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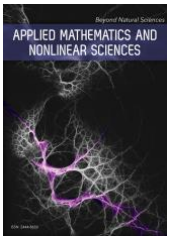

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Color Use and Psychological Feeling in Modern Interior Design - Based on Emotional Calculation Perspective

Jian Dong[1,†], Lan Qin[1], Shilong Han[1], Zhanpeng Wang[1], Junyue Chen[1], Xiaochen Liu[1], Jiaxin Xu[1], Xiyuan Zhang[1]

1. HBU-UCLan School of Media Communication and Creative Industries, Hebei University, Baoding, Hebei, 071000, China.

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Abstract

In this paper, the HSV color space model is used to collect the color characteristics of modern interior design and classify them into three types: hue (H), saturation (S), and luminance (V). At the same time, it combines with the theory of color psychology to construct a PAD emotion model for interior design. Then, it selects experimental samples and data analysis tools to carry out an example analysis of interior design from the emotional perspective. The data show that the selection of people warm and bright color interior design in the interior design of the background color across the amplitude of the largest and more concentrated in the 47.5°, the main body color across the amplitude of the smallest and most stable, the accent color value of the whole relatively high, the highest 123.6°, the background color saturation is the highest of 34.6°, and the brightness of more than 63.9°, the overall presentation of the warmth of comfort indoor environment. Error-values were 0.004, 0.0698, and 0.038 in order, with the errors all below 10%. This study integrates psychology and color into interior emotional design to better create visually appropriate, comfortable, and culturally rich interior environments for people, and also to promote the development of the interior design field.

Keywords: HSV color space; PAD emotional model; Interior design; Color psychology.
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†Corresponding author.
Email address: dongjian@hbu.edu.cn

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1 Introduction

Color is known as the soul of interior design, and it is the most sensitive visual feeling of people in the interior environment. With people's deepening knowledge of color and increasing understanding of color function, color plays an increasingly important role in home interior design [1-3]. Interior design is the design of the interior space of a building. Interior design can be broadly divided into residential interior design, collective public interior design, open public interior design, and specialized interior design [4-6]. Different types, design content, and requirements are also very different. Family interior space is people's living space, living space, and learning space, it is a busy day after the return of the soul of the harbor, but also synonymous with home, the symbol of happiness.

With the development of the social economy, people's living standards continue to improve. Urban residents constantly update the concept of consumption, in the consumption level at the same time, to meet the basic needs of food, wear warm, live gradually to "eat nutritious, wear beautiful, live in a comfortable, easy to travel, fast communication, focus on recreation, advocate tourism, pay attention to fitness," and so on. Multifaceted and expanding [7-10]. People's pursuit of living environment and the area is getting higher and higher at the same time, the competition among the decoration companies is also getting more and more intense. In the family interior design, color not only meets the different functions of the use of indoor space but also from the psychological feeling of human color, from the actual situation, the reasonable configuration of the color suitable for living, to create a personalized, layered and moody environment [11-13].

Literature [14] proposes a three-dimensional vision-based virtual design method for interior space, which comprehensively incorporates a combination of spatial color background and visual information when carrying out interior design and uses three-for-virtual-reality technology to simulate the design scene and more comprehensively matches the design of the color scene of the interior space. Effectively enhance the design effect and practicality. Literature [15] based on the creation of artistic context and the impact of coastal climate, the processing technology, and design optimization of soft materials in interior design was integrated and analyzed. While pursuing the combination of interior design emotion and mood, it also focused on the quality of the design materials in order to satisfy the people's imagination of the beauty of the interior space environment. Literature [16] describes that the position of emotion in the current design is very important, so it provides a conceptual model to improve the immaturity of emotion in the product service system and proposes the "emotional chain reaction" in the stimulation of the user agent to design and practice based on emotion. Literature [17] creates an inference model based on the representative view selection method of visual attention and gradual preference, tracking user preferences and integrating them incrementally to satisfy users' individual needs while stimulating designers' creativity. Literature [18] proposes an interactive system for rapid design and previewing of color snapshots of interior scenes, aiming to improve the effectiveness of color design of interior scenes, using the image coloring method to quickly and efficiently obtain color snapshots in order to provide previews of interior design schemes with different color themes. The personalized design of interior scenes is made easier with it. Literature [19] conducted a color emotion association test on more than thirty participants and used machine learning algorithms to analyze the data of the test results, and found that color emotion associations are more similar when they are linguistically and geographically close to each other, and that this color emotion characteristic can also be practiced in design.

This paper is based on the perspective of emotional computing. According to the importance of color features in interior emotional design, the HSV color space model is used to obtain color features. On this basis, from the perspective of color psychology, the obtained color features are applied to the process of interior emotional design, and the interior color configuration scheme is proposed. By searching for relevant information, we get the emotion word set and establish the interior design

emotion PAD model based on design elements and the emotion word set. In order to describe more objectively the situation of the colors of the three types of interior design works, the colors extracted from the three types (A, B, C) of interior design works are counted from the three dimensions of hue, saturation, and brightness. The PAD emotion model for interior design was confirmed by analyzing the color and psychological characteristics of interior design after identifying the necessary tools and samples for the analysis.

2 Modern interior design considering psychology and color

2.1 HSV color space

The HSV color space model is shown in Fig. 1. HSV color space is a color model oriented to visual perception and, therefore, has a wide range of applications in vision-based image processing tasks, such as interior design, product design, etc. [20]. The HSV color space model describes color through three components: hue (H), saturation (S), and luminance (V). Among them, the hue is related to the wavelength of the main light in the mixed spectrum; the different wavelengths of light show different colors, which also reflect the differences in hue. Saturation refers to the relative purity of the color, which can also be interpreted as the amount of white light mixed with a color, and luminance mainly reflects the degree of brightness and darkness of the light perceived by the human eye. This index is related to the object's reflectance. HSV color space model, where the hue H is rotated 360 ° around the brightness V axis rotated 360 ° to form a circle, saturation S is a proportional value, and the value range is [0,1].

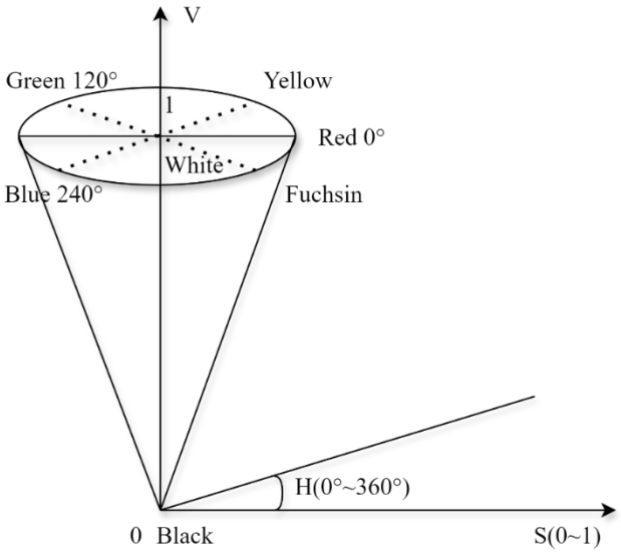


Figure 1. HSV color space model

The RGB color space is converted to HSV color space by calculation, after which the target surface can be identified. Equations (1), (2), and (3) for the HSV color space of each channel value calculation, which set max for R, G, B in the maximum value, min for R, G, B in the minimum value, (R, G, B) for the red, green, blue color in the color coordinate for the real number of 0 to 1. It can be derived:

$$H=\begin{cases}\dfrac{60(G-B)}{V-\min(R,G,B)},V=R\\ [2ex]120+\dfrac{60(B-R)}{V-\min(R,G,B)},V=G\\ [2ex]240+\dfrac{60(R-G)}{V-\min(R,G,B)},V=B\end{cases} \tag{1}$$

$$S=\begin{cases}\dfrac{V-\min(R,G,B)}{V},V\neq 0\\ 0,\text{Other circumstances}\end{cases} \tag{2}$$

$$V=\max(R,G,B) \tag{3}$$

The calculation result may appear as H<0. At this time need to do further calculation processing of H, as shown in Equation (4):

$$H=\begin{cases}H+360,H<0\\ H,\text{Other circumstances}\end{cases} \tag{4}$$

In summary, Eq. $\mathrm{H}\in[0,360],\mathrm{S}\in[0,1],\mathrm{V}\in[0,1]$. Let the size of an interior design plane image be $M\times N$. Let L be the number of gray levels and n_i be the number of pixels with gray level i, resulting in a total number of pixels in the image:

$$MN=n_1+n_2+\ldots+n_L \tag{5}$$

Let $p_i=\dfrac{n_i}{MN}$ where p_i is the probability of occurrence of gray level i. It follows that $\sum_{i=1}^{L}p_i=1$. Setting the threshold value $T(k)=k(1<k<L)$, k can classify the image into two categories C_1 and C_2, with gray value ranges of [1, k] and [k+1, L] parts, respectively. Then the probability of being divided into two parts C_1 and C_2 are respectively:

$$p_1(k)=\sum_{i=1}^{k}p_i \tag{6}$$

$$P_2(k)=\sum_{i=k+1}^{L}p_i=1-P_1(k) \tag{7}$$

The mean values of gray scale assigned to pixels C_1 and C_2 are m_1 and m_2, respectively, and are calculated as:

$$m_1(k)=\sum_{i=1}^{k}iP(\frac{i}{C_1})=\frac{1}{P_1(k)}\sum_{i=1}^{k}ip_i \tag{8}$$

$$m_2(k) = \sum_{i=k+1}^{L} iP(\frac{i}{C_2}) = \frac{1}{P_2(k)} \sum_{i=k+1}^{L} ip_i \tag{9}$$

The k-level cumulative mean can then be obtained as:

$$m(k) = \sum_{i=1}^{k} ip_i \tag{10}$$

Let the global gray mean of the image be m_T, then the formula is:

$$m_T = \sum_{i=1}^{L} ip_i \tag{11}$$

From Eq. (8) and Eq. (9):

$$P_1 m_1 + P_2 m_2 = m_T \tag{12}$$

The between-class variance is:

$$\sigma_k^2 = P_1(m_1 - m_T)^2 + P_2(m_2 - m_T)^2 \tag{13}$$

Can be obtained from Eq. (12) and Eq. (13) and $P_1 + P_2 = 1$:

$$\sigma_k^2 = \frac{(m_T P_1(k) - m(k))^2}{P_1(k)(P_1(k) - 1)} \tag{14}$$

Setting the σ_T^2 subrepresentation of the global variance can be obtained:

$$\sigma_T^2 = \sum_{i=1}^{L} (i - m_T)^2 p_i \tag{15}$$

From Eq. (15), it can be seen that to calculate the interclass variance, it is only necessary to calculate the global threshold m_T, the k-level cumulative mean m(k), and the cumulative probability P_1. In summary, the algorithm only needs to finally compute the value of k that can make σ_T^2 the maximum value, denoted as $k*$, and then $k*$ is the optimal threshold.

2.2 Relevant properties of color psychology

2.2.1 Characteristics of Color

1) Color phase

Hue is actually the phase of color [21]. Produced by the different wavelengths produced by other colors, it can directly indicate the color difference between different colors. Hue allows one to visually identify the tendency of colors, such as red, yellow, blue, and so on. The Hue ring is the color in accordance with the hue spectrum for sequential arrangement. Hue ring has a variety of color rings, such as twelve color rings, twenty-four rings, and forty-eight rings.

2) Brightness

Brightness is a specific reflection of the degree of light and darkness and shades of color contained [22]. Any color has the attribute of brightness, including black, white, and gray. White has the highest brightness, gray is second, and black has the lowest brightness.

3) Saturation

Saturation represents the vividness of the color. The higher the color saturation, the higher the saturation response, giving the strongest visual stimulation.

2.2.2 Visual perception and association of colors

The visual feeling of color is due to people in the process of life because of the accumulation of various experiences and influences, for different colors have a certain experience and feelings, so that subjectively and objectively give the color some specific associations and symbols. The subjective association of color is affected by the level of knowledge, regional culture, psychological emotions, and other factors with individual differences. The universal identity is contained in the objective feeling of color, which is authentic. The visual connection caused by color means that a specific color can cause positive and negative emotions. For example: black brings positive feelings for solid, solemn, etc., associated with black marble, but also brings negative feelings for sin, etc.Associated with mourning and death. Oranges bring positive feelings of beauty and maturity, associated with oranges, and negative feelings of fatigue. Color contact can result in psychological changes that affect people's emotions and behavior. Using the characteristics of specific colors that cause different unique psychological effects, people can enhance their health by interacting with them and even help those suffering from certain diseases to recover. Blue light has the potential to improve cognitive abilities, for instance.

2.2.3 Memory of Color

Color has a certain memory characteristic; each person, based on differences in each degree of memory for color, is also different, but in general, the memory of color has the following characteristics: brightness, color, the higher the color, the easier it is to be remembered. In the warm color chromaticity changes, memory will be based on different color changes occurring with obvious differences, but the cold color chromaticity changes, memory for different color changes there is no obvious difference, color compared to colorless graphic changes on the human more memory. The simpler the combination of colors and shapes, the higher the memory retention of the human brain.

2.3 Application of color psychology in interior design embodiment

2.3.1 Clarify the color needs of interior functions

Each interior space has its own needs, and different interior colors can be designed to produce different psychological feelings. Therefore, in the interior color design, you need to first determine the functional needs of the interior space for its functional attributes of the color selection and then use color to create an indoor atmosphere that should have, to strengthen the functional characteristics of the interior.

Indoor functionality and color psychological feeling of the design cannot only play the value of the color itself but also meet the functional needs of the interior. For example, in children's libraries,

using rich and varied colors can not only stimulate the interest of children but also be conducive to active children's thinking consciousness. The use of office space in a relatively cold color design can be conducive to improving the efficiency of office workers. Still, it is not easy to cause boredom and fatigue. The application of color psychology is always for people and services, conducive to human learning, work, and other aspects of life so that the entire interior space is rationalized to facilitate maximum functionality.

2.3.2 Establish the main color tone of the interior colors

In the interior color design, regardless of the design of the interior space function, structure layout, etc. First, we need to determine the main color tone of the interior color. The main color can be cold, warm, etc. The background color is the largest area of indoor color in the range. Because of the inherent properties of color, and thus the obvious differences in color, different color tones can determine the overall visual effect of the interior. In interior color design, color can create the atmosphere of the interior. Color can create different psychological feelings in people. Therefore, color can be used to create various types of designs, such as lively, classical, romantic, modern, and rustic styles. These can be designed using the color-matching law that each style has. The style presented by the color can give people in the indoor environment a clear psychological feeling, conducive to people in which the interior design has a psychological echo.

2.3.3 Propose interior color configurations

1) Same color

   The use of the same color refers to the use of a certain brightness and shade variation in the interior space design. The transition between high and low brightness colors is more holistic, occupies a larger area, and therefore attracts more visual attention. Interior spaces commonly use the same color selection of black, white, and gray, which can give people a simple yet luxurious feeling.

2) Similar colors

   Similar color refers to the use of color rings next to the color or the use of brightness shades of change in interior design. Cold colors and warm colors have similar color configurations, such as red, orange, and orange-red combinations, which can create an active atmosphere and generate a sense of excitement in places like children's rooms and gyms. Mixed colors and cold colors, warm color configurations such as yellow, green, and yellow-green can make people feel like they are in autumn nature.

3) Complementary colors

   Complementary color refers to the use of color rings on the most different and related colors in interior design. The use of complementary color matching and the visual stimulation of people is relatively large and not conducive to the use of large areas of the interior. The need for appropriate design interior color design using complementary color design gives people a sense of excitement to create an active atmosphere indoors, which can be used for fast-food restaurants, convenience stores, and so on.

4) Complementary colors

Neighboring complementary color refers to the use of the color ring of color and its complementary color with the color of the adjacent color in interior design. Although complementary colors are relatively close, the color with the greatest difference will create a certain contrast. For example: blue, orange-red, orange-yellow match.

2.4 PAD Emotion Modeling for Interior Design

2.4.1 Design elements

The PAD emotion model is an emotion measurement method based on the user's psychological response, which has the advantages of being fast and intuitive, good for fault tolerance, and applicable to a wide range of types. The structure of the PAD emotion model is shown in Figure 2. In the PAD affective model, the degree of pleasure (P) refers to whether the user's emotion is in a positive or negative state. When the value of P is positive, it represents that the user is in a positive emotional state of "joy". When the P value is negative, it means that the user is in a negative emotional state of "sadness". Activation (A) refers to the user's neurophysiological activation level and excitement. When A is positive, it means the user is in an excited state of "surprise". When the value of A is negative, it means that the user is in a state of "boredom". Dominance (D) is the user's dominance over the external environment or others. When D is positive, it means that the user is in a state of "resentment", i.e., the user has strong dominance and control over the external environment. When the D value is negative, it means that the user is in a state of "fear", i.e., the user's control over the outside world is weak. According to the positive and negative values of P, A, and D of the three emotional states of "joy", "boredom," and "fear", the following can be obtained The PAD emotion model with "+" (positive value)/"-" (negative value) is obtained, which has been widely used in various fields of emotion recognition and emotion expression research, such as interior design emotion analysis and product design.

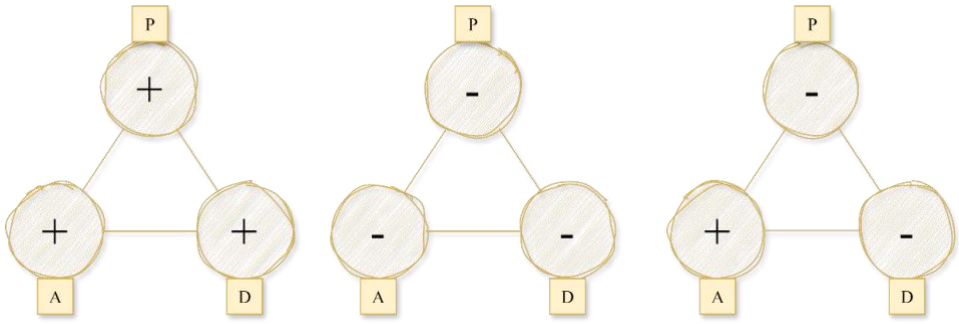


Figure 2. PAD emotional model structure

2.4.2 Acquisition of Sentiment Word Sets

Emotion is a person's attitude experience towards whether objective things satisfy their needs, and emotional words are words that can express personal attitude experience. In the Chinese vocabulary, researchers have compiled 430 emotional words that basically cover all the emotions of the Chinese people. There are both strong and weak associations between emotional words and the emotional experience of interior design within these 400 words. For example, two of the emotion words are "heartache" and "pleasant", which may appear more frequently than "heartache" in the evaluation of interior design emotions. In the review of interior design emotions, the frequency of "pleasant" is obviously much higher than that of "heartache". Therefore, not all of these emotion words are adapted

to the evaluation of interior design, and the main purpose of this subsection is to filter out the set of emotion words that are strongly correlated with the assessment of industrial interior design emotions.

2.4.3 Modeling

Through the previous statement, it is clear that the emotion evaluation model of interior design should meet two conditions. The model must include the attributes that evaluate elements that play in the process of emotional arousal. In addition, it can explain how users' emotions occur and how evaluation is characterized as a result and a variable throughout the process.

Evaluation is complex and rich in the cognitive process. It contains the user's overall view of things, and emotional evaluation is the result of synthesizing the user's physical and mental feelings. Evaluation elements are the user's object of attention - the characteristics of interior design, but also to attract users to produce emotional qualities, emphasizing the role of evaluation elements of the attributes of the user's emotional carrier.

The occurrence mechanism of emotion is mainly reflected in the external stimulus, that is, the evaluation of the object's volume layout, shape and surface characteristics, space color, component materials, and information interface of the five elements triggering different emotional perceptions. Due to the diversity of emotions, there is inconsistency in the experiences of different users of interior design. Due to the timeliness of emotions, they may change after some time. Due to the complexity of emotions, users may generate complex emotions beyond basic emotions. In cognitive psychology, the judgment mechanism can explain the problem that different users face the same engineering machinery products to produce different emotions because the construction of the judgment mechanism corresponds to the production of emotions and can get the corresponding evaluation results. Therefore, evaluation is a result of the entire process and related variables, and different emotions can lead to different evaluation results. The evaluation mechanism in this paper is the PAD three-dimensional emotion model for the emotional evaluation of the characterization of the user's emotions. The user's emotions are externalized and then analyzed the results, to get the evaluation results of the emotional words in different quadrants.

Based on this activity process, the interior design emotion evaluation model is established, and the PAD emotion calculation model for interior design is shown in Figure 3. The establishment of the interior design evaluation method with design elements as the carrier, emotion word set as the basis, and PAD 3D model as the means, on the one hand, can make the user's emotion fully externalized and get the user's emotion word domain of the design scheme. On the other hand, it provides ideas for scientifically advancing program convergence and provides an additional reliance for the subsequent iteration process.

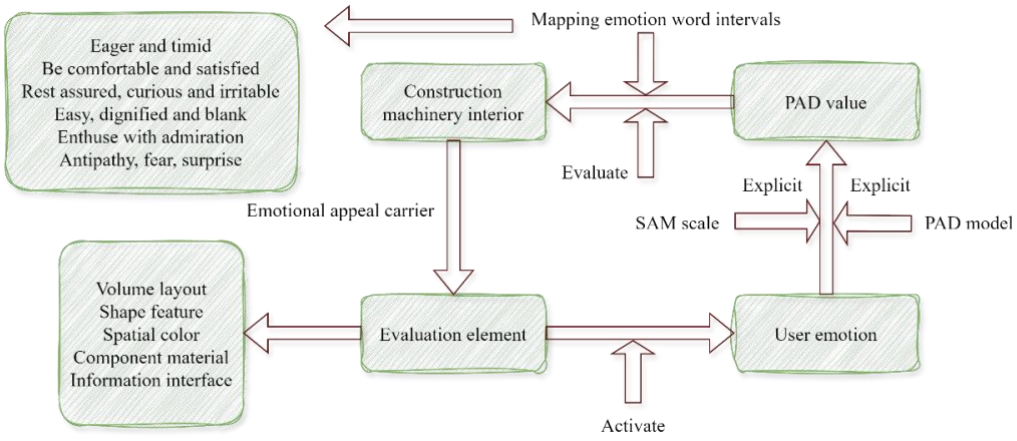


Figure 3. The design of the PAD emotional computing model for interior design

3 Case Study of Interior Design in Emotional Perspective

3.1 Color analysis of interior design based on HSV model

3.1.1 Experimental sample selection

Among other things, the colors of three (A, B, C) types of interior design works were analyzed using the HSV color space model. In order to more objectively describe the situation of the colors of the three types of interior design works, this chapter quantitatively analyzes the main color composition of the three (A, B, C) types of interior design works. Statistically, it analyzes the colors extracted from the three (A, B, C) types of interior design works in terms of the three dimensions of hue, saturation, and lightness. On the basis of quantitative analysis, combined with information, analysis of the color distribution of interior design in the emotional field of view provides a large amount of scientific data support for the study of the color and psychological characteristics of interior design later.

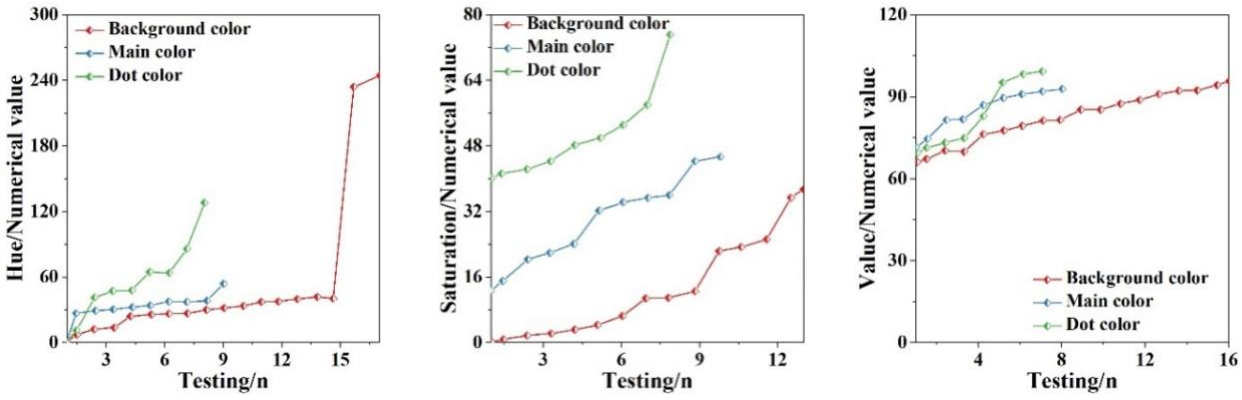
In Type A interior design, experiments were conducted before and after to determine people's preferences for colors. After the experiment, this set of colors was ranked first in terms of preference. In the initial research, monochromatic people like orange and orange-red, such as warm colors, in the color design of the appropriate elderly room to take into account people's monochromatic preferences and combined with people's visual and psychological HSV thresholds for the design. The whole is warm in color with the same color phase matching, overall coordination, and unity.

Type B interior design: this set of color matching schemes selected people's preference score ranked second color matching design, the overall background color coordination, and unity, the main color of a small area for the orange-purple contrast. Preliminary research has shown that people prefer monochromatic colors such as orange. The design will be used as part of the main color scheme.

Type C interior design: this set of color matching selection preference evaluation rankings for the last color matching, the overall color for the background color unity, the main body color, a small portion of orange, and blue complementary color for contrast. Initial research has shown that people prefer monochrome colors like blue and orange, so they are used as a small portion of the main colors used in the design.

3.1.2 Data analysis

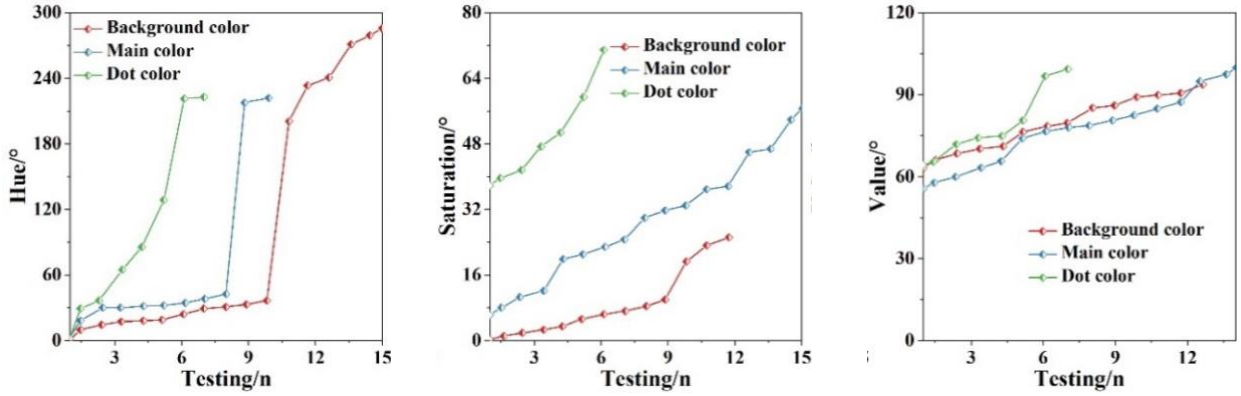
Type A interior design is mainly used to make people warm and bright room colors, room color overall warm color phase, background color brightness from the ceiling, walls, the ground in order to reduce the saturation from the background color, the main body color, accent color in order to increase, the overall color of the living space is coordinated and unified, the type A interior design color analysis results are shown in Figure 4, which (a) ~ (c) were the hue, saturation, brightness. As can be seen from the figure, from the hue point of view, the background color across the amplitude of the largest and more concentrated in the 47.5 ° within the body color across the amplitude of the smallest and most stable, the embellishment color value of the overall relative high, the highest for 123.6 °. From the saturation point of view, the trend of the background color, body color, and accent color folds is clear, with the lowest background color and the highest accent color, and the lowest value is as low as 0°. The highest value is not more than 82.3°, of which the highest saturation of the background color is 34.6°. From the brightness point of view, the three folds are more than 63.9 °, are high brightness color, the highest accent color up to 97.9 °, and accent color selection of saturation in the standard threshold for relatively low color to ensure the unity of the color of the living room.



(a) Hue (b) Saturation (c) Value

Figure 4. Type A interior design color analysis results

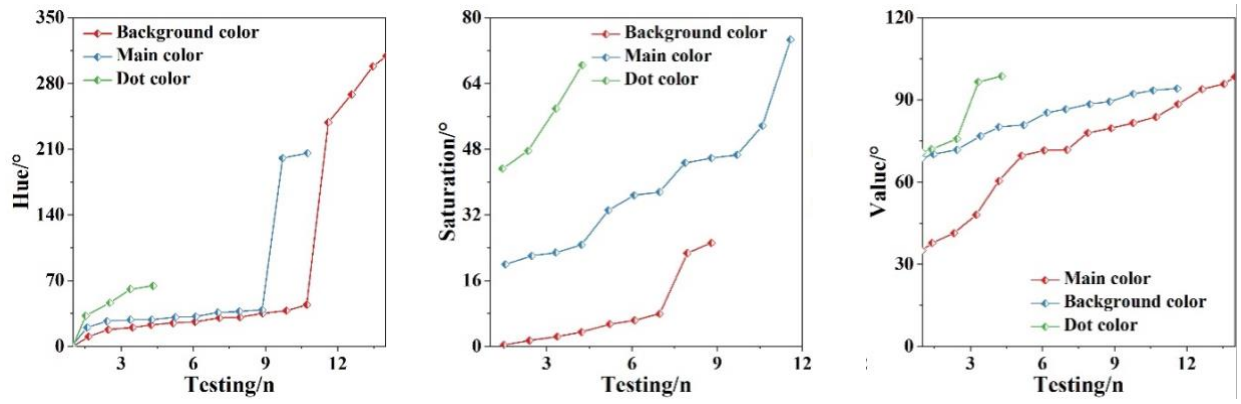
Type B interior design chooses the overall color scheme as a cool color scheme, while the main color and accent color are warm colors. The main body color is cold wood, with parts of the area being warm orange and purple. The accent colors are orange, purple, and green. The space color is richer than the first set of living room colors. Type B interior design color analysis results are shown in Figure 5, where (a) ~ (c) are hue, saturation, and brightness, respectively. It can be seen that in terms of hue, there is a period of rapid growth in the background color, body color, and accent color, which can be seen in addition to most of the colors within 47.5 °, but also more than 195.8 ° of color, the highest background color up to 268.9 °. In terms of saturation, the accent color fold is farther away from the background color, the subject color, and the lowest saturation of 39.1 °, higher than the prevalent background color, the subject color saturation, the background color saturation is the lowest overall, the highest value of 24.3 °. In terms of brightness, the background color, body color, and accent color are greater than the saturation, and the accent color brightness is as high as 97.8 °, the brightest. The sense of color unity in the living room is weaker than in the first set of colors.



(a) Hue (b) Saturation (c) Value

Figure 5. Type B interior design color analysis results

Type C interior design space overall color for the warm phase selected the least warm and bright space color. There is a sense of dullness. The main color part of the area uses orange and blue complementary colors to enhance the color effect of the space. The use of yellow, green, and orange for living room color accents enhances the color effect of the space. The results of the Type B interior design color analysis are shown in Figure 6, where (a) to (c) represent hue, saturation, and brightness in turn. The data show that from Figure 6 (a), it can be seen that the background color, body color, and accent color values are generally not high, all within 47.5 °. The background color, the main body color also contains a few spanning a large number of values, up to 297.4 °. As can be seen from Figure 6(b), the background color, body color, and accent color folds are distinct, with the background color generally having the lowest value, the body color the second highest, and the accent color the highest, with the body color having the highest value of 72.3°, slightly higher than the accent color. From Figure 6(c), it can be seen that the background color, body color, and accent color values are all greater than 40.8°, and most of them are above 58.7°. The overall luminance of the accent color is high, the overall luminance of the background color is relatively low, and it is lower than the minimum and maximum thresholds for luminance for the one or two sets of colors.



(a) Hue (b) Saturation (c) Value

Figure 6. Type C interior design color analysis results

3.2 Interior Design Color and Psychological Characteristics Analysis

3.2.1 Research tools

1) HSV color system

In this study, interior design from the perspective of affective computing was used as the research object, and the samples were divided into six basic colors, namely red, yellow, green, cyan, blue, and magenta, according to the HSV color system.

2) PAD emotion scale

In this paper, the PAD three-dimensional emotion model in the continuous emotion model is chosen to measure user emotion, which is divided into three dimensions, namely pleasure (P), arousal (A), and dominance (D), to describe the human emotional state.

3) Selection of eye movement indicators

Combined with the acquisition range of laboratory instruments, gaze rate [count/s], sweep rate [count/s], average sweep time [ms], average pupil value [mm], minimum sweep time [ms], average sweep time [ms], which are potentially correlated with emotion, were selected as the eye movement indicators for this experimental study.

3.2.2 Analysis of experimental results

The correlation between color attributes and emotion dimensions and the correlation analysis results between eye movement indexes and emotion dimensions are shown in Table 1, from which it can be seen that there is a moderate negative correlation between hue and emotion dimensions ($r = -0.463$, $p < 0.01$ (P), $r = -0.358$, $p < 0.01$ (A), and $r = -0.282$, $p < 0.01$ (D)), and similarly there is a strong positive correlation between saturation, luminance, and emotion dimensions were strongly positively correlated with each other, so the two color attributes of hue and lightness were chosen to be used as dependent variables in the final emotion measurement model.

Table 1. Correlation analysis of eye movement index and emotional dimension

Affective dimension	H	S	V
P	-0.463**	0.002	0.572**
A	-0.358**	0.118*	0.506**
D	-0.282**	0.008	0.663**

The results of the correlation analysis between the color attributes and the emotion dimensions are shown in Table 2. The data indicate that the minimum sweep time does not correlate with the emotion dimensions, the average gaze time shows a moderate negative correlation with Pleasure P ($r=-0.484$, $p<0.01$), Arousal A ($r=-0.473$, $p<0.01$), and Dominance D ($r=-0.588$, $p<0.01$), and the gaze rate, pupil mean, scanning rate, and mean scanning time also all showed some positive correlation with the 3 dimensions of emotion.

Table 2. The correlation analysis results of color properties and emotional dimensions

Eye Indicator	P	A	D
Average time	-0.484**	-0.473**	-0.588**
Fixation rate	0.352**	0.406**	0.369**
Pupil average	0.195**	0.394**	0.508**
Scanning rate	0.379**	0.144**	0.279**
Minimum scanning time	0.043	-0.046	0.048
Mean scanning time	0.375**	0.364**	0.408**

Substituting the data into the emotion model constructed above, the eye movement data and color phase attributes are shown in Table 3, and the predicted and actual values of the emotion dimensions are shown in Table 4. The predicted and actual values of the experimental results were subjected to a paired-sample t-test. The results showed that the combined mean values of mean gaze time, gaze rate, pupil mean, sweep mean, and time sweep rate were 0.7734, 0.6691, 4.2151, 30.8214, and 0.4209, respectively, and that the mean differences between the actual and predicted values of P, A, and D were 0.004, 0.0698, 0.038. The errors are all below 10%, indicating that there is no significant difference between the predicted and actual values of the model. When the arousal level of the interior design color scheme is high, the brightness can be appropriately reduced to avoid excessive arousal, causing pressure on the user or interfering with their attention. Tundra green has a lower level of pleasantness, and a color scheme with higher brightness can be chosen to stimulate emotion. This result is consistent with the prediction of the emotion evaluation model, indicating that the evaluation results are valid. This study combines color psychology and interior design to refine and summarize the interior color design configuration strategies suitable for today's interiors. Also, it provides a theoretical basis and practical reference for the construction and optimization of color aspects of interior design.

Table 3. Eye movement data and color properties

No.	Average time	Fixation rate	Pupil mean	Scanning average time	Scanning rate	S	V
1	0.544	0.805	4.328	27.735	0.612	19	81
2	0.684	0.81	3.833	27.854	0.452	19	81
3	0.662	0.725	4.61	29.716	0.297	19	81
4	0.434	0.483	4.375	29.711	0.521	19	81
5	0.64	0.628	4.451	26.736	0.524	19	81
6	0.491	0.764	4.464	35.685	0.332	131	79
7	0.922	0.681	4.138	36.668	0.586	131	79
8	1.347	0.443	3.789	34.626	0.123	131	79
9	1.43	0.746	3.917	21.78	0.382	131	79
10	0.58	0.606	4.246	37.703	0.38	131	79

Table 4. The predicted values and the actual values of each dimension of the emotion

No.	P actual value	P predictive value	A actual value	A predictive value	D actual value	D predictive value
1	0.998	0.849	0.995	0.796	0.972	0.849
2	0.982	0.781	0.496	0.709	0.514	0.681
3	0.997	0.742	0.518	0.634	1.007	0.746
4	0.482	0.778	0.999	0.748	1.006	0.855
5	1.012	0.744	0.992	0.718	0.996	0.719
6	0.502	0.468	0.512	0.361	0.51	0.69
7	-0.018	0.451	0.502	0.414	0.493	0.495
8	0	0.14	0.014	0.02	0.011	0.017
9	0.018	0.105	-0.008	0.056	-0.006	-0.036
10	0.506	0.461	0.513	0.379	0.501	0.608

4 Conclusion

The use of color and psychology theory in interior design provides a direct channel for indoor environments to elicit human emotional expression. The combination of the HSV color space model and psychological theory is applied to interior design under the emotional perspective to create a PAD emotional model for interior design. Based on research data, data analysis tools are used to analyze the case study of interior design from an emotional perspective. Compared with the B and C interior design cases, the performance of the A-type interior design case is more reasonable, corresponding to the highest hue, saturation, and lightness (123.6°, 82.3°, and 97.9°), respectively. The eye movement index has a significant correlation with the emotion dimension, $p<0.01$.

In contrast, the average gaze time has a moderate negative correlation with P ($r=-0.484$, $p<0.01$), A ($r=-0.473$, $p<0.01$), and D ($r=-0.588$, $p<0.01$), which confirms that the data of this type of index can be used in the calculation of the emotion of interior design. Through the emotion calculation of interior design, it can be seen that the average difference between the actual value and the predicted value of P, A, and D is 0.004, 0.0698, and 0.038, respectively. The corresponding average error value of the actual value and the predicted value is 0.004, 0.0698 and 0.038, which is kept within 10%. The result is in line with the prediction of the emotion evaluation model, which verifies the validity of the emotion model constructed in the previous paper and its Practicality. The research results of this paper can effectively improve the indoor environment, enhance the comfort of the sense of sight, and have positive practical significance and certain theoretical value for the optimization of indoor color design under the perspective of emotional computing.

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About the Authors

Jian Dong (1980.5-), male, Beijing, Master graduate of University of Central Lancashire, lecturer at HBU-UCLan School of Media Communication and Creative Industries, Hebei University, main research direction: Interior design, space environment design, innovative thinking.

Lan Qin (2000.8-), female, Dengzhou, Henan, master's degree student from Hebei University, main research direction: environmental design, residential space design, landscape design.

Shilong Han (2000.3-), male, Shijiazhuang, Hebei, master's degree student from Hebei University, main research direction: environmental design, space design.

Zhanpeng Wang (1999.2-), male, Dongying, Shandong, master's degree student from Hebei University, main research directions: environmental design, semiotics in space design.

Junyue Chen (1996.12-), male, Xinyang, Henan, master's degree student from Hebei University, main research direction: urban environment update design.

Xiaochen Liu (2001.1-), female, Jinzhong, Shanxi, master's degree student from Hebei University, main research direction: future residential space design.

Jiaxin Xu (2000.12-), female, Handan, Hebei, master's degree student from Hebei University, main research direction: the design of the aging habitat.

Xiyuan Zhang (1998.12-), male, Yantai, Shandong, master's degree student from Hebei University, main research direction: landscape design, display space design, old environment transformation.