Original paper

EVALUATION ON COLOR FABRICS FOR COMFORT IN HEALTHCARE INTERIOR FACILITY

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Abstract: This study investigated human impression of favorability and gender sensitivity response on color fabrics for comfort in health care interior facility. Three groups of color fabric; Pink (10), Saxe Blue (10) and White (10), total of 30 different stimuli were selected. 12 subjects evaluated the stimuli with 29 adjective-pair words that meet comfortability of psychological term of healing. The obtained data was analyzed in few steps; favorability rating, impression and gender sensitivity response by using factor analysis and semantic differential method. The findings support previous medical study that warm color physiologically induces more arousal, a cool color stimulates cooling and calming effect, and a plain of White appear to give only a little effect on relaxation. Women were more sensitive in perceiving bright-dark and warm-cool of a color than Men. This finding may contribute to gain applicable knowledge in interior design application in regard of applying therapeutic environments.
Keywords: Color, Impression, Pink-Blue-White, Interior fabric

1. Introduction

Currently, the health care are increasingly recognizing the importance of alternative healing treatments such as therapy, where color is considered as one aspect of psychological approach to reducing stress through the creation of therapeutic environments [1, 2]. The goal of all healing environments is to involve patients in the process of self-healing. Interior environment and furnishings are designed to create therapeutic atmosphere to reduce stress and provide psychological comfort through color treatment setting. Many studies of color intensify on people's moods and emotions. Although the studies are inconsistent on determining which colors bring out specific moods and emotions and different color stimuli varies from person to person. Some research has concluded that women tend to feel pleasant seeing 'warm' colors, while men tend to feel pleasant seeing 'cool' colors [3]. Warm colors induce more arousal; cool colors induce less arousal [4]. However, very little study about comfort focusing on few color fabrics that widely used in health care interior facilities; such as Pink, Blue, and White [5]. Therefore, this study was aimed to examine human impression, favorability rating and gender

sensitivity response on color fabrics, which commonly applied for comfort in health care interior facility.

2. Method

Kansei Evaluation is an individual's subjective impression from a certain artifact, environment or situation using all the senses as recognition [6]. One of the most common technique used in Kansei Evaluation is the Semantic Differential (SD) [7]. Considering the color range of the stimuli of color fabric were quite similar one to another, the SD technique was selected to provide subjects a direct experience by closer view and touching the stimuli. Employing other SD technique, such as image-icon technique might encounter difficulty in identifying high similarity appearance of the stimuli.

2.1 Stimuli of Color Fabrics

Three groups of color fabric widely applied in health care facilities were set; Pink, Saxe Blue and White. Each group consisted of 10 monochromatic colors with a very little difference in saturation, texture and motif. Those 30 stimuli were presented on 10x15 cm display with their

stimuli number, Pink (P1, P2,…P10), Saxe Blue (S1, S2,…S10) and White (W1, W2,…W10). Particularly on a group of white color fabric, their appearance was quite similar one to another and no fabric with motif available on this group. The stimuli were presented in Figure 1.
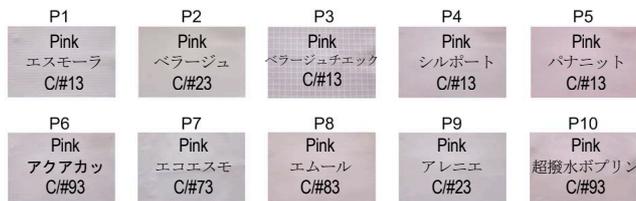

Figure 1a. Stimuli of Color Fabric (Pink)

Figure 1b. Stimuli of Color Fabric (Saxe Blue)

Figure 1c. Stimuli of Color Fabric (White)

2.2 Subjects

12 subjects (N=12) were randomly selected and took part voluntarily in this study. They consist of 6 (50%) male and 6 (50%) female; on the age of 22-35 years old. All subjects had normal vision, and assumed that none have any type of color deficiency prior to the study.

2.3 Procedures

The experiment was conducted under usual room-light illumination. Subjects were given introductory explanation prior to the experiment. They were instructed to evaluate the stimuli with a questionnaires sheet of SD scale evaluation with 29 adjective-pair words. The adjective-pair words were selected from previous research of Hong bin, et al., 2008 [8] and modified to meet suitability of psychological term of healing and comfort from general observation (i.e. restless-relieve; serene-forceful; reserved-imperious; etc) as shown at Table 1. Next, participants will evaluate the questionnaires. Semantic

Differential technique was applied as a method to evaluate perceptual response based on subjective estimations of concepts that were ranked against each other with 7 Likert-scale.

The procedure for the experiment were conducted in one phase, the evaluation of those three groups of color fabric were held at different session, which was Pink session, Saxe Blue session and White session, considering it took extra time to carry out the testing of 30 stimuli with 29 questionnaires of adjective-pair words. Each subjects were requested to evaluate the stimuli randomly one at a time within its color group, nevertheless they were allowed comparing differences and/or similarities among the stimuli, also to touch and sense it.

Table 1. A set of 29 adjective-pair words (before reduced)

No	Left adjectives	Right adjectives
1	Conventional	Eccentric
2	Simple	Compound
3	Solemn	Funny
4	Formal	Casual
5	Serene	Forceful
6	Still	Moving
7	Pretty	Austere
8	Friendly	Awkward
9	Soft	Hard
10	Blase	Attractive
11	Flowery	Quiet
12	Happy	Normal
13	Elegant	Loose
14	Delicate	Large-hearted
15	Gentle	Pithy
16	Bright	Dark
17	Reserved	Imperious
18	Free	Regular
19	Level	Indented
20	Lustered	Matte
21	Transpicuous	Dim
22	Warm	Cool
23	Moist	Arid
24	Colorful	Sober
25	Plain	Gaudy
26	Comfortable	Disturbing
27	Light	Heavy
28	Restless	Relievable
29	Like	Dislike

To capture color favorability and gender sensitivity response, a series of analysis was conducted as follows:
1. Rating the gender favorability from each group of color by using like-dislike adjective word.
2. Conducting an Exploratory Factor Analysis (EFA) using Principal Component Analysis (PCA) method with number of extraction was limited to 3 factors.

Considerably low/high Variance from 28 adjective-pair words were reduced, and 14 adjective pair-words was available at last. We separated no. 29, the adjective-pair word (Like and Dislike) to obtain favorability rating (the like most and dislike most) apart from 28 adjective-pair for factor analysis.

3. An orthogonal scatterred diagram were applied as perceptual matrices to study the color impression and confirm with the favorability rating.

4. Identifying the gender sensitivity response on different group of color to observe the latent correlation.

3. Result

3.1 Favorability Rating

Before performing factor analysis, gender favorability rating (like-dislike) was applied. This provides a conformity data for cross-referenced. Result of descriptive statistics (Table 2) indicates that:

Favorability rating:

a. Pink color:

P7 was perceived to be the like most by overall (mean value = 5.08), P7 was perceived to be the like most by men (mean value = 5.00). P2 was the like most by women (mean value = 5.33).

b. Saxe Blue color:

S3, S8 were perceived to be the like most by overall (mean value = 5.33), S6, S8, S9, S10 were the like most by men (mean value = 5.00) and S3 was the like most by women (mean value = 6.00).

c. White color:

W6, W9 were perceived to be the like most by overall (mean value = 5.08). W1, W6 and W9 were the like most by men (mean value = 5.17) and W4, W6, W9 and W1 were the like most by women (mean value = 5.00).

The result of favorability rating, S3 was the like most by overall (mean value = 5.33) presented in Figure 2.

Unfavorability rating:

a. Pink color: P5 was perceived to be the dislike most by overall (mean value = 3.83) and by men (mean value = 3.83) also by women (mean value = 3.83). P3 was also dislike most by men (mean value = 3.83).

b. Saxe Blue color: S1 was perceived to be the dislike most by overall (mean value = 4.17) and by men (mean value = 3.67) also by women (mean value = 4.67).

c. White color: W7 was perceived to be the dislike most by overall (mean value = 4.50), W10 was the dislike

most by men (mean value = 4.33) and W1,W7 were the dislike most by women (mean value = 4.17).
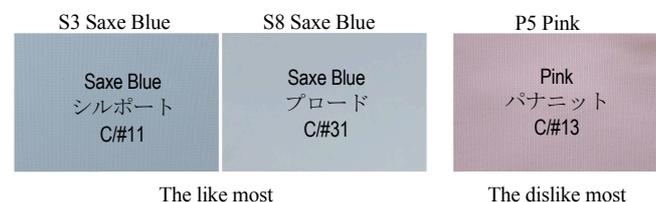
The result of unfavorability rating, P5 was the dislike most by overall (mean value = 3.83) presented in Figure 2.

Table 2. Favorable rating (like-dislike)

PINK					
Overall		**Men**		**Women**	
P7	**5.08**	**P7**	**5.00**	**P2**	**5.33**
P2	4.92	P4	4.83	P6	5.17
P4	4.83	P1	4.50	P7	5.17
P6	4.83	P2	4.50	P8	5.17
P8	4.83	P6	4.50	P9	5.17
P9	4.83	P8	4.50	P10	5.17
P10	4.83	P9	4.50	P3	4.83
P1	4.42	P10	4.50	P4	4.83
P3	4.33	**P3**	**3.83**	P1	4.33
P5	**3.83**	**P5**	**3.83**	**P5**	**3.83**

SAXE BLUE					
Overall		**Men**		**Women**	
S3	**5.33**	**S6**	**5.00**	**S3**	**6.00**
S8	**5.33**	**S8**	**5.00**	S2	5.67
S2	5.17	**S9**	**5.00**	S8	5.67
S7	5.17	**S10**	**5.00**	S7	5.50
S9	5.08	S7	4.83	S5	5.33
S6	5.00	S2	4.67	S9	5.17
S10	4.92	S3	4.67	S6	5.00
S5	4.67	S4	4.33	S4	4.83
S4	4.58	S5	4.00	S10	4.83
S1	**4.17**	**S1**	**3.67**	**S1**	**4.67**

WHITE					
Overall		**Men**		**Women**	
W6	**5.08**	**W1**	**5.17**	**W4**	**5.00**
W9	**5.08**	**W6**	**5.17**	**W6**	**5.00**
W5	4.92	**W9**	**5.17**	**W9**	**5.00**
W8	4.92	W5	5.00	**W1**	**5.00**
W2	4.83	W8	5.00	W2	4.83
W4	4.83	W2	4.83	W3	4.83
W1	4.75	W7	4.83	W5	4.83
W1	4.67	W8	4.67	W8	4.83
W3	4.58	W9	4.50	**W1**	**4.17**
W7	**4.50**	**W10**	**4.33**	**W7**	**4.17**

S3 Saxe Blue   S8 Saxe Blue   P5 Pink

Saxe Blue シルポート C/#11   Saxe Blue ブロード C/#31   Pink パナニット C/#13

The like most   The dislike most

Figure 2. Overall the like most and dislike most

3.2 Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) is an approach to find patterns in the data with variable reduction technique, which identifies the number of latent constructs and the underlying factor structure of a set of variables [9]. This analysis was conducted to examine the nature of the
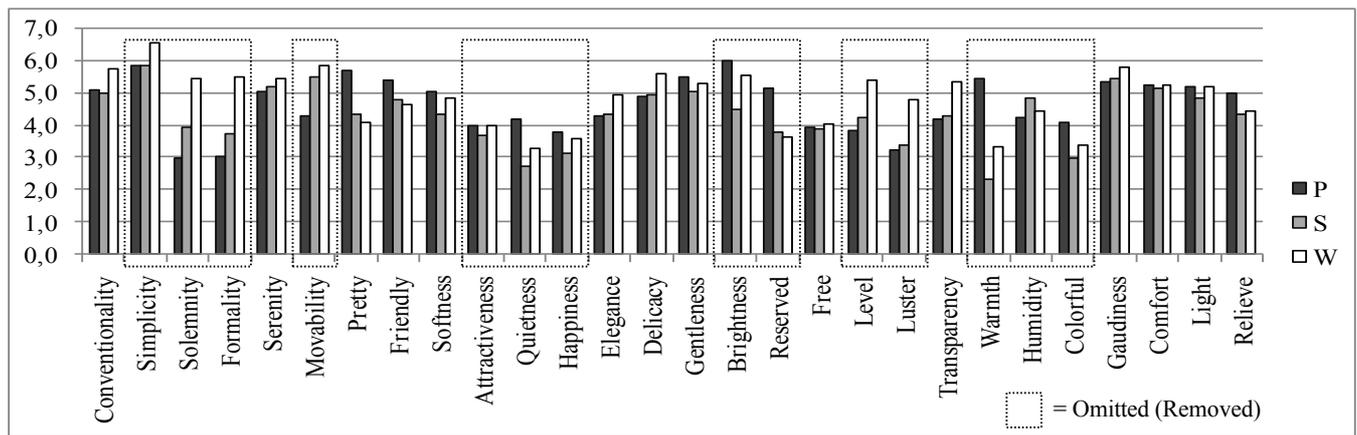
Figure 3. Variance distribution

constructs influencing a set of response. Considerably low/high Variance from 28 adjective-pair words were reduced become 14 adjective-pair words.

The initial eigenvalue of Factor Analysis were F1: 6.222, F2: 3.475, F3: 1.022. After varimax rotation, the first factor (F1) had an eigenvalue 4.104 and total variance explained 29.3%. The second factor (F2) has an eigenvalue 3.475 and total variance explained 24.82%. The third factor (F3) had an eigenvalue 3.141 and total variance explained 22.44%. Therefore, the perceptual correlation was extracted into three factors as follows:

a. Factor 1: *Serene, Free, Comfortable, Plain, Light,* and *Restless,* hereafter referred to as FREE.

b. Factor 2: *Transpicious, Conventional, Delicate* and *Elegance*, hereafter referred to as TENDER.

c. Factor 3: *Pretty, Friendly, Soft* and *Gentle* hereafter referred to as PLEASANT.

Table 3. Rotated Factor Matrix

Adjectives (+)	Adjectives (-)	Factor		
		F1	F2	F3
5. Serene	5. Forceful	.808	.387	-.101
18. Free	18. Regular	.807	.170	.057
26. Comfortable	26. Uncomfortable	.721	.214	.182
25. Plain	25. Gaudy	.711	.505	-.051
27. Light	27. Heavy	.658	.392	.497
28. Restless	28. Relieve	.640	-.222	.551
21. Transpicious	21. Dim	.135	.926	-.097
1. Conventional	1. Unconventional	.348	.773	.150
14. Delicate	14. Large-hearted	.531	.716	-.087
13. Elegance	13. Loose	.188	.642	-.395
7. Pretty	7. Austere	-.234	-.270	.875
8. Friendly	8. Unfriendly	.103	-.360	.814
9. Soft	9. Hard	.323	.359	.713
15. Gentle	15. Pithy	.552	.285	.638
Eigenvalue (After rot.)		**4.104**	**3.475**	**3.141**
% of Variance		29.3%	24.82%	22.44%
KMO		**0.734**		

Table 4. Corresponding Name

Factor	Kansei Words	Eigenvalue	Factor Name
F1	Serene, Free, Comfortable, Plain, Light, Restless	4.104	**FREE**
F2	Transpicious, Conventional, Delicate, Elegance	3.475	**TENDER**
F3	Pretty, Friendly, Soft, Gentle	3.141	**PLEASANT**

Factors were split into two orthogonal diagrams to represent perceptual matrices. The result of perceptual matrices of F1, F2 and F3 shows the human impression on color that was confirmed with Favorability Rating as follows:

Pink color fabric indication:
All Pink stimuli were strongly perceived positively at PLEASANT Factor (F3). P3 (the only Pink fabric with motif) and P5, the most dislike Pink stimuli were perceived very low at FREE (F1) and TENDER (F2).

Saxe Blue color fabric indication:
Almost all Saxe Blue stimuli were perceived negative/low on the three factors: FREE, TENDER, PLEASANT (matrix F1-F2; F1-F3 and F2-F3). However, S6 (the only one Saxe Blue fabric with motif) was perceived considerably positive on the PLEASANT Factor.

White color fabric indication:
All White stimuli appeared forming a small cluster, this low dispersion (Figure 4) indicates subjects tended to response similar impression. W6 (the like most) and W7 (the dislike most) were lied adjacent in all perceptual matrices. All White colors were always perceived significantly high or positive in TENDER Factor (F2).
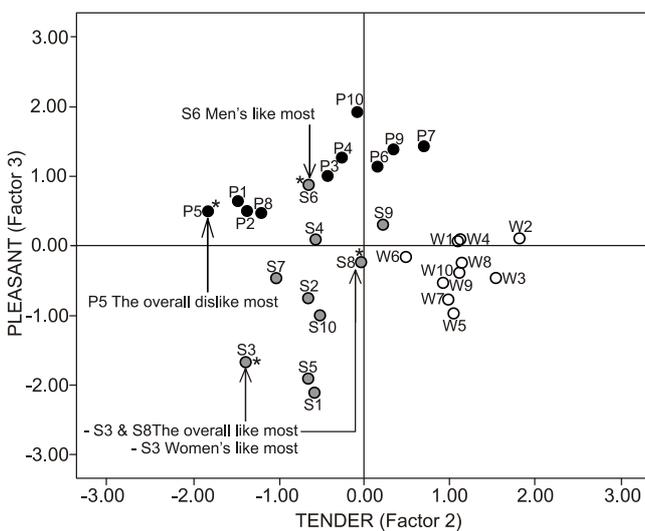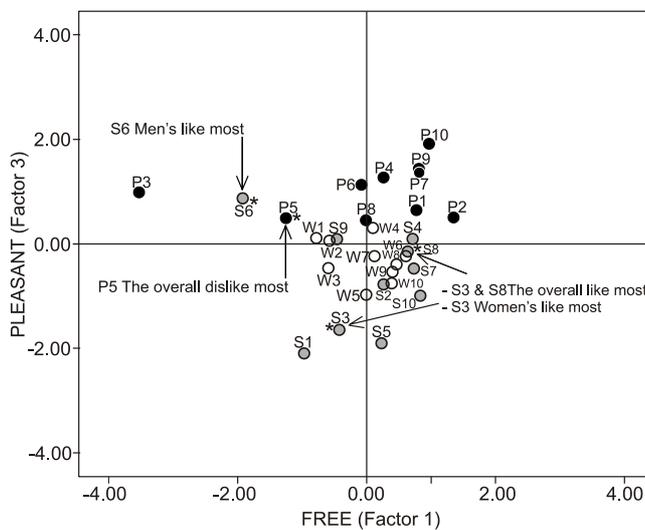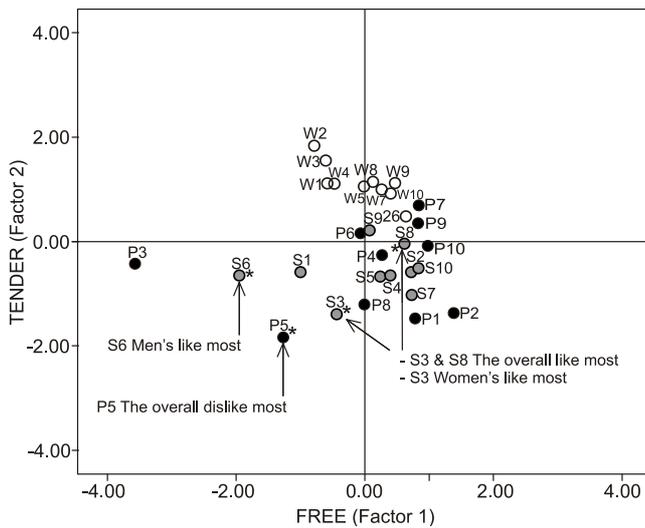
Figure 4. Perceptual matrices of F1, F2 & F3

3.3 Evaluation on Gender Sensitivity Response

By comparing the gender sensitivity response on adjective-pair words towards different group of color will uncover the latent correlation. Referring to Figure 4, the overall Pink colors were appreciated positively than Saxe Blue and White quite significant.

4. Discussion

One category of research interest focusing on color is concern with descriptive dimension, such as 'warm' or 'cool,' etc that intensifies on people's mood and emotion [10]. Previous study in color emotion concluded that women tend to feel pleasant seeing 'warm' colors, while men tend to feel pleasant seeing 'cool' colors [3]. Warm colors induce more arousal; cool colors induce less arousal [4]. Including health-care related study has conducted an experiment of viewing different colors on electroencephalogram (EEG) and skin temperature in humans, where viewing the warm color (red) caused a rise in skin temperature and the blood circulation quickened. The color blue stimulates cooling and calming effect the parasympathetic nervous system letting the peripheral circulation widen. Whilst white color appear to be increasing skin temperature very little [5].

Overall, the Pink color fabric appeared to be a little more appreciated than Saxe Blue and White color fabric. This appeared confirming the previous health care study that warm color stimulates warm physiologically that induce more arousal. However, this study showed women and men like most the Saxe Blue color, which also reflect previous study that Blue color, was calming and cooling effect physiologically (explained in Figure 5). This means the Favorability rating (like-dislike) evaluation was not necessarily related to the impression (Table 2 and Figure 5).

White stimuli showed a low dispersion, which represents similar impression. As previous study stated, the white color appeared to have only a little effect on relaxation, possibly because it was perceived as simple and plain (induce no arousal) as shown at Figure 4.

The latent correlation can be explained as follows, S3 was the overall like most because of positive evaluation in Simplicity and Comfort, P5 was the overall dislike most because of negative evaluation on Solemnity, Formal, Level and Lustered. S6, S8, S9, S10 were the like most by men because of positive evaluation on Conventionality, Simplicity, Movability, Gaudiness and Light. S3 was also the like most by women by positive evaluation on Simplicity, Movability and Comfort. Men disliked most was P3 (the only one Pink fabric with motif), on contrary, the S6 (the only one Saxe Blue fabric with motif) was perceived as the like most by men. Again, it appeared confirm that Men tended to feel pleasant seeing 'cool' colors (blue).
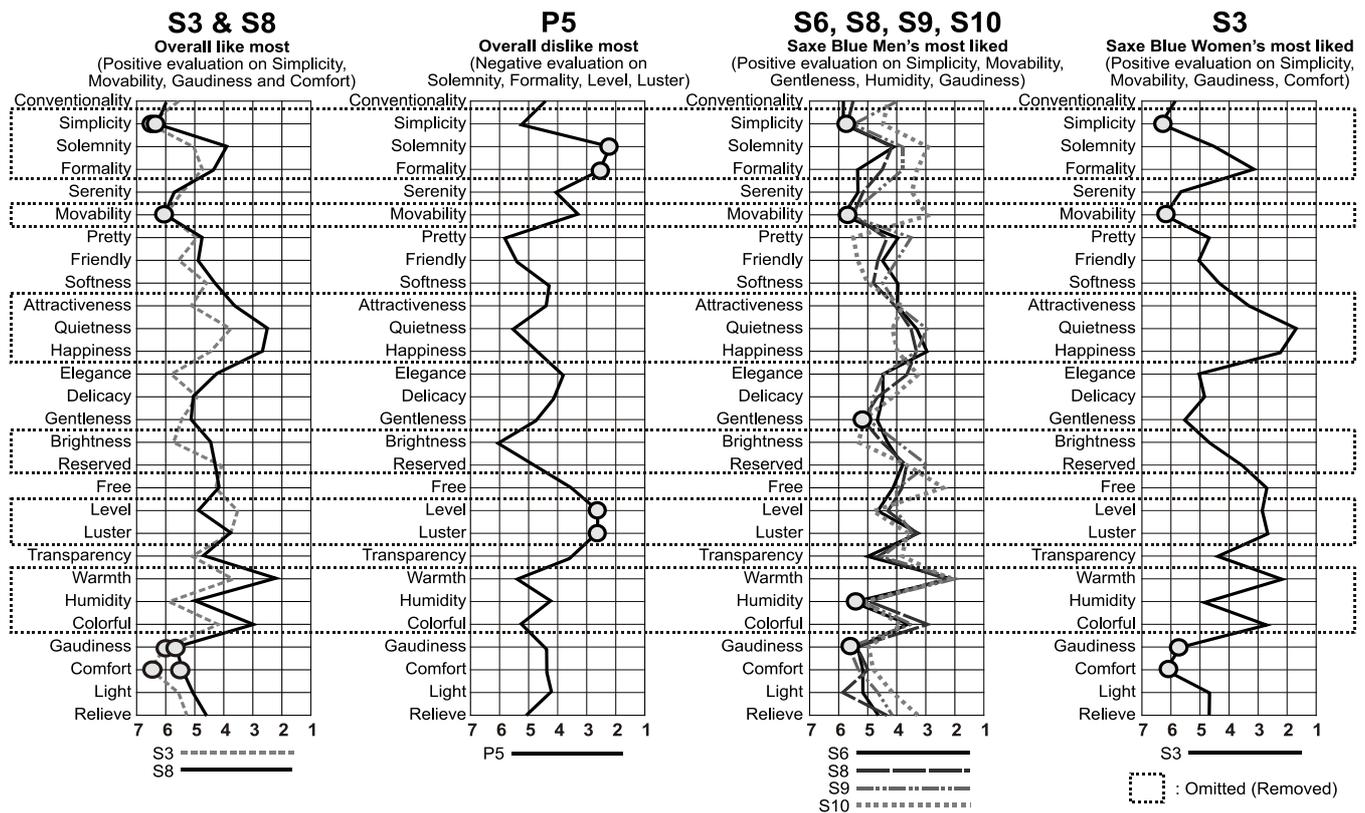
Figure 5. Gender sensitivity response (Latent correlation)

5. Conclusion

Affective values of color become more desirable to apply in the health care facility. The finding of this study supported significantly previous study concerning color and emotion. This finding can be used as referential basis to applying color for health care interior facility purpose (therapeutic environments). Future study might be continued by applying three-dimensional stimuli (i.e., wall, panel, furniture, etc.) and involve real health care patients.

Acknowledgment

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