

Gender differences in perception of saliency and colour harmony

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ABSTRACT

An experiment was conducted with observers looking into a graphic arts viewing cabinet, under D50 illumination, to establish the influence of background on colour saliency and harmony. All pair-wise combinations of sixteen colours were judged with a small square in the foreground against a large background. Results showed that male observers were more inclined than the female observers to perceive foreground colours as salient. The colours blue, pink and purple (against all backgrounds) were perceived on average as less harmonious by female than by male observers, but the reverse was true for brown.

1. INTRODUCTION

Burchett said that “two or more colours seen together to produce a satisfying affective response are said to be in harmony”. He related colour harmony to eight characteristics: order, tone, configuration, area, interaction, association, similarity and attitude.¹ Colour harmony was usually, although not always, synonymous with meanings attached to the terms tone, order and configuration. This concept has gained recognition for the effect of background on colour appearance, notably in Sato’s ‘kansei database’ of sensory assessments² and Kobayashi’s Image Word Database³. Research by Ou and Chuang suggests that a larger CIELAB colour difference leads to higher levels of colour harmony.⁴ This agrees with theories of colour harmony based on complementary colour relationships.

2. METHOD

An experiment was conducted with observers looking into a Verivide graphic arts viewing cabinet, under D50 illumination, to establish the influence of background on colour saliency and harmony.⁵ The background was a large A0 coloured card, which filled the whole rear surface of the cabinet. Sixteen different background colours were selected, as plotted in Figure 1. A square piece of coloured card, of dimensions 5x5 cm, was placed as the foreground colour in the centre of the background, as shown in Figure 2. The same sixteen colours were used for the foregrounds. At the viewing distance of 75 cm, the foreground and background fields subtended approximate visual angles of 4 and 80 degrees (horizontal) respectively.

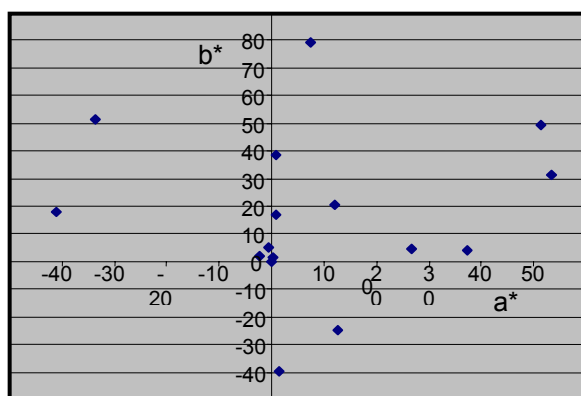


Figure 1: Sixteen test colours plotted in CIELAB space.

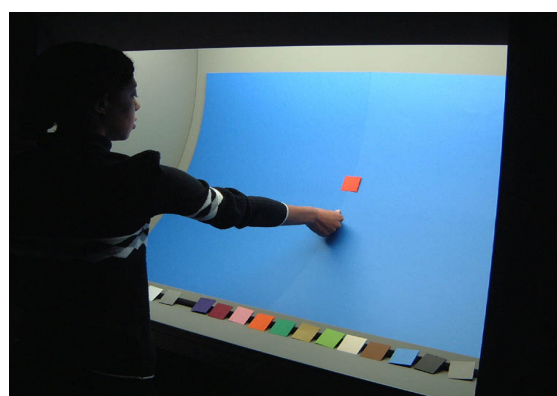


Figure 2: Experimental setup in viewing cabinet.

The sixteen selected colours incorporated Berlin and Kay’s eleven ‘basic’ perceptual categories of: white, black, red, green, yellow, blue, brown, purple, pink, orange, and grey.⁶ Cream was added to the experimental palette as a pastel, plus plum as a rich deep tone. Lime was added because of its high salience, for which it is widely used in supermarket packaging. Silver and gold had

an air of millennium sophistication, found in packaging of products intended to exude a degree of luxury. It was hoped that silver and gold would break the monotony of the 'basic' colours, and would refocus the observers' attention. Thus all the experimental colours used except for the neutrals and cream were high in chroma. This was in line with the recent research findings of Camgoz and Yener on the effects of hue, saturation and brightness on preference.⁷ Although such colour patches seemed appropriate in this experiment, however, their use carries limitations. Lee's investigation of the psychological meaning of colours with semantic ratings indicates that significant differences exist between colour chip/patch and object ratings for the same colour.⁸ In other words, what may be termed 'appealing' or 'pleasant' in colour patch form may not always appear as such when applied to the surface of an object.

Twelve observers participated in the experiment, comprising 7 males and 5 females with an average age of 33 years. All observers were screened for colour deficiency. For each foreground/background colour combination, each observer was asked to make two judgements: salient/neutral/non-salient; and harmonious/neutral/disharmonious. Salient was defined literally as '*jumping out*' to catch the eye in a prominent manner. Salient colours therefore meant those that were seen as advancing. Harmonious was defined as "Pleasant to look at – the blending in well together of foreground and background as a colour pair".

3. RESULTS

Results were interpreted based on the lightness, hue angle and chroma differences between foreground and background. Correlations were analysed by Pearson's product moment matrix. Because 5 female and 7 male observers took part in the experiment, averaged values for the two groups were used to establish whether significant differences existed between genders. The summated totals obtained for foreground and background colours were divided by 5 and 7 for female and male observers respectively, as shown in Tables 1 and 2.

The mean foreground saliency judged by the average male observer was 7.5, versus 4.8 for the mean female observer. Differences in ratings of foreground saliency are seen in all test colours, with male observers perceiving most foregrounds as relatively more salient than the female observers. This effect is clearly seen from Table 1 in the pastel foreground colours of cream (11:4), pink (11:3), and also grey, blue, orange, silver, white and yellow. Only two foreground colours were rated higher for saliency by female observers. Interestingly, they are the stereotypically 'masculine' colours of brown (0.9:3.2) and purple (2.6:3). On backgrounds promoting saliency, all mean observer ratings were considerably higher for male observers. Notable are lime (8.4:2.2), gold (9:3), orange (8.6:2.4), brown (7.9:3), also grey, plum, purple, silver and white.

Colour	Foreground mean saliency ratings		Background mean saliency ratings	
	Male	Female	Male	Female
Grey	1.6	-4.6	7.7	2.8
Black	7.3	6.2	10	8.2
Blue	11.3	8	6.9	5.6
Brown	0.9	3.2	7.9	3
Cream	11	4	6.4	4
Lime	11.6	10.8	8.4	2.2
Gold	3.4	2.6	9	3
Green	6.6	4.8	6.7	3.4
Orange	11.1	8.4	8.6	2.4
Pink	11	3	5.1	4
Plum	1.9	-0.6	7.6	3
Purple	2.6	3	8.4	3.2
Red	9.3	8.2	6.1	4.2
Silver	5.9	2.2	5.4	2.6
White	12.9	8.6	4.9	4.6
Yellow	12.3	8.4	7.6	4
Average	7.5	4.8	7.3	3.8

Table 1: Mean male and female ratings of saliency.

Colour	Foreground mean harmony ratings		Background mean harmony ratings	
	Male	Female	Male	Female
Grey	7.4	8	9.6	9.4
Black	7.7	5	8.3	5.6
Blue	6.3	0.6	4	0.8
Brown	-0.7	4	5	5.6
Cream	8.6	6.4	6.7	7.2
Lime	3.1	4.2	4.6	5.2
Gold	4.7	6	6	2
Green	1.7	-1.2	3.3	-0.6
Orange	3.1	2	4.1	2.8
Pink	7.7	1.6	3.4	2.4
Plum	3.4	5.8	6.1	1.6
Purple	6.7	1.4	6.6	3
Red	3.1	2.2	1.4	1.6
Silver	10.7	9	2.9	5.2
White	8.1	7.6	8.6	12.4
Yellow	8.1	6	9.4	4.4
Average	5.6	4.3	5.6	4.3

Table 2: Mean male and female ratings of harmony.

Analysis of mean male and female evaluations of foreground saliency indicated a moderate correlation of $r=0.79$, and the data were fitted reasonably well by a straight line as shown in Figure 3 (left). However, the correlation coefficient for background saliency between mean male and female results was low ($r=0.12$). A polynomial trend line was fitted, as shown in Figure 3 (right), but if one outlier point (black) had been excluded then the data would have been fitted rather well by a straight line of negative slope.

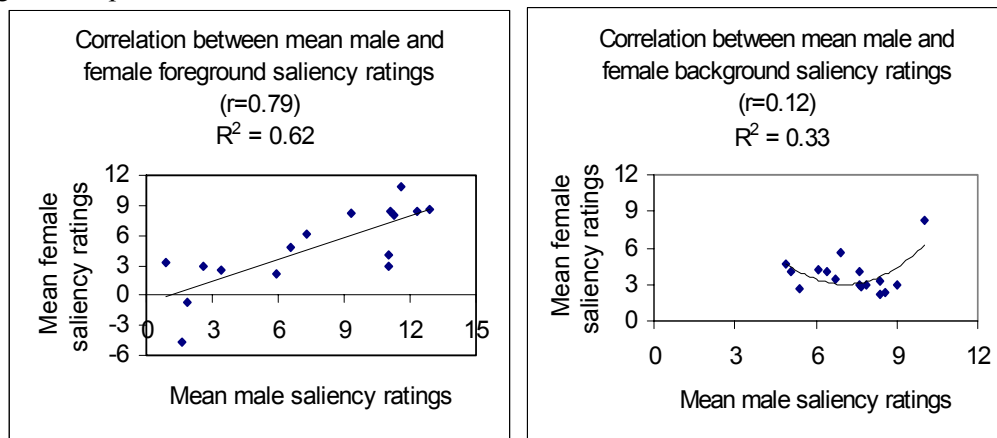


Figure 3: Mean male and female ratings of saliency for (left) foreground, and (right) background.

The mean colour harmony values of 5.6 and 4.3 for male and female observers respectively in Table 2 indicate that overall male observers perceived more foreground/background colour pairs as being harmonious relative to their female counterparts. Major differences were noted in the mean ratings of some foreground colours viewed against all backgrounds: blue (6.3:0.6), brown (-0.7:4.0), pink (7.7:1.6) and purple (6.7:1.4). This means that the colours blue, pink and purple (against all backgrounds) were perceived by the average female observer as being far less harmonious than by the average male observer, but the reverse for brown. The average female observer perceived the following background colours as contributing relatively little in promoting harmony: blue (4.0:0.8), gold (6.0:2.0), green (3.3:-0.6), plum (6.1:1.6), purple (6.6:3.0) and yellow (9.4:4.4). The reverse effect occurred for the white background (8.6:12.4).

Analysis of mean male and female evaluations for foreground and background harmony indicated a moderate degree of correlation, although the data was scattered. Correlation coefficients for mean male and female foreground and background harmony ratings were 0.51 and 0.64 respectively, as shown in Figure 4.

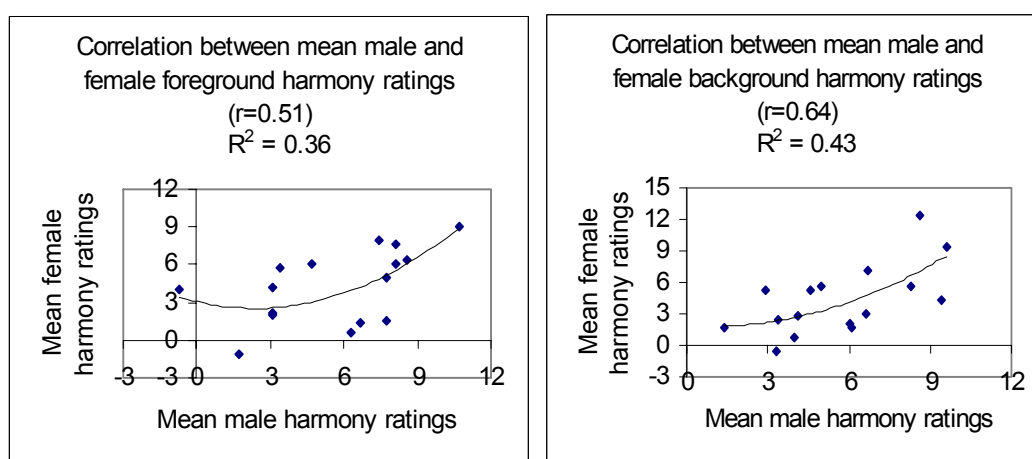


Figure 4: Mean male and female ratings of harmony for (left) foreground, and (right) background.

4. DISCUSSION

The foreground saliency rating of 7.5 made by the average male observer was higher than the 4.8 of the average female observer. Male observers perceived most foregrounds as being relatively more salient than females. This effect was most notable for cream, pink, grey, blue, orange, silver, white

and yellow foregrounds. Female observers gave higher average saliency ratings for brown and purple as foreground colours. The correlation of 0.79 between mean male and female evaluations of foreground saliency indicated a good degree of agreement. On backgrounds promoting saliency, however, all ratings were considerably higher for male observers for the background colours of lime, gold, orange, brown, grey, plum, purple, silver and white. Male and female observers were almost unanimous about black as a background, but for all the other colours there was a negative correlation between their results.

For colour harmony, the average male observer gave a higher rating of 5.6 compared to the average female value of 4.3. Major differences were noted in the ratings of some foreground colours viewed against all backgrounds, including blue, brown, pink and purple. This means that the colours blue, pink and purple (against all backgrounds) were perceived by the average female observer as being far less harmonious than by the average male observer, but the reverse was true for brown. The average female observer perceived blue, gold, green, plum, purple and yellow backgrounds as contributing relatively little in promoting harmony. Both male and female observers liked grey and (especially) white as backgrounds, and male observers also liked black and yellow. Moderate positive correlation was found between mean male and female evaluations for both foreground and background harmony.

5. CONCLUSIONS

In general, male observers produced higher average scores than females in their perception of foreground/background saliency and harmony ratings across a number of test colours. This could suggest that female observers are more particular when it comes to judging what appears to be salient and harmonious? With regards to saliency, it is clear that the male observers all shared something in common across the colours grey, orange, silver and white. These colours all attained higher average ratings in promoting both foreground and background saliency compared to female observer ratings. So does this imply that male and female observers perceive colour differently? Morton claims that gender plays a primary role in psychological and emotional reactions to colour.⁹ Women are said to be more sensitive to variations in hue than their male counterparts. Such statements tend to be subjective, however, and are affected by other variables including culture, age, personality and preference.

For further research, we suggest that a more representative choice of experimental test colours from CIELAB space be used, including those from the cyan quadrant. We also recommend that a larger number of observers be used to give results representative of the whole population. Gender differences in the perception of saliency and harmony could then be assessed in terms of age and cultural background.

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