

# The Color Simulation Experiment for Measuring of Color Sensibility in Living Room

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## Abstract

A color is the most important of all factors that have influence on interior spaces, and plays an visually and psychologically important role in making interior environment. Thus, the aim of this study is to propose predictable color models by image types specially for color design in living room.

This study was composed of three steps, and was carried out as follows.

1) The evaluation experiment was carried out by color simulation using Color Image Processor. 2) Image types were extracted by factor analysis. 3) The characteristics of colors by image types were analysed by the multi regression and as a result the predictable color models by image types was determined.

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Keywords : Color Sensibility, Color Simulation, Image Type

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## 1. INTRODUCTION

The interior of the living room is composed of constructive elements of a ceiling, floor and wall with functional elements of a number of furniture and lay-out etc. This kind of elements have much influence in the interior.

Of these elements, the color plays the most important role in making visually and psychologically comfortable interior environment.

Recently, residents can select their own interior colors freely and express their personalities and images. So, to make much

better visual environment, it is necessary to make image types of the living room and systematize the characteristics of the color by images.

Therefore, the aim of this study is to categorize image types that is needed for the color design in the living room, to analyze the characteristics of colors among image types, and to propose the predictable color models.

## 2. SUMMARY OF EXPERIMENT

### 2.1 Subjects

Subjects were limited to 25 graduate students and senior students of architecture who are accepted to have judgement ability for the colors of architecture.

The following table shows the group of subjects.

[Table 2.1] The Group of Subjects

<b>Sex</b>	Male : 12, Female : 13
<b>Position</b>	Graduate Students : 13, Senior Students : 12
<b>Total</b>	25

### 2.2 Adjectives for Evaluation

Adjectives for experiment were selected 19. We choose 19 adjectives from the adjectives selected by ladder-up in previous studies<sup>1)</sup>, The Evaluation Construct Model of Living Room.

It is table 2.2.

1) Lee, Jin-Sook etc., 「A Study on Color Sensibility Evaluation Models of make up, cars, clothes, interior and exterior」, Journal of the Korea Society of Color Studies, No. 13, 1999. 12

[Table 2.2 ] Adjectives for Experiment

Adjectives for Experiment		
Soft	Classic	Dynamic
Elegant	Natural	Bright
Refined	Harmonious	Graceful
Clear	Opening	Comfortable
Modern	Unique	Cheerful
Lively	Impact	
Variable	Gorgeous	

### 2.3 Variables

The variables for evaluation were hue, value and chroma of each ceiling, wall and floor, and the harmony of the color scheme. These are extracted at subordinate position by ladder-down in previous study, The Evaluation Construct Model of Living Room. And also, we performed the survey and analyzed the papers and documents related to interior colors in the living room. Therefore we could establish the range of colors that can be used in the living room.

The interior colors in the living room were warm colors, neutral tints and neutral mainly. But, we selected every range of colors to examine color characteristics by images.

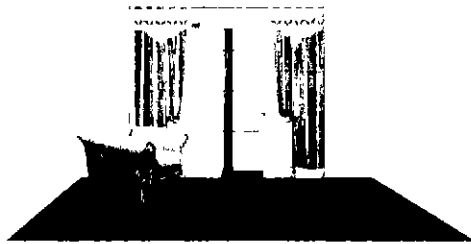
In case of value, ceiling is over 7, wall is over 6 and floor is 3~8.

In case of chroma, ceiling is under 6, wall is under 6 and floor is under 8.

Therefore, we established above color ranges of hue, value and chroma about a ceiling, wall and floor.

### 2.4 Objects

The color simulation experiment was



[Fig. 2.1] One of the Evaluation Objects

carried out by using the Color Image Processor. And it was limited to the living room in house interior. The Fig. 2.1 is one of the evaluation objects. The process of making evaluation objects is as follows:

First, we assumed that the color image in living room was greatly affected by the harmony of the color scheme. So, we focused on the hue and tone. Classified color schemes are the harmony of similarity, hue and tone. The harmony of similarity indicates that tone and hue are homogeneous or similar. The harmony of hue is that hue is same but tone of a ceiling, wall and floor is different. The harmony of tone is that the tone of factors is same but the color to be used is different.

About the concept of harmony, here we use the definition from the Japan Color Research Institute.

The colors were used total 11 of chromatic color 10, and non-chromatic color, and tone is as follows 2.3: in case of ceiling, value is over 7, chroma is under 6, in case of wall, value is over 6, chroma is under 6, and in case of floor, value is 3~8, chroma is under 8.

Also, when we made the evaluation

objects, we applied variable patterns. For example, ceiling and floor have same colors and wall has different colors, or ceiling and wall have same tone and the floor has different tone. The color palette was made by inputting selected colors. And evaluation objects were made by input of colors at living room perspective. At this point, other parts but ceiling, wall and floor have been limited to non-chromatic color in order to estimate colors of an evaluation ceiling, wall and floor.

## 2.5 Method

Measuring Scale is the scale by Semantic Differential method. The fact that colors are very sensitive to light let us to maintain stable illumination equally when the color palettes were made.

## 3. RESULTS AND ANALYSIS

### 3.1 Analysis Method

Data were analyzed by a statistical program SPSS/PC+. And by factor analysis adjectives were classified. As the result, image types were established and then the characteristics by color image were analyzed by using the multi regression.

### 3.2 Factor Analysis Results

Factor analysis was used to classify the 19 adjectives. And the results are demonstrated in the table 3.1. In the analysis, 18 of 19 adjectives were used except for [Soft] that is considered difficult to judge by people.

[Table 3.1] Factor Analysis Results

Factor Adjectives	1	2	3
Lively	.959	6.636E-02	.190
Bright	.945	.139	.168
Opening	.938	.259	-1.564E-02
Cheerful	.929	5.328E-02	.314
Clear	.865	.411	-.155
Dynamic	.768	-.111	.593
Modern	.676	.591	-9.264E-02
Elegant	.171	.956	-.126
Refined	-.276	.932	-.129
Classic	8.722E-02	.930	-2.225E-02
Harmonious	.529	.799	-.167
Graceful	.602	.757	-4.658E-02
Natural	.624	.754	-.103
Comfortable	.684	.710	-6.943E-02
Unique	-6.021E-02	-.265	.914
Variable	.247	.175	.858
Impact	-.489	-.366	.671
Gorgeous	.584	-.195	.657
Eigenvalue	10.822	4.750	1.865
Contribution rate	56.958	25.001	9.818
Cumulative contribution rate	56.958	81.959	91.776

Factor 1 is composed of [Lively], [Bright], [Opening], [Cheerful], [Clear], [Dynamic], [Modern]. In the result, [Lively · Bright] image was extracted.

Factor 2 is composed of [Elegant], [Refined], [Classic], [Harmonious], [Graceful], [Natural], [Comfortable]. In the result [Elegant · Refined] image was extracted.

Factor 3 is composed of [Unique], [Variable], [Impact], [Gorgeous]. In the result, [Unique · Variable] image was extracted.

The contribution rate of each factor is the following. Factor 1 is 56.958%, factor 2 is 25.001% and factor 3 is 9.818%. Therefore

contribution rate of factor 1 is the highest. And total can explain 91.776%.

### 3.3 The Establishment of Image Types

We selected representative items for each factors based on the analysis results extracted from 3.2. The extracted image types are 3 types and those are as follows.

[Table 3.2] Image Types

Extracted Image Types
(1) Lively · Bright
(2) Elegant · Refined
(3) Unique · Variable

### 3.4 The Analysis of Color Characteristics for Each Image Type

To analyze variable effects on the color image of the living room quantitatively, we used the multi regression.

#### 3.4.1 [Lively · Bright] Image

Ten variables of [Lively · Bright] image has the multiple correlation coefficient 0.8761 and it was greatly affected by the hue of a ceiling, the hue of floor, the value of floor, the harmony of color scheme in good order. In the case of partial correlation coefficient and quantity of category, the harmony of the color scheme has the highest correlation with the harmony of the similarity. The high value and low chromatic neutral tints; G, PB, RP or neutral colors affect [Lively · Bright] image highly in the ceiling. The high value and low chromatic warm color and cool color are as same as the wall. The high value and low chromatic warm, cool and neutral tints colors mark the image in the floor.

[Table 33] The Effect Table of [Lively · Bright] Image

R=0.8761

Division Factor	Categories	Cat. score	Partial cor.	Range	Range weight	Cat. score distribution		
						-1.0	0	1.0
Ceiling hue	R	-0.046	0.554	2.506	10.453	-----	-----	-----
	YR	-1.166						
	Y	-0.207						
	GY	0.081						
	G	0.126						
	BG	0.079						
	B	-0.510						
	PB	0.234						
	P	-0.688						
	RP	0.012						
N	1.340							
Wall hue	R	-0.014	0.423	0.917	3.825	-----	-----	-----
	YR	0.402						
	Y	0.152						
	GY	-0.181						
	G	-0.473						
	BG	-0.306						
	B	0.319						
	PB	-0.014						
	P	0.444						
	RP	-0.223						
N	-0.195							
Floor hue	R	-0.061	0.499	1.592	6.640	-----	-----	-----
	YR	0.552						
	Y	0.057						
	GY	0.140						
	G	0.223						
	BG	0.081						
	B	0.103						
	PB	-0.443						
	P	0.140						
	RP	0.015						
N	-1.041							
Harmony of the color scheme	Similarity	0.630	0.493	1.461	6.053	-----	-----	-----
	Hue	-0.958						
	Tone	0.018						
	Non-chromatic color	-0.831						
Ceiling value	Medium	-0.251	0.133	0.282	1.176	-----	-----	-----
	High	0.031						
Wall value	Medium	-0.294	0.207	0.330	1.378	-----	-----	-----
	High	0.036						
Floor value	Low	-1.694	0.658	2.202	9.185	-----	-----	-----
	Medium	-0.332						
	High	0.508						
Ceiling chroma	Low	1.999	0.001	3.326	13.873	-----	-----	-----
	Medium	-0.327						
Wall chroma	Low	0.790	0.002	8.033	33.506	-----	-----	-----
	Medium	-1.243						
Floor chroma	Low	1.999	0.001	3.326	13.873	-----	-----	-----
	Medium	-0.327						

As above, the high value and low chroma influence [Lively · Bright] image highly. Table 3.3 shows the results.

### 3.4.2 [Elegant · Refined] Image

Ten variables of [Elegant · Refined] image has the multiple correlation coefficient 0.9102 and it was greatly affected by the hue, value and chroma of floor, the hue and chroma of wall in good order. In the case

[Table 34] The Effect Table of [Elegant · Refined] Image

R=0.9102

Division Factor	Categories	Cat. score	Partial cor.	Range	Range weight	Cat. score distribution		
						-1.0	0	1.0
Ceiling hue	R	-0.076	0.622	3.228	24.654	-----	-----	-----
	YR	0.035						
	Y	-0.234						
	GY	0.283						
	G	0.461						
	BG	0.038						
	B	-0.910						
	PB	-0.584						
	P	-0.606						
	RP	-0.750						
N	1.252							
Wall hue	R	0.538	0.605	1.167	8.913	-----	-----	-----
	YR	0.246						
	Y	0.288						
	GY	-0.545						
	G	-0.629						
	BG	-0.545						
	B	0.080						
	PB	-0.129						
	P	0.246						
	RP	0.246						
N	0.052							
Floor hue	R	0.379	0.548	1.292	9.868	-----	-----	-----
	YR	-0.114						
	Y	-0.129						
	GY	-0.254						
	G	-0.754						
	BG	-0.387						
	B	0.232						
	PB	0.330						
	P	0.080						
	RP	0.538						
N	0.218							
Harmony of the color scheme	Similarity	0.409	0.524	2.264	17.292	-----	-----	-----
	Hue	0.311						
	Tone	-0.150						
	Non-chromatic color	-1.855						
Ceiling value	Medium	-0.010	0.008	0.012	0.062	-----	-----	-----
	High	0.001						
Wall value	Medium	-0.079	0.064	0.088	0.672	-----	-----	-----
	High	0.010						
Floor value	Low	0.890	0.758	1.271	9.707	-----	-----	-----
	Medium	0.605						
	High	-0.381						
Ceiling chroma	Low	0.216	0.001	2.195	16.765	-----	-----	-----
	Medium	-1.979						
Wall chroma	Low	0.711	0.003	0.788	6.018	-----	-----	-----
	Medium	-0.078						
Floor chroma	Low	0.711	0.003	0.788	6.019	-----	-----	-----
	Medium	-0.078						

of partial correlation coefficient and quantity of category, the harmony of color scheme has the highest correlation with the harmony of the similarity and hue. The high value and low chromatic neutral tints; G, GY or neutral colors affect [Elegant · Refined] image highly in the ceiling. The high value and low chromatic warm color and neutral tints color are as same as the wall. The low-middle value and low

[Table 3.5] The Effect Table of [Unique · Variable] Image

R=0.7763

Division	Categories	Cat. score	Partial cor.	Range	Range weight	Cat. score distribution
Factor						-1.0 0 1.0
Ceiling hue	R	0.149	0.537	1.129	11.074	-----
	YR	-0.589				
	Y	-0.414				
	GY	-0.233				
	G	-0.407				
	BG	-0.106				
	B	0.113				
	PB	0.399				
	P	0.137				
	RP	-0.021				
N	0.540					
Wall hue	R	0.022	0.541	0.917	8.965	-----
	YR	-0.075				
	Y	-0.033				
	GY	0.134				
	G	0.342				
	BG	0.009				
	B	0.217				
	PB	-0.075				
	P	-0.075				
	RP	-0.075				
N	-0.575					
Floor hue	R	-0.361	0.572	1.160	11.378	-----
	YR	0.421				
	Y	0.345				
	GY	0.220				
	G	0.178				
	BG	0.218				
	B	-0.273				
	PB	-0.363				
	P	0.095				
	RP	0.053				
N	-0.736					
Harmony of the color scheme	Similarity	-0.294	0.569	0.497	4.875	-----
	Hue	0.042				
	Tone	0.204				
	Non-chromatic color	0.097				
Ceiling value	Medium	-0.052	0.060	0.068	0.569	-----
	High	0.006				
Wall value	Medium	0.253	0.188	0.284	2.786	-----
	High	-0.031				
Floor value	Low	-0.227	0.229	0.304	2.982	-----
	Medium	0.077				
	High	0.036				
Ceiling chroma	Low	1.358	0.007	1.507	14.782	-----
	Medium	-0.148				
Wall chroma	Low	0.279	0.007	2.832	27.778	-----
	Medium	-1.553				
Floor chroma	Low	-0.148	0.001	1.507	14.781	-----
	Medium	1.368				

chromatic warm, cool and neutral tints colors mark that image in the floor.

As above, the low value and low chroma of floor and neutral tone influence [Elegant · Refined] image highly. Table 3.4 shows the results.

### 3.4.3 [Unique · Variable] Image

Ten variables of [Unique · Variable] image has the multiple correlation coefficient is

0.7763 and it was greatly affected by the hue of a floor, ceiling and wall in good order. In the case of partial correlation coefficient and quantity of category, the harmony of color scheme has the highest correlation with the harmony of the tone. The high value and low chromatic cool color affect [Unique · Variable] image highly in the ceiling. The middle value and low chromatic cool color does in the wall. The middle-high value and middle chromatic warm color and neutral tints color mark that image in the floor.

As above, the high chroma influences [Unique · Variable] image highly to the floor. and harmony of contrast, different color patterns influence the images. Table 3.5 shows the results.

## 4. CONCLUSION

In this study, the analysis of the color characteristics of a ceiling, wall and bottom in the living room and the harmony of the color scheme was done to know how much they affect in the image of the living room. The results is as follows ;

1) As a result of simulating variable color of the living room, 3 image types of [Lively · Bright], [Elegant · Refined], [Unique · Variable] are extracted by factor analysis.

2) [Lively · Bright] image was deeply influenced by the high value, low chroma of ceiling, wall, and floor and it was marked high with the harmony of similarity.

3) [Elegant · Refined] image was related to the hue and chroma of ceiling. And it was marked high with the harmony of similarity and hue.

4) [Unique · Variable] was greatly influenced by the chroma, hue and the harmony of tone. So this image was marked in high chroma of floor and harmony of contrast, which is different from color patterns.

Consequently, color palettes based on the analysis are developed by the image types.

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