Perceptual Imagery of Soft Sofa Fabrics Based on Visual-Tactile Evaluation

Ziyao Tu, and Wei Wang *

In the contemporary era of quality and personalization, this article explores how soft sofa fabrics enhance users' emotional experience and convey perceptual images. Users' visual-tactile perception data on 10 common soft sofa fabrics were gathered by questionnaire surveys, utilizing the Kansei engineering approach, and the visual-tactile evaluation theory. With SPSS software, the data were processed and examined in-depth using a variety of techniques, including cluster analysis and factor analysis. The experiment screened fabric samples and emotional vocabularies *via* the KJ method and expert evaluation, and questionnaires were designed and implemented based on the semantic differential method and Likert scale. Fabrics were categorized into four groups based on cluster analysis, which are suitable for users pursuing different home environments. The two primary factors that comprise the fundamental aspects of the perceptual image of soft sofa fabrics were found to be the texture, quality experience factor, and the typical emotional reaction factor, which were extracted by factor analysis. Both theory and practice were considered, enriching the theoretical framework of emotional imagery and user emotion research while offering valuable practical guidance for the design, production, and marketing of soft sofas.

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*Contact information: College of Furnishings and Industrial Design, Nanjing Forestry University, Nanjing 210037, China; *Corresponding author: wangwei1219@njfu.edu.cn*

INTRODUCTION

The criterion for consumers to buy things has changed from "function first" to "emotional orientation" in the age of seeking a high-quality life and individualized experience (You 2012). Soft sofas are the primary piece of furniture in living rooms or dens because they are a vital component of modern homes. In addition to fulfilling the very minimum requirements for sitting and lying, they should also take into consideration the aesthetic feelings and emotional experiences of users while they are using them (Qu 2020). The color, texture, and material of soft sofa fabrics, which intimately engage consumers both visually and tactilely, have a significant impact on their perceptual images and are among the most important factors influencing users' buying decisions (Kim and Park 2020; Song *et al.* 2023).

Users have varying emotional experiences from different fabrics. Through subjective evaluations based on touch and vision, users select a more pleasant, comfortable, and psychologically satisfying home experience (Eom and Jeong 2011). Future soft sofa designs should anticipate a greater focus on intelligence, emotionalization, and

personalization due to the ongoing advancement of smart home technologies and the upgrading of consumer concepts (Xiong *et al.* 2018).

Perceptual images, formed by the interplay of senses and subsequent brain processing, capture subjective emotions, reactions, and aesthetic preferences. These visuals serve as an important link between users' psychological experiences and the physical features of objects, considerably impacting purchasing decisions (Suh *et al.* 2018; Espinoza *et al.* 2021). Visual-tactile evaluation not only expands our understanding of perception mechanisms, but it also catalyzes novel design and marketing tactics, as well as having a significant synergistic effect on material assessment, color perception, and marketing psychology. When architectural students evaluated building materials, Wastiels *et al.* (2013) discovered that while vision is the primary sense, it frequently cannot predict touch and that the subjects lacked enough tactile knowledge of these materials. To improve the experience and practicality of design, additional non-visual factors should be included in design education and practice. The impact of textile color and material properties on tactile and visual temperature perception was examined by Oh and Park (2018). They discovered that there are notable differences between textile categories, particularly light and transparent products, and that both warm and cold color and material properties affect visual temperature perception. New research sheds light on the interplay between tactile-visual temperature sensing. To explain the relationship between visual-tactile interaction and consumer cognition, emotion, and behavior, Eklund and Helmefalk (2018) combined marketing and psychology to create a conceptual framework and model of visual-tactile interaction and consumer response. This model deepened the theory of the intersection of marketing and psychology and offered useful guidance for corporate strategies.

Widespread usage of Kansei engineering has improved product value and user emotional satisfaction while deepening our understanding of the relationship between user-perceived needs and product design characteristics. To create an interdisciplinary design platform that would assist designers in increasing the value of fabrics and offer theoretical and technical support, Yin *et al.* (2010) incorporated Kansei engineering into the field of fabric design. To increase fabric functions and raise consumer happiness, they investigated the tactile sensation of fabrics, accomplished quantitative evaluation, and optimized the design. Liang *et al.* (2020) investigated users' emotional preferences for automotive interior design by building a sensory experience and perceived value model using Kansei engineering. With the aim of providing a user-oriented reference for vehicle interior design, the sensory experience was weighted based on sample scores, and the perceived value evaluation was improved by questionnaire analysis. This revealed the relationship between user preferences and design characteristics. To investigate how the look design of portable air purifiers can satisfy the user's perceived needs, Wang *et al.* (2021) applied Kansei engineering. They identified the relationship between design features and perceptual space and extracted important perception terms through factor analysis, market research, and semantic difference. They developed a design methodology to offer fresh concepts and approaches for creating air purifiers that satisfy the perceptual requirements of users.

Through using visual-tactile evaluation and Kansei engineering methods, user perceptions and emotional reactions to products composed of various materials were explored. This will provide a scientific foundation for design optimization, market satisfaction, and user experience improvement. Shitara *et al.* (2017) investigated the function of vision and touch in assessing the impression of wooden items using multiple regression analysis. They discovered that while touch was important, vision dominated the overall impression. The significance of multisensory evaluation of wooden items is

revealed by the close relationship between subjects' impressions of the specimens and their perceptions of the objects' tactile roughness and visually perceived brightness. In addition to conducting subjective evaluation experiments under visual, tactile, and visual-tactile conditions to assess the perceptual differences between artificial and genuine leather, Watanabe and Horiuchi (2021) conducted a subjective experiment to assess the representative impressions formed by users during their interaction with leather samples. The study aids in the creation of more lifelike fake leather, which benefits sales while also preserving animal welfare. The psychological and emotional perception of textured plastics in automotive interiors was investigated by Sousa *et al.* (2022) using Kansei engineering. They discovered that perceived roughness was correlated with emotional response and visually modulated by texture. This information is crucial for comprehending the visual-tactile perception of texture and for designing texture components for automotive interiors. Ge *et al.* (2023) used Vosviewer to identify research hotspots and trends in aircraft design, applied Kansei engineering to translate client wants into design, and visualized the network for classification and overview. The study discovered that elements such as color coordination, aircraft layout, and materials have an impact on people's sensations and behaviors. It also gave a case for the efficient use of materials based on Kansei engineering. To improve the quality of life for home-based elderly care, Jin and Li (2023) focused on the design of cabinets for the elderly from the perspective of materials, combined visual and tactile experience, classified and screened market material samples, and constructed a "emotion-physical performance" evaluation model through physical testing and subjective emotion analysis. Zhou *et al.* (2023) classified wooden door market consumers into four categories and created a questionnaire for user research on wooden doors by examining user lifestyles and consumption patterns. They also employed various data processing techniques, such as factor analysis, cross analysis, and cluster analysis. It was discovered that user classification is influenced by gender, age, and occupation, offering market insights for wooden door enterprise product design.

By summarizing existing literature, it is apparent that, while the importance of visual and tactile evaluation in material assessment is widely recognized, existing research primarily has focused on a single sensory dimension (such as only visual or tactile), ignoring the synergistic effect of visual and tactile aspects and their profound impact on users' overall perception. There is still a lack of a thorough and systematic evaluation framework for soft sofa fabric design that integrates users' multi-sensory experiences and delves deeply into the psychological mechanisms underlying them. This inhibits designers' ability to comprehend and effectively meet users' actual wants. Many studies have provided theoretical insights but have failed to incorporate market demand and customer behavior, resulting in limited use of research findings in actual product design.

In light of the aforementioned issues, this article sought to solve them through research on multi-sensory synergy, the development of a systematic evaluation framework, market-oriented study design, and the creation of differentiated competitive advantages. This study focused on the soft sofa industry, beginning with the core element of fabric, and thoroughly examined how users' emotions are affected by various soft sofa fabrics in both the visual and tactile domains. During the questionnaire study, participants received real and comparative samples of soft sofa fabric. These examples cover a wide range of fabrics and styles, allowing users to fully experience and evaluate the texture, softness, comfort, and other properties of various fabrics. Cluster analysis makes it possible to comprehend the diversity and differences in consumers' perceptions of fabrics, whereas factor analysis enabled a more comprehensive understanding of the main elements of fabric sensory

imagery. These two methodologies complement each other, resulting in a comprehensive and in-depth framework for fabric perception study. These techniques were chosen for their ability to systematically uncover patterns and relationships in user perception. Obtaining users' sensory semantic aspects of various soft sofa fabrics not only can improve user experience, but it can also serve as a direction for design innovation and optimization. This approach can give soft sofa manufacturers differentiated competitive advantages in a severe market rivalry, enhance sales revenue, and promote the industry's overall growth.

EXPERIMENTAL

Sample Selection

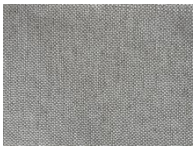
Consumer choices can be heavily influenced by regional characteristics such as aesthetic preferences, climate, and social norms. This study looked at China's online preferences for purchasing soft sofa fabrics. An online survey method was used to browse and analyze sofa products on mainstream domestic e-commerce platforms and finally select eight home furnishing brands with high popularity, stable consumer groups, and wide acclaim in China. These brands include LINSY Home, Yeswood, QuanU Home, Original Home, WAYS Home, Kuka Home, CHEERS, and ZUOYOU Home. Eight popular sofa brands were chosen, and a total of 80 soft sofas were the subject of this survey. The sales data from Taobao's official flagship shop was used to determine which of the top 10 soft sofa products had the largest sales. The primary materials of soft sofas that have the biggest area in direct touch with the user's body were the focus of the survey; supplementary materials were not considered. Table 1 displays the six categories into which Taobao's official store's fabric information for eighty soft sofas was divided. There may be some limitations in the selection of samples. It is hoped that the expert evaluation method and the KJ method can minimize the impact on the generalization.

Table 1. Statistical Results of Soft Sofa Fabric

Serial Number	Contact Surface Material	Number	Percentage (%)
1	Head Cowhide	28	35
2	Technology Cloth	16	20
3	Imitation Cotton/Imitation Hemp	11	13.75
4	Corduroy	5	6.25
5	Cotton/Cotton Linen	3	3.75
6	Others (PU Leather, Polyester, Deer Fur Velvet, Imitation Lamb Cashmere, Cat Fleece Cloth, Chenille, *etc*.)	17	21.25

Combining the KJ method with the expert evaluation method, it was determined that there are ten typical and representative soft sofa fabrics: head cowhide and PU leather, technology cloth, imitation hemp, corduroy, cotton, deer fur velvet, imitation lamb cashmere, cat fleece cloth, and chenille. The samples were numbered, as have been indicated in Table 2.

Table 2. Research Samples of Soft Sofa Fabric

M1	M2	M3	M4	M5
				
Head Cowhide	PU Leather	Technology Cloth	Imitation Hemp	Corduroy
M6	M7	M8	M9	M10
				
Cotton	Deer Fur Velvet	Imitation Lamb Cashmere	Cat Fleece Cloth	Chenille

Questionnaire Design and Survey

Through books, websites, exhibitions, articles, and other outlets, this article gathered 161 groups of perceptual evaluation terms connected to soft sofa fabrics. Phrases with similar meanings or unrelated evaluations were first selected out. Nine groups of representative visual and tactile evaluation words, including "rough-delicate", "coarse-smooth", "thin-thick", "dull-interesting", "uncomfortable-comfortable", "individual-popular", "simple-luxurious", "indifferent-friendly", and "difficult to clean-easy to clean", were identified using the expert evaluation method and the KJ method. The survey was conducted using Chinese terms, with care taken to accurately match them to English terms for purpose of reporting in this article.

The five-point Likert scale questionnaire used in the experiment was created using the semantic differential method. Actual users of the soft sofa or potential users with purchasing intentions were chosen as subjects. They were provided with sofa fabric samples of the same size and characteristics. In a calm setting, they scored nine sets of sensory evaluation terms of ten sample fabrics using subjective visual and tactile assessments. The five score values were -2, -1, 0, 1, and 2 (Liu *et al.* 2014). This study involved 40 individuals, aged 18 to 40, of which 15 were male and 25 were female.

Reliability Analysis and Data Processing

With a valid questionnaire rate of 90%, a total of 40 questionnaires were collected for this experiment, of which 4 were deemed invalid and the remaining 36 were judged to be valid. The questionnaire data was initially put through a reliability analysis to make sure the results were stable and consistent with the experiment, as well as to reflect the genuine degree of the assessed features. A statistical technique for assessing the dependability of measurement instruments is reliability analysis. A common evaluation tool for perceptual surveys is the Cronbach coefficient (Sun *et al.* 2007). The data from the questionnaire were tested for reliability using SPSS25 software. The Cronbach's alpha was 0.824, indicating good authenticity and reliability, according to the results.

The average value of the subjective evaluation data was utilized to lessen the disparity because the individuals' subjective evaluations varied throughout the experiment due to a variety of circumstances. Table 3 displays the average perceptual image

vocabulary value for each sample, which was determined after data processing was completed on nine pairs of perceptual image phrases of ten soft sofa fabrics.

Table 3. The Average Score of Visual Tactile Evaluation of Soft Sofa Fabric

Sample Number	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
Rough-Delicate	0.50	1.72	0.06	-0.94	0.11	-0.33	1.14	-1.56	1.14	-0.33
Coarse-Smooth	0.44	1.17	0.06	-0.92	-0.08	-0.31	1.17	-1.44	0.69	-0.58
Thin-Thick	0.42	-0.19	0.22	0.11	0.56	-0.33	0.61	1.31	0.44	0.89
Dull-Interesting	-0.47	0.11	-0.53	0.33	0.50	0.08	0.61	0.92	0.64	0.53
Discomfort-Comfortable	1.00	1.22	0.31	0.31	1.00	0.44	1.11	-0.17	1.06	0.56
Individual-Popular	0.64	0.72	0.47	0.22	0.03	0.33	-0.22	-0.89	0.22	-0.50
Simple-luxurious	0.61	0.28	-0.42	-1.00	-0.42	-0.64	0.81	-0.36	0.31	0.36
Indifferent-Friendly	0.19	0.64	0.03	0.47	0.83	0.25	0.97	0.50	0.86	0.61
Difficult to Clean - Easy to Clean	1.11	1.08	0.64	-0.44	-0.78	-0.25	-0.28	-1.31	-0.44	-0.89

Subjective Comfort and Mean Analysis

As illustrated in Fig. 1, the experimental results indicate that M2: PU leather, M7: deer fur velvet, M9: cat fleece cloth, M1: head cowhide, M5: corduroy, M10: chenille, M6: cotton, M3: technology cloth, M4: imitation hemp, and M8: imitation lamb cashmere were rated highest in terms of comfort for the subjective visual-tactile evaluation test. M2: PU leather was selected as the most comfortable fabric; M8: imitation lamb cashmere was judged to be the least comfortable fabric.

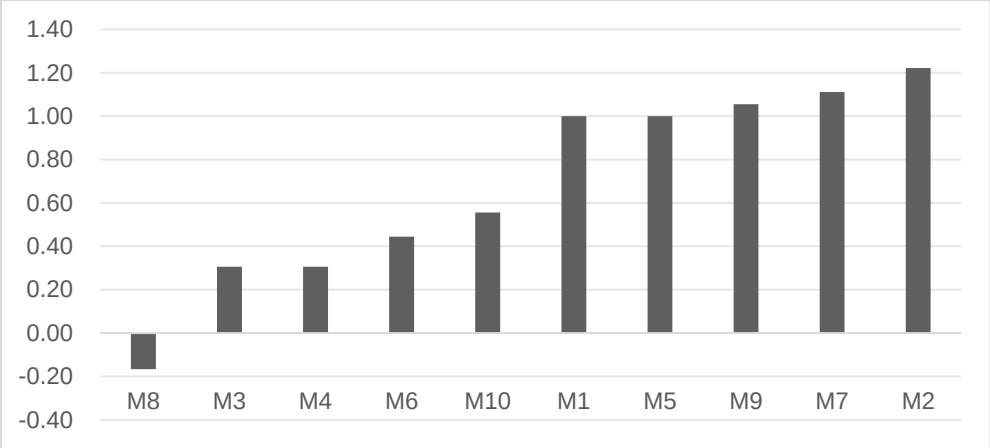


Fig. 1. Subjective comfort evaluation

Together with the perceptual words "uncomfortable-comfortable" the other eight categories of perceptual words were also analyzed for their various sentiments related to soft sofa fabrics. The words having the highest three absolute values were then counted, as

shown in Table 4. It can be seen that M1: head cowhide, M2: PU leather, and M3: technology cloth were judged to be the easiest to clean, while M5: corduroy, M8: imitation lamb cashmere, and M10: chenille were viewed as the most difficult to clean; M2: PU leather, M7: deer fur velvet, and M9: cat fleece cloth is the most delicate and smooth, while M4: imitation hemp, M6: cotton and M8: imitation lamb cashmere was the most rough and coarse; M1: head cowhide, M3: technology cloth and M6: cotton were the most popular; M5: corduroy, M9: cat fleece cloth and M10: chenille were the most friendly.

Table 4. Analysis Table of Sensory Imagery of Soft Sofa Fabric

Sample Number	Emotional Words		
M1	Easy to Clean	Popular	Luxurious
M2	Delicate	Smooth	Easy to Clean
M3	Easy to Clean	Dull	Popular
M4	Simple	Rough	Coarse
M5	Friendly	Difficult to Clean	Thick
M6	Si mple	Rough Thin Popular	Coarse
M7	Smooth	Delicate	Friendly
M8	Rough	Coarse	Thick Difficult to Clean
M9	Delicate	Friendly	Smooth
M10	Thick Difficult to Clean	Friendly	Coarse

Cluster Analysis

Based on the similarity between complex variables of the samples, cluster analysis is an exploratory dimensionality reduction analysis method that separates several groups of data into different levels of groups (Crowther *et al.* 2021). The ten soft sofa fabric samples were analyzed using the systematic clustering method. Figure 2 displays the tree diagram of the clustering findings.

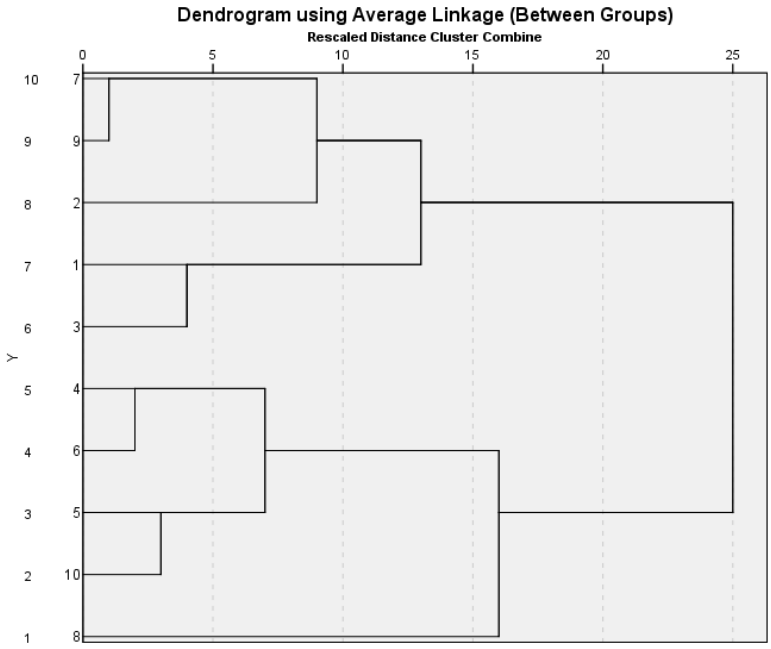


Fig. 2. Cluster analysis dendrogram

The samples of soft sofa fabric are represented by the vertical axis, and the relative distance between the samples is shown by the horizontal axis. A vertical line is drawn from the quantitative value 10 downward on the horizontal axis. The soft sofa fabric samples are grouped into four groups because the vertical line crosses the horizontal lines at four different locations.

The first category named velvet and leather series includes M7: deer fur velvet, M9: cat fleece cloth, and M2: PU leather. This type of soft sofa fabric has a delicate and smooth texture and is suitable for a home environment that pursues comfort and luxury; the second category includes M1: head cowhide and M3: technology cloth. This type of soft sofa fabric is easy to clean and is suitable for a home environment that pursues high durability; the third category includes M4: imitation hemp, M6: cotton, M5: corduroy, and M10: chenille. This type of soft sofa fabric is commonly used in clothing and home textiles and is suitable for a home environment that pursues natural simplicity, and friendly fun; the fourth category includes M8: imitation lamb cashmere. This type of soft sofa fabric is thick and interesting and is suitable for a home environment that pursues warmth and personality.

RESULTS AND DISCUSSION

Validity Analysis

The complex correlations between various perceptual words make it necessary to simplify the initial diverse images into several core comprehensive semantic measures to explore the dimensions of the perceptual image of soft sofa fabrics. Then, using the concept of dimensionality reduction, factor analysis was performed on the average values of perceptual evaluation data. A statistical method called factor analysis was used to identify potential common factors among several variables, which helps to make the data structure more understandable and highlights the inherent relationships between the variables. To more thoroughly capture and integrate the important information in the original image,

several comprehensive indicators were extracted as primary factors using principal component analysis. This increased the understanding of how fabric influences the perceptual cognition of soft sofas. When exploring the dimensions of the perceptual image of a soft sofa to determine whether the data were suitable for factor analysis, the first step was to perform a validity analysis on the data. Validity analysis is a crucial component of social science research, primarily employed to assess the reliability and validity of research methodologies or measuring instruments (Watson and Thompson 2006).

The Bartlett sphericity test and the KMO value are useful markers for determining if the data is suitable for factor analysis. The data can often be used for factor analysis when the KMO value is larger than 0.5 and the sphericity test significance is 0. The questionnaire data was subjected to the KMO and Bartlett sphericity tests using SPSS25 software. According to the test results, the soft sofa fabric's perceptual image data had a KMO value of 0.614, a chi-square value of 91.548, a degree of freedom value of 36, and a significance level value of 0. A thorough examination demonstrates that factor analysis can be performed on the questionnaire data.

Correlation Analysis

The correlation matrix is displayed in Table 5 and indicates a specific relationship between the nine pairs of perceptual image words and the perceptual psychological states they reflect. The perceptual phrases are compared in pairs. The larger the absolute value, the stronger the correlation, and the smaller the absolute value, the weaker the correlation. The soft sofa fabric, according to the data, exhibited the largest link with the terms "rough-delicate" and "coarse-smooth" and made individuals feel "uncomfortable-comfortable". The user experiences more comfort with fabrics that are smoother and finer. Conversely, the consumer experiences greater discomfort with coarser and rougher fabrics.

Table 5. Correlation Matrix

	R-D	C-S	T-T	D-I	D-C	I-P	S-L	I-F	D -E
R-D	1.000	0.982	-0.402	-0.219	0.917	0.576	0.676	0.379	0.612
C-S	0.982	1.000	-0.404	-0.272	0.894	0.576	0.687	0.333	0.639
T-T	-0.402	-0.404	1.000	0.564	-0.318	-0.847	0.248	0.301	-0.615
D-I	-0.219	-0.272	0.564	1.000	-0.115	-0.78	0.017	0.772	-0.841
D-C	0.917	0.894	-0.318	-0.115	1.000	0.505	0.659	0.512	0.471
I-P	0.576	0.576	-0.847	-0.78	0.505	1.000	0.009	-0.362	0.869
S-L	0.676	0.687	0.248	0.017	0.659	0.009	1.000	0.389	0.306
I-F	0.379	0.333	0.301	0.772	0.512	-0.362	0.389	1.000	-0.436
D -E	0.612	0.639	-0.615	-0.841	0.471	0.869	0.306	-0.436	1.000

Note: R-D means Rough-Delicate; C-S means Coarse-Smooth; T-T means Thin-Thick; D-I means Dull-Interesting; D-C means Discomfort-Comfortable; I-P means Individual-Popular; S-L means Simple-Luxurious; I-F means Indifferent-Friendly; D-E means Difficult to Clean-Easy to Clean.

Principal Component Analysis

The principal component analysis method was used to conduct factor analysis on nine groups of perceptual words to simplify and deepen the user's understanding of the perceptual image of soft sofa fabrics. The common factors were extracted with the standard factor eigenvalue higher than 1, with the goal of extracting the primary perceptual dimensions that influence fabric perception. The first two components were identified as the primary factors, as indicated in Table 6, because the analysis findings demonstrate that

their eigenvalues were greater than 1 and that their cumulative contribution approached 86.1% of the overall eigenvalue.

Table 6. Explanation of Total Variance

Component	Initial Eigenvalue			Extract the Sum of Squared Loads			Sum of Squared Rotational Loads		
	T	V %	C %	T	V %	C %	T	V %	C %
1	4.787	53.188	53.188	4.787	53.188	53.188	3.889	43.215	43.215
2	2.962	32.915	86.103	2.962	32.915	86.103	3.86	42.887	86.103
3	0.904	10.043	96.146						
4	0.147	1.632	97.778						
5	0.09	1.004	98.782						
6	0.065	0.724	99.506						
7	0.027	0.305	99.811						
8	0.011	0.122	99.933						
9	0.006	0.067	100.00						

Note: T stands for total; V stands for Variance; C stands for Cumulative

As shown in Fig. 3, the principal component analysis's scree plot more clearly displays the data in Table 6. It is suitable to extract the first two components as the primary factors because they have the largest eigen values, and the broken line flattens out after the third factor until it gets close to 0.

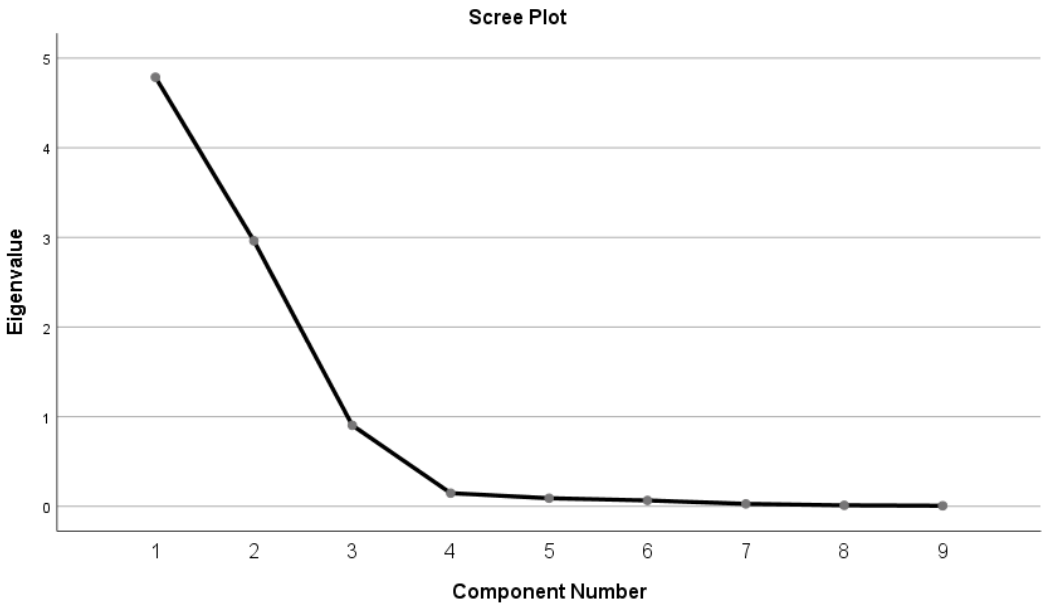


Fig. 3. Scree plot

Analysis of Factor Rotation Results

The factor loading matrix was further processed using the maximum variance orthogonal rotation technique. The rotated factor component matrix is displayed in Table 7. The primary metric for gauging how closely the factor and the variable is associated, is

the factor loading's absolute value. The stronger correlation between the factor and the variable results in a larger value, and the smaller the absolute value, the weaker the association.

Table 7. Rotated Component Matrix

	Component	
	1	2
Rough-Delicate	0.934	0.317
Coarse-Smooth	0.918	0.347
Thin-Thick	-0.131	-0.8
Dull-Interesting	0.058	-0.934
Discomfort-Comfortable	0.94	0.19
Individual-Popular	0.303	0.915
Simple-luxurious	0.805	-0.126
Indifferent-Friendly	0.628	-0.687
Difficult to Clean-Easy to Clean	0.37	0.875

The component diagram in the rotated space shows the correlation between the components and the variables after the two components are rotated more intuitively. The higher the correlation between the component and the variable, as illustrated in Fig. 4, the larger the component coefficient.

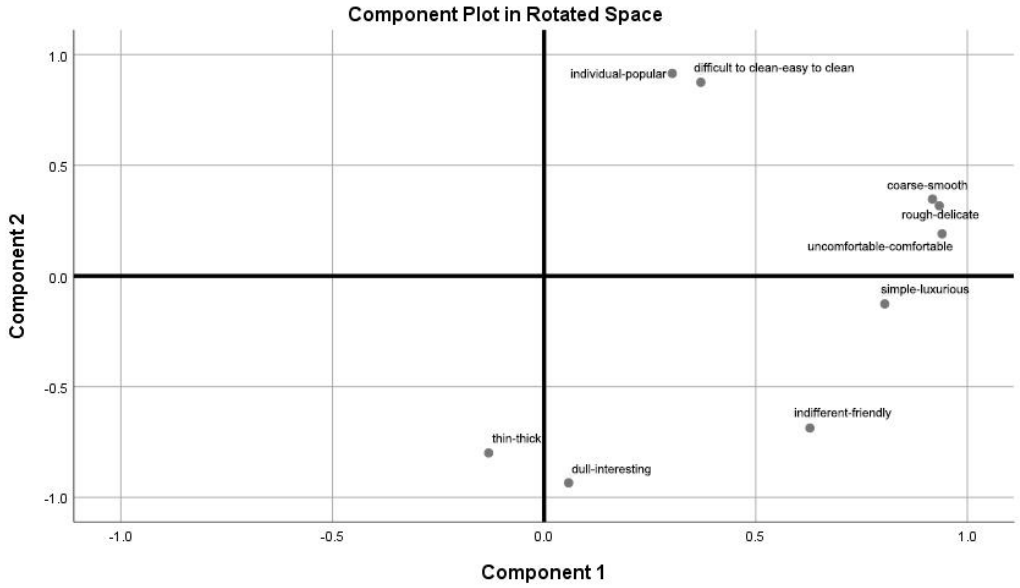


Fig. 4. Component diagram in rotated space

The adjective pairs "rough-delicate", "coarse-smooth", "uncomfortable-comfortable", and "simple-luxurious" gave substantial absolute values of factor 1 loading components. The comprehensive semantics are summed up as texture and quality experience factors, and the four sets of adjective pairs exhibit a strong link with factor 1. The adjective pairs "thin-thick", "dull-interesting", "individual-popular", "indifferent-friendly", and "difficult to clean-easy to clean" are those having high absolute values of factor 2 loading components. The complete semantics are summed up as traits and

emotional reaction factors, and the five groupings of adjective pairs have a strong link with factor 2.

Sensory Image Analysis

As indicated in Table 8, the ten fabric samples were arranged according to average scores on the nine categories of perceptual words. M2: PU leather and M7: deer fur velvet were rated quite highly overall for the factors of texture and quality experience.

Table 8. Sorting of Soft Sofa Fabric Samples Corresponding to Sensory Vocabulary

Common Factor	Sensory Vocabulary	Sorting of Corresponding Soft Sofa Fabric Samples
Texture and quality experience factors	Rough-Delicate	M8<M4<M6<M10<M3<M5<M1<M7<M9<M2
	Coarse-Smooth	M8<M4<M10<M6<M5<M3<M1<M9<M2<M7
	Discomfort-Comfortable	M8<M3<M4<M6<M10<M1<M5<M9<M7<M2
	Simple-luxurious	M4<M6<M3<M5<M8<M2<M9<M10<M1<M7
Characteristics and emotional response factors	Thin-Thick	M6<M2<M4<M3<M1<M9<M5<M7<M10<M8
	Dull-Interesting	M3<M1<M6<M2<M4<M5<M10<M7<M9<M8
	Individual-Popular	M3<M1<M6<M2<M4<M5<M10<M7<M9<M8
	Indifferent-Friendly	M3<M1<M6<M4<M8<M10<M2<M5<M9<M7
	Difficult to Clean-Easy to Clean	M8<M10<M5<M4<M9<M7<M6<M3<M2<M1

The textures of these two fabrics are smooth and delicate, offering a sumptuous and pleasant feel. Consequently, selecting one of these two fabrics for upholstered couches can greatly enhance the sofa. The overall quality and comfort of the dwelling area provide exceptional enjoyment. M8: imitation lamb cashmere and M9: cat fleece fabric were graded relatively high overall among the characteristics and emotional response factors. These two textiles emotionally arouse people's sense of closeness, fun, and public recognition. They are thick and challenging to clean. The use of these two fabrics for soft sofas can resonate with users on an emotional level, creating a warmer and more interesting home atmosphere.

Correlation between Cluster Analysis and Factor Analysis

The first cluster analysis category (M7: deer fur velvet, M9: cat fleece cloth, and M2: PU leather) showed a high correlation with the descriptors "rough-delicate", "coarse-smooth", and "uncomfortable-comfortable" in factor 1 (texture and quality experience factors). The significant effect of factor 1 implies that the delicate and smooth texture and comforting touch of these fabrics are the primary reasons consumers prefer them, influencing their clustering. The luxury these fabrics represent is likewise consistent with the "simple-luxurious" characteristic in component 1, reinforcing the rationale for their classification.

The second cluster analysis category (M1: head cowhide and M3: technology cloth) is closely associated with the adjective pair "difficult to clean-easy to clean" in factor 2 (characteristics and emotional response factors), which is directly tied to the fabrics' durability and practicality. At the same time, these fabrics show considerable disparities in the dimensions of "dull-interesting", "individual-popular", and "indifferent-friendly", showing factor 2's consideration of user emotional responses and tailored demands.

The adjectives "rough-delicate", "coarse-smooth", and "simple-luxurious" in factor 1 (texture and quality experience factors) influence the third category in cluster analysis (M4: imitation hemp, M6: cotton, M5: corduroy, and M10: chenille), indicating that the prominent texture of these fabrics can give users a simple feeling.

The fourth cluster analysis category (M8: imitation lamb cashmere) is fully reflected in the adjectives "thin-thick", "dull-interesting", and "individual-popular" in factor 2 (characteristic and emotional response factors), reinforcing factor 2's critical role in fabric classification and user preferences.

The preceding analysis demonstrates how the two elements in factor analysis (texture and quality experience factors, characteristics, and emotional reaction factors) influence fabrics grouping in cluster analysis. Each component influences users' decisions and preferences across multiple dimensions, determining the attribution of fabrics in cluster analyses. This connected analysis method not only broadens and deepens research, but it also serves as a valuable guide for fabric makers, house designers, and consumers when selecting and matching soft sofa fabrics.

CONCLUSIONS

The first category includes M7: deer fur velvet, M9: cat fleece cloth, and M2: PU leather. This type of soft sofa fabric has a delicate and smooth texture and is suitable for a home environment that pursues comfort and luxury; the second category includes M1: head cowhide and M3: technology cloth. This type of soft sofa fabric is easy to clean and is suitable for a home environment that pursues high durability; the third category includes M4: imitation hemp, M6: cotton, M5: corduroy, and M10: chenille. This type of soft sofa fabric is commonly used in clothing and home textiles and is suitable for a home environment that pursues natural simplicity, and friendly fun; the fourth category includes M8: imitation lamb cashmere. This type of soft sofa fabric is thick and interesting and is suitable for a home environment that pursues warmth and personality.

1. The mean analysis revealed that there are notable variations in perceptual imagery between various soft sofa fabrics in terms of visual-tactile perception. These variations have an immediate impact on users' emotional reactions to the fabrics. When selecting a soft sofa, users who value comfort and luxury may prefer delicate and smooth PU leather, deer fur velvet, or cat fleece fabric, which can substantially improve the level and comfort of the home environment. Consumers who prefer a natural and basic style, on the other hand, will select rough imitation hemp, cotton, and imitation lamb cashmere, which can create a more welcoming and natural home environment.
2. The cluster analysis results strongly corroborate the market segmentation of sofa fabrics. Furniture producers and designers can create and sell couch goods with related styles based on market demands. For home situations that prioritize comfort and luxury, the vendor has the option to promote deer fur velvet, cat fleece cloth, and PU leather; for consumers seeking high durability, head cowhide and technology cloth are better options. Furthermore, the natural simplicity of imitation hemp, cotton, corduroy, and chenille is appropriate for producing warm and intriguing home spaces, while imitation lamb cashmere can provide unique options for consumers seeking warm and individualized home surroundings.

3. The texture and quality experience factors, as well as the characteristic and emotional response factors extracted through factor analysis, provide crucial guidance for the design and development of sofa fabrics. In the design process, designers need to comprehensively consider the influence of these two factors to ensure that the product not only meets users' quality experience needs but also evokes their emotional resonance. By optimizing the fineness, smoothness, and comfort of the fabric, the luxuriousness of the product can be enhanced. Meanwhile, increasing the fabric's lightness, interest, and personalization can attract more consumers who pursue fashion and individuality. Additionally, given the importance of easy cleanliness, designers can also prioritize the fabric's stain resistance and ease of maintenance when selecting fabrics, thereby satisfying modern households' high standards for home cleaning.

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