A Study on Design Factors of Cultural Creative Products in the Capital Museum

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Abstract. This study aims to explore the development directions of cultural creative products in the Capital Museum and to unearth innovative ideas in design. Interviews and surveys were conducted among different age groups, and web scraping technology was utilized for data collection and analysis. Field photography was employed to gather artifacts and Peking Opera materials, which were then categorized, processed, and filtered. Utilizing analytical graph techniques and a K-means based theme color extraction program, relevant morphological factors, color factors, and semantic factors were extracted from the materials for the design of cultural creative products. A direction for the cultural creative products of the Capital Museum, integrating elements of Beijing’s urban culture, was discovered. A design factor extraction model based on factor analysis was constructed, and cultural creative product designs for themes of Yan Di Qing bronze and ancient jade were carried out. Design factor extraction is an effective method for cultural creative product design; the development of the cultural creative industry not only aids in the preservation and inheritance of cultural traditions but also provides new opportunities for the diversification of cultural products. This study furnishes a robust foundation for the future development of museum cultural creative industries.

Keywords: Design Factors; Cultural Creativity; Capital Museum; Pattern; Factor Analysis; Peking Opera

1 Introduction

With the rapid development of cultural industry and the strengthening of globalization trend, the importance of cultural and creative products in various fields has become increasingly prominent [1]. In this era of information explosion, cultural and creative products are not only a business model, but also an important means to spread culture and educate the public [2]. Especially in the special cultural space of museum, the role of cultural and creative products is more prominent. As one of the national museums in China, Capital Museum bears rich historical and cultural heritage and precious art collections. With the development of society and the change of audience demand, Capital Museum also actively explores the design and development of cultural and

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creative products [3] to meet the diverse needs of audience, and enhance the image and influence of the museum through the innovation and promotion of cultural and creative products. Therefore, its creative product design is a topic worthy of in-depth study. The purpose of this paper is to explore the transformation of cultural relics and culture of Capital Museum into symbolic features with both morphological factors, color factors and semantic factors based on design factor extraction, and then present the culture of Capital Museum by visual means, and further design various cultural and creative products. At the same time, the systematic design methods of cultural and creative products will be summarized in order to provide useful theoretical and practical reference for related fields and promote the development of cultural industries and the innovation of museums.

2   Research status

Design factors can be divided into dominant factors and recessive factors [4]. Dominant factors refer to genes that can be directly perceived and observed, such as appearance, shape and color. Implicit factors are related to emotional, cultural and historical connotations, such as semantic factors.

By searching the topics of Chinese and foreign core journals and manually screening, as of June 2023, a total of 63 related articles have been collected. These articles mainly focus on urban culture, national culture and other fields. Among them, the studies that have a certain degree of correlation with cultural relics and culture are as follows: You Lisi et al. [5] use shape grammar and other methods to extract Mongolian costume cultural factors and apply them to the design of audio, building blocks and other products; Liu Liang [6] established a design factor extraction model with factor weight to extract Qiang traditional dance culture; Wang Weiwei et al. [7] chose saline soil culture and Han Dynasty costume culture as the research basis, refined cultural factors through eye movement experiment and spectrum analysis, and organically integrated them into product design. These studies put forward effective design factor extraction methods for different cultural objects, and some of them have been successfully applied to product design practice.

Current research on design factor extraction in museum culture, particularly regarding the Capital Museum’s cultural creation, is scarce. This results in the museum’s cultural products, like metal badges, being mostly decorative with limited practicality. Additionally, the design of these products often fails to fully capture the museum’s cultural heritage. To enhance the appeal and quality of cultural and creative products, it’s essential to employ advanced design concepts and technologies for more innovative and practical items.

3   Research framework

As shown in Figure 1, the research is mainly carried out through the following three stages. 1) Research and summary stage: Go to the Capital Museum and other tourist attractions to interview tourists to understand their preferences and needs for cultural
and creative products; Deeply understand and analyze the development status of cultural and creative product design, so as to find out and put forward the direction of cultural and creative industry in museums. 2) Design factor determination stage: crawling, sorting and analyzing data information, extracting explicit and implicit design factors, and building a map. 3) Application practice stage: carry out weight ratio and factor combination of multiple factors, summarize systematic cultural and creative product design methods, and apply them to actual product design to verify its feasibility.

4 Research content

4.1 Investigation and induction stage

Target user interviews.

Data collected from shopping software and semi-structured interviews with 56 tourists at the Capital Museum and other attractions reveals preferences for cultural and creative products. The findings indicate a preference for high-value products (38 respondents), underscoring the importance of design and appearance in purchasing decisions. Additionally, daily use and commemorative products were favored by 32 and 29 respondents, respectively, highlighting the value placed on functionality, practicality, and commemorative significance. A minority showed interest in collectible products, suggesting limited expectations for value appreciation. Most respondents preferred high-tech exhibition modes over traditional ones[8]. These insights will guide the design of products that are valuable, practical, and commemorative, with an emphasis on integrating high-tech exhibition methods.

Cultural and Creative product analysis.

The main cultural and creative products of the Capital Museum, primarily metal badges, exhibit limited functionality and a lack of innovative design, often resorting to simple replication of colors, shapes, and patterns. This reflects a deficiency in design capabilities. To enhance product quality and market appeal, it is imperative to integrate advanced design concepts and technologies, fostering the development of distinctive and practical items.

Moreover, the prevalent issue of homogenization among cultural and creative products, as illustrated by the “I Know” series tapes from the Taipei Palace Museum, underscores the excessive commercialization and superficial engagement with cultural elements. Most products merely aggregate various patterns without meaningful differentiation or cultural depth. To counteract this trend, it is crucial to deeply explore and articulate cultural characteristics, prioritizing creativity and design uniqueness. This approach will ensure that products not only resonate with cultural narratives but also embody them authentically.

This paper investigates the cultural and creative products of the Forbidden City in Beijing, which are developing well at present, and selects the products with better sales performance for in-depth analysis. In order to understand the market feedback
more comprehensively, the PYTHON crawler program is compiled and applied to crawl and analyze 2090 user comments, and a word cloud map is generated. It can be clearly seen from the word cloud picture that users pay great attention to the appearance, workmanship and packaging design of products.

Based on the above research results, in the subsequent product design, more detailed planning and design will be carried out to meet consumers’ expectations for the overall product experience.

**Exploration of cultural tasks.**

Facing increasing tourism competition, museums like the Capital Museum in Beijing must differentiate to avoid aesthetic fatigue and diminished trust among visitors. This museum, focused on Beijing’s history and culture through its displays, competes with entities like the National Museum of China and the Palace Museum. However, its smaller collection and exhibit limitations necessitate the exploration of unique resources and elements, particularly in urban culture. To combat product homogenization, cultural and creative outputs should leverage specific exhibits like the Yandi Bronze Art and Ancient Jade Art Exhibition Halls, aligning product development with the museum’s unique aspects and ensuring relevance and practicality.

**Development direction of cultural and creative industries.**

The cultural and creative industry direction of Capital Museum stems from in-depth research results. It is planned to design cultural and creative products with high value, practicality and commemorative significance, and actively explore the exhibition mode integrating high technology to meet consumers’ higher expectations for museum visiting experience. In the subsequent product design, more detailed planning will be carried out to ensure that the product achieves excellent standards in visual appeal, practicality and commemoration. At the same time, we will deeply integrate the cultural elements of Beijing to ensure that the products have unique characteristics and avoid homogenization. These development directions aim to lead the museum's cultural and creative industry and enhance its leading position in market competition and attractiveness.

4.2 **Design factor determination stage**

In the process of in-depth study of cultural relics in Capital Museum, it is necessary to consider many characteristics of cultural relics, including their patterns, shapes and functional uses. When considering the cultural and creative industry direction of Capital Museum, special attention is paid to and the elements of Peking Opera culture are included, including the headdress and facial makeup of Peking Opera. Therefore, in this study, the patterns of jade articles, the shapes of bronzes, the headdresses and facial makeup of Peking Opera are used as the basis to extract morphological design factors, while the colors of Peking Opera costumes and bronzes are used as the basis to extract color design factors, and semantic factors are extracted by analyzing the
Analytic Hierarchy Process (AHP) and Factor Analysis (FA) are commonly used methods in extracting design factors. Analytic Hierarchy Process [10] is a multi-criteria decision analysis method, which is mainly used to determine the relative importance of each criterion in complex decision-making problems. Its core idea is to compare the relative importance of each criterion by constructing a judgment matrix, and at the same time consider the performance of alternatives relative to each criterion. This enables decision makers to systematically quantify the weights of each criterion and provides a structured basis for decision-making. In contrast, factor analysis [11] aims to reveal the potential structure of data sets. This study employs factor analysis to extract morphological characteristics from cultural relics and Peking Opera headgear, forming morphological factors. Additionally, it identifies commonalities in the colors of cultural relics and Peking Opera costumes to further refine these morphological factors. Furthermore, the functional uses of cultural relics are analyzed to uncover core semantic factors. Factor analysis reduces data complexity and dimensions by maximizing the variance of factor loadings, identifying and extracting latent factors, though it often requires subjective judgment.

**Extraction of morphological factors.**

Morphological factor is a kind of dominant design factor, which is mainly used to show the morphological characteristics of extracts. In product design, this factor will be intentionally integrated into the shape of the target design product to highlight specific appearance features or shapes, thus enhancing the uniqueness of the product.

In the study of the morphological factors of ancient jade articles, the patterns on exhibits are taken as the core objects, and the design optimization is carried out in the direction of cultural and creative products which are integrated with Peking Opera elements. The representative pattern elements on all cultural relics are preliminarily collected. Considering the historical position and cultural importance of cultural relics in museums, as well as the representativeness and symbolic meaning of patterns, the most representative pattern morphological elements are selected, and then the selected patterns are discolored, summarized, and refined, and line drawn to extract the smallest unit. On this basis, the pattern is further redesigned by means of corner and continuity, so as to ensure that the subsequent application is more convenient and professional. The research process and results of this part are shown in Figure 2.

In the study of morphological factors of Yandi bronzes, the appearance characteristics of cultural relics are abstracted, and the shapes and characteristics of these cultural relics are recorded in detail by accurately capturing key feature points to ensure the professionalism and depth of the research. Through comprehensive consideration of expansibility, series coordination and overall unification, the decision of in-depth study of cultural relics Pansy Tripod, Gui food container made for Ban and Ke He was finally determined. The refined appearance features are as follows: the two handles, three feet and the ornamentation on the lower edge of the Pansy Tripod; The overall shape of the two handles of the Gui food container made for Ban; The overall shape of the handle and container mouth of the Ke he. This series of in-depth research
work ensures a comprehensive understanding of the appearance characteristics of these cultural relics and provides a solid foundation for the subsequent design.

**Color factor extraction.**

Color factor is also one of the dominant design factors, which reflects the main color or color combination of the extracted product. In product design, designers can endow products with unique visual charm and convey specific emotional or cultural connotations by means of color factors, so as to achieve far-reaching design influence.

In the study of color factors of bronzes in Yandi, the images of bronzes were professionally processed. By removing the environmental content other than bronzes in the image, the theme color of bronzes is accurately extracted by using the Python program based on K-means clustering [12]. This step aims to eliminate the interference of environmental factors on the theme color of cultural relics and ensure that the extracted color set is true and accurate. The extracted bronze theme colors are optimized to ensure that they can be better and more directly applied to the subsequent design process.

In the study of the color factors of Beijing Opera, the clothing data of the four major trades were collected, and these data were carefully sorted out, classified and screened. By running the theme color extraction program many times, five characteristic colors of each line were successfully extracted, as shown in Figure 3, and these colors will be used in the subsequent design process.

**Semantic Factor Extraction.**

Semantic factors are implicit design factors, which represent the main semantic features of the extracted products. By integrating these features into the design products, the products are endowed with deeper design meanings and meanings.

In the study of semantic factors of bronzes in Yandi, we are committed to deeply understanding the uses of these cultural relics, and systematically divergent thinking based on the uses. Taking Pansy Tripod as an example, its main purpose is to cook food, which is similar to modern cooking pots, which leads to associations related to cooking, such as the profession of cooks or chefs; Taking Ke He as an example, its main purpose is to hold wine, which is equivalent to the current wine glass or container for holding wine, and it is associated with wine appraisers. This accurate use analysis and conscious divergent thinking provide a solid foundation for the follow-up design work, and ensure the depth and professionalism of the design.

4.3 Application practice stage

**Application practice of Yandi bronzes.**

In the application of Yandi bronzes, morphological, color, and semantic factors were integrated for the IP image design of three artifacts, considering the cultural and creative industry trends at the Capital Museum. Specifically, Beijing cultural elements were incorporated into each design: Pansy Tripod features roast duck, Gui food container made for Ban includes the bean juice cake element, and Ke He integrates Pe-
king Opera aspects. These considerations led to the creation of IP image drafts, which were then converted into three-dimensional visuals using Vega AI, with further refinement through Midjourney AI and Photoshop, resulting in the final IP image shown in Figure 4.

To enhance the appeal and authenticity of our series IP imagery, extensive design efforts were undertaken, focusing on creating rich backstories and compelling characteristics for each IP image. Furthermore, a variety of cultural and creative products have been created to appeal to a wide range of audience interests, as depicted in Figure 5. Additionally, an AR-enabled viewing method through special blind box cards has been devised, as illustrated in Figure 6. This innovative approach allows smartphone users to engage in an immersive cultural viewing experience. Integrating such technology brings cultural heritage into contemporary life in an interactive and engaging manner, offering museum visitors a unique viewing experience.

Application practice of ancient jade articles. 

In the application practice of ancient jade articles, special emphasis is placed on the introduction of Peking Opera elements and the integration of more traditional Chinese culture. Therefore, a series of masks were designed, which combined the four major trades of Peking Opera with the elements of the Zodiac, and added Peking Opera hair accessories to each mask to present a unique and diverse cultural creation. Then, based on the four major color factors of Peking Opera, combined with the morphological factors of jade articles and the facial makeup design of the Zodiac, the main visual design is formed, as shown in Figure 7 below. This main visual design subtly blends these elements together to create an image full of cultural connotations. This image not only has artistic beauty, but also conveys the unique essence of Beijing culture.

Further, apply this design to the derivative design of actual products, as shown in Figure 8. The design of these practical products is not only impressive, but also successfully incorporates modern elements into Beijing culture, realizing the goal of daily dissemination and dissemination of culture. The overall research provides an innovative way for the inheritance and development of Chinese traditional culture. By combining Peking Opera, jade articles and Zodiac elements, it shows the charm of Beijing culture in a unique and creative way, and provides a valuable reference for the practical application of cultural inheritance and innovation.

5 Conclusion

In the current economic tide of globalization, the exchange and penetration of soft power among countries has reached an unprecedented level. As the key medium of cultural soft power, design is shaping the future of cultural exchange with extraordinary power. At the same time, the living standards and cultural literacy of Chinese people have generally improved. With the relative abundance of living conditions, people's demand for spiritual and cultural aspects is increasing day by day. Capital Museum, located in the center of Beijing, is not only a cultural treasure house full of
profound cultural connotations, but also a precious carrier of Beijing's cultural traditions. Starting from the culture in the Capital Museum, this study establishes a set of design factor extraction model based on morphological factors, color factors and semantic factors, puts forward the development direction and design ideas of cultural and creative products, and designs cultural and creative products incorporating Beijing cultural elements through practice. This research has not only made remarkable achievements in the field of cultural and creative product design, but also provided new opportunities for the further development and dissemination of museum cultural and creative products. This is a positive response to the promotion of the country's soft power, and it is also a profound exploration of the inheritance of local culture, closely following our mission in today's globalization era, that is, to protect, inherit and innovatively inherit our cultural traditions, so as to make them shine more brightly on the international stage.

**Fig. 1.** Research Process on Design Factors of Cultural Creative Products in the Capital Museum
<table>
<thead>
<tr>
<th>Cultural Relics Name</th>
<th>Extraction Location of Cultural Relic Pictures and Patterns</th>
<th>Pattern Type</th>
<th>Pattern Extraction and Redesign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jade Cloud-Shaped Pendant</td>
<td></td>
<td>Rolling Cloud Shape</td>
<td><img src="image1" alt="Rolling Cloud Shape" /></td>
</tr>
<tr>
<td>White Jade Dragon Ornament</td>
<td></td>
<td>White Jade Dragon Ornament</td>
<td><img src="image2" alt="White Jade Dragon Ornament" /></td>
</tr>
<tr>
<td>White Jade Twin Cranes Ling Pattern Jade Ornament</td>
<td></td>
<td>White Jade Twin Cranes Ling Pattern Jade Ornament</td>
<td><img src="image3" alt="White Jade Twin Cranes Ling Pattern Jade Ornament" /></td>
</tr>
<tr>
<td>Green Jade Phoenix Pattern Set Pendant</td>
<td></td>
<td>Cloud Pattern</td>
<td><img src="image4" alt="Cloud Pattern" /></td>
</tr>
<tr>
<td>White Jade Fish-Shaped Pendant</td>
<td></td>
<td>White Jade Fish Shape</td>
<td><img src="image5" alt="White Jade Fish Shape" /></td>
</tr>
</tbody>
</table>

**Fig. 2.** Study and Outcomes of Morphological Factor Extraction in Jade Artifacts

**Fig. 3.** Extraction Results of Color Factors in the Four Major Roles of Peking Opera

**Fig. 4.** Process and Showcase of Intelligent Property Character Creation
Fig. 5. Series of Cultural and Creative Derivative Products 1

Fig. 6. AR Viewing Cards Display

Fig. 7. Key Visual Design Showcase
Fig. 8. Series of Cultural and Creative Derivative Products 2

Reference


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