

Iranians' Color Emotional Dimensions

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Abstract—The purpose of the current work is to examine the universality of the color emotion dimensions for single-colors. Different scales in color emotion are investigated for single colors in CIELAB color space within a psychophysical experiment. The current work, in which ten word pairs were applied, is a development of the Ou's study among Iranian observers. The applied word pairs are "Warm-Cool", "Active-Passive", "Like-Dislike", "Clean-Dirty", "Fresh-Stale", "Modern-Classical", "Heavy-Light", "Hard-Soft", "Tense-Relaxed" and "Masculine-Feminine", which are translated into Persian, accordingly. The psychophysical experiment is carried out by forty Iranian university students. All of the observations are divided into two groups of "male" and "female" as well as two cultural groups in Iran and the effect of gender and culture are investigated.

Data are analyzed using the method of factor analysis (FA). Three factors are extracted, accounting for 91.8 % of the total variance among Iranian. Color emotional dimensions of Iranians are divided into three categories, namely, Color Activity, Color Weight and Color Heat. These three color emotional dimensions agree well with the ones in the Ou's models. Results show that there is no significant effect of gender and culture on Iranian color emotional responses. The results of the present research are compared to the results in the Ou's research, and it is shown that the correlation coefficients values between color emotion scales are equal or more than the ones obtained in the Ou's research. Also, the relationship between the color emotional responses of Iranian, British and Chinese, reported by Ou [5], are obtained using correlation coefficients (r). Apart from "Like-Dislike" and "Tense-Relaxed" color emotion scales, there is a good agreement between different emotional responses of Iranian, British and Chinese observers.

Key words: Color emotion, single color, British, Chinese, Iranian

I. INTRODUCTION

This paper is the extended work of the previous research done by the authors [1] and is based on the development of Ou's study to Iranian observers [2-5]. Color is seen everywhere in our daily life. It appears in natural objects such as plants, sky and animals and in the industrial products such as food, textile and car. Color is considered to be one the major significant and important visual element in each early vision [6-8]. The language of color has even considered as a tool to describe people's emotions. The study of color emotion has been recently investigated by many scientists, psychologists, artists and

designers [2, 9-12].

As emphasized earlier, the current study is a development of Ou's study [5] among Iranians for ten emotional word pairs which are "Warm-Cool", "Active-Passive", "Like-Dislike", "Clean-Dirty", "Fresh-Stale", "Modern-Classical", "Heavy-Light", "Hard-Soft", "Tense-Relaxed" and "Masculine-Feminine". All the word pairs can be divided into three primary factors, namely, "Evaluative", "Potency" and "Activity" regarding the literal meanings of words and on the basis of Osgood's study [13]. Table I shows the word pairs which were translated into Persian language, accordingly. The purpose of the current work is to extract the color emotional dimensions of Iranians and to compare those dimensions with the results obtained in the Ou's research [5] for British and Chinese color emotional scales.

TABLE I
EMOTIONAL WORD PAIRS USED IN THE EXPERIMENTS
(IN ENGLISH AND PERSIAN LANGUAGES)

English	Persian
Warm - Cool (WC)	گرم - سرد
Heavy - Light (HL)	سنگین - سبک
Hard - Soft (HS)	سخت - نرم
Fresh - Stale (FS)	تازه - کهنه
Clean - Dirty (CD)	تمیز - چرک
Modern - Classical (MC)	مدرن - سنتی
Active - Passive (AP)	فعال - غیرفعال
Tense - Relaxed (TR)	عصبی - آرام
Feminine - Masculine (FM)	زنانه - مردانه
Like - Dislike (LD)	دوست داشتن - دوست نداشتن

II. EXPERIMENTAL

A total of forty observers, seventeen males and twenty three females, who were Iranian students aged between 20 and 30 with normal color vision, according to the Ishihara color vision test, took part in the experiment. Since the psychophysical experiments were conducted in Isfahan, which is one of the metropolitan cities in Iran, all observations were divided into two groups of "from Isfahan, or Isfahani" and "not from Isfahan, or other Iranian". Nineteen "Isfahani" students and twenty one "other Iranian" students took part in the experiment. Twenty color stimuli which were selected from the NCS Color Atlas, suggested by Ou [5], with a reasonable range of hue, lightness, and chroma, were used in the experiment.

The stimuli generally provided a suitable scatter over CIELAB color space. The stimuli were measured in 3×3 cm² and contained one color, surrounded by black borders.

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TABLE II
OBSERVER ACCURACY VALUES (CORRECT DECISION) FOR THE 10 SINGLE-COLOR EMOTIONS IN THE PRESENT RESEARCH

	WC	HL	MC	CD	AP	HS	TR	FS	MF	LD	Mean
Female	0.75	0.80	0.68	0.80	0.64	0.78	0.76	0.75	0.67	0.71	0.73
Male	0.75	0.73	0.67	0.78	0.67	0.78	0.75	0.74	0.72	0.75	0.73
Isfahani	0.74	0.75	0.65	0.80	0.60	0.74	0.73	0.74	0.69	0.72	0.72
Other Iranians	0.74	0.79	0.65	0.79	0.65	0.79	0.77	0.76	0.69	0.74	0.74
Mean	0.74	0.78	0.65	0.79	0.64	0.76	0.75	0.75	0.68	0.73	0.73

TABLE III
THE CORRELATION (R) BETWEEN COLOR EMOTIONAL RESPONSES OF MALE AND FEMALE OBSERVERS IN THE PRESENT RESEARCH AND IN THE OU'S RESEARCH

	WC	HL	MC	CD	AP	HS	TR	FS	MF	LD	Mean
Present research	0.94	0.94	0.83	0.94	0.83	0.89	0.92	0.91	0.69	0.65	0.86
Ou's research [5]	0.94	0.85	0.68	0.82	0.77	0.67	0.62	0.94	0.74	0.68	0.77

TABLE IV
COMPARISON OF THE PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENT (R) BETWEEN ISFAHANI AND OTHER IRANIAN OBSERVERS IN THIS RESEARCH, AND THE ONES IN THE OU'S RESEARCH AMONG CHINESE AND BRITISH OBSERVERS

	WC	HL	MC	CD	AP	HS	TR	FS	MF	LD	Mean
Present research	0.91	0.95	0.94	0.96	0.80	0.89	0.94	0.88	0.86	0.81	0.89
Ou's research [5]	0.79	0.92	0.72	0.80	0.73	0.79	0.27	0.63	0.86	0.46	0.70

TABLE V
HIGH LOADINGS EMOTIONAL SCALES IN EACH COMPONENT IN THE PRESENT RESEARCH FOR ALL OBSERVERS AND THE OU'S ONE FOR CHINESE AND BRITISH OBSERVERS

	Component 1	Component 2	Component 3	Total Variance
Present research	Heavy-Light Hard-Soft Tense-Relaxed	Masculine-Feminine Active-Passive Modern-Classical Warm-Cool	Clean-Dirty Fresh-Stale Like-Dislike	91.8%
Ou's research in Chinese[5]	Modern-Classical Fresh-Stale Clean-Dirty Like-Dislike	Masculine-Feminine Hard-Soft Heavy-Light Tense -Relaxed	Warm-Cool Active-Passive	89.8%
Ou's research in British [5]	Modern-Classical Fresh-Stale Clean-Dirty Tense -Relaxed Active-Passive	Masculine-Feminine Hard-Soft Heavy-Light	Warm-Cool Like-Dislike	78.9%

The stimuli were randomly displayed on a mid-grey background and were viewed in a darkened room. A "LaCie324i" LCD computer display was used for the psychophysical experiment and a "Lacie Blue eye pro" ICC Profile Maker colorimeter and the related software were applied in order to characterize the display. The observers were asked to sit in front of the display with a viewing distance of about 50 cm and to select more appropriate word to describe the displayed color on the LCD monitor. A document containing a brief explanation of the translation of the word in Persian as seen in appendix 1 was given to the observers in order to clarify the meaning of the pair words.

III. RESULTS AND DISCUSSION

Categorical judgment technique was applied for all selections of the observers (raw data) and the z scores were calculated for all the ten color emotional word pairs. Correct decision (CD) which is a measure of agreement between observers decision on a set of stimuli was computed according to Equation 1.

$$CD = \frac{\sum_i c_i}{N} \quad (1)$$

where N is the number of color stimuli, c_i is the number of the observers who agree with "majority decision" of the group for the i^{th} color stimulus. The observers' color emotion responses are either 1 or 0, demonstrating, for example, (1) for "warm" or (0) for "cool". The majority decision is the mean value of these binary responses (1 or 0) for each color stimulus on each color emotional scale. For instance, in the "warm-cool" scale, if the majority decision is greater than 0.5, the majority of the observers agree that the color stimulus is affiliated with "warm" and if the majority decision is less than 0.5, the majority is associated with "cool".

As seen in Table II, the maximum average value of the correct decision is relevant to "Clear-Dirty" emotional response and is equal to 0.79. Although, the mean values of the observations within males and females are equal to 0.73, there is a little difference in "Heavy-Light" emotional scale. The mean values within Isfahani and other Iranians' groups differs 0.02 and the total mean value of the correct decisions between the observers are 0.73, which

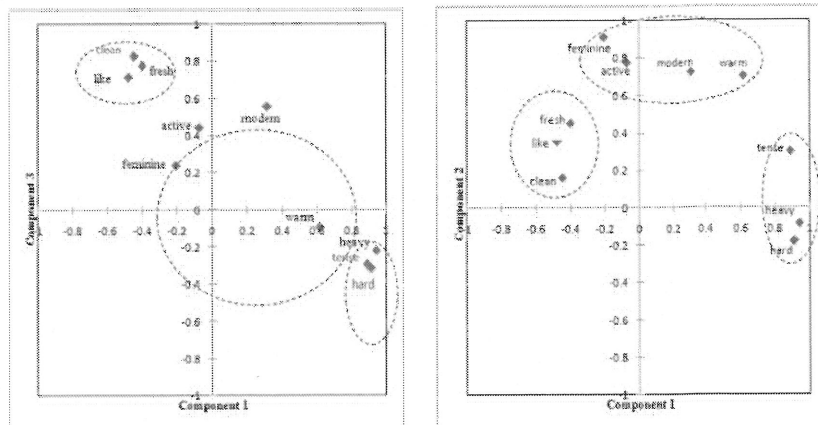


Fig. 1. Component plot for the ten emotional scales among Iranian observers.

TABLE VI
PRINCIPAL COMPONENT MATRIX FOR SINGLE-COLOR EMOTION, EXCLUDING THE SCALES "LIKE- DISLIKE", "TENSE-RELAXED" AND "WARM-COOL"
(THE TOTAL VARIANCE OF 87.76 %)

	Component I	Component II
Percentage of Variance	61.57%	26.19%
Active- Passive	0.88	-0.21
Fresh- Stale	0.69	-0.68
Clean-Dirty	0.45	-0.78
Modern-Classical	0.95	0.06
Hard-Soft	-0.12	0.96
Masculine-Feminine	0.95	0.06
Heavy-Light	0.02	0.97

TABLE VII
PREDICTION OF IRANIAN'S COLOR EMOTIONAL RESPONSES IN OU'S MODEL BY THE CALCULATION OF THE COEFFICIENT OF DETERMINATION VALUES (R^2)

	Ou's Data[5]	Present research
Color Activity	0.93	0.32
Color Weight	0.73	0.86
Color Heat	0.74	0.69

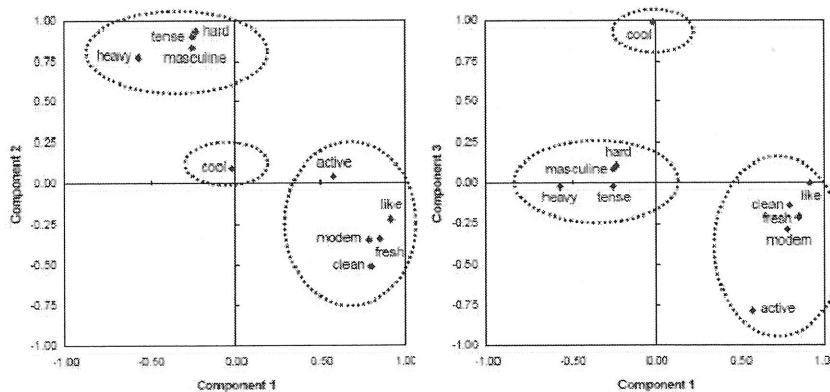


Fig. 2. Component plot for the ten emotional scales among Chinese observers in the Ou's research [5].

is an acceptable agreement among the observers.

The Pearson product-moment correlation coefficient (r) was applied to measure the effect of gender and culture on the observers' color emotional responses. Regarding the gender data analysis, Table III shows that most of the correlation coefficients were fairly high (more than 0.7). As the correlation coefficient of (+1) indicates the perfect positive correlation [2], there is no significant disparity between male and female responses; and thus, there is no

statistically significant effect of gender in all applied scales. As seen in the Table III, the least value is relevant to "Like – Dislike" emotional scale, which is equal to 0.65.

In comparison between different cultures among Iranian, there seems to be a good agreement between Isfahani and other Iranian, as all the correlation coefficients are more than 0.8 the observers' color emotional responses. As seen in Table IV, the correlation coefficients for "Tense-Relaxed" and "Like-Dislike" emotional scales among

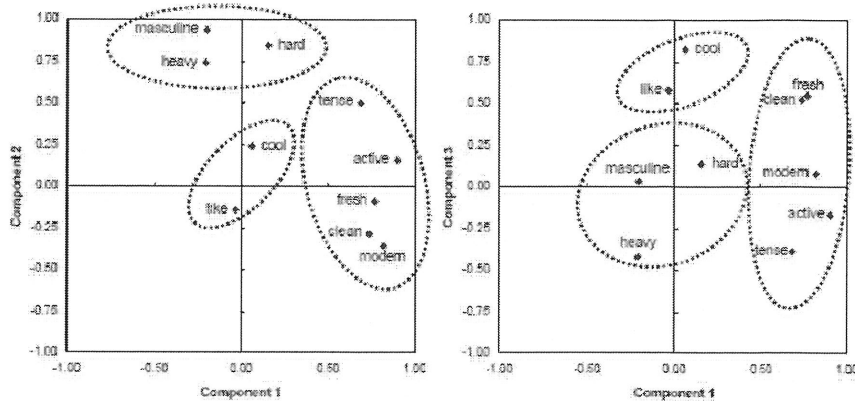


Fig. 3. Component plot for the ten emotional scales among British observers in the Ou's research [5].

Chinese and British observers in the Ou's research [5] are 0.27 and 0.46, respectively. In fact, in the both aforementioned emotional scale, the effect of culture are noticeable in the results.

Furthermore, the values of correlation coefficients in this research are equal or more than the ones in the Ou's research, which were carried out among British and Chinese observers for all applied word pairs. This result show that there is almost no significant difference between two Iranian cultural groups selected in the present research.

To further investigate the effect of culture on color emotion, the data were analyzed using the method of factor analysis (FA). Due to obtaining a good agreement between different cultural groups in Iran within their emotional responses, FA method was applied for all Iranian and the results was compared to the Ou's ones. Three factors were extracted, accounting for 91.8 % of the total variance among Iranian. Table V classifies all word pairs within three components and shows that the principle components among Iranian, Chinese and British observers are different.

Principle structures of Iranians' color emotion are examined by plotting a three-dimensional component for the ten color emotion words "cool", "active", "like", "modern", "fresh", "clean", "hard", "masculine", "tense" and "heavy". It is notable to mention that there is no need to locate the opposite terms of the aforementioned words, as two words in a pair are located diagonally opposite to each other in the plot. In comparison among the principle structures of Iranians' color emotional responses (Figure 1), the ones of Chinese (Figure 2) and British (Figure 3) [5], apart from "Like" and "Tense" terms, all color emotional words are located at similar positions in the plots.

According to the Figure 1, Iranian like "clean" or "fresh" colors because the word of "like" is located near these words in the desired figure. Regarding the Ou's research [2, 5], British prefers "cool" colors and Chinese prefers "clean", "fresh", or "modern" colors. The figure also indicates that "heavy" or "hard" colors may tense Iranian, but according to the Ou's research [2, 5], Chinese feel tense by "heavy", "hard", or "masculine" colors, however, "active" colors make British to be tensed.

The results of the present research and the Ou's one indicate that there seems to be a worldwide structure which can be a multi-dimensional color space [2]. As the authors were looking for some universal dimensions for color emotion, "Like-Dislike" and "Tense-Relaxed" color emotional scales were extracted from the considered terms, because these terms found to be different within different cultures. "Warm-Cool" scale is also the only term which was independent and can be considered as one of the dimensions for the color emotion space. There was found by Ou that the "Warm-Cool" scale is the most important factor in a single-color emotion. The other two dimensions are found on the basis of the FA method. Table VI shows the principal factors matrix for single-color emotion, excluding the scales "like-dislike", "tense-relaxed" and "warm-cool". The two components account for 87.8% of the total variance.

Finally, the three axes of the color space are determined:

Dimension 1: color activity, consisting of "active-passive", "fresh-stale", "clean-dirty" and "modern-classical".

Dimension 2: color weight, involving "hard-soft", "masculine-feminine" and "heavy-light".

Dimension 3: color heat, is defined by "warm-cool".

The aforementioned dimensions for color emotion agree well with Kobayashi's three color image scales, namely, "Clear-Greyish", "Soft-Hard" and "Warm-Cool" [14-15], and also agree with Sato's three color emotion categories, namely, "Activity", "Potency" and "Warm-Cool" [2]. It is notable to mention that there may be more color emotional dimensions than these three ones. In fact, these three dimensions selected among a wide ranges of color emotional dimensions.

To examine if the Ou's model can predict Iranian color emotional responses, the R^2 coefficient of determination values was calculated and the results are depicted in Table VII. As shown in this table, the Ou's model can predict the Iranians' color emotional responses within the two dimensions of "Color Weight" and "Color Heat". However, it cannot be a good predictor for Iranian's emotional responses in "Color Activity" dimension.

IV. CONCLUSIONS

Ten emotional word pairs of "Warm-Cool", "Active-Passive", "Like-Dislike", "Clean-Dirty", "Fresh-Stale", "Modern-Classical", "Heavy-Light", "Hard-Soft", "Tense-Relaxed" and "Masculine-Feminine" were examined among Iranian students. The effect of culture and gender were assayed. The results showed consistent emotional responses among Iranian students. There was no significant disparity between male and female responses; and thus, there was no statistically significant effect of gender in all applied scales. In comparison between different Iranian cultures, there seemed to be a good agreement between Isfahani and other Iranian observers. Apart from "Like-Dislike" and "Tense-Relaxed" color emotional scales, there is a good agreement between different emotional responses of Iranian, Chinese and British observers. Three axes of the Ou's color emotion space were probationed with the Iranians' responses. The Ou's color emotion models predicted color weight and color heat dimensions but cannot be a good predictor for "Color Activity" dimension.

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Appendix

A brief explanation of the translation of the words in Persian

- گرم - سرد
گرم: داغ نیست، یک گرمای مناسب دارد.
سرد: کمی سرد، دمایی پایین دارد.
سنگین - سبک
سنگین: وزن آن زیاد است، جابجا کردن آن نیاز به تلاش دارد.
سبک: سنگین نیست، دارای وزن کمی است.
دوست داشتن - دوست نداشتن
دوست داشتن: از آن لذت می برید و آن را می پسندید.
دوست نداشتن: احساس ناخوشایندی ایجاد می کند و آن را نمی پسندید.
فعال - غیرفعال
فعال: برون گرا، آماده اجرای کار یا هرفعالیت مشخصی است.
غیرفعال: درون گرا، اراده ای برای تغییر موقعیت (یا اجرای فعالیتی) ندارد. به دیگران اجازه می دهد که آن را کنترل نمایند.
مدرن - سنتی
مدرن: طراحی و ساخت آن با استفاده از روش ها و ایده های جدید انجام می شود.
سنتی: ظاهر قدیمی دارد و پایه آن در سال های گذشته ایجاد شده است.
جفت واژه های مرحله دوم
تمیز - چرک
تمیز: کثیف نیست.
چرک: آغشته به آلودگی است.
سخت - نرم
سخت: محکم است و به راحتی بریده، شکسته و یا مخلوط نمی شود.
نرم: سخت نیست، در اثر فشار شکل آن تغییر می کند (در موقع لمس و تماس، لطیف و ملایم به نظر می رسد).
عصبی - آرام
عصبی: احساس تنش، دلواپسی و ناآرامی ایجاد می کند.
آرام: حس آرامش و عدم نگرانی را ایجاد می کند.
تازه - کهنه
تازه: جدید و هیجان انگیز است و علاقه مندی ایجاد می کند.
کهنه: جدید و تازه نیست، مدت هاست که وجود دارد.
مردانه - زنانه
مردانه: برای مردها مناسب است.
زنانه: برای زن ها مناسب است.