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Semantic Analysis and Quantitative Application of Xinjiang Unearthed Brocade Patterns

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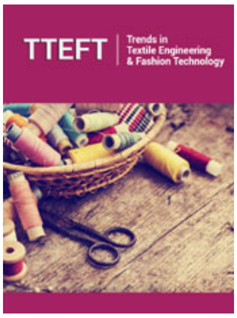

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Abstract

Xinjiang unearthed brocade patterns underlie Chinese traditional culture along with aesthetic perception and have been widely applied in modern pattern design. In order to improve the modern design of Xinjiang unearthed brocade patterns, a semantic quantification method was proposed to divide the pattern semantics into six dimensions and use the pattern semantic coding data after dimension reduction to cluster and reorganize the patterns. Further, the semantic clusters of patterns that represent the representative semantic elements were conducted and turned to guide the modern pattern design on the basis of the matching results to form a new design. In doing so, this study offers insight for promoting the engagement between the semantics of brocade patterns unearthed in Xinjiang and the needs of modern pattern design.

Keywords: Xinjiang unearthed brocade patterns; Multidimensional semantics; Semantic cluster; Pattern design

Introduction

The brocade patterns unearthed in Xinjiang were created by various ethnic groups, which represent Chinese traditional culture as well as aesthetics orientation and contribute a lot to modern pattern design [1]. When designing modern patterns, most designers only innovate from the external appearance of Xinjiang unearthed brocade patterns, ignoring the internal cultural significance, resulting in misuse of pattern elements and failure to fully present the cultural attractions. Therefore, modern pattern design applying Xinjiang unearthed brocade patterns should not simply focus on the external pattern elements, but also the internal pattern semantics contained in it.

In the current literature, there are a few works regarding semantic mining and application of brocade patterns. For instance, Cheng X et al. [2] introduced the classification of Xilankapu through semantic description and interpreted the image connotation [2]. Qin Z et al. [3] extracted and selected the patterns of Dong brocade based on Extenics theory and applied them into a new pattern design [3]. Guo B et al. mined the aesthetic characteristics of Li Brocade through semantic symbiosis and extension and applied them into pattern design [4]. The above research has bridged the gap between the semantics of brocade patterns and modern pattern design to varying degrees, however, they only focus on either the external or internal aspect and lack a comprehensive analysis of brocade semantics. Therefore, this study will explore the multiple aspects of brocade patterns unearthed in Xinjiang, encode these patterns with multi-dimensional semantics, and then divide them into semantic clusters to obtain a quantitative model. The semantic requirements of pattern design will be matched with the analysis results of the quantitative model to generate a new pattern design.

Semantic analysis of Xinjiang unearthed brocade patterns

The patterns of Xinjiang unearthed brocade record the cultural life of various ethnic groups in Xinjiang, representing the ideology, history, culture, life and aspirations of the nation. By sorting out literatures [5-8], six representative pattern semantics of Xinjiang unearthed brocade were selected, namely subject element, object element, color characteristics, composition, pattern implication and aesthetic significance. Both the subject element and the object element represent the brocade patterns unearthed in Xinjiang, which implies the history, culture, living environment and nature within the people of various ethnic groups in Xinjiang with the most common themes being animals, plants, characters, landscapes and geometry. Due to the fact that each brocade pattern contains multiple pattern elements, which are divided into different degrees, there is trouble numbering them. To fix the problem, these pattern elements have to be distinguished into subject elements and object elements when encoding semantic data. In addition, color characteristics represent the color attributes of Xinjiang unearthed brocade patterns, mainly including lightness, saturation, etc.

This study applied Adobe Photoshop to iteratively extract the colors of 56 brocades, and ultimately identified 8 main color characteristics, namely chocolate, charcoal, cool black, brown, almond, cream, mint and white. Besides, composition refers to the method of arranging and organizing the pattern elements of Xinjiang unearthed brocade patterns. The main composition includes 4 ways, which is scattered points, wave points, vertical points and string points. Pattern implication refers to the symbolic and cultural meanings conveyed by the patterns. Each element of Xinjiang unearthed brocade pattern often contains different implications. This study combined Extension Semantics and KJ Affinity Diagram to comprehensively analyze the implication of the patterns and then obtained four major categories of implications as beauty, prosperous for children, seeking blessings and freedom and happiness [7,8]. Aesthetic significance refers to the aesthetic analysis of patterns and the perceptual image evaluation based on the subjective feelings brought by the composition and elements of patterns. This study collected a total of 70 Kansei words from relevant literature, books and internet resources to describe the aesthetic significance of brocade patterns unearthed in Xinjiang. Further, the above 70 Kansei words were preliminarily classified according to emotion, appearance, texture and feeling, and a total of 20 Kansei words were obtained. After screening by researchers, four representative Kansei words of aesthetic significance were finally determined, namely gorgeous, warm, mysterious, and fresh [8]. By fully analyzing the pattern elements and implication of Xinjiang unearthed brocade from the above six dimensions of pattern semantics, a semantic quantification model of Xinjiang unearthed brocade was constructed to develop modern pattern design.

Semantic quantification application of Xinjiang unearthed brocades patterns

Through the preliminary regularization work, this study screened out a large number of original Xinjiang unearthed brocade patterns while eliminating ones with low resolution and similar content, and 56 patterns were determined as research samples. In order to ensure that colors do not affect the extraction of semantic data, the research samples were subjected to color removal and unified color tone processing. Based on the previous work, the multi-dimensional semantics of the patterns were divided, and each dimension of semantics was further subdivided into multiple semantic elements, which is as shown in Table 1.

Table 1: Pattern semantic elements.

Pattern Semantics	Semantic Elements
Subject element	Flower element, bird element, cloud element, beast head element, geometric element, bead element (numbered 1-6)
Object element	Diamond element, round flower element, turtle shell element, sheep element, deer element, rolled grass element (numbered 1-6)
Color characteristics	Chocolate, charcoal, cool Black, brown, almond, cream, mint, white (numbered 1-8)
Composition	Scattered points, wave points, vertical points, string points (numbered 1-4)
Pattern implication	Beauty, prosperous for children, seeking blessings, freedom and happiness (numbered 1-4)
Aesthetic significance	Gorgeous, warm, mysterious, fresh ((numbered 1-4)

This study used SPSS to perform Principal Component Analysis on the semantic elements of sample patterns to obtain low dimensional feature data of the semantic elements. Before conducting principal component analysis, a compatibility test was conducted on the raw data in Table 1 based on Kaiser Meyer Olkin (KMO) and Bartlett's test of sphericity. The results show that the KMO value was 0.509, and the significance probability of Bartlett's test of sphericity was 0.000. According to the standard of KMO test that coefficient >0.5 and Bartlett's test of sphericity significance probability $P<0.05$, it can be seen that Principal component analysis can be used to reduce the dimensionality of the semantic elements of sample patterns data in Table 1. The results are shown in Table 2.

Table 2: Principal component eigenvalues and contribution.

Component	Eigenvalues	Variance Contribution/%	Cumulative Contribution/%
1	1.997	33.288	33.288
2	1.102	18.373	51.661
3	1.016	16.933	68.594
4	0.835	13.919	82.513
5	0.746	12.431	94.994

As shown in Table 2, it is noted that the cumulative contribution of the first three principal components is 68.594%, and the eigenvalues are all greater than 1, which indicates that the first three principal components can represent the most information of the semantic elements in the sample patterns. Further, these three principal component data were used as the basis for semantic clustering. K values were taken from 2 to 10 according to the sample size, and the K-means algorithm was executed sequentially. By comparing the clustering results, K=5 was selected as the final number and the frequency of semantic elements of each sample pattern dimension in these 5 semantic clusters has been calculated. The results are shown in Table 3.

Table 3: Semantic representative elements of sample patterns in each semantic cluster.

Pattern Semantic	Semantic Cluster Category				
	1	2	3	4	5
Subject element	Flower element	Beast head element	Bird element	Flower element	Geometric element
Object element	Round flower element	Rolled grass element	Round flower element	Sheep element, rolled grass element	Diamond element
Color characteristics	Brown	Brown	Brown	Mint, cream	Brown
Composition	String points	Wave points	String points	Wave points	String points
Pattern implication	Freedom and happiness	Seeking blessing	Prosperous for children	Prosperous for children, seeking blessing	Freedom and happiness
Aesthetic significance	Fresh	Mysterious	Gorgeous	Warm, fresh	Fresh

By Setting up the semantic quantification model, it can be used to guide the general process of pattern design. Firstly, obtain user's pattern design requirements Q= [a pattern with flower elements, which has auspicious meanings and can remind people of fresh feeling]; Secondly, extract and summarize the semantic element E_Q= [subject element: flower element, code: 1; pattern implication: seeking blessings, code: 3; aesthetic significance: fresh, code: 4]; Then, using Table 3 as a reference, the Euclidean distance calculation shows that the semantic cluster category 4 has a higher similarity. Therefore, the semantic element data in semantic cluster 4 can be selected as the design inspiration for pattern design, as shown in Figure 1.

Figure 1: Pattern design.

Conclusion

This study proposes a method to enhance modern pattern design by quantifying the semantics of Xinjiang unearthed brocade patterns. Instead of exploring from a single semantic dimension, this approach begins with multi-dimensional semantics, encoding and clustering the patterns to efficiently uncover their semantics, which can not only help to reveal the pattern semantics but also improve the modern pattern design of Xinjiang unearthed brocade by responding to the needs of user effectively. In future work, this study will focus on product innovation across different domains to improve the research's applicability.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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