Analysis of Evaluation Indicators of Furniture Appearance Imagery by Different Consumers

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Consumers rely on sensory perception to judge the appearance of furniture, often guided by intuitive associations with shape. This process allows furniture designers to better understand and respond to consumer preferences and expectations. This work used a questionnaire design and analysis survey by using the material, color, style, shape, and surface decoration of furniture as the main evaluation indexes. Additionally, consumers' furniture appearance indicators were analyzed by combining quantitative and qualitative research methods. Satisfaction analysis (attitude index) of color, shape, material, style, and surface decoration of furniture for different consumers' age, education level, and gender. Finally, consumers' psychological and perceptual preferences were analyzed based on the correlation between indicators to form product imagery. This study can guide the appearance design of furniture and avoid design blindness, thus reducing the design risk.

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INTRODUCTION

The competition among furniture enterprises has become more intense, which has led to the shortening of the product life cycles (Borowiecki *et al.* 2022; İnce *et al.* 2024). With the increasing emphasis on personalization, aesthetics, and lifestyle alignment in consumer choices, there is growing evidence that expectations for furniture products are evolving (Lei *et al*. 2024; Li *et al*. 2024). These shifts may challenge the adequacy of traditional product design concepts and methods in addressing current user demands. Appearance, as an important medium for users' perceptual cognition of products, has become one of the core factors affecting consumers' purchase (Chen *et al.* 2024). The consumers continue to pursue the personalized appearance of furniture products with the rapid development of the modern economy and the continuous improvement of living standards (Fu *et al.* 2021; Mao *et al.* 2024). How to more fully explore the user's needs and expectations, and accordingly the appearance of the product innovation design is currently the hot spot of furniture product research.

To our knowledge, two core theories underpin furniture design evaluation. Kansei engineering (Liu *et al*. 2023) connects emotional responses to product aesthetics. Consumer imagery research explores how consumers perceive and mentally represent product designs. Furniture product image refers to the intuitive association of consumers to the shape of furniture products by virtue of their own senses, which fully conveys the

emotional needs of consumers (Khojasteh-Khosro *et al.* 2022; Tsang *et al.* 2022). Meanwhile, it is also important for designers to accurately grasp the real feelings and expectations of consumers, as well as to understand consumers' emotional cognition of furniture products (Latif *et al.* 2024). Furniture products form the language of communication with people through their own shape, line, color, texture, structure, and the meaning given by the external environment and culture (Foong *et al.* 2022; Wu et al. 2025; Zhu et al. 2025). Design evaluation is the process of making judgments on the value of a design solution after weighing all the influencing factors of the design solution in a comprehensive manner by using the knowledge of design, statistics, and other related disciplines in the design (Chen *et al.* 2017; Markus *et al.* 2021). As a complex decision-making process, everyone has a different understanding of furniture product modeling and form design, thus making the evaluation much more difficult (Manavis *et al.* 2024; Mohamed Elsadek 2024). Currently, research on the evaluation of the perceptual design of furniture product styling is mainly based on Kansei engineering (Khalaj *et al.* 2014; Alpak *et al.* 2020). The semantic difference method is used to collect evaluation words that can represent the styling perceptual design of the target product and to formulate a scale for a specific group of people to carry out subjective questionnaire research (Huang *et al.* 2012; Qureshi *et al.* 2023). Then, the specific details of product styling perceptual design are extracted by combining quantitative analysis. Therefore, this study builds upon these foundations by integrating both emotional and perceptual evaluation dimensions, offering a comprehensive framework that enhances furniture design evaluation.

Previous research has focused on product design through furniture product imagery (Wang *et al.* 2021). By analyzing the main evaluation indexes involved in consumers' evaluation of furniture appearance design effects, the relevant studies have come up with consumers' psycho-sensual preference for product imagery (Chen 2022; Zhu *et al.* 2023). A positive perceptual engineering model for product color design has been established by extracting the perceptual imagery of the target product, which can guide the design of the scheme (Xue and Jin 2024). Furthermore, artificial intelligence (AI) technology can assist in the design of product solutions to meet the needs, and an imagery-driven intelligent design method for product modeling has been proposed (Takeda *et al.* 2024). In recent years, AI-driven methodologies, such as data-driven aesthetic optimization, have been increasingly utilized in product design to refine visual features based on consumer preferences. These approaches use machine learning algorithms to analyze consumer feedback and predict aesthetic trends, ensuring that designs align more closely with consumer expectations. Furthermore, AI can be employed for consumer preference prediction, where deep learning models analyze large datasets to forecast individual tastes, providing a foundation for more personalized furniture designs.

Building upon these studies, the present research proposes an integrated perceptual evaluation model that combines consumer imagery preferences with data-driven analysis of furniture form features, enabling a more systematic and quantifiable approach to guide furniture appearance design—an aspect that has not been fully addressed in previous work. Therefore, the feasibility and scientific basis for innovative design guidance can be supported by referring to consumers' evaluations of photographic furniture appearance samples using perceptual indicators (*e.g.*, modern, elegant, natural) derived from product imagery research.

EXPERIMENTAL

Research Methodology

The consumer satisfaction index (CSI) was used for the collection of questionnaire items (Kim *et al.* 2021). The brainstorming method, semantic quantification method, and imagery word concretization were used in the questionnaire design process. Brainstorming method (Wahyuanto *et al.* 2024). A brainstorming session was conducted by the authors together with three experienced experts in furniture design and user research, in order to identify and refine a set of representative perceptual descriptors based on initial survey feedback. Consumers' perception of the appearance of furniture involves various factors such as material, style, shape, color, surface decoration and so on as subjective variables. Adopting divergent thinking and brainstorming and visualizing different characteristics of each factor (Table 1).

Table 1. Furniture Appearance Imagery

Furniture Appearance Factors	Imagery
Material	Metal, solid wood, cloth, fabric, rattan, plastic
Colour	Elegance, romance, dynamic, magnificent, fashion
Style	Neo-Chinese, European, modern simplicity
Shape	Shape adaptation function, unique shape
Surface decoration	Decoration with function, art deco beauty, decoration with environment

Semantic Quantification Method

According to the semantic quantification method (Diveica *et al.* 2023), a question is formulated and organized into a questionnaire based on the imagery of furniture appearance. Moreover, the questionnaire sentence style adopts declarative sentences and tries to be as concise as possible to clearly and accurately convey the idea, which is easy to understand and convenient for consumers to answer. The answers to the questionnaire were rated on a semantic differential scale, with 5 indicating very like or very important, 4 indicating very like or very important, 3 indicating more like or more important, 2 indicating not too like or not too important, and 1 indicating not like or not important. Finally, these ratings were averaged to form an attitude index. The relationship between the age and gender of different consumers and the evaluation index of furniture appearance is considered comprehensively.

Concretization of Imagery Words

The concretization of imagery words method (Malhi *et al.* 2021) considers that consumers' understanding of these imagery words may not be clear enough, leading to a lack of scientific validity and rigor of the questionnaire. Therefore, images corresponding to each imagery were found online and added to the questionnaire. This will enable consumers to more fully understand the meaning of the questionnaire's questions and make their responses more reasonable and accurate.

Research Process

Various characteristics of the population (diverse occupations, social classes, geographic locations, and cultural backgrounds) were chosen to participate in the questionnaire filling. Furthermore, this research also expanded the participants'

classification by incorporating additional dimensions, including geographic background, purchasing behavior, and psychological preferences. These factors will provide a more comprehensive view of consumer preferences and enable the design of furniture that aligns with diverse market segments. A total of 350 questionnaires were distributed and 350 valid questionnaires were returned, with a recovery rate of 100%. In order to make the statistical analysis more interpretable to the sample, some of the items in the sample characteristic variables were combined for this purpose. Among them, the education level was categorized into 4 categories: graduate and above, undergraduate, college, high school, and below. Age can be categorized into 4 categories: 20 years old and below, 20 to 30 years old, 30 to 50 years old, and 50 years old and above. As can be seen from Table 2, the age group in the survey sample was favored by middle-aged and young people, who are the main target consumers of furniture. Other types of literacy levels were also covered, and the overall profile of consumers of furniture products as a whole was generally consistent. Therefore, the survey sample basically meets the statistical significance.

Table 2. Characterization of Survey Samples

Characterization	Categorization	Percentage
Genders	Male	62.86%
	Female	37.14%
Educational level	Graduate and above	14.29%
	Undergraduate	74.29%
	Junior college	5.71%
	High school and below	5.71%
Age	Under 20 years	37.14%
	20 ~ 30 years	45.71%
	30 ~ 50 years	14.29%
	Over 50 years	2.86%

The questionnaire survey was conducted over a period of more than three weeks, which is a reasonable time period and rigorous research. The longer survey period ensured that respondents from different time periods and different backgrounds had the opportunity to participate in the survey, thus increasing the diversity and representativeness of the sample. It also allows for preliminary data analysis and validation during the data collection process, which improves the quality and accuracy of the data by identifying and correcting problems in a timely manner.

Credibility Analysis of the Questionnaire

A one-way ANOVA was performed to test whether differences in perceptual descriptor ratings across the design samples were statistically significant, with the null hypothesis being that no differences existed among the sample groups. In addition to the reported p-values, we conducted ANOVA to further assess the statistical significance of various furniture characteristics on consumer evaluations. The p-values were all greater than 0.05, which indicates that the data satisfy the assumption of normality and are not significantly different. This means that statistically the difference between the two sets of data could be due to random variation and not due to some systematic factor (Sun *et al.* 2023). In this case, it can be assumed that the two sets of data are statistically consistent and therefore the data can be used for analysis. Furthermore, these tests confirm that this questionnaires are statistically significant, indicating that these factors have a meaningful impact on consumer preferences.

The distribution of sample data is shown in Fig. 1. The data are normally distributed and have good predictability. This means that there are no significant skewness or outliers in the data, making the interpretation and reporting of the data clearer and more intuitive. Therefore, improving the reliability and representativeness of the data.

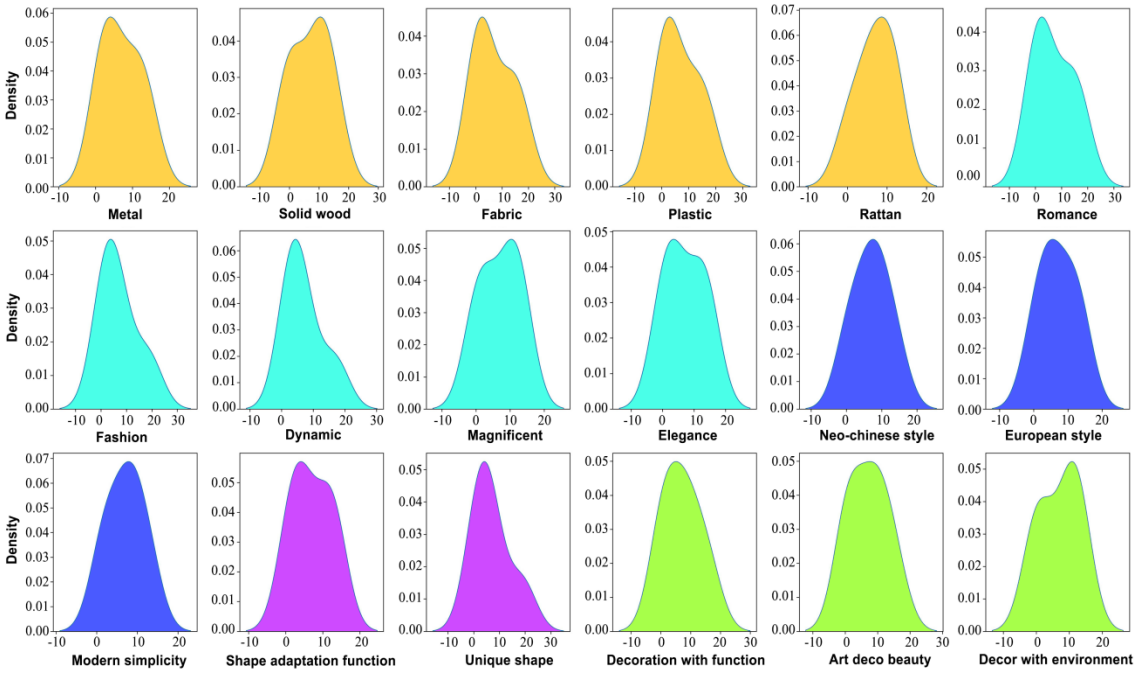

Fig. 1. Sample data

RESULTS AND DISCUSSION

Aggregate Analysis

It should be noted that in some of the visualizations, the vertical axes were scaled to fill the graph area for clarity, which may inadvertently emphasize relatively small differences in scores. Readers are advised to interpret the visual differences alongside the statistical analysis provided, rather than relying solely on visual impression. Confidence intervals for the correlation coefficients were calculated to assess the precision of the observed relationships, as displayed in Fig. 2. Additionally, regression models were applied to identify the predictive power of furniture attributes on consumer evaluations. As shown in the consumer's attitude index of product image in Fig. 2a, the participants in the survey showed the highest preference for solid wood furniture, romantic colors, and neo-Chinese style. Moreover, these participants expressed the belief that it was relatively important to adapt the function of furniture shape and decoration with the environment. Figure 2b shows that the participants of different ages had different product image evaluations on the appearance of furniture. For example, the participants between 30 and 50 years old preferred rattan furniture and solid wood furniture. However, young people aged 20 to 30 preferred solid wood and fabric furniture. The participants between 30 and 50 years old preferred elegant furniture exterior colors, while younger people preferred romantic colors. Additionally, the obtained data on consumer satisfaction were organized, and their p-values were calculated using data analysis software (Table 3). The p-values indicated that the statistically recorded differences were significant.

Table 3. Significance Analysis of Evaluation Data

Evaluation indicators	P-value	Evaluation Indicators	P-value	Evaluation Indicators	P-value
Metal furniture	0.34596	Fashion	0.37000	Modern simplicity	0.93695
Solid wood furniture	0.20062	Dynamic	0.21273	Shape adaption function	0.42858
Fabric furniture	0.23385	Magnificent	0.40136	Unique shape	0.37981
Plastic furniture	0.43238	Elegance	0.37759	Decoration with function	0.82661
Rattan furniture	0.69984	Neo-Chinese style	0.96640	Art deco beauty	0.42234
Romantic furniture	0.29201	European style	0.90522	Decor with environment	0.19627

For the art deco beauty of furniture, the participants in the survey around 20 years old may be more concerned. Middle-aged participants from 30 to 50 years old pay more attention to the function of furniture shape than young people, and they feel that the function of furniture should be more important than the shape. Additionally, Fig. 2c shows that the participants of various genders have different image ratings on furniture appearance. Men's preference for plastic furniture was significantly higher than that of women, and women's color ratings for dynamic were particularly low. Therefore, the color selection of furniture products should match the audience of different genders. Women's scores on the beauty of decorative art and the adaptability of decoration to function were significantly higher than men's, which showed that women attach importance to furniture decoration. A factor analysis was conducted to identify the underlying dimensions of the furniture attributes. This revealed that factors such as materials, coloration, style, shapes, surface decoration of furniture significantly influence the participants preference.

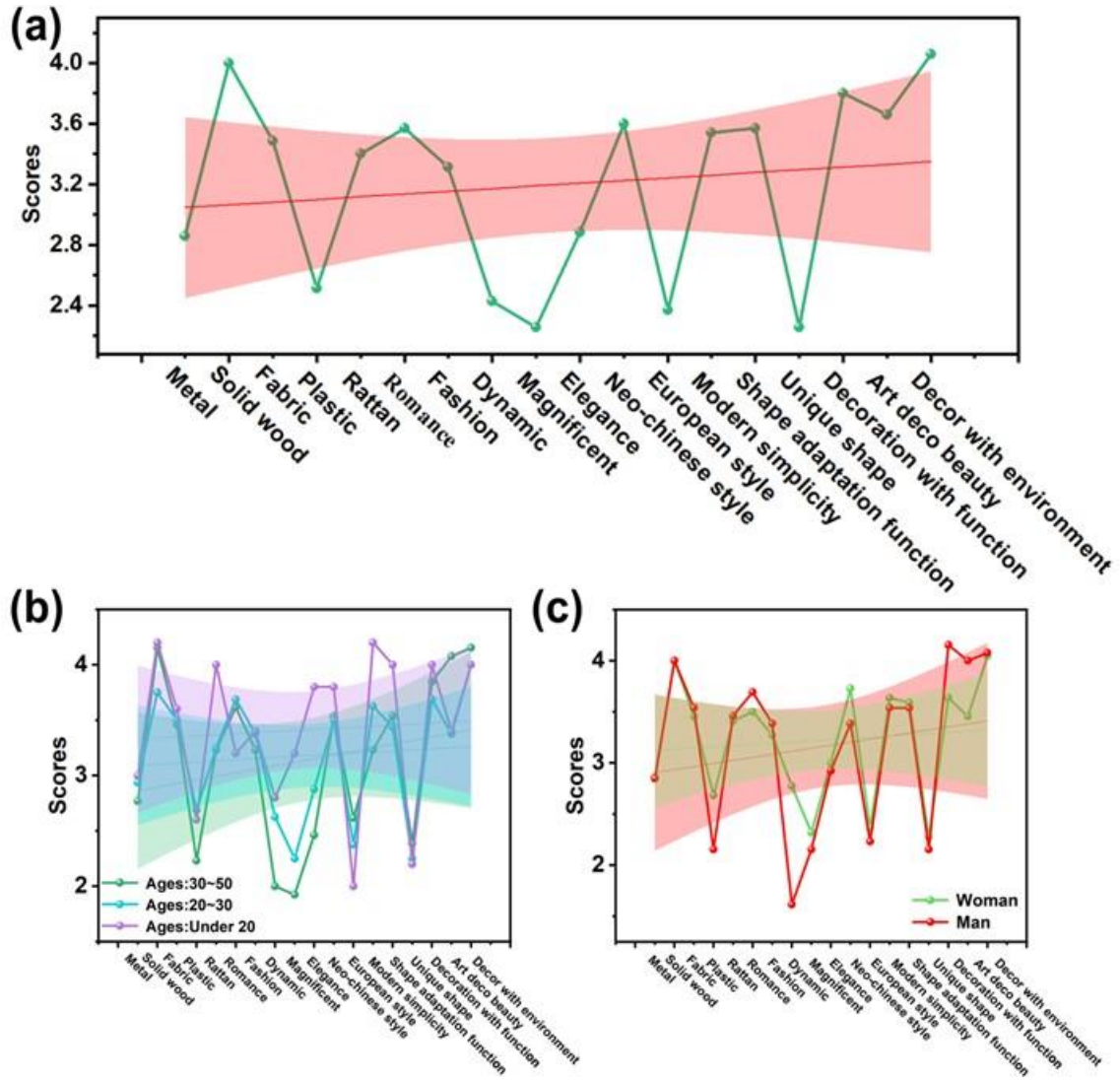

Fig. 2. Furniture product intentions score. (a) Overall attitude index, (b) consumer attitude index by age, and (c) gender-specific consumer attitude index

Materials of Furniture

Figure 3a shows that the value of attitude index ranged between 2.25 and 4.25, and the curve levels were relatively clear. That is to say, there were obvious differences in the attitudes of the participants at different ages towards the evaluation items of furniture materials. The attitude index towards fabric furniture and metal furniture did not change much with the increase of age, and the views were more consistent. The treatment of rattan furniture increased with age. This shows that with the growth of age, consumption habits were relatively stable and consumption concepts were relatively enlightened. Material selection is most important in furniture design and should be given focused attention. Figure 3b displays that the attitude index of the participants to the product imagery of furniture appearance material is ranked as follows: solid wood > fabric > rattan material > metal > plastic. Solid wood furniture, fabric furniture, and bamboo and rattan furniture were the first choice of the participants, which is inseparable from the modern green furniture consumption concept. In light of today's relative lack of solid wood, designers should focus on the development of bamboo furniture or bamboo wood composite furniture to meet consumer demand.

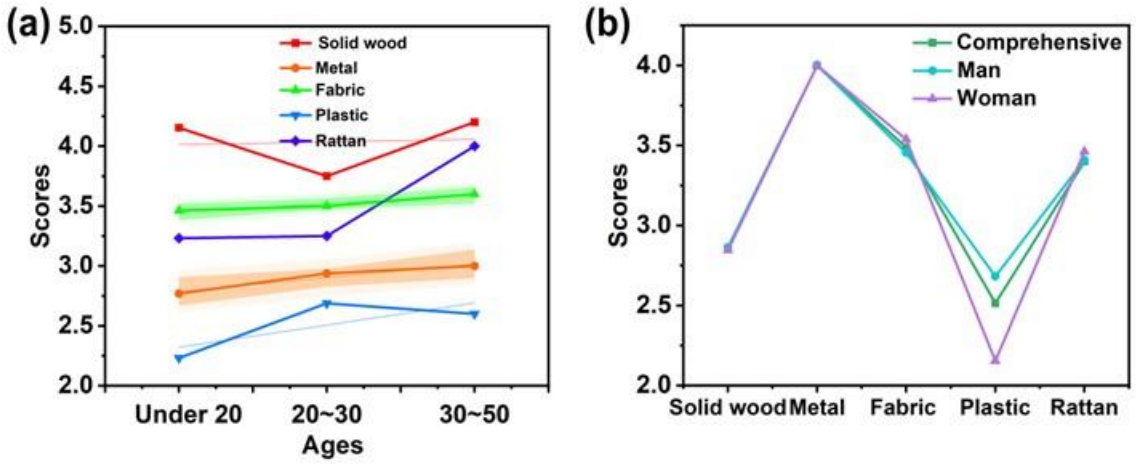

Fig. 3. (a) Attitude index of furniture materials with the participants' age: (b) Correlation of furniture materials and the participants' gender

Coloration of furniture

Figure 4a shows that there was a large variation in consumer evaluations of coloration with respect to the age of the respondent. The attitude indexes of "elegance" and "magnificent" colors increased significantly with age. The attitude index of "fashion" color was more stable with age. The attitude index of "romance" colors started to decrease significantly from 30 to 50 years old, which indicated that older participants had formed inherent consumption habits and were relatively conservative in color preferences. However, on the other hand, older participants also maintained the mentality of pursuing fashion, which also determined their demand for color. It is obvious from Fig. 4b that the participants of different genders were more consistent in their evaluation of colors. Among them, the attitude index of women's evaluation of "dynamic" color was too low, which may be due to the fact that women's attitude towards personalized color was more rigorous and important than that of men.

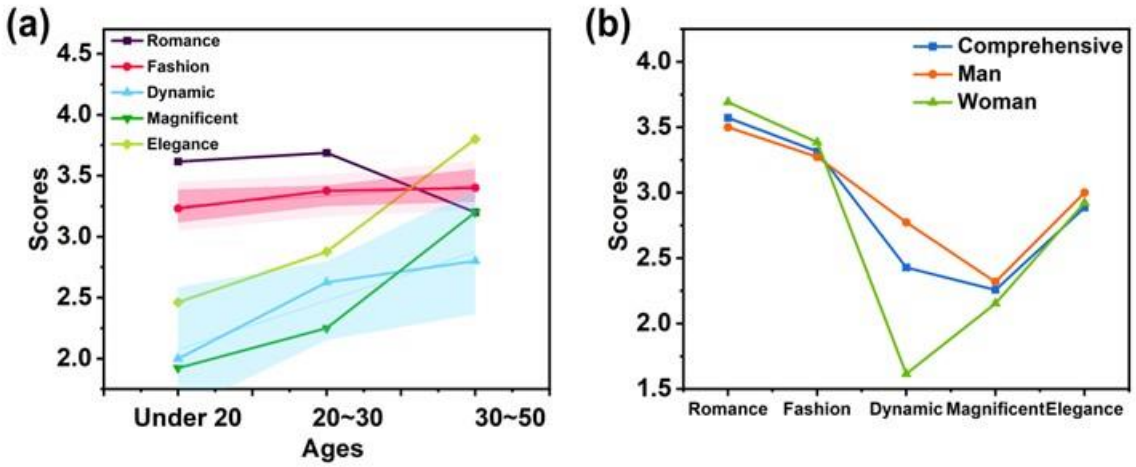

Fig. 4. (a) Correlation of furniture color and the participants' age; (b) attitude index of furniture color with the participants' gender

Furniture style

As depicted in Fig. 5a, there were some differences in the attitude index of participants of different ages towards furniture style, but they were not obvious. The attitude index of neo-Chinese style and modern simplicity style furniture was greater than 3.0, while the European style furniture was significantly lower than 3.0. The European style was not very popular with the participants in the Chinese market. Figure 5b shows that the attitude index of neo-Chinese style and modern simplicity style furniture was high. However, there was no significant difference in the attitude index of different gender participants towards product image of each style item, and the overall attitude of the participants was consistent.

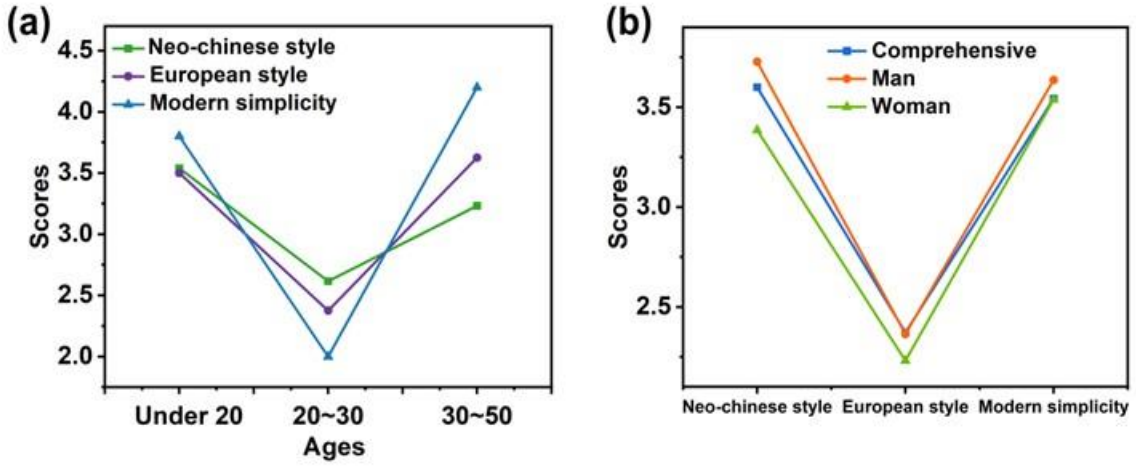

Fig. 5. (a) Correlation analysis between furniture style and consumer gender; (b) analysis of the attitude index between furniture style and consumer age

In summary, the style of furniture is relatively unimportant for the general consumer group, possibly because the public's understanding of the style of furniture is not deep enough. Therefore, the furniture design process does not need to overemphasize the style of furniture.

Shapes of furniture

Figure 6a shows that young participants are more inclined to choose simple, fashionable, and functional modern designs. Middle-aged and elderly participants prefer classic, stable, comfortable, and practical traditional modeling. With age, consumer demand for furniture has shifted from focusing on appearance to focusing more on practicality and emotional value. At the same time, the aesthetic preferences and lifestyles of different age groups also profoundly affect the choice of furniture modeling. Furthermore, Fig. 6b displays that the participants' attitude index of "shape adaption function" is significantly higher than that of "unique shape," regardless of age. This result shows that the average consumer agrees that the functional coordination of the styling is far more important than the quirky styling. The shape of the furniture should be in harmony with its function, rather than just pursuing visual uniqueness. This means that designers and manufacturers should consider the practicality and functionality of the product more when designing furniture products, rather than excessive pursuit of the uniqueness of the appearance.

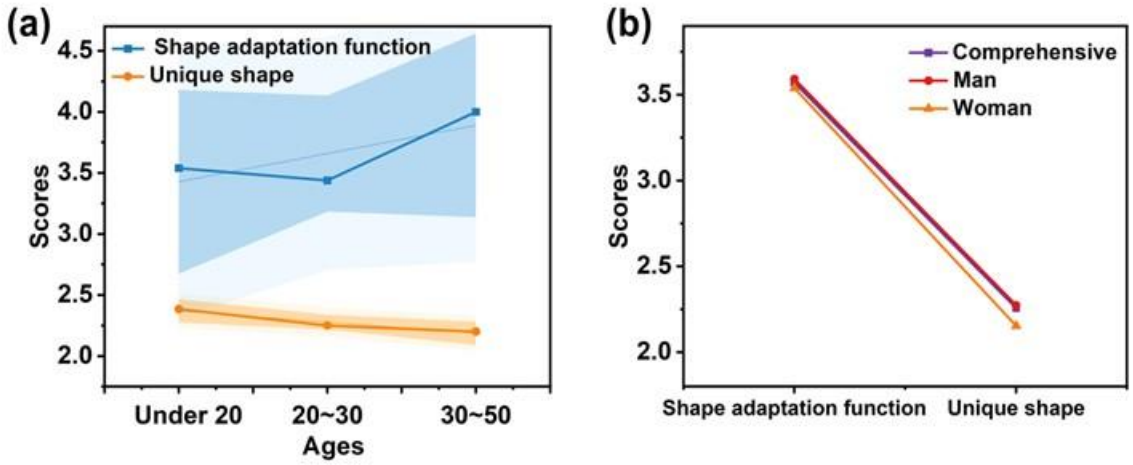

Fig. 6. (a) Correlation analysis between furniture shapes and consumer age. (b) The attitude index between furniture shapes with consumer gender.

Surface decoration of furniture

Figure 7a shows that the attitude index of young participants around 20 years old toward "decor art beauty" was greater than 4.0, which was significantly higher than that of participants of other ages. This result indicates that young people had higher aesthetic requirements for home decoration, and they may be more inclined to choose furniture with unique design and aesthetics to meet aesthetic needs. The attitude index of "decor with environment" was lower than 4.0, indicating the necessity of external environment for furniture decoration. It is also found that the participants between 30 and 50 years old had a higher attitude index about "decoration with function" than the participants in other age groups. This may be due to the fact that the participants between the ages of 30 and 50 are generally in the mature stage of their careers and families. Their requirements for the home environment are more comprehensive and detailed, not only focusing on the beauty of the furniture, but also attaching great importance to the functionality and practicality of the furniture.

Moreover, Fig. 7b shows that the participants of different genders have positive and consistent attitudes towards "decoration with environment". The attitude index of "art deco

beauty" and "decoration with function" of women was higher than that of men. This result showed that female participants attached more importance to the art deco beauty of furniture and the balance between function and aesthetics. Therefore, female participants have unique aesthetic needs and practical requirements in the choice of home decoration and furniture.

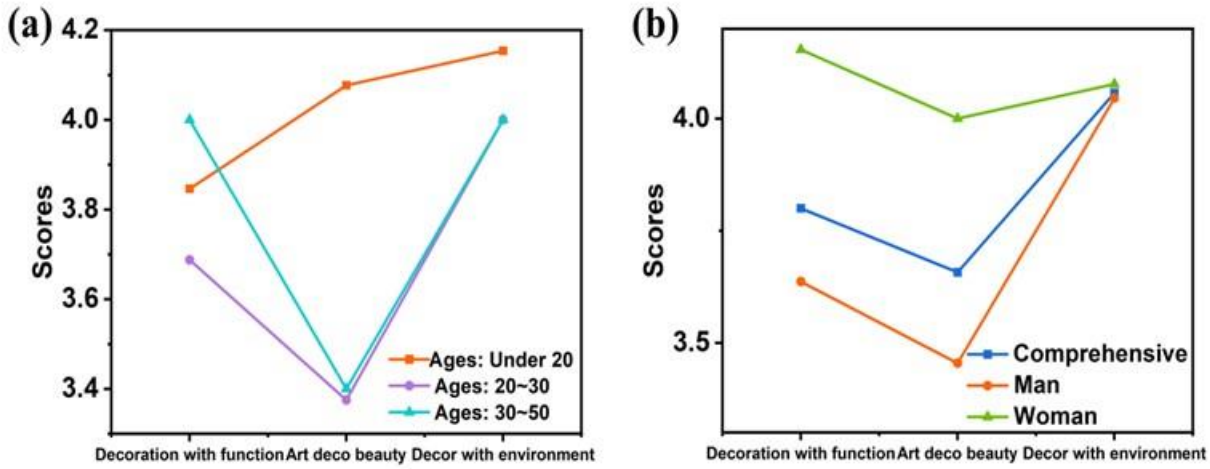

Fig. 7. (a) Correlation curves between furniture decoration and consumer age; (b) The attitude index between furniture style and consumer gender

Correlation analysis

Ten indicators such as solid wood, plastic, rattan, romance, neo-Chinese style, modern simplicity, and shape adaptation function were selected, as shown in Fig. 8. Pearson correlation analysis was carried out through the attitude index of the participants of different genders and different ages. As shown in Fig. 8, there was a strong positive correlation between plastic furniture and dynamic colors. It shows that the participants' low evaluation of the dynamic color may also be less fond of plastic furniture. Therefore, it may be important not to combine it with dynamic colors in the design of furniture appearance about plastic. One may consider combining it with an elegant color that has a weaker positive correlation, which may be more popular with the participants. Rattan furniture has a strong correlation with elegance, modern simplicity and shape adaptation function at the same time. Meanwhile, the participants have a higher attitude index towards "modern simplicity style" and "shape adaption function". Therefore, the designer can consider the "modern simplicity style" and meet the characteristics of the "shape adaptation function" when designing the environmentally friendly furniture of rattan. There is a strong negative correlation between romantic color and "modern simplicity style" and "neo-Chinese style". Therefore, the design of furniture products should avoid the collision of these two styles and romantic colors to ensure the overall harmony and beauty of the furniture product. Meanwhile, "plastic furniture" also has a strong negative correlation with the "decorative with function", so it cannot be decorated in order to adapt to the function in the design process of plastic furniture. Too much decoration of plastic furniture may affect its functionality and practicality.

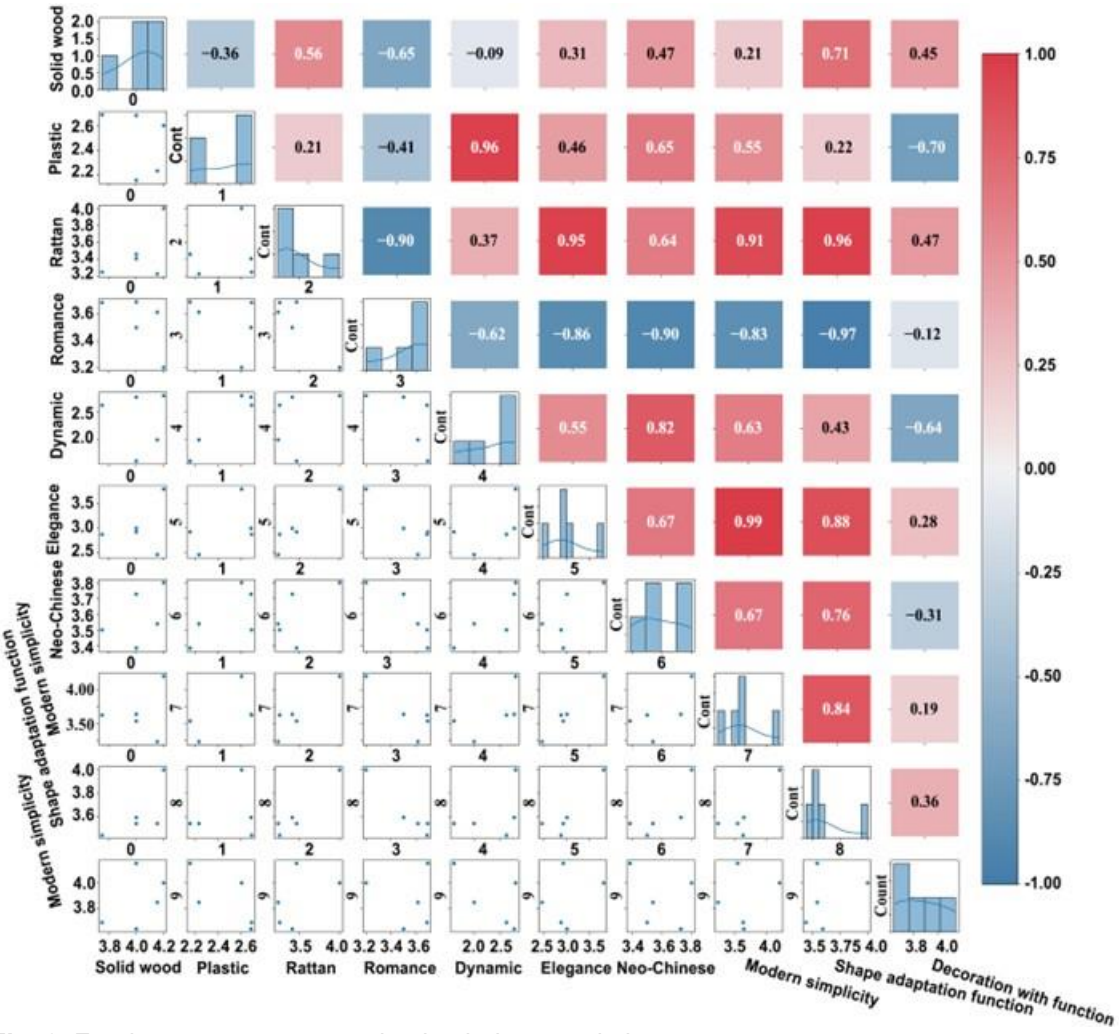

Fig. 8. Furniture appearance evaluation index correlation

CONCLUSIONS

1. The results show that the participants in the survey liked solid wood furniture, fabric furniture, and rattan furniture in terms of furniture types. In today's relative lack of solid wood, furniture product designers should focus on bamboo furniture, bamboo wood composite furniture, and solid wood environmentally friendly furniture development and research.
2. Meanwhile, it can expand the production of fabric furniture or combine fabric with bamboo and wood materials to meet the psychological needs of the participants. In terms of style, the participants in the survey liked modern simple furniture and neo-Chinese furniture. Therefore, modern simplicity furniture and neo-Chinese furniture can be expected to be the mainstream of market furniture. Academics and designers will devote themselves to the research and development of modern minimalist furniture and neo-Chinese furniture to meet the psychological needs of the participants.
3. In terms of shape, the participants in the survey paid attention to furniture products that adapt to the function of the shape and cannot be too strange to meet consumer

needs. On other hand, the furniture design process should focus on the use of romantic colors and fashion colors. In the decoration, the appearance of the furniture decoration should first be coordinated with the environment, then adapt to the function, and finally consider the artistic beauty of the decoration.

4. Gender and age affected the participants' preference for perceptual image of furniture products, so furniture development and design should be considered.
5. The correlation between material, color, style, shape, and surface decoration should be considered. This work can be used to guide the design of furniture products to avoid subjectivity and blindness in design, thus enhancing the innovativeness of furniture appearance design.

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