The Influence of the Value Changes on the Perception of Costume Colour

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Abstract: The purpose of this study was to investigate the relationship between perceptual attributes of costume colour and the colour value changes. In this study, "gorgeous" and "plain" as words for description of human colour emotion were used, and costume picture samples and colour piece samples of same colours with 40 hues and 9 levels of values were evaluated on emotion variables by 32 subjects in the behavioural trials. The results showed that the colours of medium values have the most gorgeous emotion, and presented sensitivity to subjects during the evaluation of "gorgeousness", the RT (response time) of costume is less than the RT of colour pieces, it is easier to make judgment on colour emotion in costume, while the lower-value-colour and the higher-value-colour reduce the effect on "gorgeous" emotion.

Keywords: colour perceptual, colour emotion, reaction time, colour value, behavioral, costume

1. Introduction

As a principal factor of costume perception, colour plays an important role in people's psychological suggestion, emotional expression and image building, and it also can produce great influence on apparel design, production and sales. Colour may influence human perceptions or emotions, for example, some colours may make one happy, while other colours may make one depressed. These feelings, evoked by either colours or colour combinations, are called colour emotions. However, the relationship between colour and emotion is very complex, because colour emotion may be influenced by subjects' gender, as well as their cultural backgrounds. The value of colour is the lightness or darkness of colour, light colours are achieved by different amounts of white, and dark colours are achieved by the addition of black, so the different values can also induce dissimilar emotions among people. From the literature, some researches were conducted to categorize human emotions induced by colours and to find their relationship with colour perception, such as cross-cultural colour emotion, colour emotions for single colours and so on [1] [2], and the other studies on colour preference [3]. However, few studies involved the evaluation of costume colour on emotion, and if any, most were carried out through questionnaires. As a result, these studies can just obtain the result, but can't evaluate subjects' perceptual course of colours. In this paper, the psychology and behavioural testing software were

applied to evaluate the influence of colour value on the costume perception, especially to analyze the emotional changes evoked by different colour value and the process of perceptual judgment. This study has three main objectives as follows:

1. To explore the influence of different colour value on the perception of costume and evaluate the differences of colour piece and similar coloured costume in order to explore the characteristics of costume colour perception;
2. To explore the influence of different colour value on the time of judgment of costume perception;
3. To testify the perceptual differences of gender on the colour.

2. Method

2.1 Apparatus and Stimuli

The stimuli were presented on a Pentium desktop computer with a 17-in monitor set at a refresh rate of 85Hz in a dimmed room, the distance between participant and monitor was about 70cm, and the visual angle was 12.3°×4.9°, using E-Prime 2.0 (Psychology Software Tools, Inc.) [4]. Costume pictures with different colour value and two sensory words of 'gorgeous' and 'plain' were regarded as stimuli. Pictures were produced using the Photoshop procedure. Forty basic colours were selected evenly from the 360° colour wheel with the interval of 9°. Then, according

to the hue/saturation pattern, every basic colour was changed into 9 sub-colours with different values, in which the fifth colour was considered as the new basic colour. Finally, all these colours were presented in a costume and a rectangular piece whose area was similar to that of the costume are shown in Figure 1 and Figure 2. All the colours are based on the RGB colour mode. In this way, there were 720 images used as stimuli.

Figure 1 Samples of value changes for colour piece

Figure 2 Samples of value changes for costume

2.2 Participants

Thirty two undergraduate students from Soochow University (16 males, 16 females, and aged 20-23) participated in the experiment, whose majors in studies have nothing to do with clothing, and all of the participants were from urban areas, there were no participants from small towns or rural areas with diverse cultural backgrounds. All subjects had normal or corrected-to normal vision and were unaware of the purpose of the experiments.

2.3 Procedure Design

The experiment consisted of two blocks, one block was evaluating the colour piece and the other block was evaluating the costume colour. Each trial has only one sensory word and one colour image, and it began with the presentation of a fixation cross in the centre of the screen for 100ms. After 400ms interval, a sensory word "gorgeous" or "plain" was displayed for 300 ms on a uniform white background, and then followed a colour image which randomly appeared, after that, the participants must evaluate the emotion of the colour of image. The subjects pressed "Z" in keyboard if he thinks the colour emotion is in accordance with the sensory word, otherwise, he must press "/" in keyboard. These responses including RT (reaction time) were

collected via keyboard.Before the experiment, a block of 10 trial images was provided to get the participants acquainted with the manipulative method and the short display times. After that phase, an instruction page informing the participants that they are done with the first phase and that the second phase is about to begin. The stimuli and the procedure in Phase 2 were identical to those of Phase 1.

3. Results and Discussion
3.1 Value Changes Influence on the Perception

The influence of the value changes on the perception of piece colour and costume colour were analyzed, as shown in Figures 3 and 4. They presented a rule that emotion of "gorgeous" gradually weakened after enhancing according to value level changes from 1 to 9, the lower value colours and the higher value colours have weaker "gorgeous" emotions, but the medium value colours have stronger sense of "gorgeous", i.e, the colours of medium value have the most gorgeous emotion. Especially, the colour value level ranging from 5 to 6 have the strongest sense of gorgeous emotion because these two colours are most pure without adding white or black, directly selected from the colour wheel.
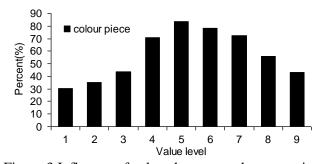

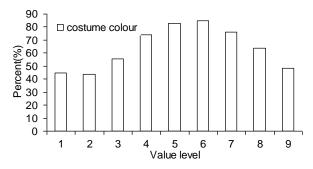Figure 3 Influence of value changes on the perception of colour piece

Figure 4 Influence of value changes on the perception of costume colour

3.2 The contrast of Perception Between Colour Piece and Costume Colour

As the value level increases, emotion of "gorgeous" of colour pieces and costume colours tend to be consistent. Figure 5 also shows that their gorgeousness is similar in level 5. Compared with colour piece, the same costume colour has the stronger sense. In lower value level, the differences are more obvious.
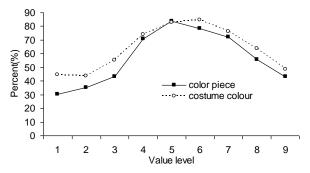

Figure 5 Comparison of perception between colour piece and costume colour

Figure 6 shows the perceptual behaviour to estimate gorgeousness, the figure shows that with the increase in value level the reaction time fluctuates. At the minimum value level, medium value level and maximum value level, participants were able to make rapid test cognitive judgments, in particular, considered to be the most gorgeous colour of levels 5, 6 and 7. It is very hard to test the colour in the sector of low value level to medium value level and medium value level to high value level, so there was longer time awareness. The figure also shows that it is easier to perceive the costume colours than the piece colours, because it takes a relatively shorter time to judge them [5].
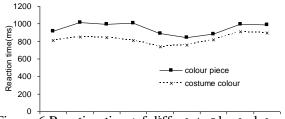

Figure 6 Reaction time of different value colours in colour piece and costume colour

3.3 The Gender Contrast of Perception to Colour

Figures 7 and 8 show that the differences between male and female to test the colour pieces and costume colours are not obvious. In low value level, female

considered the colour pieces are more gorgeous. In the lowest value, female thought that the gorgeousness of costume colour is most significant.
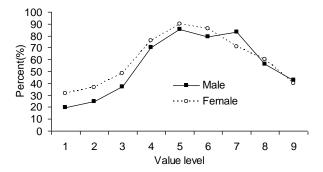

Figure 7 The gorgeous sense of male and female in colour piece
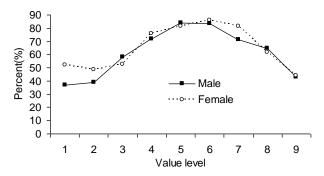

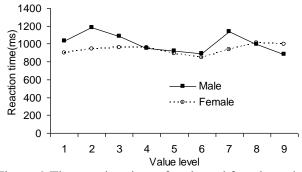Figure 8 The gorgeous sense of male and female in costume colours

Figure 9 The reaction time of male and female to the gorgeous sense of colour piece
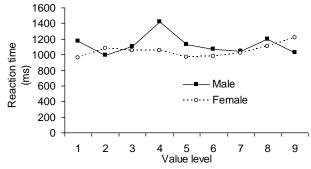

Figure 10 The reaction time of male and female to the gorgeous sense of costume colour

Figures 9 and 10 show the different reaction times between male and female to test the gorgeous sense of colour piece and costume colour. Males found it more difficult to tell the gorgeous sense than female between low value level and medium value level or between medium value level and high value level. In low value level, the reaction time of male to test both colour piece and costume colour was longer than that of female. But in the highest value, the reaction time of female was longer than that of male [6].

3.4 Establishment of Fitting Model

From Figure 3 and 4, it can be seen that there are obvious curve correlation between the colour in colour piece, costume and the "gorgeous". SPSS was applied to model the curve equation according to the data in Figs. 2 and 3 respectively. It can be seen from Figures 11 and 12, the value as abscissa (x), and the "gorgeous" (the ratio of the percentage of gorgeous /100) as vertical coordinate(y). The green line represents the measured data and the red one represents the data of the cubic. The results show that the cubic significantly anatomized with the curve of the two measured data. And then these two equations of the cubic model were drawn out.

The regression relation can be seen in the Figure 11 and 12 respectively. And the correspondent regression equations are as follows:

$$Y_1 = 0.162717 + 0.076999x + 0.025069x^2 - 0.00343x^3 \quad (1)$$
$$Y_2 = 0.376634 + 0.002419x + 0.0348x^2 - 0.003793x^3 \quad (2)$$

Compare the data of cubic model with the original data (Tables 1 and 2). These two data were statistically analyzed respectively, using paired-samples t-test. The test values of two data were both seen: T=0, sig=1.00>0.05. which implies, there are no significant difference between the data of cubic model and the original data in significant level 0.05.
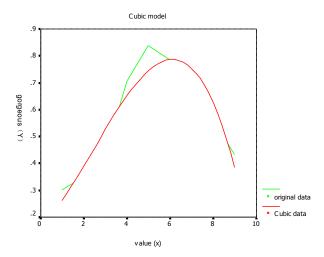

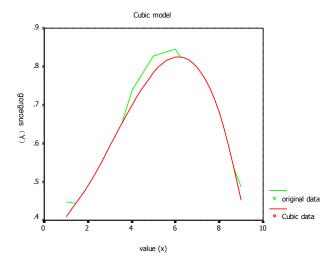Figure 11 Regression curve of colour piece

Figure 12 Regression curve of costume colour

Table 1 Comparison between the cubic model data and the original data for colour pieces

Colour piece	Original data	Cubic data
1	0. 3028	0. 26135
2	0. 3502	0. 38955
3	0. 4343	0. 52672
4	0. 7062	0. 65228
5	0. 8376	0. 74565
6	0. 7838	0. 78625
7	0. 722	0. 7535
8	0. 5581	0. 62681
9	0. 4327	0. 3856

Table 2 Comparison between the cubic model data and the original data for costume colour

Costume colour	Original data	Cubic data
1	0.4468	0.41006
2	0.4379	0.49032
3	0.5544	0.59467
4	0.7393	0.70034
5	0.8274	0.78456
6	0.8464	0.82459
7	0.7618	0.79766
8	0.6358	0.68101
9	0.4853	0.45189

4. Conclusion

In the relationship between brightness's change and gorgeous sense in this paper, the colours of medium value levels have the most gorgeous sense. However, the colours of lower and higher value levels have the least gorgeous sense. The costume colours have higher gorgeous sense than their single colour counterparts. When evaluating the gorgeous sense, the reaction to medium value level is the fastest, and the mean time is less than 800ms for costume colour. The reaction to lower and higher value level is the slowest, that the mean time is more than 1000ms for colour piece.

Men and women's cognition of colour were compared. The tendency of cognition is generally the same. However, compared with the males, the females felt that the colours of both colour piece and costume with lower value level were more gorgeous. As a whole, the females are more sensitive to the colour, and their colour evaluation is quicker. The males were more hesitant while evaluating the gorgeous sense.

The attributes of value play a great role in perceiving colours. For some costumes, the attraction can be enhanced through changed colour value and contrast. The conclusion of this study can be used in garment industry such as design and can help people to select satisfied colour for their clothing. To express the sense of gorgeousness, the costume colour should be of medium value without any addition of black or white. On the contrary, for the costume of plain style, the use of colours at lower or higher levels of value will be a good choice.

Since the colour samples in this study are generated by the computer, the results are more suitable for the application of costume colours based on the principles of optics, e.g. the computer aided costume design, the LED costume display, etc.

References:

[1] Gao XP, Xin JH. Investigation of human's emotional responses on colours. colour research and application 2006; 31(5): 411-417.
[2] Xin JH, Cheng KM., Taylor G, Sato T, Hansuebsai A. Cross-Regional Comparison of Colour Emotions Part I: Quantitative Analysis. colour research and application 2004; 29(6): 451-457.
[3] Derefeldt G, Swartling T, Berggrund U, Bodrogi P. Cognitive Colour. Colour research and application 2004; 29(1): 7-19.
[4] Holmes A, Franklin A, Clifford A, Davies I. Neurophysiological evidence for categorical perception of colour. Brain and Cognition 2009; 69: 426-434.
[5] Simmons WK. A common neural substrate for perceiving and knowing about colour. Neuropsychologia 2007; 45: 2802-2810.
[6] Johnson A, Jepma M, Jong Rd. Colours sometimes count: Awareness and bidirectionality in grapheme–colour synaesthesia. The Quarterly Journal of Experimental Psychology 2007; 60(10): 1406-1422.