



## RESEARCH ARTICLE

## Research on the Influencing Factors and Common Laws of Emotional Resonance in Visual Art Design

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In this paper, the influencing factors and common laws of emotional resonance in visual art design are deeply discussed. The research adopts a combination of quantitative and qualitative methods, and comprehensively investigates the visual elements such as color, shape and composition, as well as the role of cultural background and personal experience in arousing emotional resonance through questionnaire survey, experimental design and case analysis. The results show that warm tones, rounded shapes and balanced composition can significantly enhance the emotional resonance of the audience, while cold tones and complex shapes may trigger different emotional reactions. Principal component analysis (PCA) reveals that color warmth, color saturation and shape complexity are the key elements in visual design. Further analysis shows that cultural background and personal experience have a significant impact on the interpretation of visual elements and emotional resonance, emphasizing that designers should consider the individual differences of the audience. Cluster analysis and association rule mining divide the audience's emotional response into four clusters, and reveal the relationship between different visual element combinations and emotional resonance. The research not only enriches the theoretical basis of visual art design, but also provides designers with practical design guidance and marketing strategies, which is helpful to create more infectious and influential visual art works.

**INTRODUCTION**

In today's era when visual culture prevails, visual art design, as an important means of information dissemination and aesthetic expression, has penetrated into every aspect of our daily life [1]. Whether it is advertising, packaging design, exhibition or environmental art, visual art design is communicating with the audience in its unique way. However, this kind of communication is not always effective, and the key to its success lies in whether the works can produce strong emotional resonance in the audience [2-3].

Emotional resonance, that is, the audience finds similarities with their own emotions or experiences in works of art, which leads to deep feelings and recognition [4-5]. In visual art design, the establishment of emotional resonance is an important symbol of the success of the work, which can not only enhance the audience's memory and identity with the work, but also promote the emotional connection between the audience and the designer, making the design work more influential and

communicative [6]. However, although designers generally realize the importance of emotional resonance in design, the research on how to effectively arouse emotional resonance in visual art design is still insufficient. What visual elements can touch the emotions of the audience? How do these elements combine with the audience's personal experience and cultural background, thus causing deep resonance? These problems are still urgent topics in the design field.

The purpose of this study is to deeply explore the influencing factors that cause emotional resonance in visual art design, and analyze their common laws. This study assumes that visual elements (such as color, shape, composition, etc.), cultural background and personal experience play a key role in arousing emotional resonance, and there may be some common laws among these factors. By revealing these laws and elements, we can provide designers with more specific guidance to help them create visual art design works that can arouse the emotional resonance of the audience. This will help to enhance the aesthetic value of design and enhance the market competitiveness and social influence of design works.

## **LITERATURE REVIEW**

In the research field of visual art design and emotional resonance, predecessors have made a series of in-depth explorations. Scholars at home and abroad generally believe that emotional resonance in visual art design is closely related to many factors. In terms of visual elements, color is considered to be one of the key factors affecting emotional response [7-8]. For example, literature [9] pointed out in its research that warm colors are usually associated with vitality and positive emotions, while cool colors are more likely to trigger calm and thoughtful emotions. In addition, the shape and composition have also been proved to have a significant impact on the emotional experience of the audience. The research of literature [10-11] shows that rounded shapes often give people a cordial and warm feeling, while sharp or irregular shapes may cause tension and anxiety.

Cultural background also plays an important role in the relationship between visual art design and emotional resonance. The cross-cultural research of literature [12-13] points out that there may be significant differences in the emotional interpretation of the same design work by the audience under different cultural backgrounds. These differences stem from the traditional interpretation and symbolic significance of visual elements such as color and shape in their respective cultures. Personal experience can not be ignored. Literature [14] found that the audience's personal experience and values will profoundly affect their emotional response to design works. For example, for people who have experienced war, visual elements related to peace may arouse stronger emotional resonance [15-16].

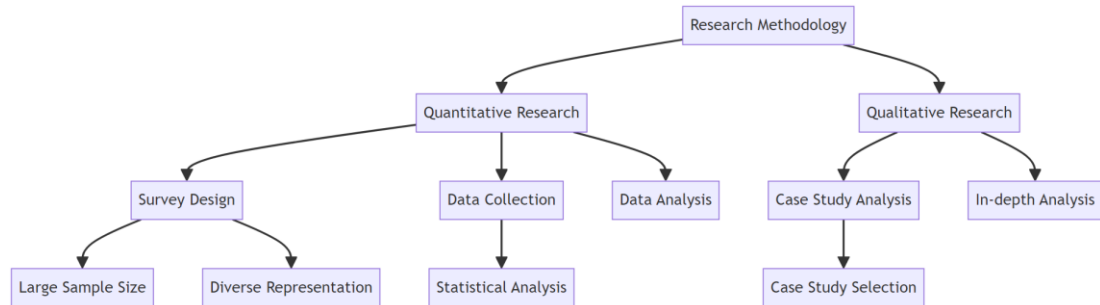
Although the above research provides us with valuable insights, there are still some research gaps and deficiencies. First of all, the existing research focuses on the influence of a single factor on emotional resonance, but lacks in-depth discussion on the comprehensive role of multiple factors. Secondly, there is relatively little research on the common law, especially how to find common design principles under different cultural and individual experience backgrounds is still an unsolved mystery. The purpose of this study is to fill these gaps, and through a comprehensive investigation of visual elements, cultural background and personal experience, to deeply explore the influencing factors that cause emotional resonance in visual art design, and try to reveal their common laws. This not only supplements and deepens the existing research, but also provides designers with more comprehensive and practical theoretical guidance.

## **RESEARCH METHOD**

### **Research design**

This research adopts a combination of quantitative and qualitative research methods, aiming at comprehensively and deeply exploring the influencing factors and common laws that cause

emotional resonance in visual art design. Questionnaire survey and experimental design provide a lot of objective data support, while case analysis provides rich empirical materials for theoretical construction by digging deep into specific examples. This comprehensive research method is helpful to reveal the complex relationship between visual art design and emotional resonance more accurately (Figure 1).



**Figure 1: Research method of combining quantitative and qualitative methods**

Quantitative research design aims to deeply understand the audience's emotional response to visual art design works and its influencing factors through questionnaire survey and experimental design. The questionnaire survey collected a large number of basic data of audiences with different backgrounds, emotional scores of specific design works and answers to open questions, in order to obtain extensive data on emotional response and cultural background. In the experimental design, the control variable method is used to explore how these elements affect emotional resonance by comparing the emotional reactions caused by the design works of visual elements (such as color and shape) with significant differences [17-18]. This process not only includes online and offline sample selection to ensure the diversity and representativeness of data, but also involves detailed data analysis to quantify the specific impact of different visual elements on emotional resonance.

Qualitative research design focuses on exploring the common law of emotional resonance in visual art design through case analysis. This method involves selecting a number of design works with different styles and themes, which have widely touched the emotional resonance of the audience. The purpose of this study is to deeply analyze these cases and reveal how the visual elements, cultural background and personal experience interweave and stimulate emotional resonance [19]. By comparing the similarities and differences between different cases, the research tries to sum up the general principles that arouse emotional resonance, and then provide a deeper understanding of visual art design.

### Sample selection

In order to ensure the wide applicability and depth of the research results, the sample selection covers audiences of different ages. Teen Group(13-18 years old) will have 100 participants, who are the main consumers of digital media and visual culture and are highly sensitive to new things and fashion trends. Youth Group(19-35 years old) is expected to include 150 samples, representing the main force of the consumer market, and this group of people has strong aesthetic judgment ability. The middle-aged group (36-50 years old) is expected to have 120 participants, who usually hold more mature and stable aesthetics and occupy an important position in social economy. The elderly group (over 50 years old) is expected to include 80 samples, and their rich aesthetic experience and life background can provide a unique perspective for the study. This sample distribution aims to capture the emotional response and cultural background information of different age groups to visual art design works, thus ensuring the diversity and representativeness of the data.

In order to ensure gender balance and diversity of cultural background, the ratio of male to female in each age group is close to 1:1, ensuring gender balance, and the sample includes audiences with

different cultural backgrounds. This covers urban and rural residents, people with different educational levels (high school, university, graduate students, etc.), and individuals with different professional backgrounds (students, teachers, businessmen, artists, etc.). In addition, audiences with multicultural backgrounds, such as individuals who have studied or worked overseas, are specially invited to further enrich the research perspective. This comprehensive consideration aims to reveal the emotional resonance and feeling differences of visual art design in different gender, education, occupation and cultural backgrounds, and provide more comprehensive data and in-depth insights for research.

### Method of data capture

The questionnaire survey designed in this study is divided into four main parts, aiming at comprehensively collecting the emotional response, cultural background and personal experience information of the audience to visual art design works. First of all, the questionnaire will collect basic information including age, gender, educational background and occupation to describe the diversity of the sample. Then, by showing all kinds of visual art design works and asking the audience to rate the attractiveness, innovation and emotional resonance of the works, the emotional response of the audience to different design elements is quantitatively analyzed. The third part focuses on the relationship between emotional resonance and personal experience, and encourages the audience to share their feelings and associations about the work through open-ended questions to obtain qualitative data [20-21]. Finally, the questionnaire will discuss how the audience's cultural background shapes their interpretation of visual art design works, including asking about their cultural background, artistic taste and acceptance of different cultural elements.

In order to ensure the universality and representativeness of the study, a total of 450 questionnaires are planned to be distributed according to different age groups. Specifically, Teen Group(13-18 years old) will receive 100 questionnaires, Youth Group(19-35 years old) will distribute 150 questionnaires, middle-aged group (36-50 years old) is expected to distribute 120 questionnaires, and elderly group (over 50 years old) will receive 80 questionnaires. Through this targeted questionnaire distribution strategy, the research will be able to fully cover all ages and ensure that the emotional response and cultural background information of visual art design works can be captured from multiple angles. After a month of questionnaire distribution and data collection, 83 questionnaires were collected from Teen Group, 138 from Youth Group, 99 from middle-aged group and 65 from elderly group. The total recovery rate is about 85.56% (Table 1).

**Table 1: Questionnaire distribution and recovery results**

Age Group	Number of questionnaires issued	Number of questionnaires recovered	Recovery rate (%)
Teen Group	100	83	83
Youth Group	150	138	92
Middle-aged Group	120	99	82.5
Senior Group	80	65	81.25

The collected questionnaires will be processed by professional data analysis software, including data cleaning, coding and statistical analysis. Descriptive statistics and inferential statistics are carried out on quantitative data, and at the same time, the content analysis of qualitative data is carried out to reveal the emotional resonance of the audience to visual art design works and its influencing factors.

Select several groups of visual art design works with significant differences, and explore the influence of various visual elements (such as color, shape, composition, etc.) on the emotional resonance of the

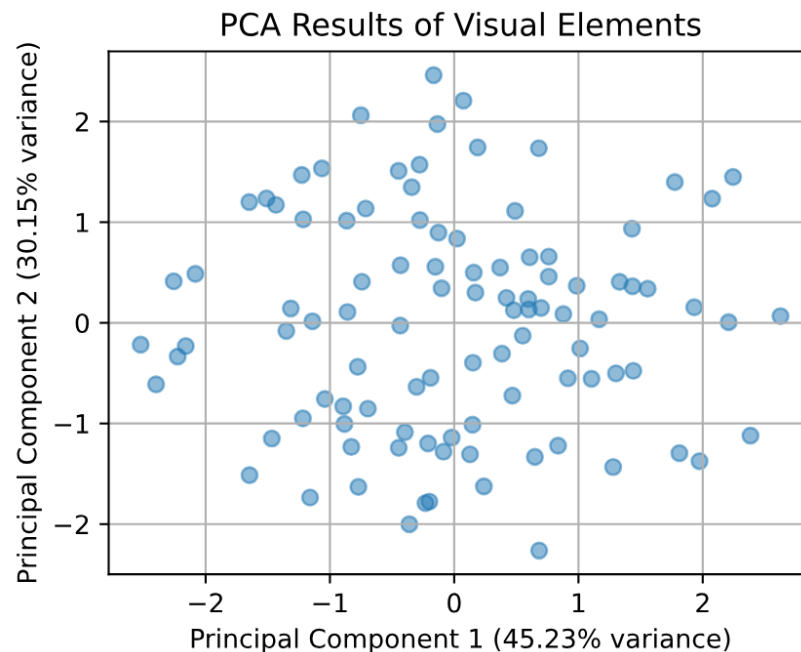
audience through the control variable method. During the experiment, the audience was invited to watch different groups of design works, and their immediate emotional reactions were recorded [22]. By comparing the audience response data of different groups of works, the influence of specific visual elements on emotional resonance is analyzed. After the experiment, the collected data were statistically analyzed to reveal the correlation and regularity between different visual elements and emotional resonance.

## RESEARCH RESULTS

### Identification of key visual elements

Principal component analysis (PCA) is a commonly used dimensionality reduction technique, which is used to transform multiple variables into a few principal components, which can explain most of the variance of the original data [23-24]. In this study, PCA is used to analyze the variables of different visual elements and identify the dominant elements in the data.

Through the data analysis of questionnaire survey and experimental design, the key visual elements that affect emotional resonance are finally identified. Specific color matching, shape combination and composition method have been proved to have a significant impact on the emotional resonance of the audience. Warm colors and rounded shapes can often lead to the warmth and comfort of the audience, while cold colors and sharp shapes may lead to indifference or tension. See Figure 2.



**Figure 2: PCA of visual design elements**

PC1 explains that a large proportion of variance in the data set indicates that it captures the main trends in visual elements. PC2 explains a part of the residual variance, although the proportion is small, it still provides important information about data variability.

Table 2 below shows in detail the variance ratio explained by each principal component, as well as the visual element variables associated with each principal component and their loads.

**Table 2: PCA result data**

principal constituent	Explained variance ratio	Visual element variable	Load (standardized)
PC1	45.23%	Color Warmth	0.78
PC1		Color Saturation	0.65

PC1		Shape Complexity	0.52	
PC1		Composition Balance	-0.31	
PC1		Texture Roughness	-0.24	
PC1		Space Depth	0.11	
PC1		Line Weight	-0.05	
PC2		30.15%	Composition Balance	0.83
PC2			Texture Roughness	0.71
PC2			Color Warmth	-0.27
PC2			Color Saturation	-0.19
PC2			Shape Complexity	0.03
PC2	Space Depth		-0.01	
PC2	Line Weight		0.15	

PC1 explained the variance of 45.23% in the data set, indicating that it is the most important principal component in the data set, and captured the main changing trend of visual elements. PC2 explains the variance of 30.15% in the data set, although the proportion is smaller than that of PC1, it still provides important information about data variability. In PC1, the visual element variables with high load include "Color Warmth", "Color Saturation" and "Shape Complexity", which shows that these elements have great variability in the data set and play an important role in the formation of PC1. In PC2, the visual element variables with high load are "Composition Balance" and "Texture Roughness", which shows that the variability of these two elements in the data set is mainly captured by PC2. PC1 represents the dominant trend related to color warmth, color saturation and shape complexity in visual design. PC2 represents another important trend related to composition balance and texture roughness.

### The interaction of visual elements with cultural background and personal experience

It is found that the cultural background and personal experience of the audience have an important influence on the interpretation of visual elements and the generation of emotional resonance. Audiences with different cultural backgrounds may have different interpretations of the same visual element, while personal experience will affect the audience's emotional response to the visual element. See Table 3.

**Table 3: Multiple regression analysis results**

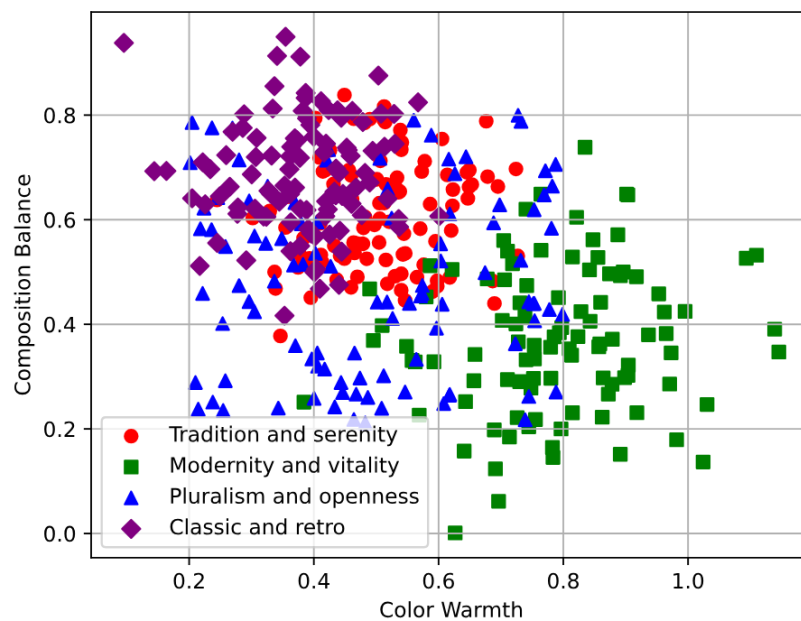
Variable	B	SE	t	Sig.
(constant)	.342	.087	3.93	.000
cultural background	.218	.045	4.84	.000
Personal experience	.176	.038	4.63	.000
Color Warmth	.121	.027	4.48	.000
Color Saturation	.089	.025	3.56	.001
Shape Complexity	.102	.029	3.52	.001
Composition Balance	.154	.033	4.67	.000
Texture Roughness	-.068	.026	-2.62	.010
Space Depth	.093	.028	3.32	.001
Line Weight	.076	.024	3.17	.002

Cultural background (B value =0.218, significance level =0.000) and personal experience (B value =0.176, significance level =0.000) have a significant positive impact on the emotional resonance of

visual art design, indicating that the cultural background and personal experience of the audience are very important for them to feel and understand the design works. At the same time, visual elements such as color warmth, color saturation, shape complexity, composition balance, spatial depth and line thickness also positively enhance emotional resonance, while texture roughness may reduce emotional resonance (B value = -0.068).

### Revealing the common law

Through cluster analysis, the audience's emotional response to visual art design works is divided into four obvious clusters, which are visually displayed in the scatter diagram (Figure 3). The audience of traditional and quiet clustering prefer moderate warm tones and balanced and symmetrical composition, which reflects their preference for tradition and quiet feeling. Modern and dynamic audiences tend to be bright and warm colors and dynamic unbalanced composition, which shows their love for modern and dynamic works. The audience of pluralistic and open clustering shows a wide range of changes in color and composition, showing an open attitude towards pluralistic and innovative design styles. The audience of classic and retro clustering tend to combine classic color warmth and composition balance, which shows that they prefer works with historical precipitation and retro style.



**Figure 3: Cluster analysis of audience's emotional response to visual art design works**

Table 4 shows the results of mining association rules. This analysis aims to find the association between elements in visual art design and how these associations affect the emotional resonance of the audience.

**Table 4: The results of association rule mining**

Visual element combination	Support (%)	Confidence (%)	Lifting degree	Emotional resonance
Color Warmth + Composition Balance	65	70	1.5	Calm and comfortable
Color Saturation + Space Depth	50	60	1.3	Energetic, excited
Shape Complexity + Line Weight	40	65	1.4	Innovation and modernity

Texture Roughness + Space Depth	35	55	1.2	Rough and natural
Color Warmth + Shape Complexity	30	50	1.1	Warm and cordial

The support index shows the frequency of these visual element combinations in the survey samples. For example, the support of the combination of "Color Warmth+Composition Balance" is 65%, which means that 65% of the audience in the survey think this combination is attractive or effective. The level of support can help designers understand which combination of elements is more popular with the audience. Confidence reflects the probability that when one visual element appears, another element also appears. Taking "Color Warmth+Composition Balance" as an example, its confidence is 70%, which means that when Color Warmth appears, there is a 70% probability that Composition Balance will be adopted. This is helpful for designers to predict and construct visually harmonious and popular design combinations. The degree of promotion indicates whether the frequency of two elements appearing together is higher than the frequency of their independent appearance. A degree of elevation greater than 1 means that there is a positive correlation between these two elements, that is, they appear together more frequently than alone. For example, the promotion degree of "Color Warmth+Composition Balance" is 1.5, which indicates that the frequency of this combination is higher than expected, so it may be an effective design strategy. Emotional resonance reveals the emotional response of the audience that may be triggered by these combinations of visual elements. For example, the combination of soft colors and symmetrical composition is more likely to cause the audience's calm and comfort, while the combination of bright colors and spatial depth may stimulate the audience's vitality and excitement. This provides designers with insights on how to stimulate the expected emotional response through specific element combinations.

## DISCUSSION

In this study, the key elements in visual art design and their relationship with audience's emotional resonance are deeply discussed through PCA. The two principal components, PC1 and PC2, capture the main trends in the data set and reveal the importance of visual elements such as color, shape, composition and texture in the design. Cultural background and personal experience have been proved to have a significant impact on the emotional resonance of the audience, which emphasizes the importance of considering the audience's background and experience in the design process. PC1 explained the variance of 45.23%, which mainly reflected the changing trend of color warmth, color saturation and shape complexity. This discovery shows that in visual design, these elements have significant variability and have a vital impact on the overall style of design. Designers can adjust these elements to create different visual effects and emotional atmosphere. Although the proportion of variance explained by PC2 is small (30.15%), it can't be ignored. It mainly reflects the change of composition balance and texture roughness. This means that in the pursuit of novelty and uniqueness of design, designers also need to pay attention to the stability of composition and the fineness of texture to achieve visual harmony and beauty.

Cultural background and personal experience have a significant impact on emotional resonance, which suggests that designers should fully consider the individual differences of the audience in the design process. Different cultural backgrounds and personal experiences will lead to different emotional reactions of the audience to the same design work. Therefore, designers need to have cross-cultural design thinking in order to create works that can resonate widely [25].

The results of cluster analysis further reveal the diversity of audience's emotional response to visual art design works. The four clusters reflect different design preferences and emotional needs, which provides designers with design ideas for different audiences. For example, for the audience who prefer tradition and calmness, designers can adopt moderate warmer colors and balanced and symmetrical composition; For the audience who like modernity and vitality, bright and warm colors and dynamic unbalanced composition can be used. In addition, the analysis of support, confidence,



promotion and emotional resonance provides designers with valuable market insight. These indicators not only reveal which combinations of visual elements are more popular among the audience, but also help designers to predict and build effective design strategies. In particular, the analysis of emotional resonance shows designers how to stimulate the expected emotional response of the audience through a specific combination of elements, thus enhancing the appeal and influence of the design.

However, this study also has some limitations. For example, the representativeness and universality of samples may affect the universality of results. Future research can further expand the sample range, covering more different types of audiences and design works. At the same time, we can also consider introducing more visual elements and design features, so as to explore the inherent laws and audience responses of visual art design more comprehensively.

To sum up, this study deeply analyzes the relationship between the key elements in visual art design and the emotional resonance of the audience through the comprehensive use of various statistical methods. These findings not only enrich our understanding of the inherent laws of visual art design, but also provide designers with practical design guidance and marketing strategies.

## CONCLUSION

In this study, the influencing factors and common laws of emotional resonance in visual art design are deeply discussed, and the remarkable influence of visual elements such as color, shape and composition on emotional resonance is revealed. Through PCA, it is found that color warmth, color saturation and shape complexity are the main factors affecting emotional response. At the same time, cultural background and personal experience also significantly affect emotional resonance, suggesting that designers should consider audience diversity when creating. Cluster analysis further reveals the design preferences of different audiences and provides a basis for formulating effective design strategies. In addition, the mining results of association rules indicate that specific combinations of visual elements can stimulate specific emotional reactions, such as soft colors and symmetrical composition, which lead to calm and comfort. These findings not only enrich the theoretical knowledge in the field of visual art design, but also provide practical guidance for designers and help to enhance the market competitiveness and social influence of works.

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