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## INNOVATIVE DESIGN OF DUN HUANG CAISSON LOTUS PATTERN IN SUI DYNASTY

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### ABSTRACT

This paper proposes a method for designing culture-creative products of the caisson Lotus pattern to better inherit the art of Dunhuang and meet contemporary aesthetic requirements. Initially, researcher analyzes the caisson Lotus patterns of Dunhuang in the Sui Dynasty. Then, a practical case study of the Lotus pattern is designed based on four stages of design practice, namely: association, concretization, transformation, and implementation. Literature reviews and case studies are the main research methods used in this paper. The literature review was used to summarize Lotus pattern types and characteristics. In the case study a series of workshops was conducted to implement cultural and creative product design. Research diaries, text analysis, observations, interviews and other data collection methods are used in the data collection process. This study shows that the Lotus pattern from the Sui dynasty is the most representative pattern. The design products created using the Lotus element are cultural, functional, and aesthetic and meet people's needs. It provides a feasible solution to the innovative pattern design problem.

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## 1. Introduction

The Dunhuang Mogao Caves, located in China's western corridor, are a significant repository of Buddhist art, featuring 735 caves and 45,000 square meters of frescoes, with only 492 caves fully preserved.

Spanning from the pre-Qin era through multiple dynasties, including the influential Sui Dynasty (581–618 AD), the Mogao Grottoes are renowned for their vibrant caisson ceiling patterns. These patterns, particularly the Lotus motifs, reflect a blend of Northern Dynastic, Central Plains, and Central and West Asian influences. Despite their cultural significance, the preservation of these murals faces challenges due to natural and human factors, leading to deterioration. While efforts to preserve and innovate Dunhuang's heritage are increasing, research on Sui Dynasty caisson patterns remains limited. In the context of growing interest in traditional cultural innovation and creative industries, this study aims to systematically examine the Sui Dynasty Lotus patterns and develop a methodology for their application in cultural and creative product design, addressing both aesthetic and emotional consumer needs.

## **2. Literature Review**

### **2.1 The Evolution and Significance of Caisson Patterns in the Sui Dynasty Mogao Caves**

The Dunhuang Mogao Caves are in China's west corridor. The Dunhuang culture dates to the pre-Qin era, crossing the Sixteen Kingdoms, Northern Dynasties, Sui, Tang, Five, XiXia and Yuan Dynasties. A total of 735 caves and 45,000 square meters of frescoes makes this site one of the largest and richest Buddhist art site in the world. However, only 492 caves have been preserved in their entirety. Aside from this, the Mogao Grottoes in Dunhuang are well known for their vibrant decorative pattern art, which has earned them the title "world art treasure house" (Duan Wenjie, 1999). The Sui dynasty (581 AD–618 AD) was a great unification dynasty after three centuries of division. The unification of the north and the south, the connection of the Silk Road, and the integration of northern and southern cultures exerted a great impact on the patterns of the Mogao Grottoes. The structure of the inscribed caisson ceiling in the Sui Dynasty (439 AD–581 AD) broke away from the Northern Dynasties. A few unique patterns were created by painters of the Sui Dynasty, by inheriting pattern characteristics from the Northern Dynasty, drawing from Central Plains culture, and integrating many Central Asian and West Asian arts into both the Central Plains and foreign styles. Obviously, the Caisson pattern of the Sui dynasty is famous for its variety and richness and is worth studying by researchers.

Caisson (ZaoJing) is the ceiling of traditional Chinese architecture. It is a roof shaped like a well. The caves are decorated with the caisson motif, which is the focal point of Dunhuang patterns. The ceiling of traditional Chinese architecture is known as the ZaoJing. It has a well-shaped roof. The name of the structure, Zaojing, is derived from the Chinese legend of putting out fire with water. Traditional structures are made of timber, which are flammable. Our ancestors used "algae" to refer to a form of algae and grass pattern associated with water centuries ago. The caisson refers to the indoor ceiling in traditional Chinese architecture. In the Dunhuang Dictionary, the definition is as follows: "The square part of the Dunhuang Grottoes" (ji,1998). The caisson is shown in Figure 1.

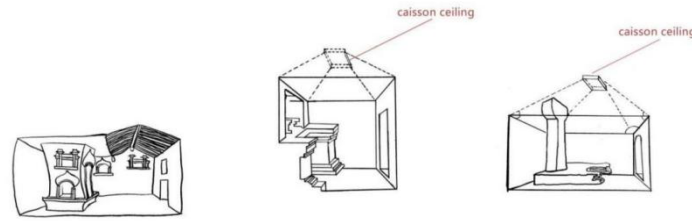


Figure 1. Caisson in Dunhuang Grottoes  
(source: The author painted herself)

## 2.2. Challenges and Innovations in the Preservation and Creative Design

In recent decades, mural resources have dwindled due to natural and anthropogenic factors. According to the latest statistics, more than half of the murals and color sculpture in the caves of Mogao Grottoes have diseases such as discoloration, shedding etc. (Fu et al., 2019). An increasing number of institutions, scholars, and artists have joined the Dunhuang preservation team, considering the importance of Dunhuang's intangible cultural heritage to the Chinese government. Unfortunately, only a small number of scholars devote research to the caisson patterns of the Sui Dynasty in Dunhuang art research. Moreover, it was failed to inherit and innovate Dunhuang culture effectively, due to a lack of systematic and innovative research on Lotus patterns by scholars. Thus, the Caisson Lotus pattern of the Sui dynasty is the focus of this paper.

In recent years, traditional cultural Innovation has increased in the field of design. An increasing number of researchers and designers have begun to pay attention to cultural and creative products design. The Beijing Municipal Committee of the CPC and the Beijing Municipal People's Government issued "Opinions on Promoting Cultural and Creative Industries Innovation and Development" on June 21, 2018. The concept of a cultural and creative product design industry is regarded as one of the most significant strategies for inheriting and innovating traditional culture, by academia and the Chinese government. There is no doubt that Dunhuang is one of the greatest cultural treasures of China and the world. It is well-known for its patterns and time-honored culture. Thus, the Caisson pattern is frequently used in the design of cultural and creative products, and there are a lot of cultural and creative products on the market. At present, however, Dunhuang cultural products design lacks innovation, homogenization is more prominent, not only can't fully extract Dunhuang cultural elements, but also are relatively simple in design. Furthermore, the innovative design of the Lotus pattern lacks a unified system of design methods that can be used for implementing a unified design methodology. Therefore, the innovative design of traditional patterns has always been a challenging issue in design, particularly on the cultural and creative markets.

## 2.3. Integrating Emotional and Cultural Elements in Product Design

It is difficult to differentiate product design, as consumers look for functionality and appearance, but also for an emotional experience with the products. The selection of a particular design method is also crucial to Lotus' cultural and creative products. Cultural creative products are the result of design activities in which cultural resources and elements are utilized creatively and strategically to produce

unique products (Lee, 2018). Clearly, a design strategy that emphasizes the relationship between emotional and cultural elements may be more pertinent to the design of culturally creative products. However, the integration of emotional characteristics into the design of cultural and creative products is not as straightforward as the form and function of product design. This requires a high level of cultural literacy and exceptional design skills on designers. To achieve the high level of emotional value, or design innovation, requires carefully developing products' visual aesthetics and creativity of design (Lee, 2019). You's design model is valid in the design process (Lee et al. 2019). Figure 2 shows the three steps of the image transforming design process (You et al. 1996). It is inextricably linked to this design process model, which emphasizes the Transformation of abstract concepts into symbolic images and then into tangible product forms, to design a culturally creative product, which involves creatively and strategically utilizing and transforming cultural resources and elements into new products.

Based on You et al. design process theory (1996), this study applies the Lotus pattern to the design of cultural and creative products, to fit the innovative design of the Lotus pattern and satisfy consumers' aesthetic requirements. This design model includes 3 stages (see Figure 2):

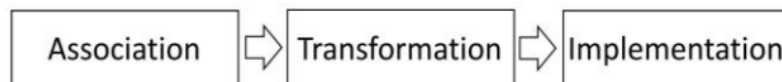


Figure 2. Image transforming design process (You et al. 1996)

Association is the initial stage of design in which the primary objective is to investigate and describe experience, ideas, and perception of the design subject, i. e., to reflect available cultural resources.

Transformation is the second stage of the design process, which is composed of divergent and convergent thought. At this stage, the primary focus is on visualizing and symbolizing concepts, from selected ideas and images to simplified graphics to feasible product forms, using either freehand Sketching or Software.

The final stage of the design process, which involves both convergent and divergent thinking. In this stage, the primary objective is to transform selected product concepts into actual products or prototypes. In this phase, product form details, structure design, color scheme, and material selection are completed. In certain instances, the design team must also consider production issues.

### 3. Methodology

Qualitative and case study methods were used in this paper to achieve the research objective. The concept of qualitative research revolves around understanding and interpreting the subjective experiences, meanings, and perspectives of individuals or groups. It is a research approach that seeks to explore the complexities and nuances of human behavior, social interactions, and cultural phenomena (Chen Xiangming, 2000). This qualitative study aims to summarize the types and characteristics of Lotus during the Sui Dynasty. In the process of collecting data, literature reviews and text analyses are employed.

A case study is an empirical inquiry that investigates contemporary phenomena in their real-world context (Yin, 1984). As the distinctions between the phenomenon and its context are not readily apparent, researchers construct their studies using multiple sources of evidence. In other words, a case study is a specific method of observing any natural phenomenon that exists within a data set (Yin, 1984). An online workshop was conducted in this study to analyze the participants' experiences and design ideas regarding design innovation activities. To ensure the effective development of the cultural creative product design-tea set, ten participants were invited to Workshop based on the design process theory of You. During the workshop, each participant is required to record the design thinking process, to verify that the initial design of the product model has been defined correctly.

#### 4. Findings and Discussion

##### 4.1 Types and Characteristics of Lotus Patterns in Mogao Grottoes during the Sui Dynasty

The Sui Dynasty can be divided into three phases based on the form, content, and artistic style of the grottoes: the early stage, the middle stage, and the last stage (Fan Jinshi, 2022). Based on the data from books and fieldwork at Dunhuang, we have been able to calculate the number of caissons installed during the Sui dynasty. A total of 735 caves in Dunhuang have been discovered, of which 84 date back to the Sui Dynasty (618-907 AD). Details are shown in Table 1.

Table 1

Statistics on the Number of Caves with Caisson in Mogao Grottoes in Different



| Phase             | Era            | Total Number of Caves | Number of Caves with |
|-------------------|----------------|-----------------------|----------------------|
| I (early stage)   | 581-589 A.D.   | 7                     | 2                    |
| II (middle stage) | 589-613 A.D.   | 33                    | 10                   |
| III (late stage)  | After 613 A.D. | 44                    | 29                   |

It has been found that the lotus patterns in the center of the caisson of Mogao Grotto are the most prevalent, numerous, and representative ones. Thus, in this paper, the caisson lotus pattern is investigated. The lotus is the most prevalent pattern in the Mogao Grottoes of Dunhuang, representing Buddhist purity, and it is a symbol of good fortune and purity. In China, people call them Hehua. The lotus in the Mogao Grottoes is not a realistic image of lotus, but rather an image of a lotus that has been sketched and manipulated by painters who have extracted the most distinctive forms of the lotus. It represents a lotus that is decorative, symbolic and allegorical. In the inscribed caisson ceiling pattern, the lotus is generally referred to as an unfolding figure, placed in the center of the well. There are three, four or more layers, and the lotus petals are either single or compound lotus petals. Based on their designs and organizational forms, researchers divided Sui Dynasty caisson lotus patterns into four categories: A: round-shaped petal lotus pattern, type B: peach-shaped lotus pattern, type C: lapped lotus pattern, and type D: triple hares lotus pattern.

***Type A round-shaped petal lotus pattern***

The round-shaped petal lotus pattern is the only one of its kind in the Sui Dynasty, as we have found through our research. The main feature is a three-layer lotus flower pattern with a single layer of nearly oval shaped petals, densely arranged. The slender petals, colorful painting, and haloed method, which makes it look like a sunflower. The lotus pattern consists of three single layers of lotus flowers, represented by Grotto 305 of the Sui Dynasty. Although this is the only example of the type A available from the Sui Dynasty, by comparing with other types of lotus pattern in previous period of history, it reveals that this type of pattern is an inheritance of the oval shape of the large lotus pattern in the circular wheel of Grotto 296 from the Northern dynasties, with one additional layer of petal. In terms of timeline, there is a relationship of inheritance and development of the lotus pattern, as shown in Table 2.

Table 2  
Type A round-shaped petal lotus pattern



| Code   | Illustration  | Source from   |
|--|---|---|
| Grotto 296<br>from the Northern Zhou Dynasty |   | Dunhuang caisson ceiling, edited by Yang Dongmiao and Jin Weidong |
| Grotto 305 from the Sui Dynasty              |  | Dunhuang caisson ceiling, edited by Yang Dongmiao and Jin Weidong |

***Type B peach-shaped Lotus Pattern***

Pattern type B, a single layer of eight-petal lotus pattern, the main feature of which is the peach-shaped, slightly fattened petals, the top of which is colored with a halo of pale pink peach heart color blocks. This type of lotus pattern is represented by Grotto 403 in the middle Sui Dynasty and Grottoes 313 and 393 in the late Sui Dynasty, as shown in Table 3.





Table 3  
Type B peach-shaped Lotus Pattern

| Cod   | Illustration  | Source from   |
|---|---|---|
| Grotto 403<br>from the Sui Dynasty                                  |  | Dunhuang caisson ceiling, edited by Yang Dongmiao and Jin Weidong |
| Grotto 403 from the Sui Dynasty<br>Partial image of caisson ceiling |  | Dunhuang caisson ceiling, edited by Yang Dongmiao and Jin Weidong |

**Type C lapped lotus pattern**

Type C is a double overlapped lotus pattern, the petals of which are broad in form and oval peach-shaped, and a peach tip is placed at the top and a semi-circular calyx at the bottom between the petals. The first layer of petals around the center of the well resembles a triangular shape with a peach tip at the top. This type of lotus pattern was inherited and developed in the later Sui Dynasty in Grottoes 311, 314, 390 and 394, as shown in Table 4.



Table 4  
Type C lapped lotus pattern

| Code  | Illustration  | Source from   |
|---|---|---|
| Grotto 405<br>from the Sui Dynasty                                  |  | Dunhuang caisson ceiling, edited by Yang Dongmiao and Jin Weidong |
| Grotto 405 from the Sui Dynasty<br>Partial image of caisson ceiling |  | Dunhuang caisson ceiling, edited by Yang Dongmiao and Jin Weidong |

### **Type D triple hares and lotus pattern**

The main feature of triple hares lotus pattern is the drawing of three hares in the center of the lotus, which is divided into two patterns, depending on the shape of the petals and the number of layers. The center of the lotus flower pattern of pattern is painted with three rotating rabbits, and the petal type is two layers of similar peach-shaped petals, which are represented by Grotto 406 and Grotto 407 of the Sui Dynasty.

Table 5  
Type D triple hares and lotus pattern

| Code                               | Illustration   | Source from   |
|------------------------------------|--|---|
| Grotto 406<br>from the Sui Dynasty |   | Dunhuang caisson ceiling, edited by Yang Dongmiao and Jin |
| Grotto 407<br>from the Sui Dynasty |  | Dunhuang caisson ceiling, edited by Yang Dongmiao and Jin |

Since ancient times, our people have held the lotus flower in high esteem. The Lotus "emerges from the mud and remains undefiled" (quoted from Chinese classical literature) and is known as the gentleman of flowers. Lotus pot unearthed from Chinese Bronze Age is extremely famous. By comparing the Lotus patterns from different periods, a combination of Lotus patterns and other patterns emerged in the middle of the Sui Dynasty, however, the succession of Lotus petals image has a returning tendency of localization.

#### **4.2 Case Study - From Caisson Lotus Pattern to Cultural and Creative Product Design**

In this module, research is conducted through workshop. An innovative product project incorporating a Lotus pattern was developed based on the theory of the design process. To conclude the research, it is necessary to conduct four workshops with five Chinese graduates with design expertise. The assignment given to the design team was "developing a cultural creative product inspired from Lotus pattern, analyzing and applying image of Lotus to product design". In addition, this novel product would be utilized in a small museum of culture for educational purposes. In the subsequent sections, the case study illustrates the design process in detail.

##### **4.2.1 Association Stage: Artwork Conception**

###### **4.2.1.1 Symbolize the Dunhuang Image to Inherit and Develop Dunhuang Culture**

The art of Dunhuang is extensive and substantial, encompassing mural paintings, painted

sculptures, and architectural masterpieces from multiple historical eras. It is a cultural treasure that represents the combination of Buddhist art and traditional Chinese culture in a concentrated form. It is crucial to develop Dunhuang art to produce outstanding artistic design works that not only have traditional cultural connotations but also adhere to the Times' aesthetics.

For instance, during the interview, interviewee A (Professor) stated:

"Dunhuang art, with Dunhuang grottoes art as its primary body, combines art categories such as murals, colored sculptures, and architecture, and expresses the contents of ancient art, architecture, music, dance, clothing, decoration, and crafts. It can be seen that Dunhuang art is extensive and profound, and outstanding design works have played a crucial role in enhancing the aesthetic character of the people and promoting Dunhuang culture."

It stands to reason that as designers we ought to try to inherit the culture of Dunhuang.

#### **4.2.1.2 Developing a Tea set products using Lotus pattern as element**

In China, people usually refer to Lotus as the HeHua. Lotus is the predominant motif in the Mogao Grottoes of Dunhuang. It represents the Pure Land of Buddhism and serves as a symbol of purity and good fortune. First, the association method was employed by researchers and design participants during the brainstorming phase to establish a cultural link between the Lotus pattern and the tea set product. For example, as early as the Spring and Autumn period, bronze ware in China included Lotus ornamental designs; later, as interest in Buddhism expanded, porcelain took its place as the preferred material. Lotus is also highly regarded by Chinese writers and poets. The Northern Song Dynasty scholar Zhou Dunyi wrote in his essay 'Love the Lotus', „The Lotus is immaculate in the mud, clean in the water, straight in the middle and straight outside, and not a vine; it is a pavilion of pure plants that can be viewed from a distance but not profanely touched. „The scholarly class of the Song dynasty associated the natural characteristics and morphology of the Lotus with ethics and humanism, as demonstrated above. As a result, the researchers determined to create cultural and creative products with Lotus as the design element. Mind Maps are used in seminars to assist designers in exploring, locating, and documenting design concepts (See Figure 3).

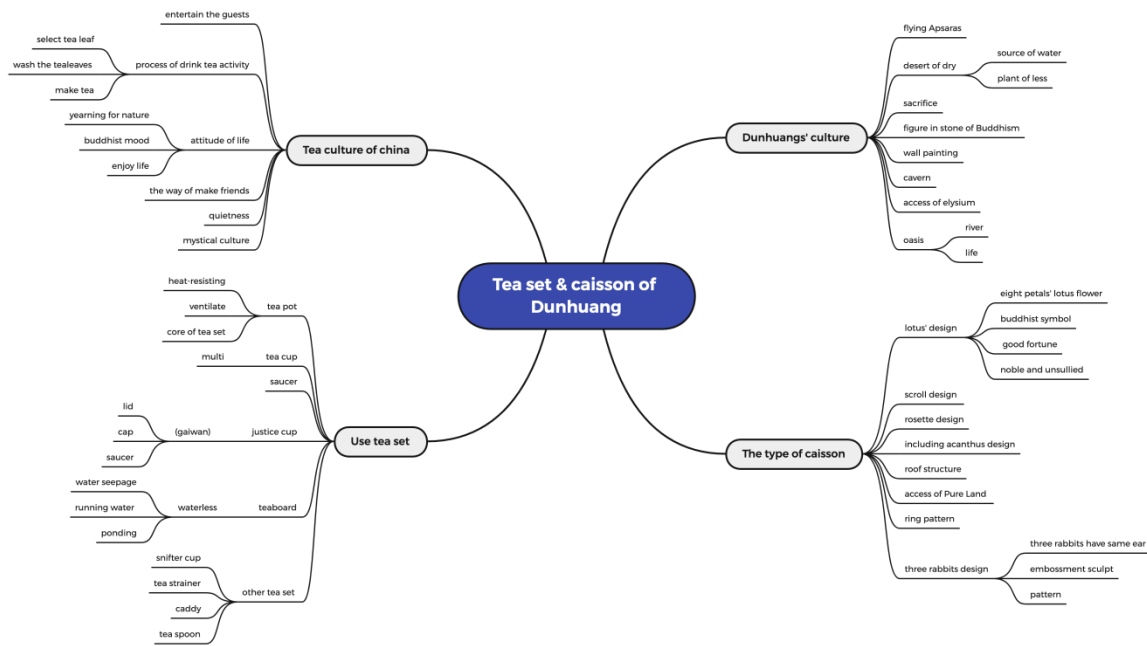


Figure 3. Using mind mapping techniques to explore, seeking, and recording ideas

### 4.3 Idea Development Stage: Defining Design Objectives

At this stage, convergent thinking is essential for determining design objectives. After analyzing the ideas generated in the previous phase, the researchers identified a few key concepts closely associated with the users, which is Buddhism, peace, beauty, kindness and tolerance. The combination of flowers and product design in China can be traced back to the Song Dynasty (Yang Zhishui, 2016). During the Song Dynasty, people's love of flowers was integrated into their daily lives, from the court nobility to the common people. While at the same time, China is a country that has a strong tea culture. The habit of drinking tea is one that people from all walks of life have in common. As a result, the tea set's shape is blended with the Lotus pattern, created innovative products that are more easily accepted by the audience.

### 4.4 Transformation Stage: Visualizing Design Concepts

This is a critical step in transforming abstract notions into physical visuals. The design activities are complicated and could be an iterative process in which divergent thinking and convergent thinking frequently interchange (Lee, 2019). The researcher employed design techniques to visualize and represent the five emotional terms described in the preceding phase. Additionally, the product's function, structure, and manufacturing processes must be considered. The creative process is guided by cultural, aesthetic, contextual and pragmatic principles. (Liping Qiu 2015).

### 4.5 Implementation stage: Finish the prototyping

There are two sub-stages within the implementation phase. In the first stage, researchers primarily use 3D computer software to design tea set structures; the primary objective at this stage is to create models of novel products. (See Figure 4) The main objective of the second sub-stage is the prototyping a new product. After the two stages are completed, the tea set design will be displayed in a cultural museum exhibition with the goal of spreading Dunhuang culture. There is more to the Lotus tea set

designed by researchers than just a tea set; It is also a philosophy of life. This design resembles a coiled Lotus symbolization, symbolizing that a person should be tolerant of the world.



Figure 4. The prototypes of Tea Set (source: Kang Sujuan and Liu Zhoulin 2023)

## 5. Results

To verify the design effect, researchers conducted a study on Tea set creative product design involving 100 participants aged 26 to 60 years old in China. The study was carried out via an online questionnaire.

In the survey of 100 respondents, 80% of respondents were willing to purchase this tea-set product. However, 15% of respondents felt the product's design was too complicated and refused to purchase it. An additional 5% of respondents believe that the item could be used as a personal collection. The results indicate that it is feasible to use Lotus patterns as design elements to create new products (see figure 5).

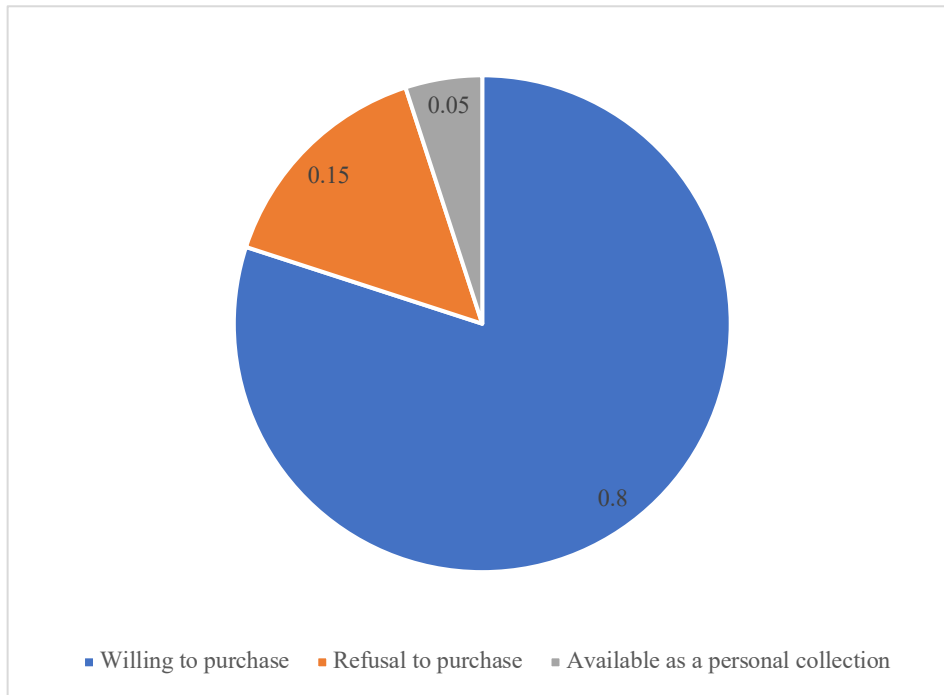


Figure 5. Tea set product survey report

## 6. Conclusion

As the cultural and creative industries encompass a vast array of facets, there are numerous factors that influence the design of cultural and creative goods. Due to limited human resources, time and space, there is still place for improvement in this investigation. Its decorative patterns are inspired by the Dunhuang caisson patterns, showing the culture of Dunhuang. This inspiration should guide the next generation of Chinese people to continue inheriting traditional culture with new and innovative ideas. Local designers are becoming increasingly interested in Dunhuang culture because of the emphasis being placed on the understanding and application of traditional pattern concepts in the design of cultural and creative products. It is thus possible to expand this research not only to cover lotus patterns, but also to include other Dunhuang patterns as well, which would contribute to the creative development of products.

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## Authors Contributions

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No conflicts of interest were disclosed by Kang Sujuan in relation to the research, authorship, or publication of this article.

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