to an American chromatologist, Faber Birren's arrangement principle. Figure 1 showed the 2-colors arrangement sample used in this experiment, and this sample was based on setting the suitable location on the color wheel. Through some color experts' verification process about 55 color arrangements in the 1st sample, the 55 colors were reduced into 26 arrangements consisting into the 2nd sample seen in right side.

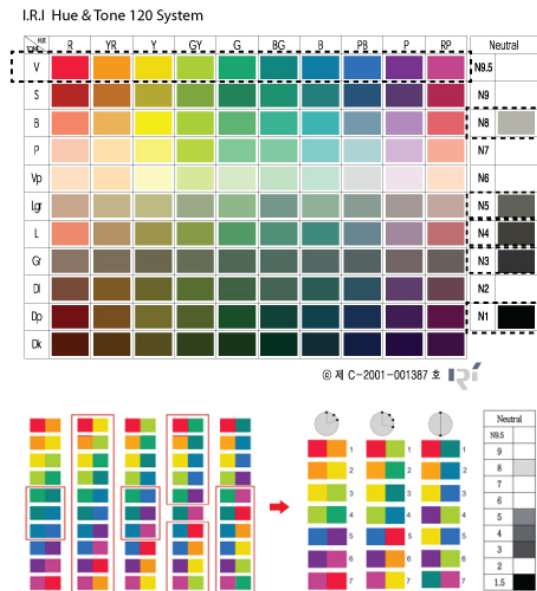


Fig. 1. Color Sample

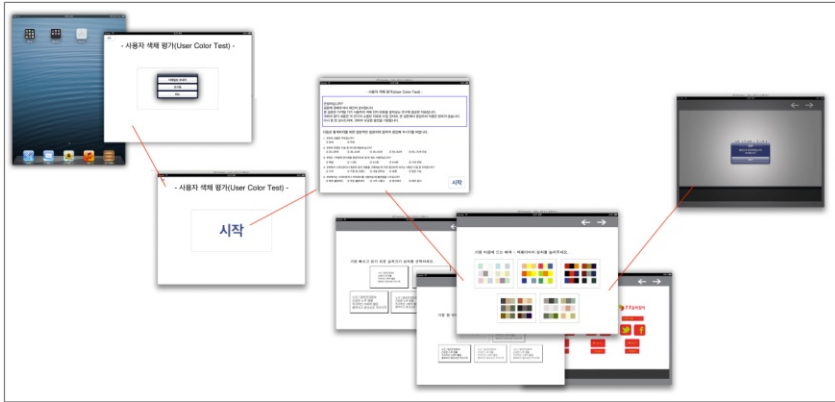


Fig. 2. System flow

Table 1. Application Development Brief

Application development information	
<i>H/W</i>	<i>Device: iPad 1 & 2 (not retina)</i>
<i>S/W</i>	<i>Tool: X Code, Library: UIKit</i>

3 Senior User Survey

We conducted a survey targeting 74 seniors (28 males and 46 females) ranging from early 50s to 70s in their ages. Specifically, 22 males and 44 females were 50s in their ages, and 6 males and 2 females were 60s in their ages. We provided only a brief explanation about the method and procedure to operate the application programs in a tablet PC. Average experiment time spent by these participants was within about 4 minutes.

3.1 Survey Methodology

In order to experiment senior generations' color cognition abilities, we proposed three questions. It was to investigate the background and text brightness and size preference measurement, preference of color combination for visual element, preference of the color combination. We conducted the SPSS 18.0 program for statistically analyzing the survey data, and conducted the cross analysis (cross-tab) in order to recognize respondents' characteristics by gender, and then used the chi-square (χ^2) value in order to identify both genders' characteristics difference.

For the arrangement evaluation and the preferred arrangements, each question item was transformed into each score and the t-text by gender was conducted in order to identify genders' differences.

Figure 3 shows the experiment for verifying H1, H2's validity. So the web page's background color was set as the basic white color, and the text's achromatic colors and sizes were randomly applied, and they were measured and analyzed in Likert 5-point scale.

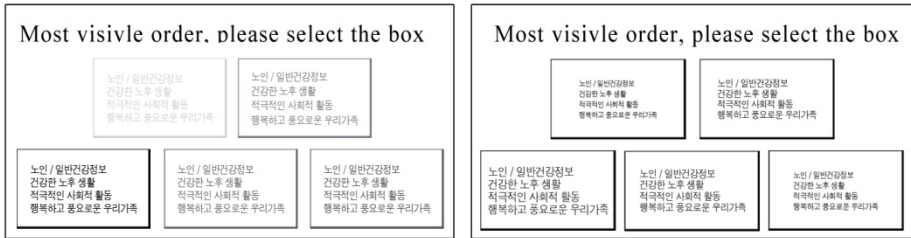


Fig. 3. Background and text color brightness & text size preference measurement

Figure 4 shows the experiment verifying H3's validity, so investigated if there were more preferred arrangement patterns in color combinations of graphic factors like menu and icons.



Fig. 4. Experiment of preference of the color combination for visual elements

Figure 5 shows the experiment verifying H4's validity, so investigated if there was any gender difference in senior generation's preference for arranged images. For this, experiment sample was made by based on Korea I.R.I.'s 'Color Image Scale'.

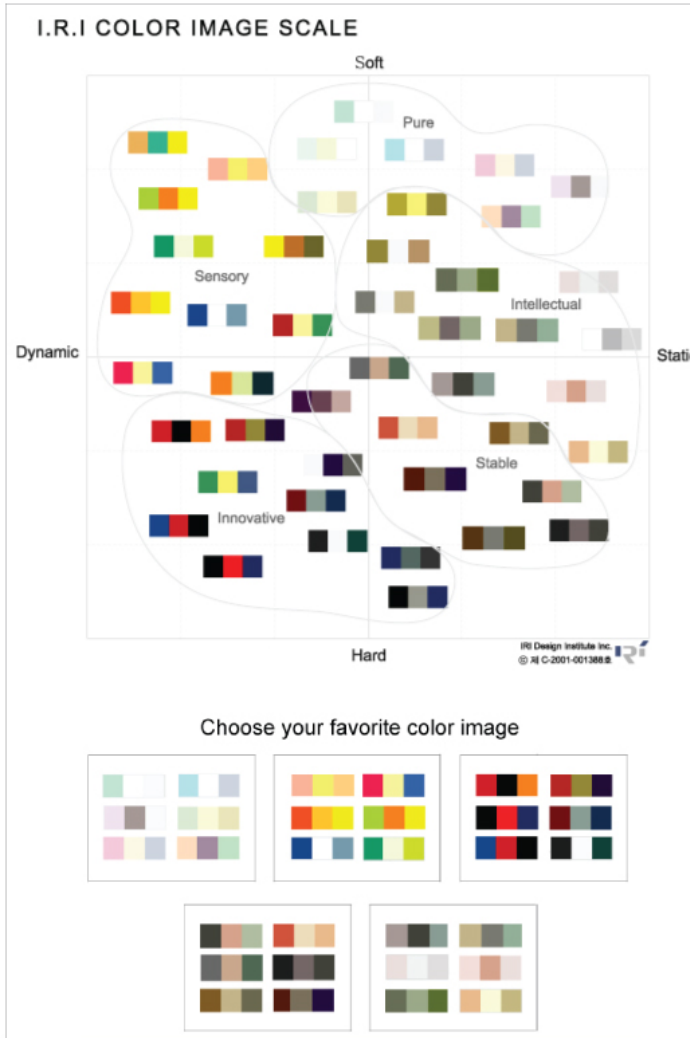


Fig. 5. Preference for Arranged color Images

3.2 Survey Result

First question is about the results of cross analysis (cross-tab) on the subjects' preference for the font brightness and the font size by gender. Statistical analysis is shown on Table 2.

For the font brightness, the response rate in order of 'N1.5, N3, N4, N5, N8' was absolutely higher in both genders, and the rates was 85.7% for male subjects and 95.7% for female subjects, respectively. As the result of chi-square (χ^2) test, there was no significant difference between the both genders ($\chi^2=3.988, p=.136$). For the

font size preference, the response rate in order of ‘17, 15, 14, 12, 11pt’ was the highest as 57.1% for male subjects and 60.9% for female subjects, and the both genders generally preferred for larger font sizes. As the result of chi-square (χ^2) test, there was no gender difference ($\chi^2=6.144$, $p=.523$).

Table 2. Statistical analysis of the experiment shown in Figure 3

Division		Participant		Total	χ^2 (p)
		Male	Female		
Text value	N1.5, N3, N4, N5, N8	24 (85.7%)	44 (95.7%)	68 (91.9%)	3.988 (.136)
	N1.5, N3, N5, N4, N8	0 (0.0%)	2 (4.3%)	2 (2.7%)	
	N1.5, N4, N3, N5, N8	4 (14.3%)	0 (0.0%)	4 (5.4%)	
Text size	14, 11, 17, 15, 12pt	2 (7.1%)	0 (0.0%)	2 (2.7%)	6.144 (.523)
	14, 12, 11, 15, 17pt	0 (0.0%)	2 (4.3%)	2 (2.7%)	
	14, 12, 15, 17, 11pt	0 (0.0%)	2 (4.3%)	2 (2.7%)	
	14, 15, 17, 12, 11pt	0 (0.0%)	2 (4.3%)	2 (2.7%)	
	15, 14, 17, 12, 11pt	2 (7.1%)	4 (8.7%)	6 (8.1%)	
	15, 17, 14, 12, 11pt	2 (7.1%)	6 (13.0%)	8 (10.8%)	
	17, 14, 15, 12, 11pt	6 (21.4%)	2 (4.3%)	8 (10.8%)	
	17, 15, 14, 12, 11pt	16 (57.1%)	28 (60.9%)	44 (59.5%)	
Total		28 (100.0%)	46 (100.0%)	74 (100.0%)	

Second question is about the more preferred arrangement patterns in color combinations method of graphic factors like menu and icons. Statistical analysis is shown on Table 3.

As the results evaluating whole arrangements, it was found that in most experiments, opposing color arrangements like the colors of red, yellow-red, yellow, and green-yellow generated the highest cognition rates.

Table 3. Statistical analysis of the experiment shown in Figure 4

Contrasting(C) Opposite(O) Similar color(S)	R	YR	Y	GY	PB	P	RP	Full
C – O – S	2 (2.7%)	24 (32.4%)	20 (27.0%)	12 (16.2%)	50 (67.6%)	50 (67.6%)	66 (89.2%)	224 (45.6%)
C – S – O	2 (2.7%)	0 (0.0%)	0 (0.0%)	2 (2.7%)	2 (2.7%)	2 (2.7%)	0 (0.0%)	8 (1.5%)
O – C – O	58 (78.4%)	48 (64.9%)	54 (73.0%)	60 (81.1%)	22 (29.7%)	20 (27.0%)	8 (10.8%)	270 (49.8%)
O – S – C	12 (16.2%)	2 (2.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (2.7%)	0 (0.0%)	16 (3.1%)
Full	74 (100.0%)	74 (100.0%)	74 (100.0%)	74 (100.0%)	74 (100.0%)	74 (100.0%)	74 (100.0%)	518 (100.0%)
χ^2 (p):	114.993***(.000)							
	***p<.001							

Finally, the third question was the experiment verifying H4's validity. Statistical analysis is shown on Table 4. Research hypothesis is senior generations will prefer for harder-feeling, clearer color combinations rather than soft-feeling, dull color combinations. As the results of this experiment, it was found that the response rate in order of '3-2-1-5-4' was 43.5% for female seniors, and the response rate in order of '3-2-4-5-1' was 42.9% for male seniors.

Table 4. Statistical analysis of the experiment shown in Figure 5

Division	Male	Female	Total	χ^2 (p)
2-1-5-4-3	0(0.0%)	2(4.3%)	2(2.7%)	21.128* (.012)
2-3-5-4-1	0(0.0%)	2(4.3%)	2(2.7%)	
2-3-5-1-4	0(0.0%)	2(4.3%)	2(2.7%)	
2-3-4-5-1	4(14.3%)	8(17.4%)	12(16.2%)	
4-5-1-2-3	0(0.0%)	2(4.3%)	2(2.7%)	
3-2-5-1-4	4(14.3%)	0(0.0%)	4(5.4%)	
3-2-4-5-1	12(42.9%)	8(17.4%)	20(27.0%)	
3-2-1-5-4	0(0.0%)	20(43.5%)	20(27.0%)	
3-2-1-4-5	0(0.0%)	2(4.3%)	2(2.7%)	
3-4-2-5-1	8(28.6%)	0(0.0%)	8(10.8%)	
Total	28(100.0%)	46(100.0%)	74(100.0%)	

4 Discussion and Conclusions

We surveyed 74 senior people to investigate senior generation's color cognition and color sensibility. This study's hypotheses verification and its conclusion are as follows.

H1: Senior generations will prefer for larger text sizes. Seeing the Table 2 Experiment about the brightness difference between the background color and the text color, and the text size, it was found that senior generations preferred for more distinctive brightness contrast and also larger font sizes. As the results of chi-square (χ^2) test, there was no significant difference between the both genders.

As the results of Table 2, it was identified that senior generations preferred for more distinctive brightness contrast between the background color and the text color.

H2: Senior generations will prefer for more distinctive brightness contrast between the background color and the text's color. As the results of Table 2, it was identified that senior generations preferred for more distinctive brightness contrast between the background color and the text color.

H3: Senior generations will prefer for more distinctively contrasting color arrangements in graphic factors like menu and icons.

As the results evaluating whole arrangements, it was found that senior generations preferred for 'the opposing color arrangements' the most and they preferred for clear contrasts.

H4: Senior generations will prefer for harder-feeling, clearer color combinations rather than soft-feeling, dull color combinations. This hypothesis was exactly coincided in the term of both genders' most favorite color combinations. It was found that senior generation's most favorite color arrangements were clear, dynamic high-chromatic color combinations, and their unfavorable arrangements were dull, static low-chromatic color combinations. However, there were gender differences in 2nd and 3rd preferring color combinations. While female seniors preferred soft-feeling color combinations, but male seniors did hard-feeling color combinations.

The results of this study identified that color cognition was similarly appeared according to a man's age, that is, a generation's visual ability, and clear color contrasts were needed so that seniors could conveniently cognize colors. Besides, it was found that the arrangement preference had some subjective, sensitive characteristics, so it showed some differences in both genders. We hope that the results of this study will actively be utilized at setting color plans while designing a web interface.

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