

The Effects of Colour and Light on Space Perception

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ABSTRACT

This study analyzes and compares colour emotions of people with respect to the difference in illuminance and wall colour at a full scale test room, without daylight. 20 undergraduate students from the Department of Interior Architecture and Environmental Design evaluated the visual appraisal of the wall colours and lighting design separately through a semantic differential scale. Statistical test results indicated that, colour emotions are consistent across men and women. It was also observed that a 200 lx gradual increase in the illuminance leads to positive impressions. The results show that when wall colour is the dependant variable, while illuminance is constant, light yellow room is associated with positive factors with respect to light blue room. Light yellow room is more "stimulating" than light blue room while mean of the responses are same under both of the rooms for the impression of "intimate".

Keywords: Colour Emotion, Interior Design, Light-colour Interaction, Space Perception,

1. INTRODUCTION

Light and colour are two basic factors of human perception, they are a matter of well design and, both are considered a neurological process that operates in arousability. Recent researches of Kwallek [1], Küller [2, 3] support that the strength of arousal response to sudden increases in variation and/or unexpectedness of stimuli is effective on individual's performance and space perception.

Starting from Flynn [4], Küller [2, 3], Ou et al[5], there are various studies on colour association and colour emotions which are greatly concerned with a large number of colour-emotion scales and are evaluated by the method of

ternatives, participants evaluated appraisal of the wall colours. The Natural Colour System (NCS) is used to describe the colour scheme of the walls. An attempt was made to use colour panels as the customary colours for offices. In designing the colour schemes for value, an attempt was made to select colours having a close distance of lightness. Table 1 gives the technical data of the study.

Lighting system	Illuminance level	Wall colour	NCS CODE	Reflectance factor
Luminaire type: TBS	300 lx	Light blue	L90 C10 H230	%74,1 (r=0,74)
631	500 lx	Light yellow	L85 C14 H70	%72,3 (r=0,72)
Lamp type: TL'5 28W 840	750 lx			

Table 1. Technical data of the study.

Horizontal illuminance and luminance distribution (on the working surface) and the vertical illuminance-luminance distribution (on the wall surface) are measured on various points according to the grid system to evaluate physical comfort conditions. Measured illuminance and luminance values at 54 points indicate that physical comfort conditions are satisfied.

In the study, semantic differential scale through the use of bipolar adjective pairs was developed with reference to previous studies. Bipolar adjective pairs are grouped and they are evaluated under three categories; personal evaluation factor, spatial appearance factor and factor of originality were tested by 10 pairs of colour emotional words.

3. HYPOTHESES

In terms of the arousability, it was predicted that wall colour would affect the appraisal of the environment under constant illuminance. It was also hypothesized that the pattern of difference in the illuminance for light blue and light yellow wall colours would be affective on the arousal level. In other words, it was expected that the gradual increase in the illuminance would change personal evaluation factor, spatial appearance factor and factor of originality. Also, the role of gender was assumed to be affective on the arousal level.

4. EXPERIMENTAL PROCEDURES

The participant group was undergraduate students from the Interior Architecture and Environmental Design Department at IKU, aged between 21-34 and had good colour vision. 21 subjects, 11 male and 10 female participated in the visual assessments. Each student was asked to take Ishihara Colour Blindness Test before the experimental session to ensure they had normal colour vision. 1 subject from the male group was recorded "colour blind" whose results showed great discrepancy. For this reason, statistical results were applied among 20 students; 10 male and 10 female.

10 pairs of colour emotional words (Table 2) were selected in the study to describe the wall colours. Subjects were

asked to view the wall colours at approximately 15° to normal with a distance around 140 cm. After viewing a wall colour (light blue for example), each subject was asked to fill in the questionnaire for each of the ten word pairs to describe the wall colour under the specified lighting alternative. The experimental session was repeated for each of the lighting alternative, for “light blue” and “light yellow” wall colours separately.

		Lighting alternative 2 (LA ₂ : 4000°K-300 lx)		Lighting alternative 5 (LA ₅ : 4000° K- 500 lx)		Lighting alternative 7 (LA ₇ : 4000° K- 750 lx)		p value
		Mean	Sd	Mean	Sd	Mean	Sd	
Light Blue wall	Bright-dull	3,33	1,22	1,56	0,88	0,89	0,78	0,000*
	Warm-cool	3,33	1,22	2,22	1,09	1,33	1,32	0,010*
	spacious-boring	3,33	1,12	2,44	1,13	1,78	1,39	0,018
	comfort-depressed	3,33	1,22	2,11	1,27	2,11	1,36	0,054
	lively-colourless	3,33	1,12	2,33	1,41	1,00	0,87	0,011*
	luminous-dark	3,44	1,01	1,56	1,01	0,78	0,83	0,001*
	emotive-quietened	3,33	1,41	2,33	0,87	1,89	0,93	0,006*
	intimate-distant	2,22	1,30	2,44	1,13	2,33	1,73	0,871
	restful-restless	3,22	0,97	2,56	1,24	1,78	1,39	0,031
	calm-stimulating	0,89	1,05	2,22	1,09	2,67	1,73	0,030
Light Blue wall	Bright-dull	2,44	1,13	1,00	0,71	1,00	1,00	0,004*
	Warm-cool	2,67	1,22	2,11	1,17	2,00	1,22	0,056
	spacious-boring	2,67	1,66	2,22	0,97	1,89	1,27	0,393
	comfort-depressed	2,33	1,50	1,56	1,13	1,67	1,32	0,568
	lively-colourless	2,89	1,05	1,22	1,09	1,33	1,00	0,001*
	luminous-dark	2,00	1,32	1,22	0,97	1,00	1,22	0,047
	emotive-quietened	2,67	1,32	2,11	1,05	1,78	1,20	0,209
	intimate-distant	2,22	0,97	2,11	0,78	2,11	1,05	0,999
	restful-restless	2,44	1,59	1,89	1,17	2,67	1,12	0,250
	calm-stimulating	1,11	0,60	2,00	1,32	3,44	0,88	0,004*

Friedman test, $p < 0,016$

Table 2. Comparison of the lighting alternatives for light blue and light yellow colours

5. RESULTS AND DISCUSSION

Statistical Package for Social Sciences (SPSS) 17.0 was used for data analysis. Non parametric tests were applied depending on the number of the participant group. The Mann Whitney U Test was used in the study as a measure of gender and illuminance difference in colour emotions. The statistical analysis of gender on the appraisal level of the wall colours under different illuminance indicate that, there is not a significant difference between gender and colour emotions. In other words, there is not any difference between the appraisal level of light blue and light yellow wall

colour for men and women.

Mean of the responses under three lighting alternatives are compared both for the yellow and the blue wall. The bigger value for the mean indicates that participants chose the negative adjectives. Similarly, smaller value indicates that participants chose positive adjectives. Mean of the responses and standard deviation are summarized in the Table 2 above.

The Friedman Test was used as a measure of the influence of lighting alternatives on the colour assessment indicated that, there is a significant difference between the three lighting alternatives in terms of the bipolar adjective pairs; bright-dull ($p=0,000$), warm-cool ($p=0,010$), lively-dark ($p=0,01$) and emotive-quietened ($p=0,006$). When the frequency distribution of each adjective pair is compared in relation to lighting alternatives, results show that light blue wall colour was found more dull, cool, boring, colourless, dark and quietened.

For the light blue wall room, under LA_2 , the impression of "dull" is significant (meaningful) than the test results at LA_5 and LA_7 . Similarly, under LA_2 the impressions of "cool", "colourless", "dark" and "quietened" are significant with respect to LA_5 and LA_7 . A gradual decrease in illuminance, the test room is associated with negative impressions. On the contrary, gradual increase in the illuminance (200 lx and 250 lx) leads to positive impressions.

For the light yellow wall room, under LA_2 , the impression of "dull" and "colourless" is significant (meaningful) than the test results at LA_5 and LA_7 . The impression of "stimulating" is significant for the LA_7 . The gradual increase in the illuminance affected the stimulation level in the light yellow room positively.

As shown in Figure 2, under 300 lx, light yellow room is associated with positive factors with respect to light blue room. Light blue room is more stimulating than light blue room while mean of the responses are same for the impression of intimate (mean value=2,22).

6. CONCLUSION

The experimental study demonstrated that the colour of an interior space has effects on the arousal level and perception of people. Significant differences were recorded in the visual assessment of the test room under the same illuminance for light blue and light yellow wall colours. Mean of the responses indicate that, the tested colours had an impact on the appraisal of the test room.

Similarly, a gradual increase in illuminance affected colour evaluation. As the illuminance increased, an increase in the positive assessment has also recorded. In the study, test results show that colour emotions are consistent across men and women.

The experimental research indicates that lighting scheme of an interior is a design factor that shall be studied together with the colour scheme of the interior (wall-ceiling-floor-furniture colour).

It is intended to enlarge the study in order to be more directly relevant for design application. The study can be enlarged with a greater number of subjects, different colour palettes and lighting scheme in order to generalize the results.

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