

Innovative application of batik patterns in Cheongsam design

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ABSTRACT – REZUMAT

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To explore the sensory imagery differences in Cheongsam styling resulting from the combination of various batik pattern themes, this study selected four different thematic categories of batik patterns and used commonly worn Cheongsams as the research carrier. By integrating these elements, 24 Cheongsam research samples were developed, along with six pairs of Kansei words forming the semantic space for evaluation. A survey questionnaire was designed to collect consumers' sensory evaluation of the Cheongsam samples. Subsequently, data analysis was conducted using SPSS 26.0. The results indicate that two primary Kansei factors influence the appearance of batik-patterned Cheongsams, which were identified as the style factor and the temperament factor based on their characteristics. Different batik pattern themes combined with Cheongsam exhibit distinct sensory imagery in their appearance. Cluster analysis further revealed that Cheongsam samples within different clusters possess unique sensory evaluation characteristics, while those within the same cluster show a high level of consistency in overall sensory evaluation of appearance. This study proposes design methods and recommendations for the integration of batik patterns with traditional Cheongsam, expanding the development path for the application of batik patterns in traditional garment design. It contributes to the preservation and development of batik culture from the perspective of intangible cultural heritage and provides insights into the innovative design of traditional handicrafts.

Keywords: batik, Cheongsam, factor, Kansei engineering, sensory imagery, SPSS

Aplicarea inovatoare a modelelor Batik în designul rochiilor Cheongsam

Pentru a explora diferențele de imagistică senzorială în stilul rochiilor Cheongsam rezultate din combinarea diverselor teme de modele Batik, acest studiu a selectat patru categorii tematice diferite de modele Batik și a utilizat rochiile Cheongsam purtate în mod obișnuit ca suport de cercetare. Prin integrarea acestor elemente, au fost create 24 de probe de rochii Cheongsam pentru cercetare, împreună cu șase perechi de cuvinte Kansei care formează spațiul semantic pentru evaluare. A fost conceput un chestionar de sondaj pentru a colecta evaluarea senzorială a consumatorilor cu privire la probele de rochii Cheongsam. Ulterior, analiza datelor a fost efectuată utilizând SPSS 26.0. Rezultatele indică faptul că doi factori Kansei primari influențează aspectul rochiilor Cheongsam cu modele Batik, care au fost identificați ca factorul stil și factorul temperament pe baza caracteristicilor lor. Diferitele teme ale modelelor Batik combinate cu Cheongsam prezintă imagini senzoriale distincte în ceea ce privește aspectul lor. Analiza cluster a relevat, de asemenea, că probele Cheongsam din cadrul diferitelor cluster dețin caracteristici unice de evaluare senzorială, în timp ce altele din cadrul aceluiași cluster prezintă un nivel ridicat de consistență în evaluarea senzorială generală a aspectului. Acest studiu propune metode de design și recomandări pentru integrarea modelelor Batik cu Cheongsam-ul tradițional, extinzând astfel perspectivele de dezvoltare pentru aplicarea modelelor Batik în designul vestimentar tradițional. Acesta contribuie la conservarea și dezvoltarea culturii Batik din perspectiva patrimoniului cultural imaterial și oferă perspective asupra designului inovator al meșteșugurilor tradiționale.

Cuvinte-cheie: Batik, Cheongsam, factor, inginerie Kansei, imagini senzoriale, SPSS

INTRODUCTION

As an important part of China's traditional culture, Batik holds a unique status and plays a significant role in Chinese heritage. It also serves as a valuable resource for contemporary cultural innovation. Batik, historically known as wax-resist dyeing, is recognised as one of the four major traditional Chinese dyeing and weaving techniques, alongside clamp-resist dyeing, tie-dyeing, and ash-resist dyeing [1]. Batik is a traditional Chinese folk handcrafted printing and dyeing technique that mainly uses wax knives and liquid wax as tools and materials, and natural fibre fabrics such as cotton and linen as creative carriers.

Through the processes of indigo solution dyeing and boiling-water dewaxing, batik creates patterns with strong ethnic and regional characteristics, embodying historical depth and artistic value [2]. In 2006, Miao batik was included in the first batch of national intangible cultural heritage representative projects [3]. Regarding batik craft, many scholars have taken Miao batik techniques and patterns as research objects, analysing their unique cultural connotations, artistic characteristics and innovative design applications in modern products. For example, Tian et al. [4] proposed an automatic generation method for batik floral patterns based on the Iterated Function System within fractal geometry. This method aims to facilitate

the digitalisation and innovative design of the printing and dyeing industry while supporting the spread and development of intangible cultural heritage, such as batik. By incorporating fractal theory, designers and users can achieve the automatic generation and transformation of batik patterns. Chen et al. [5] proposed a method to extract batik fabric patterns and elements. The method preprocesses digital images of batik fabrics using morphological preprocessing, extracts pattern elements, and generates independent element images. The Canny algorithm extracts the overall contours of batik elements. This method enables efficient digital storage and promotes the further development of batik patterns. To promote the inheritance of batik techniques among young people, Zheng et al. [6], from the perspective of user experience, established the Kano model to classify and optimise the demand factors generated by users during the batik experience, and proposed new ideas such as the re-creation of the pattern of batik, finished product carrier, and experience process. Finally, they designed a batik technique process that meets the user experience of young users. Bao et al. [7] analysed the artistic expression techniques of batik fabrics and conducted innovative research on the method of combining batik and other handicraft printing and dyeing techniques by examining the artistic expression of batik fabrics. They broadened new perspectives for the preservation and development of the traditional art of handmade printing and dyeing. Li et al. [8] combined batik patterns with clothing design, segmented and reorganised batik patterns and colours, and created derivative patterns by combining the three-dimensional craftsmanship of fabrics, enriching the cultural heritage and artistic connotation of modern fashion and protecting the continuation and inheritance of batik culture. This approach is guided by the interests and aesthetic preferences of modern people.

However, the above research mainly focuses on the digital generation and preservation of batik patterns, the user experience of batik techniques, batik process innovation and the design of modern products, but there is a lack of research on the innovative application of batik patterns in traditional clothing. The Cheongsam reflects China's historical and cultural tradition, still popular and practical today, and it serves as an ideal medium for integrating batik pattern elements [9]. Based on the existing research results, this paper takes batik patterns as the research subject, the traditional Cheongsam as the design medium, and uses Kansei engineering as the theoretical framework. It uses objective analysis methods such as quantitative analysis and factor analysis to explore the changes in consumers' cognitive perception of different styles of batik patterns combined with Cheongsam. The findings of this study provide a theoretical reference for designers in creating and developing batik Cheongsams that better meet consumers' sensory needs and provide a reference for consumers to choose products that meet their sensory needs. Furthermore, this paper summarises design and application methods for combining

batik patterns with Chinese traditional clothing, Cheongsams, based on Kansei engineering. This is to offer practical insights and help for the application of batik folk culture in the innovative design of traditional clothing, and to promote and develop new directions for batik art. At the same time, the integration of batik and Cheongsam fosters symbolic reconstruction and cultural hybridity, revealing aesthetic characteristics typical of the Chinese cultural context and reaffirming the role of dress as a marker of identity construction [10].

DETERMINE THE STUDY PROTOCOL

Theory of Kansei Engineering

The concept of Kansei engineering was first proposed by Kenichi Yamamoto in October 1986 [11]. Kansei refers to the overall perception a person experiences of an artefact, environment, or situation through their senses of sight, hearing, touch, smell, taste, and cognition [12]. Kansei engineering technology is a method that visualises and quantifies the user's sensory imagery and finds the correlation between it and product attributes to guide design and research [13]. While meeting the subjective needs of consumers, it provides designers with a more efficient product design and development approach [14]. Currently, Kansei engineering is involved in clothing style, colour, fabric and function design [15].

Determine the batik pattern

Batik refers to a dyeing process in which wax is melted into liquid form and applied to the preconceived pattern areas of the fabric. The fabric is then immersed in dye to achieve colouration. Due to the water-insoluble properties of wax, the applied wax forms a resist layer on the fabric's surface, protecting the original colour and preventing the dye from penetrating the material. Finally, the wax is removed through washing, revealing the desired pattern [16]. From an overview of the current batik product market, the rapid development of the market economy has driven the transformation of batik production from traditional handmade family workshops to mechanised factory-based production. To some extent, this shift has increased the production volume of batik products and expanded production channels. However, challenges remain, such as the lack of diversity in patterns, motifs, and the types and properties of substrates used in batik production. However, batik products still face challenges such as a lack of diversity in patterns, motifs, and the types and properties of carriers used.

Batik patterns, as an embodiment of artisans' aesthetic consciousness, are characterised predominantly by stylised visual forms and composition [17]. In this study, extensive batik patterns were collected and systematically classified through market surveys and website research. Subsequently, expert consultations, interviews, and literature reviews were conducted to categorise the collected batik designs into four categories based on their subject matter and stylistic features: plant patterns, animal patterns,

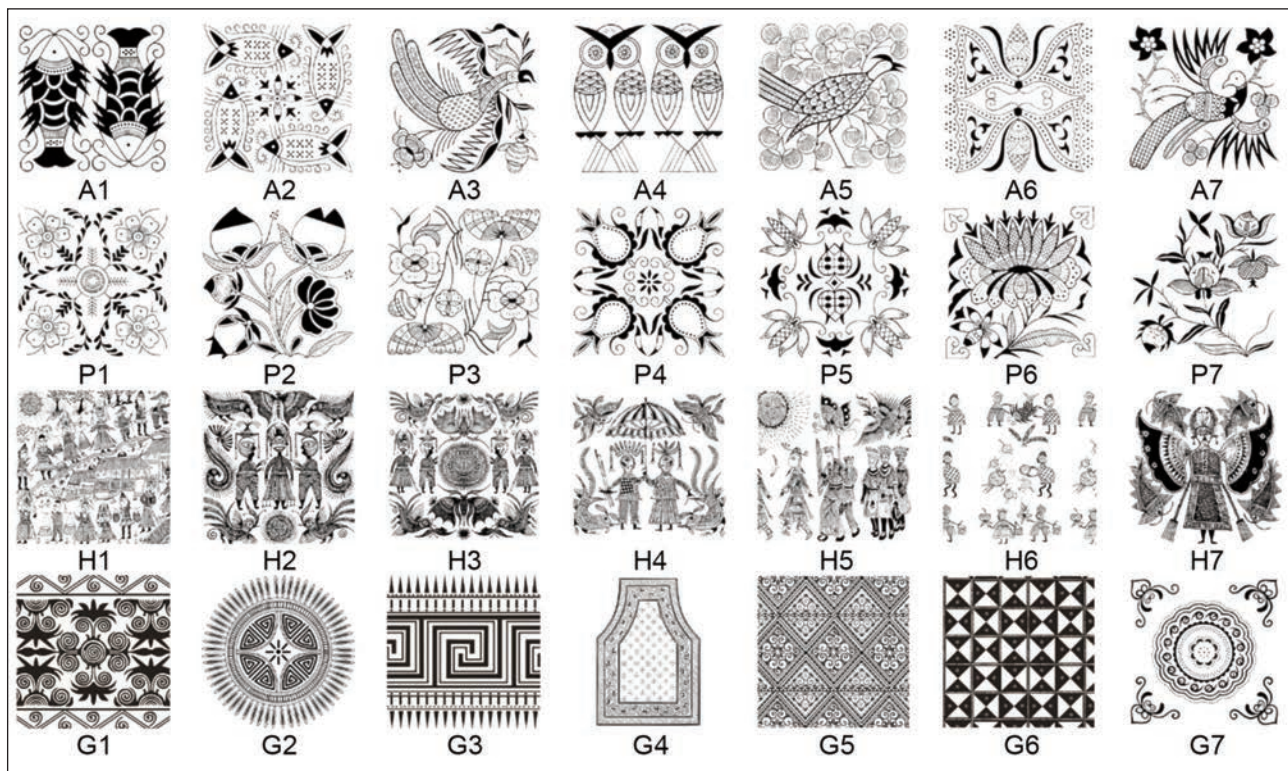


Fig. 1. Study sample of the batik pattern

geometric patterns, and human figure patterns. Through field research and the examination of physical artefacts, the collected patterns were further analysed and categorised. Ultimately, seven representative patterns were extracted from each category, resulting in a total of 28 batik patterns selected as representative samples for subsequent pattern analysis. To ensure that the subsequent sensory evaluations were not influenced by fabric material, colour, clarity, or size, the 28 selected batik patterns were standardised using Adobe Photoshop 2021. The images were subjected to correction, desaturation, sharpness adjustment, and parameter modification. All pattern samples were converted into black-and-white vector graphics with identical settings, and the image dimensions were uniformly set to 2.0 cm × 2.0 cm. In addition, batik patterns with high similarity were arranged separately to improve differentiation. The specific styles of batik patterns are shown in figure 1. Patterns No. A1-A7 are animal batik patterns, No. P1-P7 are plant batik patterns, No. H1-H7 are human figure batik patterns, and No. G1-G7 are geometric batik patterns. The numbering system includes a visual key in which the letter before each number serves as an index to differentiate the pattern categories.

Determine the Cheongsam sample

Using CorelDraw software, the batik patterns from figure 1 were individually applied to a stand-up collar basic Cheongsam design of the same size, with adjustments made to their arrangement, combination, and orientation as needed. All samples were

then standardised as black-and-white vector graphics with dimensions of 5.0 cm in height and 2.0 cm in width, yielding 28 final images. Cheongsam samples No. a₁–a₇ incorporate animal batik patterns; p₁–p₇ incorporate plant batik patterns; h₁–h₇ incorporate human figure batik patterns; and g₁–g₇ incorporate geometric batik patterns. The 28 samples were randomly coded, as shown in figure 2.

QUESTIONNAIRE INVESTIGATION AND ANALYSIS

Determine the Kansei word pair

A large collection of adjectives describing the style and design of batik-patterned Cheongsams was first compiled. Subsequently, a focus group consisting of 40 participants was invited to discuss and refine the adjective set. The group included: ten senior practitioners with over 20 years of experience in traditional ethnic hand-dyeing and garment craftsmanship; ten university faculty engaged in teaching and research on ethnic textile printing and apparel design, with an average teaching tenure of more than 10 years, several of whom have 15–20 years of academic experience; ten professional designers specializing in ethnic hand-dyeing clothing with substantial practical experience in the industry; and ten Cheongsam enthusiasts who consistently purchase, collect, and wear Cheongsams and have a deep understanding of their stylistic attributes. All participants had close connections with either batik or Cheongsams and long-term exposure to batik Cheongsam design, enabling them to make informed judgments. This

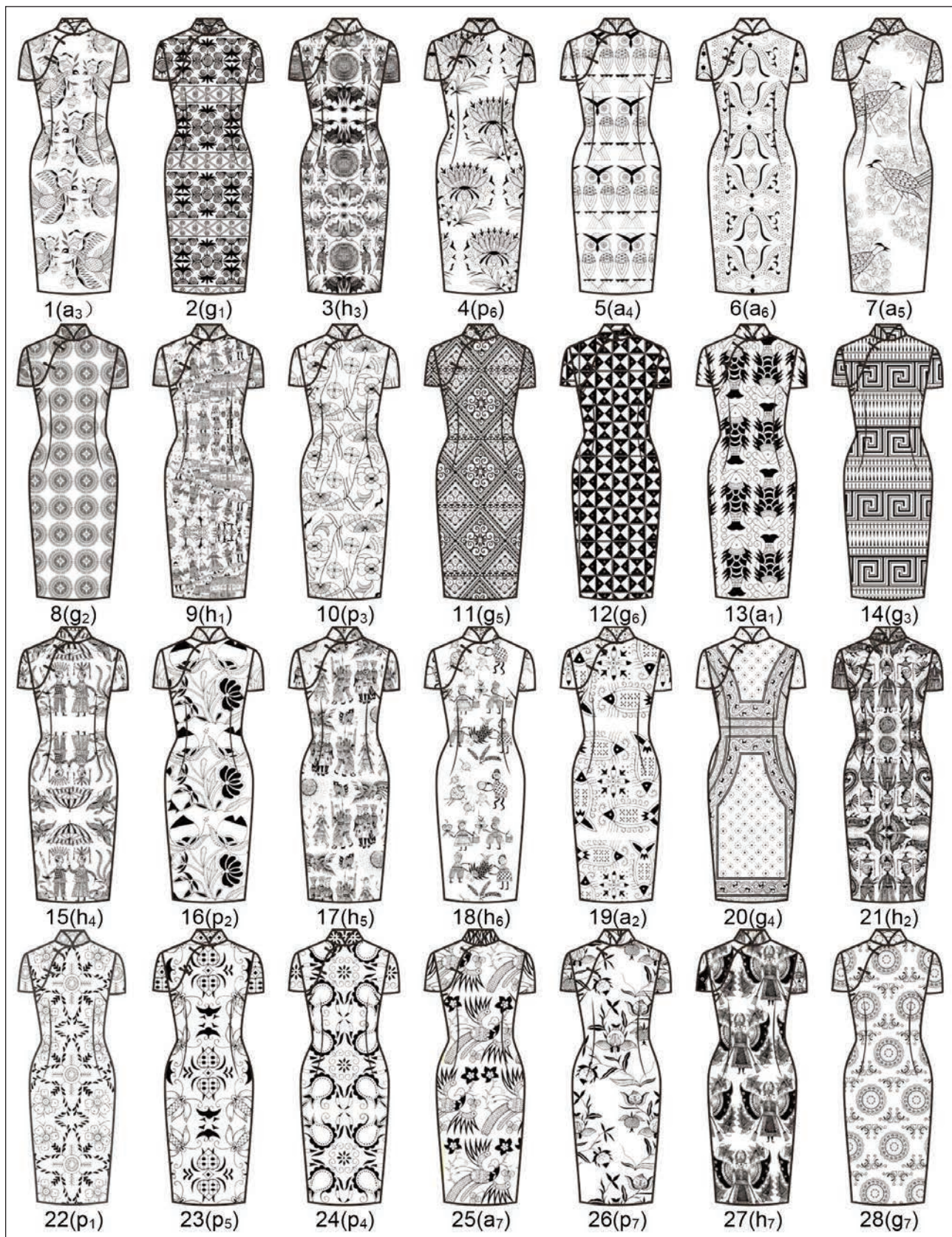


Fig. 2. Cheongsam study sample

composition ensured the reliability and validity of the adjective selection process. Through a structured screening process, less commonly used, redundant, and semantically similar adjectives were eliminated. Ultimately, six pairs of high-frequency, semantically opposite adjectives were identified as Kansei words

for subsequent research. The final six pairs of Kansei words are as follows: Simple-Complex, Modest-Luxurious, Reserved-Expressive, Traditional-Avant-garde, Orderly-Disorderly, and Youthful-Mature.

To further ensure the reliability and objectivity of the adjective selection process, both Cronbach's alpha

and the Intraclass Correlation Coefficient (ICC) were employed for dual verification. Cronbach's alpha was used to assess the internal consistency of the 40 evaluators' ratings regarding the "validity of the Kansei adjectives". A coefficient of Cronbach's alpha ≥ 0.70 was considered indicative of acceptable reliability. The ICC was used to examine the inter-rater agreement on the "priority ranking of Kansei adjective pairs", where $ICC \geq 0.60$ was considered acceptable, and $ICC \geq 0.75$ was regarded as excellent. The results demonstrated high reliability across both indicators. For Cronbach's alpha, the coefficient for "relevance ratings" was 0.82, and the coefficient for "semantic clarity ratings" was 0.79, both exceeding the acceptable threshold of 0.70. This indicates strong internal consistency among the 40 evaluators and the absence of substantial subjective discrepancies. Regarding inter-rater agreement, the ICC calculated from the "adjective priority ranking" data was 0.81 (95% CI: 0.72–0.88), surpassing the 0.75 benchmark for excellent reliability. These results confirm that the six selected Kansei adjective pairs were recognised with a high degree of consensus and were not affected by evaluator background differences. Accordingly, they can be considered a reliable semantic basis for subsequent Kansei evaluation.

Questionnaire survey

The survey questionnaire was designed using a five-point semantic differential scale. Participants evaluated the research samples based on the meanings of six pairs of Kansei words, assigning sensory ratings accordingly. The assigned scores indicate the degree of association between each Kansei word pair and the corresponding Cheongsam sample. The five scale points were set as follows: -2, -1, 0, 1, and 2. For example, considering the Kansei word pair "Simple-Complex", a score of -2 indicates that the sample is perceived as highly simple, 1 represents moderately simple, 0 signifies a neutral perception (neither simple nor complex), 1 suggests moderately complex, and 2 indicates highly complex. The specific evaluation format of the questionnaire is shown in table 1.

Table 1

QUESTIONNAIRE EVALUATION FORM						
Kansei word	Scale points					Kansei word
	-2	-1	0	1	2	
simple	-	-	-	-	-	complex
modest	-	-	-	-	-	luxurious
reserved	-	-	-	-	-	expressive
traditional	-	-	-	-	-	avant-garde
orderly	-	-	-	-	-	disorderly

Questionnaire distribution

The respondents of this survey were all drawn from professional groups closely related to the research topic. The sample included: undergraduate students

majoring in fashion design (junior year or above) with coursework in Kansei Engineering; university faculty with academic and practical backgrounds in ethnic hand-dyeing and apparel design; professional designers engaged in ethnic batik and garment development; and Cheongsam consumers with extensive experience in purchasing and wearing such garments. A total of 80 valid participants were included. The demographic characteristics of the respondents are presented in table 2. Due to the specialised nature of this study, the questionnaire content is relatively complex. The survey includes 28 Cheongsam samples, each assessed with six questions, resulting in a total of 168 questions. The questionnaire was conducted through a combination of online and offline methods. A total of 80 questionnaires were distributed, with 78 valid responses collected, achieving an effective response rate of 97.5%, which meets the sample size requirements for the study. The participants provided subjective evaluations of 28 batik-patterned Cheongsam samples. Each questionnaire generated 168 scores (28 Cheongsam sample images \times 6 pairs of Kansei words). The average sensory evaluation scores for the 28 Cheongsam samples were calculated based on the valid responses. The specific average sensory evaluation scores for the Cheongsam research samples are shown in table 3.

Table 2

DEMOGRAPHIC CHARACTERISTIC OF THE RESPONDENTS			
Demographic	Characteristic	Frequency	Percentage
Gender	Male	32	40
	Female	48	60
Age	20–29	10	12.5
	30–39	20	25
	40–49	30	37.5
	Above 50 years old	20	25
Occupation	Undergraduate students (junior year or above)	10	12.5
	University faculty	30	37.5
	Professional fashion designer	20	25
	Batik Cheongsam consumer	20	25

To analyse the sensory tendencies of the 28 Cheongsam designs, the origin-point method was applied for further data processing and calculation. The score of 0 was set as the origin point of the evaluation scale. The closer participants' psychological perceptions of the samples align with the meaning conveyed by the Kansei word, the more the Cheongsam sample's average score deviates from 0. In other words, a higher or lower score indicates a

MEAN SENSORY RATINGS OF CHEONGSAM SAMPLES						
Sample number	Kansei word pairs					
	Simple-Complex	Modest-Luxurious	Reserve-Expressive	Traditional-Avant-garde	Orderly-Disorderly	Youthful-Mature
1(a ₃)	0.72	0.22	0.70	-0.24	-0.18	0.96
2(g ₁)	0.26	0.18	0.38	-0.44	0.08	0.46
3(h ₃)	1.04	0.80	0.78	0.10	0.48	0.50
4(p ₆)	0.54	0.62	0.44	-0.24	-0.12	0.60
5(a ₄)	0.38	0.44	0.32	0.70	0.00	-0.62
6(a ₆)	0.72	0.80	0.48	0.04	-0.10	-1.00
7(a ₅)	0.70	0.54	0.56	-0.44	-0.28	-0.66
8(g ₂)	-0.02	-0.10	-0.12	-0.24	-0.50	0.62
9(h ₁)	1.28	0.96	1.04	0.14	1.14	0.76
10(p ₃)	0.68	0.58	0.62	-0.08	0.80	0.84
11(g ₅)	-0.18	0.12	0.10	0.00	-0.98	0.08
12(g ₆)	-0.26	-0.42	-0.16	-0.08	-0.32	0.10
13(a ₁)	0.52	0.62	0.50	-0.08	-0.36	-0.54
14(g ₃)	-0.50	-0.48	-0.20	0.58	-0.42	0.02
15(h ₄)	1.14	0.96	0.80	0.44	0.48	0.20
16(p ₂)	0.18	0.34	0.58	0.00	-0.14	0.14
17(h ₅)	1.02	0.94	0.98	0.52	0.80	0.32
18(h ₆)	0.46	0.52	0.64	0.12	0.20	0.66
19(a ₂)	0.32	0.58	0.42	0.16	0.14	-0.56
20(g ₄)	0.92	0.64	0.42	0.22	-0.56	0.34
21(h ₂)	0.86	0.76	0.74	0.28	0.66	0.36
22(p ₁)	0.68	0.64	0.42	-0.18	0.00	1.02
23(p ₅)	0.82	0.64	0.56	-0.06	0.20	0.68
24(p ₄)	0.82	0.72	0.72	0.06	0.24	0.76
25(a ₇)	0.66	0.62	0.42	-0.18	0.00	1.04
26(p ₇)	0.54	0.64	0.44	-0.20	-0.10	0.62
27(h ₇)	1.06	0.83	0.78	0.10	0.47	0.54
28(g ₇)	0.00	-0.12	-0.14	-0.24	-0.50	0.66

more distinct positive or negative subjective impression. For example, Cheongsam Sample No. 1(a₃) received a score of 0.72 on the “Simple-Complex” Kansei scale, suggesting that it evokes a relatively complicated impression. On the “Youthful-Mature” scale, its average score was 0.96, indicating that its styling characteristics tend to convey a mature image.

As shown in table 3, the combination of Cheongsams with batik patterns of different themes influences individuals’ subjective impressions and evaluations of the garments. In other words, the integration of different thematic batik patterns with Cheongsam samples leads to variations in the subjective sensory evaluation of their overall design style. To identify the Kansei words that best characterise the design features of each Cheongsam sample, the ranking method was applied. The absolute values of the sensory scores for all Cheongsam samples were ranked, and the top three Kansei words with the highest absolute scores were extracted for each sample. The

main imagery styles of the 28 Cheongsam samples are presented in table 4.

Table 4 indicates that when batik patterns with animal designs are integrated into cheongsam designs, the most prominent imagery style is “Youthful”. Firstly, animal patterns are often associated with vitality, energy, and nature [18]. These patterns, characterised by vibrant colours and dynamic forms, evoke positive emotions in viewers, thereby creating a sense of youthfulness and liveliness. Psychological studies have shown that visual stimuli can influence an individual’s emotional state and self-perception [19]. The dynamism and wildness conveyed by animal patterns can effectively enhance the wearer’s youthful image. Secondly, as a traditional Chinese garment, the cheongsam inherently symbolises elegance and beauty. The integration of animal-themed batik patterns into Cheongsam designs enhances its modern and fashionable appeal. This fusion of traditional and contemporary elements reinforced the youthful effect. When batik patterns with geometric

CHEONGSAM SAMPLE MAIN IMAGE STYLE							
Sample number	Sequencing of Kansei words			Sample number	Sequencing of Kansei words		
	1	2	3		1	2	3
1(a ₃)	Mature	Complex	Expressive	15(h ₄)	Complex	Luxurious	Expressive
2(g ₁)	Mature	Traditional	Expressive	16(p ₂)	Expressive	Luxurious	Complex
3(h ₃)	Complex	Luxurious	Expressive	17(h ₅)	Complex	Expressive	Luxurious
4(p ₆)	Luxurious	Mature	Complex	18(h ₆)	Mature	Expressive	Luxurious
5(a ₄)	Avant-garde	Youthful	Luxurious	19(a ₂)	Luxurious	Youthful	Expressive
6(a ₆)	Youthful	Luxurious	Complex	20(g ₄)	Complex	Luxurious	Orderly
7(a ₅)	Complex	Youthful	Expressive	21(h ₂)	Complex	Luxurious	Expressive
8(g ₂)	Mature	Orderly	Traditional	22(p ₁)	Mature	Complex	Luxurious
9(h ₁)	Complex	Disorderly	Expressive	23(p ₅)	Complex	Mature	Luxurious
10(p ₃)	Mature	Disorderly	Complex	24(p ₄)	Complex	Mature	Luxurious
11(g ₅)	Orderly	Simple	Luxurious	25(a ₇)	Mature	Complex	Luxurious
12(g ₆)	Modest	Orderly	Simple	26(p ₇)	Luxurious	Mature	Complex
13(a ₁)	Luxurious	Youthful	Complex	27(h ₇)	Complex	Luxurious	Expressive
14(g ₃)	Avant-garde	Simple	Modest	28(g ₇)	Mature	Orderly	Traditional

designs are integrated into Cheongsam designs, the most prominent imagery styles are “Orderly” and “Simple”. Firstly, the foundation of geometric patterns lies in their well-defined shapes and lines, which create a visually structured composition. Studies have shown that highly symmetrical and regular patterns can evoke a sense of cognitive comfort, leading to an orderly visual experience [20]. Secondly, the minimalist design philosophy has become increasingly valued in modern fashion. Geometric patterns reduce visual interference, emphasising the essence of the design and enhancing its simplicity in form [21]. Therefore, the application of geometric batik patterns aligns with current design trends and allows the Cheongsam to strike a balance between tradition and modernity, presenting a naturally harmonious aesthetic. When batik patterns with human figure designs are integrated into Cheongsam designs, the most prominent imagery style is “Expressive”. The primary reason is that human figure batik patterns often carry rich narratives and cultural symbolism, making them highly evocative in visual storytelling [22]. Studies have shown that human figure patterns with narrative characteristics can convey early human culture, evoking emotional resonance in viewers [23]. Therefore, when batik patterns with human figure themes are applied to Cheongsam design, viewers experience a deeper emotional response due to the cultural stories behind them. Additionally, human figure batik patterns are often depicted in exaggerated and dynamic forms, emphasising movement and emotion. This expressive artistic approach, characterised by striking lines, enhances visual impact and adds a dramatic flair to the overall design. When plant batik patterns are integrated into Cheongsam designs, the most prominent imagery styles are “Intricate” and “Mature”. The primary reason is that plant patterns often exhibit high levels of

complexity and intricate craftsmanship [24]. In Cheongsam designs, plant batik patterns, with their fine details, create a rich sense of visual depth. This intricate design language makes the wearer’s image more three-dimensional, enhancing the overall aesthetic effect and creating a complex, profound visual experience. Moreover, plant batik patterns often carry rich cultural symbolism, conveying reverence for nature and admiration for life [25]. In traditional cultures, plants often symbolise growth, prosperity, and the continuity of life. Their cultural significance makes the application of plant patterns not merely an aesthetic pursuit but also a reflection of a profound cultural identity.

KANSEI ENGINEERING ANALYSIS

Factor analysis

To conduct a more in-depth investigation into the sensory differences generated by different thematic batik patterns on Cheongsams, the SPSS 26.0 software was used to perform a KMO validity analysis and Bartlett’s test of sphericity on the mean sensory score of 28 Cheongsam samples. The specific results showed that the KMO validity analysis value was 0.747, which is greater than 0.500, and Bartlett’s test of sphericity revealed a significant P-value of 0.000, which is less than 0.050, indicating a high correlation between the variables and suggesting the suitability for subsequent factor analysis [26]. In this study, principal component analysis (PCA) was applied to reduce the dimensionality of the mean Kansei evaluation scores for the samples. According to the Kaiser criterion, the eigenvalue reflects the explanatory power of a common factor with respect to the original variables. When an eigenvalue exceeds 1, the corresponding factor explains more information than a single adjective pair and thus has value in aggregating multiple variables. Therefore,

Table 5

KANSEI WORD PAIRS EXPLAIN TOTAL VARIANCE						
Ingredient	Initial Eigenvalue			Extraction of the sum of squares of loads		
	Total	Variance (%)	Accumulation (%)	Total	Variance (%)	Accumulation (%)
1	3.520	58.708	58.708	3.522	58.708	58.708
2	1.290	21.497	80.205	1.290	21.497	80.205
3	0.740	12.458	92.663	-	-	-
4	0.280	4.682	97.346	-	-	-
5	0.090	1.592	98.938	-	-	-
6	0.060	1.062	100.000	-	-	-

factors with initial eigenvalues greater than 1 were extracted as common factors, and the total variance explained by the Kansei adjective pairs is shown in table 5.

As shown in table 5, the initial eigenvalue of the first factor is 3.522, which explains 58.708% of the variance in the original 6 pairs of Kansei words. The initial eigenvalue of the second factor is 1.290, which explains 21.497% of the variance in the original 6 pairs of Kansei words. The cumulative contribution rate of the two factors is 80.205%, and since the eigenvalues are greater than 1, these two common factors can fully represent the meanings of the 6 pairs of Kansei words and reflect the sensory information of the 28 Cheongsam samples. Therefore, two common factors can be extracted. The rationality of the two common factors is verified using a scree plot, as shown in figure 3. The first factor has the highest eigenvalue, and the inflexion point occurs at the third factor, where the line becomes flatter. Since the eigenvalues of the first and second factors are both greater than 1, this confirms that extracting two common factors is reasonable.

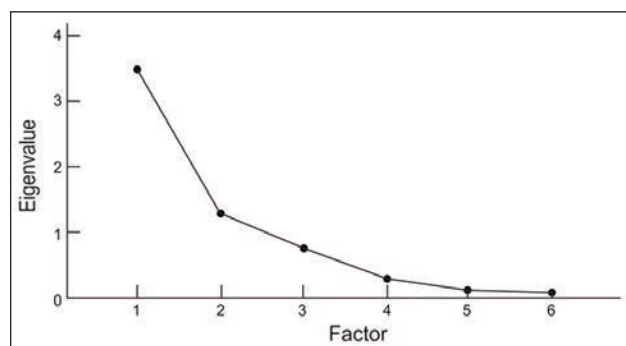


Fig. 3. Scree plot analysis figure

To further investigate the composition of the common factors and assign appropriate names, the core associated variables of the two extracted factors were distinguished. The factor loading matrix was standardised to eliminate potential interference caused by differences in the scoring scale of the Kansei adjective pairs (e.g., some pairs showing larger score variations and others smaller), thereby ensuring the objectivity of the rotation results. The Varimax method with Kaiser normalisation was then applied to

Table 6

FACTOR COMPONENT ROTATION MATRIX		
Kansei word pair	Factor	
	1	2
Simple - Complex	0.951	0.066
Modest - Luxurious	0.925	-0.087
Reserved - Expressive	0.959	0.002
Traditional - Avant-garde	0.243	-0.787
Orderly - Disorderly	0.857	-0.010
Youthful - Mature	0.224	0.812

obtain the rotated component matrix, as shown in table 6.

As shown in table 6, the factor loadings reflect the correlation between the factors and the Kansei word pairs. The higher the correlation, the greater the absolute value of the factor loadings. After rotation, the first common factor showed high loadings on the four adjective pairs "Simple-Complex", "Modest-Luxurious", "Reserved-Expressive", and "Orderly-Disorderly", with loading values of 0.951, 0.925, 0.959, and 0.857, respectively, all above 0.85. The second common factor was associated with the adjective pairs "Traditional-Avant-garde" and "Youthful-Mature", with loadings of -0.787 and 0.812, both exceeding 0.78. These clear correspondences between factors and variables verify the validity of the rotation method. In the first common factor, the Kansei word pairs with higher absolute factor loadings include "Simple-Complex", "Modest-Luxurious", "Reserved-Expressive", and "Orderly-Disorderly". This suggests that the first common factor effectively explains the variance of these four pairs of Kansei words, which reflect individual personality traits and preferences. Therefore, this factor can be categorised as the "Style factor". In the second common factor, the Kansei word pairs with higher absolute factor loadings include "Traditional-Avant-garde" and "Youthful-Mature". These Kansei word pairs primarily relate to the cheongsam itself and reflect an individual's dressing style, which can be categorised as the "Temperament factor". The analysis indicates that consumers' psychological perception of batik-patterned Cheongsams mainly

PEARSON CORRELATION COEFFICIENTS FOR KANSEI WORD PAIRS						
	Simple-Complex	Modest-Luxurious	Reserve-Expressive	Traditional-Avant-garde	Orderly-Disorderly	Youthful-Mature
Simple-Complex	1					
Modest-Luxurious	0.920**	1				
Reserve-Expressive	0.900**	0.884**	1			
Traditional-Avant-garde	0.120	0.177	0.175	1		
Orderly-Disorderly	0.709**	0.658**	0.778**	0.304	1	
Youthful-Mature	0.205	0.033	0.155	-0.279	0.265	1

Note: * P<0.05; ** P<0.01

consists of two factors: the style factor and the temperament factor. The contribution rate of the style factor is higher than that of the temperament factor, suggesting that consumers prioritise the appearance and overall style of the Cheongsam when selecting and purchasing one.

Correlation Analysis

To verify the consistency of evaluations among the Kansei adjective pairs and to examine their potential interrelationships, a Pearson correlation analysis was conducted. As shown in table 7, strong positive correlations were found among the pairs "Simple-Complex", "Modest-Luxurious", "Reserved-Expressive", and "Orderly-Disorderly". All correlation coefficients exceeded 0.70 and reached significance at the 0.01 level. For example, the correlations between "Simple-Complex" and "Modest-Luxurious" ($r = 0.920$), as well as between "Simple-Complex" and "Reserved-Expressive" ($r = 0.900$), were the highest. This indicates that the simpler the pattern, the more strongly it is perceived as modest, reserved, and orderly; conversely, the more complex the pattern, the more likely it is to evoke associations of luxury, expressiveness, and disorder.

In contrast, the adjective pairs "Youthful-Mature" and "Traditional-Avant-garde" showed relatively weak correlations with the pairs mentioned above, with coefficients generally below 0.30 and without statistical significance. This suggests that these two pairs are relatively independent constructs and are not directly associated with perceptions of pattern complexity or luxury.

Cluster analysis

Analysis results

Based on the similarity among the Cheongsam samples, hierarchical clustering in cluster analysis was

applied to analyse 28 Cheongsam samples, grouping those with similar characteristics into the same category. The clustering results under different clustering intensities were obtained, and the specific hierarchical clustering analysis results are shown in figure 4. As shown in figure 4, when the clustering scale is set to 5, the Cheongsam samples are clustered into 11 categories. When the clustering scale is set to 10, the samples are grouped into 4 categories. When the clustering scale is 15, the samples are clustered into 3 categories. Finally, when the clustering scale ranges from 20 to 25, the Cheongsam samples are classified into 2 categories. Taking the clustering scale of 10 as an example, the Cheongsam samples in cluster 1 include samples numbered 1(a₃), 2(g₁), 4(p₆), 10(p₃), 16(p₂), 18(h₆), 20(g₄), 22(p₁), 23(p₅), 24(p₄), 25(a₇) and 26(p₇). The primary imagery style

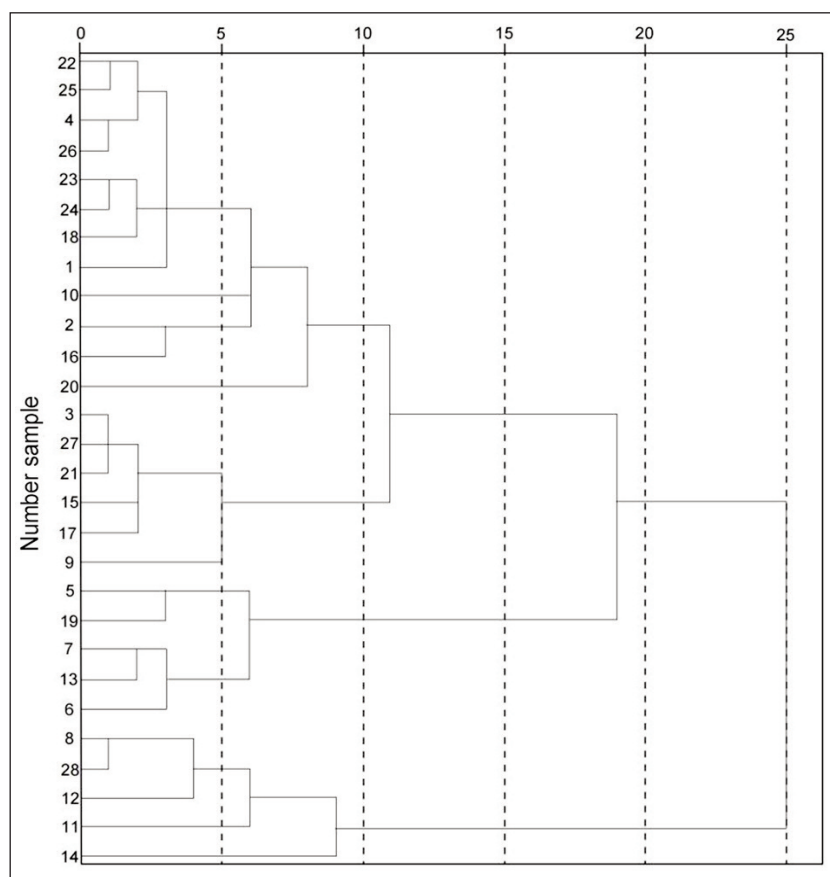


Fig. 4. Results of hierarchical clusteringe

of this cluster is characterised by “mature” and “luxurious”, encompassing all plant-themed batik patterns. According to the previously obtained mean scores of the sensory evaluations, plant patterns generally exhibit soft, delicate, and fluid artistic forms. The depiction of mature fruits and full-bloom flowers symbolises abundance and vitality. Within Cluster 1, the geometric patterns in samples 2(g₁) and 20(g₄) are more compact in composition compared to the other four geometric patterns. These designs incorporate various elements such as curves, dots, and spirals, creating a sense of fluidity and interwoven lines. Sample 18(h₆) features a human figure pattern; unlike other human figure patterns, it minimises the incorporation of animal and plant patterns, resulting in a visually more mature and composed aesthetic. Additionally, samples 1(a₃) and 25(a₇) showcase phoenix patterns. In traditional Chinese culture, the phoenix symbolises prosperity, abundance, and vitality. Therefore, the overall style characteristics of Cluster 1 emphasise opulence, sophistication, and mature elegance. The Cheongsam samples in Cluster 2 are numbered 3(h₃), 9(h₁), 15(h₄), 17(h₅), 21(h₂) and 27(h₇). This cluster is characterised by human figure patterns. The most prominent imagery style of this cluster is “intricate”, followed by “expressive”. The human figure patterns exhibit a unique narrative charm, with diverse and complex compositions. Detailed elements such as hair, clothing textures, accessories, and additional decorative patterns are rendered using meticulous and intricate realism. The depiction of human movements is exaggerated yet dynamic, enhancing the visual appeal. The background of these human figure patterns incorporates elements such as plants and animals, contributing to a visually rich, lively, and engaging aesthetic. The Cheongsam samples in Cluster 3 are numbered 5(a₄), 6(a₆), 7(a₅), 13(a₁) and 19(a₂). This cluster comprises four Cheongsam samples featuring animal batik patterns. The most striking imagery style of this cluster is “Youthful”. This is primarily due to the rhythmic arrangement of animal patterns, which conveys a sense of vitality and dynamism. The Cheongsam samples in Cluster 4 are numbered 8(g₂), 11(g₅), 12(g₆), 14(g₃) and 28(g₇). All samples in this cluster feature geometric patterns. The dominant imagery styles of this cluster are “Orderly” and “Minimalist”. The geometric patterns in this cluster are composed of systematically arranged fundamental elements such as continuous sun patterns and meander patterns, forming a structured and repetitive design. These patterns exhibit clean and sharp lines with a symmetrical and balanced composition. The key characteristics of this cluster include balance, symmetry, and repetition. Compared to other Cheongsam samples, those in this cluster emphasise a greater sense of simplicity, restraint, and harmonious order.

Through cluster analysis, it can be observed that although different batik patterns combined with Cheongsams produce varying sensory differences, Cheongsam samples within the same cluster exhibit

similar mean values and higher proportions of Kansei word pairs. Additionally, these Cheongsam samples share similar overall appearances and stylistic sensory imagery.

Validation of clustering results

To objectively evaluate the validity of the clustering outcome, a Silhouette Score analysis was conducted using Python. This method was employed to quantitatively verify the clustering performance. The overall silhouette coefficient represents the average silhouette value of all samples and ranges from -1 to 1. It reflects the balance between intra-cluster cohesion and inter-cluster separation. A silhouette value closer to 1 indicates better clustering performance; values near 0 suggest that samples lie on cluster boundaries; and values approaching -1 imply that samples may have been incorrectly assigned to clusters [9]. The silhouette analysis was performed on the clustering result with a set threshold of 10 clusters, and the corresponding results are presented in table 8.

Table 8

SILHOUETTE-BASED EVALUATION OF CLUSTER QUALITY			
Cluster	Sample size	Mean Silhouette coefficient	Cluster quality evaluation
1	12	0.81	Excellent
2	6	0.85	Excellent
3	5	0.71	Good
4	5	0.77	Good
Overall mean silhouette coefficient: 0.79		Overall mean silhouette coefficient: 0.79	

As shown in table 8, the average silhouette coefficients of the four clusters were all positive, with an overall mean value of 0.79. This indicates good intra-cluster cohesion and inter-cluster separation. Specifically, Cluster 2 (human figure patterns) exhibited the highest silhouette coefficient (0.85), suggesting that its features were the most distinct and the clustering performance was optimal. Cluster 3 (animal patterns) had a relatively lower coefficient (0.71), but it remained within an acceptable range, implying that some overlap in perceptual features may exist within this group. Overall, the clustering quality was evaluated as “good”, confirming the statistical validity of the Cheongsam sample classification based on Kansei evaluation. This result is consistent with the aforementioned hierarchical clustering analysis and further substantiates the rationality of categorising the 28 Cheongsam samples into four perceptual feature groups.

CONCLUSION

To explore the sensory imagery of Cheongsam appearance after integrating batik patterns, this study, based on the principles of Kansei engineering, selected four categories of pattern themes with typical formal characteristics and combined them with

Cheongsam designs. A total of 28 cheongsam research samples were extracted, along with six pairs of Kansei words with opposite meanings that accurately describe the stylistic characteristics of the samples, forming the semantic space for this study. Subsequently, a five-point scale sensory evaluation questionnaire was designed, and face-to-face surveys were conducted to collect participants' sensory evaluations of the cheongsam samples. The sensory rating absolute values obtained from the questionnaire were analysed using SPSS 26.0, leading to the following conclusions:

- Through factor analysis, two common factors influencing the sensory characteristics of the Cheongsam research samples were extracted, enabling an effective sensory evaluation of the 28 Cheongsam samples. Based on their specific meanings, these factors were named the Style factor and the Temperament factor, respectively. Since the contribution rate of the Style factor is higher than that of the Temperament factor, the sensory style characteristics generated by the Cheongsam's appearance play a decisive role.
- From the perspective of batik patterns, different thematic contents of batik patterns influence the overall appearance characteristics of the Cheongsam when combined. Specifically, cheongsam samples featuring animal patterns predominantly convey the sensory imagery of "Youthful". Those incorporating plant-themed batik patterns most strongly evoke the impressions of "Mature" and "Luxurious". Cheongsam samples with human figure patterns exhibit the most prominent sensory characteristics of "Expressive", followed by "Intricate". Meanwhile, Cheongsam samples with geometric patterns are most frequently associated with the Kansei words "Simple" and "Orderly", carrying the highest weight in evaluation.
- Through cluster analysis, it was determined that when the clustering scale distance is set to 10, the research samples can be grouped into four clusters. Within different clusters, the combination of various batik pattern themes with Cheongsam results in distinct sensory imagery. However, within the same cluster, Cheongsam styles exhibit a high overlap in specific pairs of Kansei words, with similar sensory evaluation scores. This consistency suggests that the Cheongsam samples within each cluster share a certain level of uniformity and regularity in their overall sensory evaluation of appearance.

Due to space limitations, this study still presents certain constraints regarding the selection of batik

pattern colours, themes, and Cheongsam silhouette classifications. Future research will expand the sample scope and further refine the methodological design to ensure more rigorous and reliable conclusions. In addition, the findings are subject to cultural contextual limitations. The ethnic symbolism embedded in batik patterns and the cultural connotations of the Cheongsam may influence participants' perceptual judgments of style and temperament. Therefore, the conclusions are primarily applicable within specific cultural contexts, and further verification and adjustment are required when extending the results to other regions or consumer groups. The study employed a research methodology that combines Kansei Engineering theory, quantitative analysis, and user evaluation. The core of this approach lies in extracting product attributes, constructing a semantic space of affective perception, and quantifying the relationships between design features and user responses. This logical framework demonstrates strong general applicability and can be extended to other product design domains to identify the correspondence between product attributes and users' emotional needs, thereby providing a scientific basis for design practice. Based on the discovered relationship between visual imagery and cultural symbolism, future research may further connect these findings with cross-cultural aesthetic theory, incorporating multicultural themes and emotional symbols to interpret the aesthetic characteristics of patterns from the perspective of both cultural commonality and diversity. This approach can also provide a theoretical basis for comparative studies of cultural patterns across regions. From the perspective of cultural heritage, the verification of the integration between batik and Cheongsam demonstrates the feasibility of transforming intangible cultural heritage into practical design applications, contributing to its living transmission. From the perspective of product design, quantifying user affective needs can support precision design, reduce unsold inventory, and enhance product added value and lifecycle sustainability through the creative reinterpretation of cultural symbols. Future work will continue to advance this research through the expansion of study scope, technological enhancement, application extension, interdisciplinary collaboration, and the deepening of user-experience insights. Furthermore, based on the current dataset, a predictive Kansei design model for batik-inspired Cheongsams will be developed to establish a rapid mapping between design parameters and affective imagery, thereby supporting the practical implementation of intelligent design tools.

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