

Significance of Colour on Room Character: Study on Dominantly Reddish and Greenish Colours in North- and South-Facing Rooms

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Room character attributable to colour appearance and spatial evaluation in different compass orientations has been studied. Rooms of the same colour, but observed in light from different compass directions will appear differently, in particular their identity colours will differ. A study was carried out in Sweden in two identical rooms, north- and south-facing. Seventy-two subjects evaluated and compared the experimental rooms. The inherent colours were six pinkish and five greenish colours, all except one in two nuances, plus one yellowish and one bluish colour, in total 13 colours. Description of room character was aided by semantic scales. Data were statistically processed using the Statistical Package for the Social Sciences (SPSS) program to analyse connections between spatial evaluation, inherent colour and compass orientation. The NCS colour vocabulary was also used. Finally, verbal descriptions using the subjects own words were used as a supplementary method to unfold nuances in response. The study showed that differences in hue and nuance affected evaluation of room character. Subjects reacted differently in pinkish and greenish rooms, describing distinct colour connotations. Differences in direction of illumination caused weakening or strengthening of associations linked to the colours by colour connotations.

1 Introduction

Identically coloured rooms illuminated by light from different compass directions will not appear the same in the Nordic countries. In clear weather a south-facing room is dominated by sunlight while a north-facing room is illuminated by skylight and reflected light. As sunlight and skylight differ in luminous intensity, light direction and spectral characteristics result in a major difference in light quality. Consequently colour appearance differs between rooms even when they have been painted in the same colour, with the same paint. Traditionally these different light qualities are referred to as 'warm light' and 'cold light'. How does this affect evaluation of room and colour? Investigations into the effect of daylight on colour and spatial evaluation have been lacking. In teaching colour design, it is important to consider emotional response to these situations and to map out impressions of colour appearance and colour design in different daylight qualities.

This study relates to research on environmental colour design, concerning the relationship between man, environment and colour. Our aim has been to understand connections between visual appearance and the significance of light and colour on room character. The main focus of the work has examined room characters as a function of direction of illumination. What happens when rooms of the same inherent colour gain different identity colours due to light from different compass orientations? Chiefly reddish and greenish colours have been used,

together with one yellowish and one bluish reference. We have evaluated space and room character. The questions to be answered are:

1. If room colouring affects evaluation of room character, and in what way?
2. If and in what way do different daylight qualities affect room character?

The main aim has been to investigate the connection between verbal expression and emotional impression of room colours due to different light qualities. A secondary aim has been to supply and test two new meaning variables: 'embracing' and 'elevating'. The study is named the 'red-green study', yet the reddish colours are referred to in terms of 'pinkish', since reddish colours in the nuances used are generally called pink.

2 Background

2.1 Different Approaches to Colour

Osgood *et al.* introduced a psychometric technique with semantic differentials used with factor analysis [1]. In this technique, subjects mark a representative value for evaluation with the help of variables or 'items' on a graded scale. The problem was to find appropriate items for the study in hand. They found that items could be grouped into 'factors' and showed that three mutually independent factors represented the basis of most descriptive words; these were value, activity and potency. Research concerning a subject's emotional reactions on colour, colour emotion, has a long history, especially among psychologists. Most studies on colour emotion have been made for single colours or two-colour combinations [2–6].

Küller developed a method for measuring and describing evaluation of built environment, the SMB method [7]. He found eight factors: affection, complexity, enclosedness, potency, pleasantness, unity, social status and originality. Küller himself particularly pointed out affection, complexity and enclosedness as important contributors to research on spatial evaluation. Hogg *et al.* worked with simulated interiors and found five factors for colour in spatial models: dynamism, spatial quality, emotional tone, complexity and evaluation [8]. Over the years, many researchers have looked at factors influencing colour emotion [9–17]. It was concluded that items can be classified under different factors in different areas of research, for example isolated colours, colour combinations, colour in spatial models and colour on exteriors. However, concerning interior spaces, the 'value factor' and a factor for activity and potency were still consistently featured in most collations of factors encountered.

2.2 Connection between Items and Factors

Many studies dealt with colour and temperature. Using colour samples it was found that a subject's reaction on colour is rooted in an experience of warm and cold colours [3,5]. Warmest are red, (red, orange and yellow) and coldest are blue and green, (blue and blue-green). In full-scale experiments it was found that colours do not cause an experience of a physical temperature, but can instead cause a cognitive experience with associations of warmth and coldness [8,11–13].

Küller searched for but found no simple connection between the 'pleasantness' factor concerning hue and nuance [11]. Greater differences were found between nuances within each hue than between different hues. Thus there was not a straightforward connection between

nuance and pleasantness, and individuals evaluated the pleasantness factor with great differences. It was found that light and whitish spaces contribute to a sense of openness, and influence the size and form of the object. They also found that red colours had a more activating effect on subjects.

2.3 Real Rooms with Complex Interactions

Billger has studied colour in real rooms in terms of the complex interactions between form, light and colour [18,19]. Her interest has been in colour appearance, colour change and colour description using complete rooms and artificial light. Billger emphasised the direct attention and conscious reflection of subjects when in rooms, finding it valuable to use subject's verbal descriptions on colour appearance.

Hårleman accomplished two full-scale studies on colour appearance in natural daylight. Both studies concerned north- and south-facing rooms, and involved yellowish/bluish [20–22] and reddish/greenish [23] colours in two nuances. Stahre *et al.* [24] compared two previous studies on associations and emotional response on colours: Hårleman's 2004 room study [23] and a study using colour patches [14]. It showed that the colour patches had to be much more colourful to give comparable associations.

2.4 Terminology

We used the NCS system and adopted its terminology [25]. Colour is thus defined as: colour percept, colour observation, colour perception; that which people see as colour and make it possible to make out objects and fields on the basis of colour differences. A hue in the NCS system is defined according to the relation to the four elementary colours: red, blue, green, yellow. Hue relation is shown through position in the colour circle. The colour triangle shows colour nuance, described as parts of blackness, whiteness and chromaticness. Chromaticness is the sum of a colour's chromatic qualities. 'Elementary attributes' are termed whiteness, blackness, yellowness, redness, blueness and greenness. Orange has thus two chromatic elementary attributes: yellow and red.

The term 'inherent colour' is used as a base point for measuring shifts in hue and nuance. Inherent colour refers to the colour a coloured object would have if observed in standardised observation conditions as denoted for NCS colour samples in agreement with their specifications, i.e. with their colour code. This entails colour samples being placed at a 45° angle, observed in a light cabinet with simulated daylight consisting of six Luma Colorette fluorescent lights at 5400 K [25,26]. Inherent colour is a constant characteristic independent of external circumstances, assuming requirements are adhered to. Inherent colour is compared to the identity colour that arises. The term 'identity colour', as developed by Billger, is a term which tallies with a holistic attitude and should thus be interpreted as the main impression of what is apprehended as a single-coloured surface in a room. The term 'experience' is used as an everyday term for mental and emotional excitation. Such experience can consist of feelings or emotional states, which arise in the experimental room. These experiences or emotional states may consist of memories, associations and metaphors. Room character here functions as an overriding term for evaluation of a room with light, colour, space, surfaces and other architectonic elements. Finally, colour connotation, as Sivik and Taft defined it, is words having meaning not primarily related to colour [6]. We use colour connotations for the idea or meaning suggested by or associated with a colour, a room colour or a colour word.

3 Study Design

3.1 Design Approach

The experimental period was June to September in Stockholm, where the sun rises between 0334 and 0634 hours and sets between 2205 and 1845. The intention with the study design was to create an environmental colour design in order to catch reactions to room and colour as subtle descriptions. The main focus during the sessions was to supply the subjects with a standard situation, in this case a calm and 'normal' (in contrast to experimental) situation, a pause for reflection permitting them to focus on room and colour. In total, 72 subjects made 118 observations. Sky conditions for each session were stated in a questionnaire. The methodology was designed for separate sequences, and to put subjects at ease in the experimental situation.

3.2 Subjects and Experimental Rooms

Subjects were architects and interior designers, plus students reading these subjects. This choice of professional category, with people interested in both colour and spaces, was made so as to obtain, as far as possible, informed and detailed descriptions¹. Each observer gave two complete descriptions of colour appearance, one in each room. These together took over one hour and during that time four further part-studies were made.

Two similar full-scale rooms were set up in a cabin positioned facing north–south. The cabin was placed in a slope, with vegetation in front of the room in sunlight and other houses with yellow plaster outside the room in skylight. Room measurements were 4.2 × 2.9 m. The inner surface of the walls consisted of plywood roller-painted with a new inherent colour for each test sequence. Floors were covered with beige-speckled lino, and ceilings were white-painted. Both rooms had similar short-end windows with white-painted frames and inner reveals. The natural daylight was transmitted from clear, double-glazed panes. The colour temperature in the rooms on a fairly cloudy day was approx 8000 K in the north-facing and approx 7000 K in the south-facing room (Figure 1).

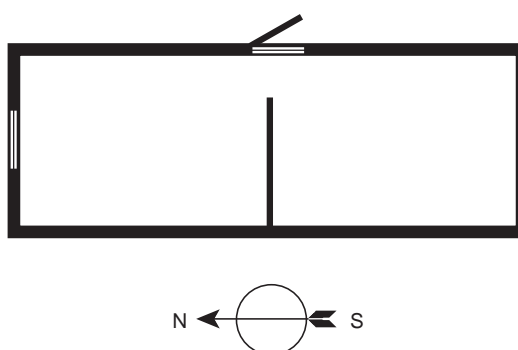


Figure 1 Experimental rooms (two similar full-scale rooms were set up in a cabin positioned facing north–south)

¹ The subjects were a rather homogeneous group and it was not intended to use observer's age and gender statistically. We started with a greater proportion of females and ended with a high proportion of students; otherwise no analysis according to age, gender or occupation was attempted.

3.3 Colour Selection

The colours chosen were three pinkish and three greenish hues in two nuances commonly used in architectural and interior colour designs. They were chosen to have perceptual equal distance². The nuances were whitish 1010 and more chromatic 1030. The hues were yellowish-pink (Y80R), pink (R), bluish-pink (R20B), bluish-green (B70G), green (G) and yellowish-green (G20Y). Due to unsuitable weather conditions for a lengthy period, the pale yellowish-green colour (1010-G20Y) was omitted. One yellowish and one bluish inherent colour that were used in a previous study were included [20–22]. These colours, reddish-yellow (1030-Y20R) and reddish-blue (1030-R80B), showed interesting patterns of hue shift, and could serve as reference points between the studies (Figure 2). The colours used are shown in Figure 3. CIELAB coordinates for the colours used are given in Table 1.

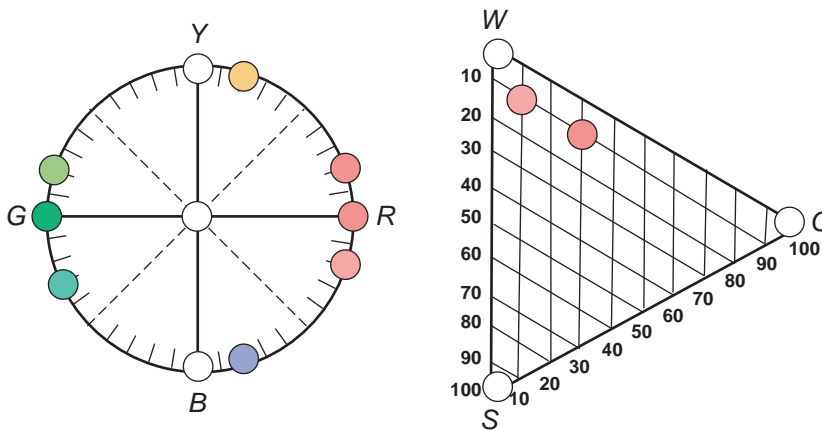


Figure 2 Selected colours, in hue and nuance: three hues in two nuances, in total six pinkish and five greenish colours



Figure 3 Colour display

² In the NCS colour system colours are arranged according to similarity with the elementary colours: white, black, yellow, red, blue and green. As a consequence, the NCS system does not define equal distance between elementary colours, and the colour circle has in fact less perceptual difference between colours in the blue-green quadrant than in the others. Consequently, we have chosen to adjust that situation by selecting one green inherent colour at a larger distance from the elementary green, 30 steps instead of 20.

Table 1 CIELAB coordinates for the used NCS colours*

NCS	<i>L</i>	<i>a</i>	<i>b</i>
S 1010-Y80R	84.67	6.72	7.44
S 1010-R	83.39	5.72	3.63
S 1010-R20B	84.33	6.24	0.04
S 1010-B70G	85.94	-6.66	0.28
S 1010-G	85.43	-7.37	3.73
S 1030-B70G	81.17	-20.85	-0.04
S 1030-G	79.94	-20.33	9.89
S 1030-G20Y	80.03	-17.57	17.65
S 1030-Y20R	82.50	9.29	34.42
S 1030-Y80R	74.83	21.74	16.21
S 1030-R	75.47	21.31	7.12
S 1030-R20B	75.80	18.92	-0.05
S 1030-R80B	77.25	-3.57	-17.91

* Illuminant D65, 10° observer

3.4 Empirical Methods

Room and colour were observed and evaluated with qualitative methods, such as semantic scales and verbal description. We have used four out of five factors developed by Hogg *et al.*: temperature, emotional tone, spatial quality, and dynamic factor [8]³. Established items for spatial experience were selected and grouped hypothetically under these factors. Two new variables for experience were added to the already established, embracing and elevating, associated with the emotional factor. The semantic scales were graded from zero to six, with six being the maximum, covering a value from 'not at all' to a value 'to a high degree', i.e. a type called Likert scales and not semantic differentials in the sense that they covered a scale from one position to its opposite. The use of Likert scales allows a better control and thus higher data quality; Table 2 show items in the original grouping.

Table 2 Selected items grouped in original factors

Temperature	Emotional	Spatial	Dynamic
Warm	Merry	Distinct	Elevating
Cold	Sombre	Open	Vivid
Sunny	Hard	Embracing	Tranquil
	Pleasant	Small	
	Formal		
	Dry		

³ The fifth factor, complexity, was not selected as it did not seem adequate in the unfurnished building shed.

A parallel method for verbal description was developed to catch the initial experience of room and colour. Subjects were encouraged to note down own thoughts and descriptive words. The given tasks were two-fold:

1. Describe your impression of the wall colour
2. Describe your impression of the room character.

The room description was the preferred option and the wall colour description was used as a complement. The subjects were instructed verbally to take their time for the process of experience and association. It was important that first impressions should not be by-passed and that evaluations and experience of the room were allowed to develop. Just as eyes must adapt to a light situation, so must experience as a whole have time to adapt in a certain spatial situation.

3.5 Procedure

The walls in two full-scale rooms were painted in the same inherent colour. Most sessions were separate but occasionally two subjects were present. After completion, the subject moved to the second room and the process was repeated. The subjects stayed in each room without any interruption, in order to adapt to prevailing light and experiment situation. Observation was thus confined to one room at a time. The adaptation to room light conditions as well as the session was made seated on a bench in a definite position with a good overview of the room. The experiment supervisor guided the subjects through the process and subsequent questionnaire, and instructed the subject to reflect on the impression that room had made. In the initial phase verbal description was performed, following by a period when more concentrated attention was required. Subjects noted their experience with a value for each item and 16 different items were used.

3.6 Methods of Analysis

Data were accumulated from studies in rooms illuminated from two different compass directions, and with six colour hues in two nuances. Data were processed statistically using the SPSS statistical program.

Factor analysis was applied to the whole data set, using data from all inherent colours. This method generated new variables for further analyses. Differences in evaluation between rooms in different colours and orientations were analysed by *t*-tests. In order to test the effect on evaluation by colour and orientation respectively an analysis of variance was carried out. To accentuate differences in factor loadings a Varimax Rotation was applied.

Verbal descriptions from the studies were made use of. The most frequently used expressions (at least five appearances) were put into three groups, one for each of the compass directions north and south respectively, and one group for expressions in common to both.

4 Study Results

4.1 New Variables for Room Character

The factor analysis was carried out for all observations, through all hues and nuances, using the principal components extraction method. Using Varimax Rotation, five new components with eigenvalues greater than 1 were constructed. The first three explained in all 54.6% of

the total variance, together with the remaining two they explained 67.7% of the total variance. The percentage under the name of the component shows the amount of variance explained by the component respectively. The grouping of new variables is presented in Table 3.

Following the factor analysis, four new variables were constructed to reduce data. The values of these four new variables were calculated as the mean of the included items [27]. Items with negative factor loadings were not included in the calculation: working as mirror images of their opposites they would have confounded the values of factor variables by levelling out the calculated mean values. Variables included have factor loadings over 0.4. New variables and characterisation based on included items are presented in Table 4.

The first two variables (elevating and harsh) in Table 4 describe two different attitudes towards the room, a positive and a negative. Temperature goes together with other emotional

Table 3 Factor matrix of room character (rotated component matrix)*

Items	Components				
	1 (31.3%)	2 (13.6%)	3 (9.7%)	4 (6.7%)	5 (6.4%)
Elevating	0.805	-0.274	-0.086	0.134	0.191
Merry	0.796	-0.302	0.113	-0.054	0.098
Vivid	0.728	-0.176	0.041	-0.342	0.367
Sunny	0.687	-0.083	0.043	0.163	-0.167
Pleasant	0.600	-0.333	-0.231	0.500	0.074
Warm	0.456	(-0.623)	0.174	0.128	-0.148
Sombre	(-0.693)	0.164	0.146	0.212	-0.093
Hard	-0.170	0.782	-0.052	-0.251	0.041
Cold	-0.286	0.741	-0.114	0.041	0.090
Formal	-0.196	0.607	-0.189	0.143	-0.201
Dry	-0.005	0.569	0.422	0.368	-0.118
Embracing	-0.095	-0.294	0.703	0.077	0.321
Small	0.215	-0.022	0.597	-0.230	-0.153
Open	0.389	0.115	(-0.664)	0.316	0.033
Tranquil	-0.055	-0.016	-0.198	0.821	-0.006
Distinct	0.165	0.045	0.004	0.007	0.881

* Extraction method: Principal component analysis
 Rotation method: Varimax with Kaiser normalisation

Table 4 New variables for room character

Elevating	Harsh	Embracing	Peaceful
Elevating	Hard	Embracing	Tranquil
Merry	Cold	Small	Pleasant
Vivid	Formal	Dry	
Sunny	Dry		
Pleasant			
Warm			

expressions: warm, sunny, merry, elevating compared with cold, harsh, formal and dry. The third variable describes an embracing spatial experience, maybe even tight or narrow. The fourth variable brings about a positive sense of peace, a mood, where the term pleasant is included as in the first variable.

4.2 Impact Caused by Colour or Orientation

The impact of hue and orientation on spatial experience was assessed by *t*-tests. Table 5 shows comparisons between categories according to orientation and colour. The comments on 'more' or 'less' show the directions of the differences. Test A concerns orientation only: all cases were compared, divided into north- and south-facing room categories. Test B concerns colour and orientation: all cases divided into pink and green categories are compared with the orientation categories. Test C concerns colour and orientation: all cases divided into smaller colour categories are compared with the orientation categories. Test D concerns only pinkish colours and orientation: a yellowish-pink and a bluish-pink category are compared with the orientation categories.

There were some significant differences in the perception of the rooms, but mostly the difference between different inherent colours overpowered the difference between the identity colours from the same inherent colour (tests B1 and C1). Using the whole data set there was an indication, but not statistically significant ($p < 0.10$), that the orientation facing north was less related to an elevating character. When the data set was grouped into sub-samples of colour

Table 5 Impact of colour or orientation

Categories compared	Details	Elevating	Harsh	Embracing	Peaceful	Distinct
A Orientation	All cases divided into 2 nuances: 104 north and 104 south studies	$p < 0.10$ (north less)	–	–	–	–
B1 Hues: pink and green	100 cases divided into 2 nuances: 54 pink and 46 green studies	–	$p < 0.01$ (pink less)	$p < 0.01$ (pink more)	–	$p < 0.05$ (pink more)
B2 Orientation in pink and green	100 cases divided into 50 north and 50 south studies	–	–	–	–	–
C1 Hues: yellowish-pink Y80R and bluish-green B70G	60 cases divided into 2 nuances: 30 Y80R and 30 B70G studies	–	–	$p < 0.05$ (yellowish-pink more)	–	–
C2 Orientation in Y80R and B70G	60 cases divided into 30 north and 30 south studies	$p < 0.01$ (north less)	–	–	–	–
D1 Hues: yellowish-pink Y80R and bluish-pink R20B	68 cases divided into 2 nuances: 30 Y80R and 38 R20B studies	–	–	–	–	–
D2 Orientation in Y80R and R20B	68 cases divided into 34 north and 34 south studies	–	–	–	–	–

in two nuances, this difference was significant for the group consisting of yellowish-pinks and bluish-greens⁴.

Pink rooms were evaluated as less 'harsh' and more 'embracing' than were green rooms. The 'embracing' character includes an allusion to a cramped condition, and this was more explicit in both pink and yellowish-pink rooms than in green and bluish-green rooms. Also the pink rooms were perceived as more distinct than the green ones. Comparison between the subgroup yellowish-pink and bluish-pink did not show any significant difference.

4.3 Effects Due to Hue and Orientation

A two-way analysis of variance was used to explain the effects of colour in relation to the effects of orientation, and their mutual interaction. The variables studied were the same as in the *t*-tests: elevating, harsh, embracing, peaceful and distinct. In Table 6 numbers in bold type signify significant connections; numbers in italic are partially significant. Table 7 presents the proportions of variance explained.

The analysis showed an explicit effect by differences in colour. Regarding pink and green hues, the main part of the variance explained stemmed from different hues. It means that differences between room evaluations are greater between red and green colours than between different orientations. Generally, the nuance 1030 did affect both positive and negative emotional items more than the lighter 1010 nuances.

4.4 Colour Connotations in Verbal Description

The subjects used a variety of expressions to describe room character and differences between them. Most obvious was that greenish and pinkish rooms evoked different colour connotations. Pinkish rooms caused associations of human skin, facial colour, strong emotional expressions such as affection and defiance and other mental characteristics, while greenish rooms caused associations of nature that could be either pure nature or artificial. Within these fields of associations subjects had all sorts of different perspectives.

Some subjects described the pinkish rooms as warm, gentle and stimulating but others experienced those rooms as pushy, demanding and glaring. Some experienced them as childish, young, fresh and funny while yet others described them as stale, tasteless, vulgar and slovenly. Pinkish rooms produced various images of skin (dressed or naked, of small children or adults), and views varied on whether they were sweet or trying, innocent or sinful.

Greenish colour connotations were of a completely different kind. Greenish rooms evoked connotations of nature, and relaxation. These rooms projected a shadow, an image of a landscape, or an unrestricted space. This in turn caused associations of calm, a retreat or shelter; elements like water and wind and objects and rooms like a pool or a bathroom were mentioned. Greenish rooms also caused associations related to health. Many subjects described them as clean and pure, and opinions differed as to whether the room could be described as living or plastic⁵. Adjectives frequently applied to in greenish rooms are calm, peaceful, light-hearted, confident, soothing and tranquil.

⁴ Using the whole dataset the inherent colours were contra productive and the smaller groups tended to be too small for statistics.

⁵ In Swedish: levande och plastig

Table 6 Explanation of variance in effect

Categories compared	Elevating			Harsh			Embracing			Peaceful			Distinct		
	H	O	I	H	O	I	H	O	I	H	O	I	H	O	I
1010 red (R) and green (G)	0.05	1.25	0.75	0.71	0.61	0.11	4.11	0.10	2.68	0.57	0.24	0.76	†	†	†
1030* red (R) and green(G)	2.96	0.06	1.79	8.05	2.84	3.48	3.35	1.87	0.07	0.01	0.25	0.15	5.64	0.27	2.41
1010, 1030 all R and G	0.72	0.42	0.07	5.61	0.00	0.18	7.39	1.13	2.24	0.39	0.48	0.63	3.21	0.43	1.72
1010, 1030* all Y80R and B79G	0.04	6.48	0.04	0.90	0.19	2.00	4.47	0.01	0.01	1.29	0.03	1.13	1.66	3.08	1.11
1010, 1030* all Y80R and R20B	0.34	2.18	3.73	0.16	0.00	0.75	4.07	0.56	1.95	0.15	1.32	0.02	4.46	0.84	0.84

* Studies in cloudy weather included
 † Studies excluded due to overcast and dark weather conditions
 H hue
 O orientation
 I interactions

Table 7 Explanation of proportions of variance (%)

Categories compared	Elevating			Harsh			Embracing			Peaceful			Distinct		
	H	O	I	H	O	I	H	O	I	H	O	I	H	O	I
1010 red (R) and green (G)	0.2	2.4	1.5	1.3	2.1	0.4	8.4	0.3	7.1	2.0	0.4	1.4	†	†	†
1030* red (R) and green (G)	9.8	0.2	4.9	25.0	4.4	5.4	10.0	5.4	0.2	0.0	1.3	0.8	18.0	0.6	5.2
1010, 1030 all R and G	1.2	0.5	0.1	6.7	0.0	0.3	8.9	1.5	3.0	0.5	0.7	0.9	5.9	0.4	1.8
1010, 1030* all Y80R and B79G	0.1	20.0	0.1	3.8	0.2	2.1	12.0	0.0	0.0	5.0	0.0	1.5	6.5	3.3	1.2
1010, 1030* all Y80R and R20B	1.6	3.8	6.5	0.9	0.0	0.9	16.0	0.9	3.1	0.6	4.0	0.1	16.0	1.8	1.8

* Studies in cloudy weather included
 † Studies excluded due to overcast and dark weather conditions
 H hue
 O orientation
 I interactions

4.5 Influence of Orientation on Verbal Descriptions

As subjects reacted to situations and different identity colours according to the direction of illumination, this showed as variations in character. Different physical qualities emphasised characters included in the colour connotation. In the strongly illuminated south-facing room, inherent colours with a yellowish content (G20Y, Y20R and Y80R) appeared with surprising chromatic intensity. Thus connotations linked to these colours were experienced and expressed in terms of stronger verbal nuances. In the pinkish rooms differences in visual impact made subjects experience variations in character as: sweetness/folly, pure/sophisticated, etc. Y20R and Y80R were considered as soft and fluffy in the south-facing room, while in the north-facing room, having less (or null) yellowish attribute, the room was considered as more bare and empty, more hard and cold in comparison. Elementary red (R) in the south-facing room appeared as yellowish-pink and was portrayed as childish, pure and innocent. In the north-facing room it was bluish-pink and represented impurity and sophistication.

As the greenish rooms evoked other associations, characters also varied. Nature and quiescence, slowness and tranquillity were common descriptions for rooms facing both compass directions, also clean and fresh. Elementary green (G) in the north-oriented room (BG identity colour) made subjects describe the room experience as uneasy to grasp, alive or plastic, disgusting or restful, pushy or relaxing. The south-oriented room of the same colour (G identity colour) provoked descriptions such as warm, calm, soothing and gloomy. In Figures 4, 5, and 6 perceived colours and verbal description of the rooms in both compass directions are arranged together to illustrate their mutual relationships.⁶

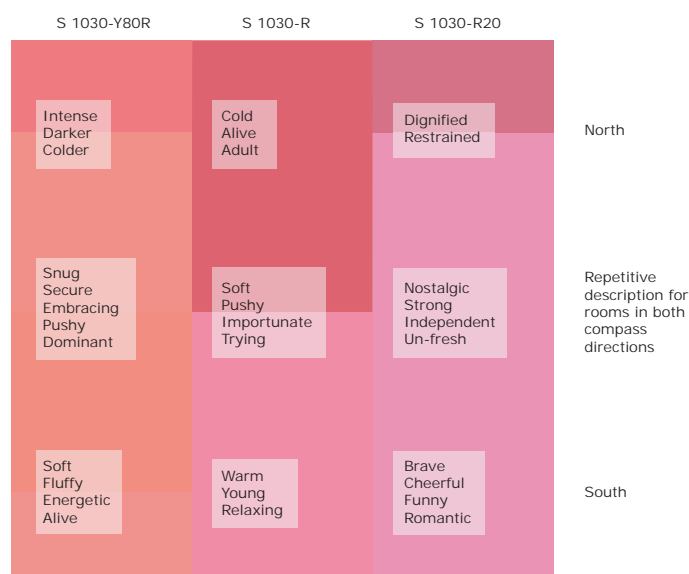


Figure 4 Frequent verbal descriptions of the pinkish rooms, showing different experiences of hue as influenced by the direction of illumination (descriptions in the middle section are in common to both)

⁶ Here, mean values are not used but observers' minimum and maximum notations have been chosen to provide a wider spectrum of perceived colour in north- and south-facing rooms. Figures showing mean values of perceived colour are presented separately [29].

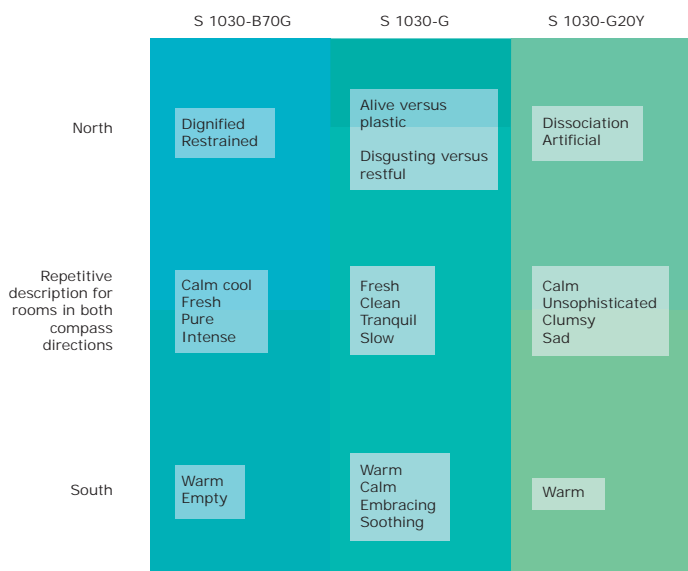


Figure 5 Frequent verbal descriptions of the greenish rooms, showing different experiences of hue as influenced by the direction of illumination (descriptions in the middle section are in common to both)

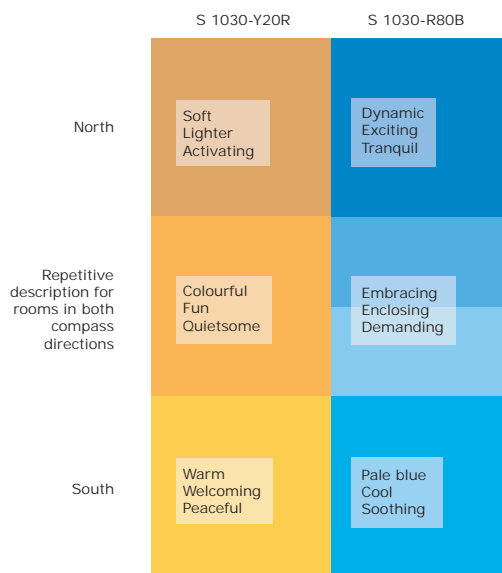


Figure 6 Frequent verbal descriptions of the yellowish and bluish rooms

5 Discussion

5.1 Compiled Analysis

Besides the overriding effect caused by differences in colour on room evaluation, some differences in orientation were statistically significant. It seems that colour connotations provide an instant starting point from where associations originated. For example, the elementary qualities of pink aroused certain expectations of evaluation content. Perhaps the colour did not suit the experimental room; it was described feminine, private and childish. Thereafter, the actual identity colour led to a second impression, for example the description of north-facing rooms as vivid was due to the intensely chromatic bluish-pink identity colours. In the act of recognising, accepting and experiencing room colour, colour connotations function as a basic idea against which specific colour impressions are compared. The general colour connotation seems to be calibrated in terms of associations with identity colour, as a

confirmation or a denial of the basic character. In this way an overall evaluation can be made through attaching descriptive words to a set context. It reflects cultural, traditional, sociological or subjective meanings, a colour connotation expressing (indirectly) a certain condition.

5.2 New Variables and Items

The SPSS methods provided clear result. However, without the supplementary information provided by the verbal descriptions, a full understanding of the complex relationships between orientation, hue, nuance and evaluation would not have been possible.

The original factors represented mutually exclusive categories: temperature, emotional tone, spatial quality and dynamism. None of these original factors remain and most of the items have changed places. The new variables represent four emotional variables with overlapping characters, and one separate variable concerning spatial quality. They are not comparable with the original factors as they emerge from different ways of analysing data. The 'elevating' variable was essential in describing room character; warm colours and the more chromatic nuances increase happy and pleasing emotional experiences. The 'distinct' variable correlated well with the observation of warm colours as proceeding while the cold ones seem to be receding. As the cold bluish and greenish walls seemed to withdraw they consequently made an indistinct impression.

5.3 Comparisons between Studies

Pink aroused strongest emotional reactions, regarding both positive and negative character. The conclusion of Hogg *et al.* that the warmth factor more often expresses an emotional tone than strict temperature is confirmed [8]. Sivik has also pointed out that pink, and in particular bluish-pink, is often described in negative terms such as ugly, disagreeable and unappetising [5]. We can see a clear relationship between these negative evaluations from pink colour samples and room character.

The new variable 'embracing', previously belonging to the emotional factor, was grouped together with the terms small and closed (not open). This tallies well with Küller's conclusion concerning the word-scales closed/airy and small/large, as being not fully correlated [11]. Rooms assessed as large could just as well be perceived as enclosed. Evidently 'embracing' is not only a spatial scale for emotional tone but also for a cramped sense.

However, trying to find connections between items and factors can be hazardous. Since many items often compose a factor, it is hard to find a perfect name that entirely encapsulates the true content. There is no standard procedure to help with the naming process and this makes it even more difficult to compare connections between colour emotion factors and colour attributes. A clearly positive evaluation in preference for warm colours did crystallise. This could be expected with subjects as a cross-section of the population but is an interesting result for architects and student architects. This unexpected tendency is worth noting as several researchers have presented evidence that the colour preferences of architects often differ from those of non-architects, the former often preferring stricter and cooler objects [8,28]. This might indicate a wider application of the results presented.

6 Conclusion

The methods used in this study have helped to explore people's experience of room and colour, resulting in three new variables that can be applied to the experience of room character: elevating, harsh and embracing.

The study present offers a new perspective for colour experience in rooms. We were able to undertake a great amount of systematic evaluation that could be arranged into a bigger pattern, thus making it easier to grasp connections between visual appearance and evaluation of colour.

Hue and nuance clearly rendered a common experience in colour connotations. Spatial evaluation was firmly bound to the identity colour. Pinkish and greenish colours caused almost opposing room characters. The difference between warm and cold colours was clearest.

Light from different compass directions resulted in variances in room character. As north- and south-facing rooms of the same inherent colour gain different identity colours, such rooms make different impacts and subjects react differently. The direction of illumination affected spatial character, by means of a strengthening or weakening of colour attribute. To some degree, the north-facing and south-facing aspects imposed their own spatial characters.

7 References

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