

Exploring Fashion Geometric Pattern Design Process Using a Semiotic Method

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Abstract

In recent years, the rapid growth of the economy and increasing degree of globalization have led to a continuous increase in demand for cross-cultural design. To meet this demand, the academic community and the fashion industry have continuously analyzed and developed methods for providing cross-cultural fashion pattern design. This study explores a symbol-based fashion pattern design method. Several commonly used geometric patterns in fashion pattern design were selected as research objects, and a method of symbolizing patterns in fashion pattern design was proposed to suit cross-cultural design. When redesigning fashion geometric patterns, typical patterns are symbolized. The results showed that the processed samples exhibited good adaptability for design applications. Therefore, this study indicates that the symbolic method can be applied to fashion pattern design, and this design method can be further systematized to achieve cross-cultural fashion design.

Keywords: semiotics, cross-cultural, fashion design, pattern design

1. Introduction

Over the past two decades, technological development and globalization have had a huge impact on fashion pattern design (Giri, 2021). Advances in digital printing technology and computer-aided design software have allowed designers to create more complex patterns more efficiently (Grow, 2019). Especially in recent years, affected by the COVID-19, e-commerce platforms have exploded, and the global demand and coverage of fashion products have expanded significantly, which also means that the demand for cross-cultural design has increased significantly (Landim & Bazaki, 2021).

However, despite these developments, fashion pattern design still faces challenges when designing across cultures. Current fashion patterns have their own pattern classification habits in each country, which makes it difficult for designers to optimize existing designs and create effective cross-cultural design (Christensen, 2018). In addition, designers must consider the local cultural significance of patterns when creating designs for audiences in different cultural backgrounds, which can also be a complex and challenging task.

To address these challenges, semiotic approaches in the field of art design have been proposed. This approach involves the classification of patterns based on the cultural meaning of symbols (Bharath et al., 2023). Among the many semiotic theories, the most widely used is Peirce's semiotic theory. Peirce's theory of semiotics divides signs into icons, object, and interpretant (Moradi, 2023). Gain insight into the cultural context and meaning of different patterns by understanding the different levels of symbolism. Based on this, designers can create more effective cross-cultural designs.

To sum up, this study uses semiotics to analyze the existing fashion geometric patterns and optimize the existing pattern classification methods. Provide a foundation for further building a cross-cultural design framework in the field of fashion design. It provides a basis for further building a cross-cultural design framework in the field of fashion design.

2. Method

2.1 Pattern Symbolization

Graphical symbolization is used in mathematics, architecture, art and other fields (Shaygozova et al., 2023). In the field of fashion art design, pattern symbolization is used to match colors and fabrics to create visually attractive design works (Huang, 2022). Graphical symbolization helps designers convert geometric patterns and other patterns into graphic elements with the help of symbolic language, classify and become more convenient building blocks for design.

Existing research mentioned that there are several ways to symbolize geometric patterns: using symbols; using diagrams or using mathematical formulas (Moradi, 2023). The choice of method depends on the purpose of symbolization, the object, the designer's field of expertise, etc. (Bowcher & Liang, 2022).

Using symbols: For example, in mathematical geometry, we usually use shape symbols such as lines, points, surfaces, etc. to represent geometric patterns (Gaita & Wilhelmi, 2019). These symbols can be used to describe the formal characteristic properties of geometric patterns and communicate these characteristics to others through the work.

Using diagrams: Diagrams can represent complex patterns in a simple and intuitive way. For example, Euler Diagram: This is a diagram that shows the relationship between different sets of objects. It consists of circles that represent each set and the overlap between them (Friedman, 2022).

Use Mathematical Formulas: This is also a powerful way to symbolize geometric pattern. When designing, it is necessary to use computer programs and other methods to construct complex patterns by adjusting parameters (Friedman, 2022). For example, Koch Curve Algorithm: This is an algorithm for creating fractal curves. It takes a straight line and keeps adding triangles to it, creating a self-similar pattern (Zimin, 2022).

This article chooses the first method: using symbols. The theoretical system of the ternary relationship of signs proposed by Peirce, an important scholar in the field of semiotics, provides a way of thinking for the research of this topic. This system includes the symbols 'Object', 'Representamen' and 'Interpretant' (Ji, 2011). He believes that representation is the visible part of the sign that can be perceived; the subject is what the sign represents; interpretation is the cognition that the sign evokes in the human brain and the psychological impression it produces (Xu, 2018).

Based on this, Peirce developed a series of symbol theories, the most influential of which is the 'Trinity' theoretical framework of 'icon', 'index' and 'symbol'. Among them, the icon is related to the objective fact by similar image; the index is related to the object through the physical or logical connection; the statistic is related to the social concept or usage rules through the conventional connection (Zhang, 2021). The relationship between these three is shown in Figure 1.

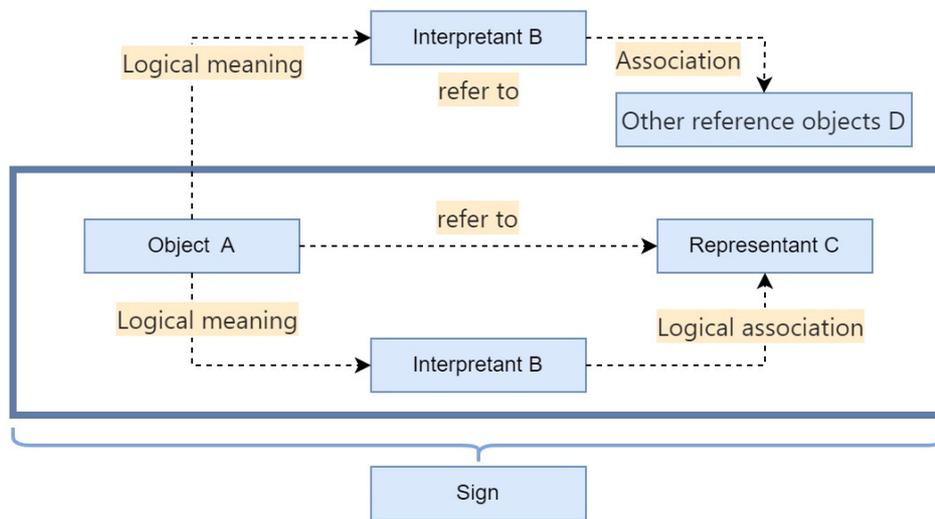


Figure 1. The relationship between Peirce's semiotic rule of thirds

As shown in Figure 1: In Peirce's 'rule of thirds' theory, the production of any selected symbolic meaning has the existence of these three elements. As shown in the figure above, the symbol itself A plays a decisive role in referring to the object C. From the point of view of referring to object C, it is referring to A. But the relationship between the symbol itself A and the referent C is not opposite, they are interrelated by the explanatory item B. The logical relationship guided by this explanatory item B is the key factor for the generation of symbolic meaning (Yin, 2022). In Peirce's theory of signs, the explanatory term of a sign is the bridge between the two 'meaning gaps' that connect the sign and the referent (Xu, 2018). Therefore, the referents corresponding to the same symbol are often not unique, and may even be multiple. Explanation item B may also exist in the form of a 'new reappearance'. This link is also called 'infinite semiosis' in Peirce's semiotic theory (Zhang, 2015).

The goal of this study is to identify the cultural knowledge behind fashion geometric patterns under cross-cultural influence, to classify forms based on cultural connotation and semiotics, to analyze the culture-specific morphological grammar of fashion geometric patterns, and to apply them in design practice. Along the way, emphasis is placed on employing semiotics to explain and understand the complex ideas embodied in symbolic data. Based on the

above-mentioned Peirce theory, this research draws a design model in combination with the requirements of specific fashion design works. This study draws a model for the design process based on Sun's research (Sun & Gao, 2021).

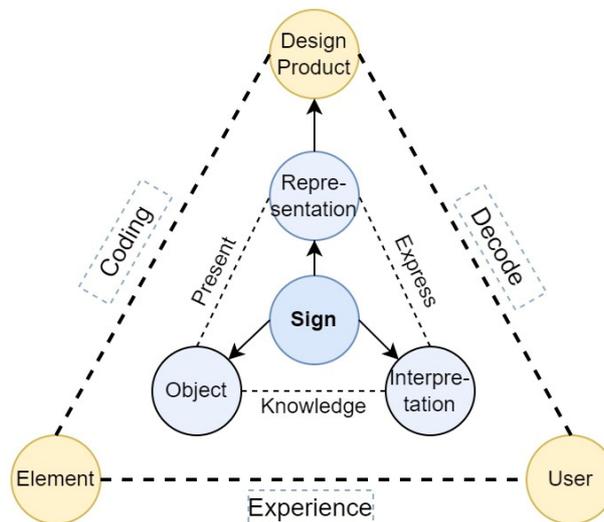


Figure 2. Design model for this study

As shown in Figure 2, the three elements of ‘representation, object, and interpretation’ are a classic model that continues Peirce's semiotic theory. When applied to fashion pattern design, the three concepts of ‘product, element and user’ are added to jointly construct the design model of this study (Sun & Gao, 2021).

The initial steps of the model include selection of pattern elements, resolution. In the subsequent design process, we start to explore patterns and symbols across different cultural backgrounds, and establish key connection points between elements and products. Then, the designer uses various design techniques, such as combination, metaphor, coding, etc., to code the pattern with cultural connotation, and considers the color and the function of the product comprehensively on the basis of focusing on the morphological characteristics (Christensen, 2018). After the coding process is complete, the designer needs to introduce and popularize the symbolic elements of the product to the user in order to get the intended meaning (Shafi, 2018). The three basic factors of this model expansion: product, element and user, respectively correspond to Peirce's representation, object and explanation ternary relationship. Thus, this model provides a useful analysis of the fashion product design process and provides guidance for considering what is in each component during the design process.

2.2 Research Procedures

According to the methodology and design model described in the previous section, combined with the 4A methodological framework (Martin, 2022), the operational steps of this research are finally clarified as shown in Figure 3.

The whole research process of this study is divided into four parts, which are: Appreciate the research situation, Analyze the research material using semiotic concepts, Assess and adjust the framework, Act to bring about change. The first stage is to evaluate the current research status of the subject, determine the research objectives, and start collecting the original data. In the second stage, samples are selected from the collected original data to carry out symbolic classification of patterns. Then, the classified data is deeply analyzed to find out how the research objective is related to the interpretant part, representation part and representation part. On this basis, this research summarizes and establishes the classification framework. Then it enters the third stage to verify, evaluate and adjust the classification framework. The verification process can be divided into internal verification and external verification. Finally, according to the above evaluation results, the classification framework generated in the early stage is refined and adjusted, and a classification framework more suitable for design practice is finally formed.

2.3 Determine the Design Goals

Define the cultural background and audience of fashion product design. Before starting the analysis, it is first necessary to define the cultural context and audience for fashion product design. This is also the primary consideration for designers when designing and creating. In addition, fashionable geometric patterns may have different meanings in different cultural backgrounds or periods (Potgieter, 2018). Therefore, it is imperative to be clear about the audience and cultural context of a fashion design project in order to be able to create meaningful and culturally appropriate designs.

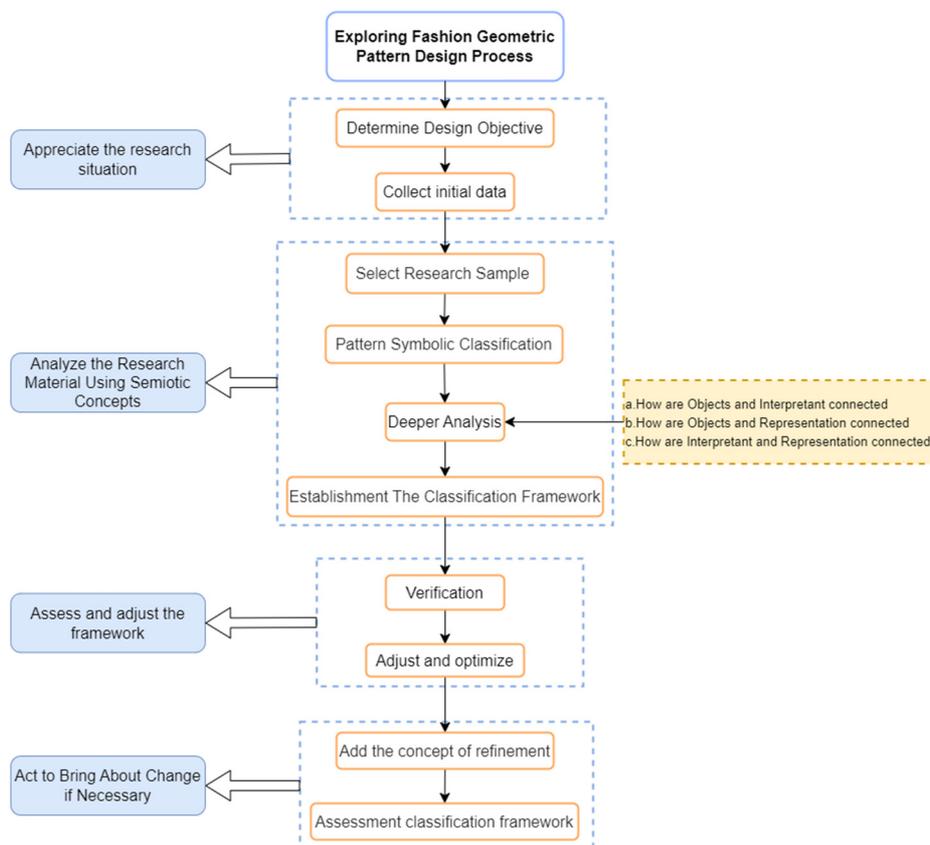


Figure 3. Design Process

2.4 Collect Initial Data and Select Pilot Sample

Identify typical geometric patterns. Collect time and area as the initial scope. Collect typical geometric patterns as initial data. As mentioned above, data should be collected by time and region as an initial scope and standard. Sources of pattern data can be books, articles, or online databases (Landim & Bazaki, 2021). A systematic and organized approach to data collection ensures comprehensiveness and validity of pattern data.

The sample population should represent the cultural region or time frame to which the selected audience belongs. Typical trendy geometric patterns in this range can be discussed. This process involves identifying certain geometric patterns in the initial data (Zhao, 2022). If necessary, subsets can be created based on various factors (such as cultural origin, historical period, and symbolic significance), so that their special cultural significance can be marked for subsequent analysis.

2.5 Symbolic Classification and Analysis

Based on Peirce semiotic theory to analyze the cultural background, identify the relevant symbols and their meanings.

Peirce's theory of semiotics holds that a sign consists of three elements: the sign, the object it represents, and the explanatory terms associated with the sign (Zhang, 2021). When studying fashion geometric patterns, we can understand the pattern according to the direct, indirect or abstract relationship between the representation and the object, and extract cultural symbols, which corresponds to Peirce's symbolic trichotomy (Moradi, 2023). In this way, not only can the visual symbols on the surface be clearly displayed, but also the cultural symbols with deep connotations can be presented, thereby providing innovative ideas for fashion pattern design.

This analysis should focus on the relationship between 'object' and 'interpretation' in Peirce's theory of semiotics. It should also examine how 'object' and 'representation' are connected, and how 'interpretation' and 'representation' are connected.

2.6 Establish a Framework of Classification Methods.

Using the analysis of steps 3-5, establish a framework of classification methods based on Peirce's semiotic theory to systematically and organizedly classify the selected geometric patterns.

2.7 Verify and Adjust the Results.

It can be verified by comparing the results of symbolic classification with the original data. It is also possible to complete the test frame by picking a new set of geometric patterns. Using the established framework, a preliminary classification system for geometric patterns can be created.

The initial classification framework was tested and refined based on feedback. This step is important to refine the classification framework and ensure its accuracy and completeness. The validation results can validate the preliminary classification system to ensure that it accurately represents different types of geometric patterns. Based on the feedback, the preliminary classification framework can be tested and improved. This involves subsequent refinement of categories or supplementary subcategories to ensure that the framework accurately reflects the characteristics of the pattern data being analyzed.

2.8 Complete the Framework.

The assortment of trendy geometric patterns can be further refined by adding the concept of refinement. and classification to complete the classification framework. Categories can be refined or subcategories can be supplemented to better analyze and understand the characteristics of fashion geometric patterns.

Finally, the taxonomy framework can be evaluated against the initial goals and cultural context. Assess whether the framework is appropriate for the audience and cultural context, fits the design goals, and whether it provides a valid understanding of the cultural significance of fashion patterns.

3. Results

With a semiotics-based pattern classification framework, we are able to quickly identify accurate fashion geometric patterns. Through further deduction, a reproducible graphic element classification framework and design method based on semiotics theory are obtained.

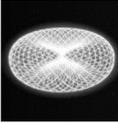
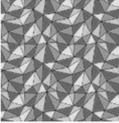
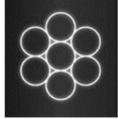
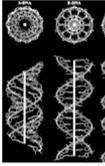
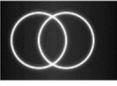
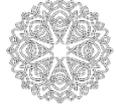
3.1 Symbol Systematization of Fashion Pattern Arrangement and Recognition

The study analyzed the fashion geometric patterns selected through the database, and extracted their characteristic elements from the perspective of semiotics. Including 'similar symbols', 'indication symbols' and 'reduction symbols'. 'Visual', 'tactile' and 'auditory' symbols were extracted in 'Like Symbols'. Symbols under the logic of 'cause and effect' and 'whole and part' were extracted in 'Denotative Symbols'. 'Cultural reduction symbols', 'historical reduction symbols' and 'artistic reduction symbols' are extracted in 'reduction symbols'.

3.2 Symbolic Framework Construction

On the basis of the basic idea of the classification of fashion geometric patterns, the symbolic classification framework is initially built as shown in Table 1 (Ni et al., 2021).

Table 1. Symbolized Pattern Classification

Iconic symbol code collection			Indicative symbol code collection			Protocol symbol code collection		
Auditory Sense	Visual Sense	Tactile Sense	Causality	Partial	Integrity	Cultural Protocol	Historical Protocol	Art Protocol
								
Fire Pattern	Tree of Life	Torus	Metatrons Cube		Star Tetrahedron	Flower Of Life	Swastika Protocol	The Egg of Life
								
Water Pattern	DNA	Icosahedron	Vesica Piscis	Mountain	Merkabah	Merkabah		Mandala Pattern
								
Wind Pattern	Monad		Hui Pattern	Lock Pattern	Hui Pattern	Hui Pattern	Lock Pattern	Bead Pattern

3.2.1 Icon

The part of the similarity symbol pointing to the object depends on the ‘similarity’, that is, the selection of patterns that are directly related to things. But likeness does not necessarily have to be images, but can also be connections in the senses of smell, hearing, touch or taste. Symbols representing resemblance are not necessarily materialized reference objects, but can be purely fictional (Ni et al., 2021).

In the part of ‘similar symbols’, starting from the morphological composition, the fashion geometric patterns are analyzed according to the ‘five senses’, focusing on the extraction of ‘visual’, ‘tactile’ and ‘auditory’ symbols. Arrange the code sets of these visual symbols to form a table of codes, see the three columns on the left in the above table for details.

Taking the extracted sound symbols as an example, in the extraction of ‘auditory’ graphic elements, by collecting a large number of pattern materials and analyzing them, it is found that the materials of the auditory part mainly come from water flow, fire, wind, human voice, birds, animals, fish and insects the sound of. Among them, different combustion states and sounds will be formed between fire and different combustibles (oil, wood, paper). There will be sound changes when the wind hits walls and bridges. The water flow can form a special form of auditory artistic expression in different flow states, objects falling into it, whether there are obstacles, etc. These changes can be reflected through changes in the shape of the lines. Like the water pattern in the picture, the shape of the vortex vividly expresses the meandering flow of the sound when the water encounters obstacles in the water, directly imitating and abstracting the natural form of the water, and obtaining the geometric pattern visible in the picture.

3.2.2 Index

A denotation is a symbol that establishes an abstract connection with an object. Indicators are like a bridge built between concepts and graphics, pointing to meanings is indirect, allowing the recipients to understand in a way similar to hints. Usually, a logical combination rule is established between the indicator symbol and the object to be expressed, so that the pattern symbols can be combined into a sequence.

In the ‘Designative Symbols’ section, the fashionable geometric patterns are analyzed from the perspective of logical relationship. Pay more attention to the relationship between symbols and objects, such as causality, adjacency, part and whole, etc., and let the receiver associate with the object through the hint of the symbol. Emphasis is placed on the extraction of the ‘cause and effect’, ‘part’ and ‘whole’ symbols. Arrange the code sets of these visual symbols to form a table of codes, see columns 4-6 in the above table for details.

Taking causal symbols as an example, the table lists the classic graphics: Metatrons Cube. It is a very complex two-dimensional geometric figure consisting of 5 platonic solid figures. Among them: the star tetrahedron symbolizes the element of fire, and the sharp figure composed of two tetrahedrons symbolizes the heat of fire. The hexahedron represents the earth element, and the regular straight lines are used to symbolize the solidity and firmness of the earth. The icosahedron represents the element of water. It consists of 20 equilateral triangles. The smooth and uniform shape reminds the audience of water. This kind of causal logic is very important in establishing the connection between graphics and audiences, and the power of this suggestion can often have a positive spiritual impact on people.

3.2.3 Protocol

Conventional signs are the most complex but richest type of signs in Peirce's semiotics theory system.

The connection between reduced symbols and objects has jumped out of the category of natural connection and direct connection, and is an abstract connection established by 'consciousness' and 'spiritual' power. For designers or audiences, it is necessary to rely on conventional interpretations to understand such symbols, which is also an important basis for realizing cross-cultural design.

In the 'Reduction Signs' section, fashion geometric patterns are analyzed from the perspective of abstract 'consciousness'. Focus on extracting the three types of symbols of 'historical reduction', 'cultural reduction' and 'artistic reduction' to form a code table, see columns 7-9 in the above table for details.

Take the swastika pattern in historical reduction as an example. The word '卍' is a symbol widely circulated in the world. It does not correspond to specific things in life, but exists in an absolutely abstract form, but it has different meanings in different cultural contexts. In China, the '卍' pattern is a pattern that has been passed down from Buddhism to daily life. Because the structure of this pattern itself can extend infinitely in four directions, and at the same time, these four lines that can extend infinitely must converge at the center, so in China this pattern means longevity and everything goes well. Similarly, in the cultural context of Buddhism and Hinduism, the swastika symbol represents good luck and happiness. But on the contrary, in the Western world, the swastika has become synonymous with the Nazi Party and its atrocities. In Germany and Austria In other countries, it is illegal to display this sign. This requires us to clearly mark such patterns when combing reduction symbols, so that designers will not only focus on their forms and ignore their cultural meanings when using such symbols.

3.3 Pilot study

A pilot study was conducted in a design application to see if the method and classification framework for symbolizing geometric patterns could aid design. Take the design theme of 'sustainable development' as an example to screen and redesign symbols (Hyojung, 2022). The process is shown in the table below. First of all, when it comes to sustainable development, the sustainability of resources comes to mind. As a circular resource, water can be used continuously, but it is in urgent need of protection. So choose 'water' as the entry point for pattern design.

From the symbolic level, it can be considered from the perspective of vision and hearing. Visually, curves can be used to express the state of water flow. Use radial concentric ripples to express the sound and state of something falling into the water. These two geometric symbols are relatively direct associations.

From the point of view, first consider the symbolic meaning of water from the perspective of causality. The state of water flow can be continuous and continuous, so the curve selected at the symbolic level can be further geometrically deformed, and the two-way continuous form can be used to express the sustainability of water. On this basis, animal and plant patterns are added in the middle of the continuous curve to express the nourishment of water to all things ((Ye , 2021).

From the level of reduction symbols, we focus on cultural reduction and historical reduction. The 'continuous' character of water extracted from the signage can be applied to other forms of pattern, such as straight lines and sharp corners. In cultural reduction, continuous linear geometric patterns are used to express happiness and wealth, which are continuous and uninterrupted like water. The pattern at this time has no direct connection with the intuitive water in terms of form, but the spiritual core is consistent, and it is an abstract expression of the spirit that wants to be conveyed. On this basis, the pattern can be done quite freely.

Next, you can use the basic principles of graphic creativity, such as contour symbiosis, replacement isomorphic graphics, and extended meaning graphics, to deform the pattern. The overall composition of the pattern can also be positive and negative, up and down interlaced to achieve two-sided continuous or four-sided Arranged in a continuous form. On the basis of retaining the core idea, further morphological evolution is carried out on the extracted visual symbol elements.

4. Discussion

This study aims to explore how to find a semiotics-based clothing pattern analysis framework and design method for

cross-cultural design in the context of the era of cross-cultural cooperation and increasing demand. After a rigorous design process, it is proved that the application of semiotics in fashion geometric pattern design is effective. By dividing the patterns into three categories of 'similarity', 'indication' and 'reduction', not only a new idea of pattern classification is proposed, but also when designing with this perspective, it can broaden the design ideas, inspire design inspiration, and accurately express Thought.

The results of the study showed that the processed samples showed good adaptability in design applications. Therefore, this study shows that semiotics methods can be well applied to clothing pattern design, and this design method can be systematized in the future to further realize cross-cultural clothing pattern design.

Some limitations of the study were also found in the semiotic classification and design of the pattern.

The first is the stage of 'reduction' classification of geometric patterns. The meaning of culture in different contexts cannot be directly recognized through vision. It requires manual and accurate information collection and processing. In the stage of data classification, there are high requirements on the time and ability of researchers.

The second is the product application stage. Designers can use geometric patterns through the classification framework. However, when users identify products, whether they can accurately understand the intentions that designers want to convey needs further research. Insufficient research on user characteristics and experience may affect the stability of the final product. Referring to other studies of the same type, visual surveys of users can be added to design applications to further address this issue.

5. Conclusions

The method used in this study is based on the third method of Peirce's semiotics to symbolize the graphic symbols. A classification framework is constructed through three stages of symbol extraction, pattern symbol classification and pattern symbol redesign. This research is also based on the excavation, verification and design of visual symbols by predecessors. After design and verification, a design framework of stylish geometric patterns was finally formed. This framework includes the complete design process from initial design target confirmation, to pattern symbolization, to symbolized pattern application

It provides more basis for the symbolic classification of fashion geometric patterns, enriches the symbolic material library of geometric patterns, and also provides effective expansion ideas for the development of patterns. This research can provide more innovative ways for designers to realize the form creativity of fashion geometric patterns and enrich the connotation of patterns. At the same time, a positive impact on fashion graphic design or similar cross-cultural and global.

Acknowledgements

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