

# A Study of Attributes of Affective Quality Affecting Judgment of Beauty for Simple Graphic User Interfaces

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**Abstract.** This article argues that aesthetic preference judgment might not depend on aesthetic prototypes, but on object's affective qualities. That is, when an object is presented, one perceives not only its feature organization, but also the perceived affective quality where it presents in some specific situations. Therefore, this study tries to find out the attributes of affective qualities which would be factors influencing user aesthetic preferences for system interfaces. Item analysis, Factor analysis and Regression analysis, were conducted to find the typical attributes of affective quality which could significantly explain the variances of aesthetic preferences. The results showed that six adjective terms of affective quality can be used to predict beauty: "Delicate", "Unique", "Robust", "Tight", "Fierce", "Mysterious", "Assertive" and "Traditional". The outcomes indicate that a delicate appearance of interactive skins is most important to design an aesthetic skin. The skin with the feelings of "Assertive", and "Robust" are well received. However, designers have to avoid design a skin with a tight feeling.

**Keywords:** Affective quality · Aesthetic preferences · Simple skins

## 1 Introduction

### 1.1 Factors Affecting Aesthetic Preferences

Aesthetics, which refers to "beauty" in this study, pertains to a sense of what is beautiful and visually pleasing. Previous studies tried to find out factors which influenced human judgment of beauty. However, physical features, aesthetic prototypes and the arousal theory do not properly explain the factors that influence audience aesthetic preferences. An interface does not only include one attribute; on the contrary, it includes many attributes with varied levels. Huang et al. classified interface attributes into six categories [1]. They are "Form elements", "Form organization", "Interactive features", "Stylistic quality", "Feeling quality", and "Emotional quality" from low to high construct. The previous discussion of physical features, aesthetic prototypes and the arousal theory on aesthetic preferences focuses on the influences of "Form elements", "Form organization", "Interactive features", "Stylistic quality". However, when an object is presented, one perceives not only its form quality, but also the perceived affective quality even audiences do not know the content, or knowledge, of the object [2]. For example, one

admired the beauty of a sunset scene not because of the knowledge of the scene, but the scene itself elicited an affective quality, “glory”. Possibly jumping off the inherent frameworks of object configuration into knowledge of emotion involved might be a feasible way to find factors of aesthetic preferences. It is worth to explore if affective qualities of system interfaces would be factors influencing user aesthetic preferences.

Among these six levels of attributes, “affective quality” referred to object’s attributes to arousing human feelings which can be expressed with affective terms, such as cute, vivacious, hard, soft ... etc. Affective quality is a stimulus’ ability to cause a change in core affect which is a neurophysiological state [3]. One feels an object is cute because it just causes him a cute feeling without any reasons. “Emotional quality” referred to object’s attributes to arousing one’s emotional responses. This kind of attributes is to describe human emotional responses, such as, sad, happy, exciting ..., etc. The terms belonged to this attribute also includes affective adjectives which imply good or bad values, such as sad, scared, bored or excited. The terms belonged to this attribute could be arranged with two approaches: the discrete emotion approach, and the dimensional approach [4]. Compared with Norman’s [5] three levels of emotional responses, “Form elements”, “Form organization”, and “Stylistic quality” would arouse visceral emotional responses; “Interactive features” would arouse behavioral responses. In addition, affective quality is the feeling description of both visceral and behavioral responses evoked from the object. Emotion quality is a kind of mood description reflecting from objects in a reflective level. Both affective quality and emotional quality influence emotional responses in the reflective level.

## 1.2 Varied Rating Consistency for Different Attribute Levels

As rated to describe the same object, the terms in lower level of constructs, i.e., attributes, such as, “clean,” or “symmetrical” belonged to form elements, are rated more consistent than those in higher construct (ex. Cute in affective quality category). The judgment of a low level product attribute (e.g. colorful) was clear and predictable for all audiences; however, the judgment of a high level product attribute (e.g. cheerful) was varied from different audiences. Besides, a low level attribute of a product might induce a high level affect. For example, the objects with “order” (form organization) feeling might arouse audience’s feeling of legibility (interactive quality).

It was found that previous studies did not find the identical affective dimensions to predict aesthetic preferences after reviewing the articles related to affective dimensions. It is possibly that those studies mixed up all attributes in different levels and did not discriminate affective meanings from the other product attributes when searching for key affective dimensions. For example, Hsiao and Chen [6] extracted four fundamental dimensions in the affective responses: “trend factor”, “emotion factor”, “complexity factor” and the “potency factor” from 28 adjective pairs. However, the adjective pairs used in their study include Excited–calm, Elegant–not elegant, Avant garde–conservative, and Streamlined–rugged, belonged to the attributes of emotional quality, affective quality, stylistic quality and form elements, respectively. Besides, Lavie and Tractinsky [7] also found a two-dimensional structure for perceived aesthetics: classical and expressive aesthetics. The classical aesthetics refers to orderliness in design, including

descriptions such as “clean,” “pleasant,” “symmetrical” and “aesthetic”. The expressive aesthetics indicates designers’ creativity and originality, and can be described by “sophisticated,” “creative,” “uses special effects” and “fascinating.” “Clean,” “pleasant,” “symmetrical” are belonged to different attributes. Moreover, Kim and Moon [8] found that the emotion space is defined by seven dimensions including attractiveness, symmetry, sophistication, trustworthiness, awkwardness, elegance, and simplicity to evaluate immediate affective feelings about cyber-banking system interfaces. Obviously, their outcomes are not consistent because they mixed up all attributes in different levels. Therefore, this study will explore the affective dimensions only with the terms in affective quality, excluding the other levels of object attributes.

### 1.3 Effects of Affective Quality and Emotional Quality on Aesthetics

Huang et al. [9] explored both effects of affective quality and emotional quality on aesthetic preferences of complicate skins by using path analysis. He found that all the attributes in emotional quality did not well predict interactive skin aesthetics, but the attributes in affective quality could predict skin aesthetics well by judging R-squares of their regression models. He found seven key attributes of feeling quality selected into the aesthetic predicted model, Delicate, Hi-tech, Formal, Fierce, Unique, Tight and Robust. The outcomes implied that skin appearances with the feelings of “Hi-tech”, “Formal”, “Fierce”, “Unique” and “Robust” were well received. A delicate appearance of interactive skins was most important to design an aesthetic skin, but the skins with a tight feeling were the worst. He also explained why emotional quality did not influence subject aesthetic preferences. He argued that one’s emotional feelings evoking from an objects would be translated into affective quality he felt, in light of the reflective level of emotional responses. For example, a dreadful skin might be deemed as a fun skin because subjects perceive the “fun” meaning of the dreadful skin and enjoyed its fun. That is, subjects received a fun feeling which belonged to affective quality, but no more than emotional quality. Therefore, this paper would only focus on effects of affective quality on aesthetic judgment; the other levels of attributes are excluded based on Huang’s findings.

### 1.4 Complexity vs. Simplicity Skins

Osgood [10] found that the E-P-A structures of affective meanings might be not existed when the rated objects were not “noun”. It implies that the affective structures would be identical when the rated objects are the same whoever the subjects are. Therefore, affective structures of complex skins might not be the same as those of simple one if different levels of complexity of interactive skins could not be deemed as the same “concept”. Therefore, it is worth to explore if different levels of complexity of interactive skins share the same affective structures. Huang et al. [9] had used complex skins selected from Windows media player to explore the affective structures of complex skins. This study will only focus on the findings of affective structures of simple skins. Besides, both affective structures will be compared to explore if they have the same structures.

## 1.5 Purpose

To sum up, the main purpose of this paper is to find the typical attributes of affective quality which could significantly predict aesthetic preference of skins. Before that it is necessary to find out the affective structures of simple skins of interactive interfaces. Besides, this paper also tried to explore the similarity of both affective structures to describe simple and complex skins, respectively.

## 2 Methods

Item analysis was performed to selection adjective terms which could be used to describe objects' attributes of affective quality firstly. Secondly, Factor analysis was used to find out affective structures from those adjective terms which could describe simple interactive skins. Finally, Regression analysis was conducted to find those affective structures could significantly predict aesthetic preferences of skins.

### 2.1 Item Analysis

Firstly, 628 feeling terms were written respectively on cards in Chinese and divided into five card groups. They were collected from resources including studies related to affective design in journals, catalogues, books and websites. Those adjectives not written in Chinese were translated into Traditional Chinese. Afterwards, five female teachers who have five year experiences at least in teaching Chinese in Junior High school arranged each one of card groups with kin diagram, respectively. Kin diagram refers to a diagram in which the terms with close conceptual affinity are put closely. Finally, those adjective terms were condensed into 296 adjective pairs.

Next, item analysis was used to discard the affective adjectives which cannot distinguish subject affects evoked from skins among 296 pairs. There are two steps to perform item analysis: semantic differential and screening with criteria.

*Semantic Differential.* Sixteen windows media player skins selected from Ms-office official website were rated with the 296 adjective pairs. Considering the reliability of subject ratings, the "independent" pair and "familiar" pair are replicated. Totally, 298 adjective pairs were used in the experiment. If the correlations between original pairs and replicated pairs are high, the reliability of subject ratings is high to accept the outcomes of the Semantic differential. Forty-six subjects rated the skins with a 7-point Likert scale. The test was programmed with Director 8.0 and performed on a 20" TFT LCD screen. There are 736 ( $46 \times 16$ ) rating scores, called Raters' opinions, for each adjective pair.

*Criteria Screening.* Six criteria were used to screen out the adjective pairs which cannot discriminate differences among skins according to the rating scores of semantic differential. First, the selection score of each adjective pair was added 1, respectively, when three criteria, Mean, Variance and skewness of each affective meaning are between 1 and  $-1$ , Variance  $> 0.1.5$ , or Skewness  $< 0.7$ , respectively. Next, Correlation of Internal

Consistency (CR) was performed. The 736 rating scores were arranged from low to high scores for each adjective pair, and divided into four groups. The group with the higher scores than other groups was called High Score Group (HSG); the group with the lower scores than other groups was called Low Score Group (LSG). The selection score of each adjective pair was added 1 when its rating scores of HSG significantly differed from those of LSG at a significant level, 0.01, which could discriminate Raters' opinions significantly. Besides, The selection score of each adjective pair was added 1 if their item-to-total-score correlations or factor loadings were larger than 0.3. Finally, the adjective pairs were selected if their selection scores were larger than 3. Consequently, 123 adjective pairs were remained. Furthermore, the previous five Chinese teachers were recruited again to pick up the adjective pairs belonged to the attributes of affective quality from the 123 adjective pairs. Finally, 75 adjective pairs were chosen.

2.2 Factor Analysis

Factor analysis was used in this experiment to condense the 75 pairs into typical attributes of affective quality. Twelve simple mobile phone skins with different color combinations were used as interactive skins shown in Fig. 1. There are named as simple skins because the icons in the skins are presented only with varied both figure and background colors as compared to the skins of Windows Media Player.

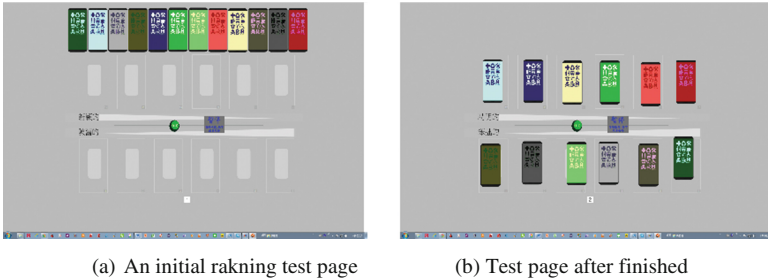


Fig. 1. Twelve simple mobile phone skins with different color combinations (Color figure online)

These twelve icons and color combinations were selected from the experimental material of Huang [11] who evaluated 3306 color combinations with their rating consistency and aesthetic preference. Huang [11] believed that the best color combinations do not only get high aesthetic preference scores, but also have high rating consistency among subjects. The twelve interfaces includes those that have high, middle and low preference rating consistence with high and middle aesthetic rating respectively in his study. For example, in Fig. 1 HH01 and HH02 have a higher aesthetic score and the highest rating consistency.

43 undergraduate students were recruited and asked to perform ranking tests which were programmed with Director 8.0 for all adjective pairs shown in Fig. 2. If feeling the skin is closer to the adjective on the bottom, subjects dragged it into the gray block closer to left on the bottom row. The skins can be moved in or out the blocks with time, or

frequency, limited. For reducing fatigue effect, subjects spent three days to complete the rankings. Each day only performed 25 ranking tests.



**Fig. 2.** The screens used in the experiment

The outcomes found that there were 8 factors which eigenvalue are larger than 1. They are “Delicate”, “Unique”, “Robust”, “Tight”, “Fierce”, “Mysterious”, “Assertive” and “Traditional”. The 8 factors can explain 63.81 % variance of the model. Huang et al. [9] found the 11 typical attributes of affect quality for complex skins: “delicate”, “unique”, “robust”, “Hi-tech”, “tight”, “saucy”, “fierce”, “mysterious”, “exaggerated”, “formal” and “pure”. Obviously, the number of attributes of affective quality for complex skins is more than that of simple skins. The outcome seems to suggest that complex skins could present more typical attributes than simple ones.

### 2.3 Regression Analysis

Regression analysis was to find out the typical affective meanings which could predict aesthetic preferences of simple skins. Like experiment 2, subjects performed ranking tasks programmed with Director 8.0. 12 simple skins in Fig. 2 were used again in this experiment; however, the adjective pairs as scales to rate simple skins were a “beauty-ugly” pair plus 8 typical attributes of affective quality from experiment 2.

43 undergraduate students performed ranking tasks which are the same as experiment 2 shown on computer screen. Believing that the feeling evoked from the skin is closer to the adjective on the top, subjects dragged the skin into the gray block closer to left on the top row. Likewise, if they believe their feelings evoked from the skin is closer to the adjective on the bottom, subjects dragged the skin into the block closer to left on the bottom row. The scores of the skins on the blocks from top left to top right are 12 to 7, respectively; from bottom left to bottom right are 1 to 6, respectively.

The scores of beautiful pair were regarded as the scores of aesthetic preferences of the skins. Moreover, aesthetic preference is as a dependent variable; the other adjective pairs are deemed as independent variables. Each model has an R-square to describe the variances of aesthetic preference explained by the terms in affective quality. The model with larger R-square than the other could be a better model to predict aesthetic preference.

### 3 Results and Discussions

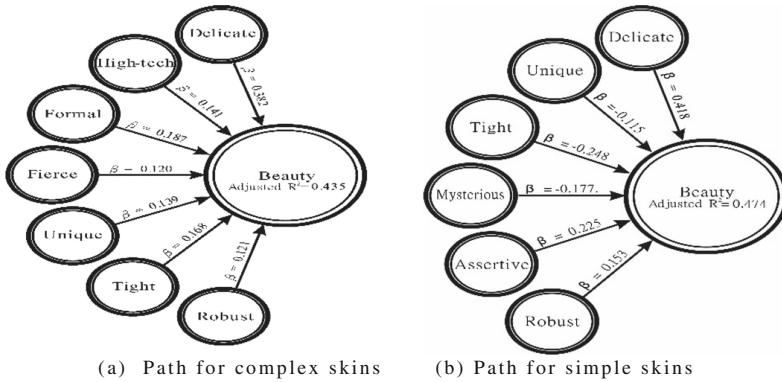
The Regression model shows that the six typical attributes of affective quality can significantly predict skin aesthetic preferences shown on Table 1. They are “Delicate”, “Unique”, “Robust”, “Tight”, “Fierce”, “Mysterious”, “Assertive” and “Traditional”. The adjusted R-square is 0.474. The Collinearity diagnoses also show that the tolerances of “Delicate” (0.860), “Unique” (0.775), “Tight” (0.673), “Mysterious” (0.805), “Assertive” (0.891), and “Robust” (0.766) are close to 1. It indicates that these attributes of affective quality do not depend linearly on each other. That is, the estimate of the regression model is more stability.

**Table 1.** Regression model of simple interfaces

Variables	Un-standardized		Standar- dized	t	Sig	Tolerance
	B-estimate	Standard error	Beta			
Constant	5.338	.565		9.446	.000	
Delicate	.418	.040	.418	10.457	.000	.860
Unique	−.115	.042	−.115	−2.736	.007	.775
Tight	−.248	.045	−.248	−5.492	.000	.673
Mysterious	−.177	.041	−.177	−4.280	.000	.805
Assertive	.225	.039	.225	5.727	.000	.891
Robust	.153	.042	.153	3.623	.000	.766
Fierce	−.077	.042	−.077	−1.826	.069	.772

Besides, “Delicate” ( $\beta$ -weight = 0.418) is the most important attributes of affective quality to influence aesthetic preference. The second important feeling term is “Assertive” ( $\beta$ -weight = 0.225). However, “Tight” has a negative  $\beta$ -weight (−0.248). The outcomes indicate that a delicate appearance of interactive skins is most important to design an aesthetic skin and that the skin appearances with the feelings of “Assertive”, and “Robust” are well received. However, designers have to avoid design a skin with a tight feeling.

Huang et al. [9] found the 7 typical attributes of affect quality for complex skins. This study finds 6 typical attributes of affect quality for simple skins. Both path diagrams of attributes predicting aesthetic references are shown in Fig. 3. Four attributes can significantly predict aesthetic preferences for both simple and complex skins: “delicate”, “unique”, “tight”, and “robust”. These evidences showed that the skins should present more intensity of delicate feelings, but not tight feelings for creating aesthetic appearances for both complex and simple skins.



**Fig. 3.** Both path diagrams of attributes predicting aesthetic references

The similarity of both Regression analysis models of aesthetic prediction for complex skins and simple skins were calculated as below:

$$\left[ \left( \frac{4}{7} \right) + \left( \frac{4}{6} \right) \right] \div 2 = 61.90 \%$$

The score of similarity (61.90 %) for both models is moderate. It indicates that the affective structures of both complex and simple skins are not entirely identical.

The outcomes show that the number of attributes for complex skins is more than for simple skins. The reason might be that subject's affective responses to both skins are different. For experiment tasks of complex skins, subjects had to operate the skins to play music before they rated the skins. However, for experiment tasks of simple skins, subjects only looked at the skins and judged their affective quality. In other words, the responses of subjects to complex skins involved two affective levels: visceral responses and behavioral responses in light of Norman's views of affective responses [5]. However, their responses to simplex skins only involved visceral affective responses. Therefore, the outcomes show that only four attributes of affective quality could affect aesthetic preferences for both complex skins and simple skins. This outcome seems to imply that factors affecting aesthetic preferences would be varied when affective responses are in different levels (i.e. visceral responses and behavioral responses). However, four attributes would commonly affect skin aesthetic preferences whether subjects' responses are in visceral or behavioral levels. These four attributes are "Delicate", "unique", "tight", and "robust". It suggests that these four attributes might have to be satisfied in skin design.

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