Study on the Kansei Image of Linear Elements of Wooden Screens on the Basis of Modern Aesthetics

Shun An
Zhongning Guo
Hai Fang

Abstract

As a primitive furniture with the longest history in China, the screen (pingfeng) originated in the western Zhou Dynasty and went through the Han and Tang dynasties, the Five Dynasties, the Song Dynasty, and the Ming and Qing dynasties and is still being used to date. This paper aims to explore the modern aesthetics contained in the traditional screen line and measure the contribution of some linear elements to the overall modern characteristics of the screen. By adopting the method of Kansei engineering, quantitative research is carried out on the Kansei image and the linear patterns of the traditional Chinese screens. The results show that the factors affecting the modern aesthetics of the screen have three linear elements: the top section (pingmao), the upright brackets (zhanya), and the base (dunzuo), with the top section and the base having the greatest influence on the ‘‘modern’’ kansei image of the screen. On the basis of these linear features, the style of the screen can be determined, and the quantitative data can provide reference for the design of modern screens.

As a traditional Chinese furniture, the screen (pingfeng) has special historical significance. The traditional Chinese design perception emphasizes the harmonious coexistence between man and nature, and a systemic holistic view of the coexistence and mutual coordination of the yin and the yang and the unity of man and nature (Wu 2011). The screen has strong vitality and promotion value since its design and use reflect the traditional way of Chinese thinking, which coincides with the current concepts of green design and sustainable development of furniture.

The current research on Chinese screens by domestic and foreign scholars can be summarized into three types. The first type focuses on the cultural development and evolution of screens, such as research on the cultural connotation of screens and the books of Chinese screen pictures. With the aim of exploring the multiple connotations of the screens in Chinese traditional paintings, Wu (1998) studied the metonymic and metaphorical nature of the screens through the internal and external space divided by the screens in the paintings. Su (2008) expounded the cultural changes of the ancient screens. Li (2014) focused on the fields and images of screens in the Tang and Song dynasties, displaying the connotation changes of screens in that period. Sullivan (1965) analyzed other names of screens, such as p’ing-men, bi-chang, chang-tzu, shu-p’ing, or hua-p’ing, and analyzed the role of screen painting as an art form in early Chinese art history. Handler and Berliner (1996) studied the structure and decorative patterns of Chinese screens in the 1960s and 1970s, reflecting the characteristics of these times and the decorative techniques. This paper showcases screens including standing screens (zuoping), folding screens (weiping), screens with detachable panels (chaping), and hanging screens (guaping), which made a great contribution to the further study of the style and evolution of Qing’s screen furniture. The second type is the study of chronology or the form of screens, including the screens of the Tang and Song dynasties, the screens of the Qing Dynasty, landscape painting screens, and lacquer screens. Yang (2020) and Ying (2018) discussed the screen’s indoor functions and decorative patterns in the Tang and Song dynasties. Wang Shixiang (2013) in the second chapter Types and Structure

The authors are, respectively, PhD candidate, School of Art and Design (shanbxnz@126.com [corresponding author]), Professor, School of Electromechanical Engineering (znguo@gdut.edu.cn), and Professor, School of Art and Design (fanghaimail@163.com), Guangdong University of Technology, Guangzhou, China. This paper was received for publication in August 2022. Article no. 22-00045

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of Ming's Furnitures of his book *Connoisseurship of Chinese Furniture: The Ming and Early Qing Dynasties* introduced only six examples of screens of the Ming Dynasty because there are few screens preserved with limited forms. Marcilhac (1991) studied the lacquer works and lacquer screens created by French artist Jean Dunant throughout his life and showed the structure of detailed parts through many photos, which provided technical support for the production and preservation of lacquer screens. Ellsworth (1970) enumerated typical hardwood furniture in the Ming and Qing dynasties and analyzed individual screen cases. The third type of screen research is related to the innovative application of modern screens and the application of screens in indoor space. Wang Lulu (2013) and Zhao (2017) respectively studied the context expression of screens in modern office space and the application of screens in modern indoor living space. Clydesdale (2016) studied the position, style, theme and other aspects of screen murals in Jiuquan tombs and researched the interior space composition. This research provides references for the modern innovative application and design of screens.

Currently, scholars in China and abroad take the screen as a content carrier or furniture for research, mostly focusing on aspects such as screen decoration, screen painting, Chinese screen atlas, and modern space application, without research on the relationship between screen line elements and modern aesthetics. However, aiming at these deficiencies, this paper studies the partial linear elements of the screen and the relationship between the whole screen and the degree of modern aesthetics. According to the different shapes of the screen, relevant samples were selected and important linear elements and perceptual imagery words were extracted. Through the coding conversion of quantitative type I and qualitative variables, the characteristics of the screen line are quantified and assigned so that the originally fuzzy line elements tend to be clear. The quantified data will provide reference and basis for modern furniture designers and design companies.

Materials and Methods

Stimuli

Both traditional screens and modern screens have two types: zuoping, or the standing screen with an undetachable panel connected with the pedestal, and chaping, or the dismountable screen with detachable panel. With the representative screens of the two types as stimuli, which focus on the screen frame and component linear type, the extraction of linear elements, image vocabulary selection, and variable analysis are carried out. The Kansei image is based on the theory and method of Kansei engineering and reflects the image expression of the user to the screen.

First, 54 screen stimuli were selected from domestic and foreign museum collections or private collections. By using the Kawakita Jiro (KJ) method (Kawakita 1970) to remove those stimuli of similar height, same type, and vague information, 26 stimuli were finally selected for research and were classified according to the types of standing screen (including multileaf standing screen, single-leaf dismountable screen, small tabletop screen/inkstone screen) and folding screen, of which there are nine standing screens, six dismountable screens, five small tabletop screens (including inkstone screen), and six folding screens (Fig. 1).

Scholars selected suitable Kansei words according to the characteristics and styles of furniture and completed the evaluation research on the basis of modern design aesthetics. Zhang and Xu (2020) made a Kansei evaluation of the morphologic characteristics of important parts such as the backrest, armrest, and legs of chairs in the Tang Dynasty. Wan et al. (2021) selected five pairs of perceptual words to analyze the surface characteristics of composite bamboo furniture and people's subjective preferences and used the quantified data in modern design. Song et al. (2016) studied the visual effects of different wooden decoration and furniture arrangements. Jing et al. (2015) studied the evaluation system of modernization design of traditional furniture. This experiment mainly involves the linear outline of Chinese screens. The evaluation results and quantitative data will provide a reference and basis for modern design. To avoid the influence of color, pattern, and process of the screen on its evaluation results, the inlaid or carved patterns on the screen were removed and only the outline of the main component was retained. The linear outlines of the 26 screen stimuli were drawn and are shown in Figure 1.

Participants

The screens are Chinese traditional furniture that are widely used in people's daily life, so the subjects of the experiment include both professionals of design and art and nonprofessionals. Among the 75 persons that participated in the questionnaire, there are 21 males and 54 females, including 41 professionals with education background of design and art or experience in a design-related field, and 34 nonprofessionals.

Experimental process

Three groups of representative Kansei image words were selected according to the shape, decoration, and weight of the screen: (1) traditional style–modern style, (2) luxury style–plain style, and (c) heavy style–light style. Each pair of the Kansei image words has a strong preference tendency. In the experiment we made a questionnaire of three groups of Kansei words. By using the semantic differential analysis method with a five-point scale (Osgood et al. 1957), 26 screen stimuli were evaluated and scored in the questionnaire.

The questionnaires were distributed online. The subjects who received the questionnaires looked through the outlines of the 26 stimuli and gave scores to the three groups of Kansei words. Scoring rules: –2 points represents very traditional, very luxurious, and very heavy; –1 point represents traditional, luxurious, and heavy; 0 points represents neutral; 1 point represents modern, plain, and light; 2 points represents very modern, very plain, and very light (see Fig. 2).

Calculation and analysis of Kansei words scoring results

After calculating the scoring results, the data in Table 1 were obtained. Under the traditional–modern type, stimulus 2 scores –1.28, representing the most traditional stimulus, and stimulus 22 is the most modern one, scoring 0.99; under the luxury–plain type, stimulus 6 scores –0.96, representing the most luxurious stimulus, and stimulus 1 scores 1.16, representing the plainest stimulus; under the heavy–light

Figure 1.—Stimuli and outlines (Hu 2015).

type, stimulus 2 scores –0.99, representing the heaviest stimulus, and stimulus 22 scores 1.07, representing the lightest stimulus.

All statistical analyses were performed using SPSS 22.0. In addition, the analyzed data of this study have passed the reliability test with Cronbach's alpha = 0.946, Kaiser–Meyer–Olkin test = 0.705 > 0.6, and the data have good structural validity. The above findings are the basis for further analysis.

Establishment of quantitative type I and mathematical model

Quantification theory is used for the prediction of quantitative benchmark variables. Its advantage is that

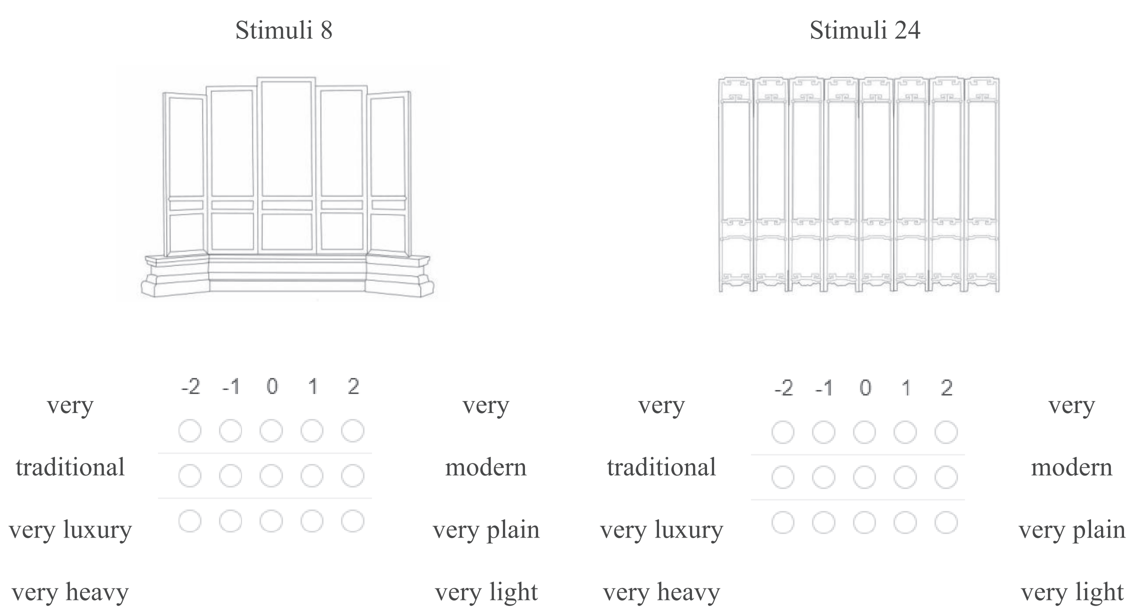


Figure 2.—Imagery vocabulary rating matrix of screens.

Table 1.—Experimental sample image vocabulary scoring results.

Stimuli	Traditional–modern	Luxury–plain	Heavy–light
1	−0.03	1.16	0.31
2	−1.28	−0.77	−0.99
3	−0.88	−0.19	−0.73
4	−0.57	−0.32	−0.33
5	−0.61	−0.31	−0.56
6	−0.88	−0.96	−0.92
7	−0.31	−0.15	−0.08
8	−0.01	0.33	0.13
9	−0.28	0.23	0.03
10	−0.59	−0.47	−0.31
11	−0.23	0.52	0.47
12	−0.51	0.03	−0.21
13	−0.35	0.12	0.03
14	−0.09	0.59	0.51
15	−0.04	0.61	0.45
16	0.16	0.33	0.68
17	0.56	0.88	0.65
18	0.51	0.64	0.55
19	0.04	0.19	0.21
20	0.11	0.39	0.48
21	0.47	0.11	−0.11
22	0.99	1.15	1.07
23	−0.59	0.28	−0.09
24	−0.55	−0.17	0.03
25	0.44	0.63	0.4
26	0.01	0.59	0.27

qualitative variables can be quantitatively studied (Jing 2015). The linear elements in this experiment are qualitative variables, which are usually called *items* in quantitative theory, and the values contained in the items are called *types*.

Quantification theory type I is used to establish the relationship between a set of qualitative variables and a set of quantitative variables by using the mathematical models established on the basis of multiple regression analysis. In this experiment, the linear element was set as x (qualitative variable, item), and the evaluation value of the stimuli Kansei was set as y (quantitative variable, type). The partial correlation coefficient represents the contribution of each item to the Kansei evaluation value. The solution method is as follows: Suppose that the matrix of the Kansei evaluation value y and item j is P:

$$P = \begin{bmatrix} 1 & P_{y1} & P_{y2} & \cdots & P_{ym} \\ P_{1y} & 1 & P_{12} & \cdots & P_{1m} \\ P_{2y} & P_{21} & 1 & \cdots & P_{2m} \\ \vdots & \vdots & \vdots & & \vdots \\ P_{my} & P_{m1} & P_{m2} & \cdots & 1 \end{bmatrix} \tag{1}$$

$$P^{-1} = \begin{bmatrix} P_{yy} & P_{y1} & P_{y2} & \cdots & P_{ym} \\ P_{1y} & P_{11} & P_{12} & \cdots & P_{1m} \\ P_{2y} & P_{21} & P_{22} & \cdots & P_{2m} \\ \vdots & \vdots & \vdots & & \vdots \\ P_{my} & P_{m1} & P_{m2} & \cdots & P_{mm} \end{bmatrix} \tag{2}$$

Then, the partial correlation coefficient between the Kansei evaluation value y and the jth item is as follows:

$$R_{yj} = \frac{-P_{yj}}{\sqrt{P_{jj}P_{yy}}} \tag{3}$$

The contribution of item j to Kansei evaluation value y is R_{yj}.

Suppose item x has r types and δ_i (j, k) is the response of type k of item j to the ith stimulus ($i = 1, 2..., n; j = 1, 2..., m; k = 1, 2..., r_j$), then

$$\delta_i(j,k) = \begin{cases} 1 \\ 0 \end{cases} \tag{4}$$

Suppose that there is a linear relationship between the Kansei evaluation value and the linear elements (items) and each type response; then, the linear model is as follows:

$$y_i = \sum_{j=1}^{m}\sum_{k=1}^{r_j} a_{jk}\delta_i(j,k) + \varepsilon_i \tag{5}$$

where a_{jk} is the kth constant that depends only on the jth item, and ε_i represents the random error of the ith sampling. The least-squares estimate a_{jk} of the coefficient a_{jk} is obtained by using the least-squares method. Then, the prediction equation is as follows:

$$\hat{y} = \sum_{j=1}^{m}\sum_{k=1}^{r_j} \hat{a}_{jk}\delta(j,k) \tag{6}$$

$\hat{y}$ is the predicted value of the benchmark variable y, and $\delta(j, k)$ is the response of any stimulus in the type k of the item j. $\hat{a}_{jk}$ is the score of the type k of the item j. The model is then further assumed to be

$$y_i = y + \sum_{j=1}^{m}\sum_{k=1}^{r_j} a_{jk}\delta(j,k) \tag{7}$$

where y is the average value of the Kansei evaluation value and a_{jk} is called the standard coefficient, representing the contribution of each type to the Kansei evaluation value of the stimulus.

Extraction of the linear elements of the top section, straight bracket, and pedestal of the screen

In the experiment, four professors and two designers used the KJ method (Kawakita 1970) to extract and classify the linear elements of the experimental stimuli, and finally selected three linear elements that are of greatest importance for the 26 screen stimuli. These three linear elements are (1) pingmao, or pingtou: the top section of the screen connected by tenon at the top of the screen with both functions of stabilization and decoration; (2) zhanya: the straight brackets that are commonly found on both sides of the pedestal of the standing screen, which is used to reinforce the panel and connect it with the pedestal; (3) dunzuo: the pedestal of the screen that is used to maintain the stability of the screen. It should be noted that the pedestal of the standing screen is called xumi zuo (Sumitomo base), and that of the standing screen with removable panel is dunzi (the foundation), which is also the linear element extracted in this experiment. The three linear elements are shown in stimulus 4 and stimulus 19 in Table 2.

Results and Discussion

Classification of linear elements of top section, straight bracket, and pedestal

Each table must be typed on a separate sheet. In this experiment, the extracted linear elements are classified respectively, that is, similar elements are classified into one type, so 26 top sections (pingmao or pingtou) have 8 types; 14 straight bracket, 6 types; and 26 pedestals, 8 types. Suppose the linear style is X, then that of the top section is X_1, and its types are expressed as X_{11}, X_{12}, $\ldots X_{18}$; the linear style of the straight bracket is X_2, and its types are X_{21}, X_{22}, $\ldots X_{26}$; the linear style of the pedestal is X_3, and its types are X_{31}, X_{32}, $\ldots X_{38}$. (See Table 3 for details.)

Data analysis

According to the above analysis of the stimuli and types by quantifying class I, the final results of this experiment are as follows: the standard coefficients in Table 4 reflect the contributions of the top section (eight types), straight bracket (six types), and pedestal (eight types) to the image evaluation values of traditional–modern style, luxury–plain style, and heavy–light style. The closer the standard coefficient is to 2, the greater the contribution of the type to the evaluation value of modern style, plain style, and light style. Conversely, the type closer to –2 contributes more to the traditional style, luxury style, and heavy style. Taking the top section as an example, the standard coefficient of the X_{16} type is 1.14, which has the largest contribution to the modern style of the stimuli in the top section type. As for the straight bracket, the X_{24} type has the largest contribution to the luxury image of the stimuli with the standard coefficient of –0.96.

The partial correlation coefficient reflects the degree of correlation between the linear element and the stimulus in terms of the images of traditional–modern. The closer the result is to 1, the greater the correlation between the two. From the data in Table 4, the linear type of the top section (pingmao or pingtou) has the greatest correlation with the traditional type, luxury type, or heavy type of the screen, followed by the linear type of the straight bracket, and that of the pedestal has the smallest correlation. The complex correlation coefficient R represents the accuracy of the model. The larger the value, the higher the degree of linear correlation between qualitative variables and quantitative variables. $R = 0.875$ in this experiment indicates a higher accuracy.

Table 2.—Extraction of linear elements of stimuli.

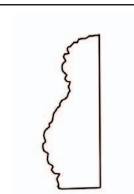
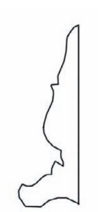
Stimuli 4	Linear elements		
	**top section**	**straight bracket**	**pedestal**
			
Stimuli 19	Linear elements		
	**top section**	**straight bracket**	**pedestal**
			

Table 3.—Classification of linear elements.

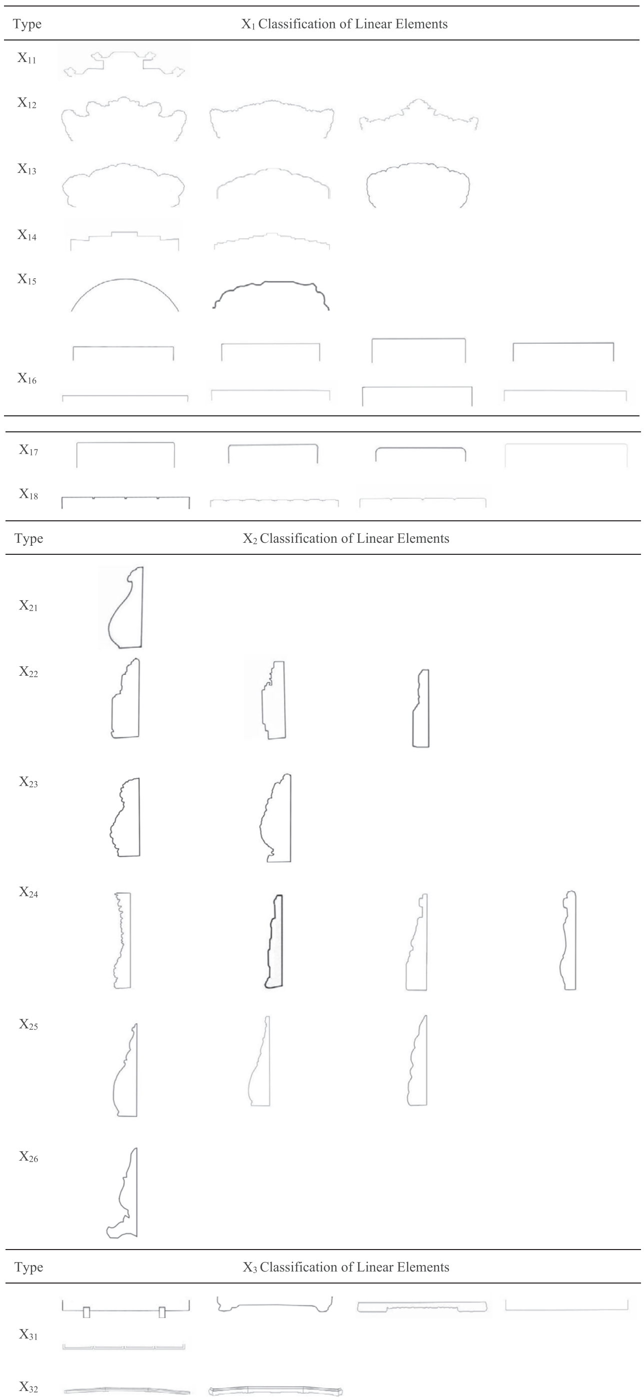


Table 3.—Continued.

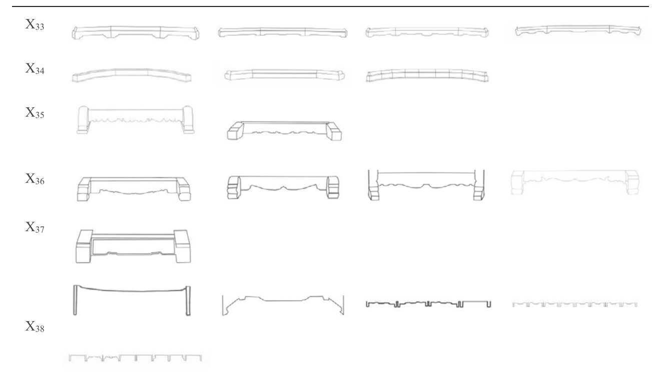


Table 4.—Experimental results of screen sample Kansei image.[a]

Linear element	Type	Standard coefficient	Partial correlation coefficient
Top section	X_{11}	−1.28	0.888
	X_{12}	−0.79	
	X_{13}	−0.323	
	X_{14}	−0.30	
	X_{15}	0.335	
	X_{16}	1.14	
	X_{17}	−0.2	
	X_{18}	−0.35	
Straight bracket	X_{21}	−0.77	0.862
	X_{22}	0.186	
	X_{23}	−0.63	
	X_{24}	−0.96	
	X_{25}	0.54	
	X_{26}	0.19	
Pedestal	X_{31}	0.622	0.675
	X_{32}	−0.86	
	X_{33}	−0.445	
	X_{34}	−0.086	
	X_{35}	0.07	
	X_{36}	0.127	
	X_{37}	0.51	
	X_{38}	0.13	

[a] $R = 0.875$.

Conclusions

This study provides a reference of design elements for contemporary designers that can improve the efficiency of modern screen design and meet the needs of modern aesthetics. The main conclusions of this study are as follows: (1) The investigation on the Kansei image of the screen stimuli shows that in addition to the sense of heaviness of the traditional type, traditional screens can also bring users a modern Kansei image with a sense of lightness, which displays the modern aesthetics of the screen. (2) Through quantitative research, the linear elements that have the greatest contribution to the modern Kansei image of the screen are determined, including the linear patterns of top section (pingtou) X_{16}, the patterns of the pedestal such as X_{31}, and others.

The above conclusions show that the linear types of the top section and the pedestal have the greatest correlation with the modern aesthetics of the screens. Therefore, they should be taken as one of the key points in the design of modern screen furniture.

This study has the following potential limitations: Because the panel of the traditional screen is generally plate type with straight lines, this experiment does not consider the linear influence of the panel. Future research will include a broader range of linear types.

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Literature Cited

Clydesdale, H. 2016. The Jiuquan tombs: Re-ordering art and ideas on China's frontier. PhD dissertation, Columbia University, New York.

Ellsworth, R. H. 1970. Chinese Furniture—Hardwood Examples of the Ming and Early Qing Dynasties. Wm. Collions & Sons, London.

Handler, S. and N. Berliner. 1996. Beyond the Screen: Chinese Furniture of the 16th and 17th Centuries. Museum of Fine Arts, Boston.

Hu, D. S. 2015. Picture of the Forbidden City Screen. Palace Publishing House, Beijing. 24 pp.

Jing, N., J. N. Su, and S. T. Zhang. 2015. Research on the evaluation system of traditional furniture modernization design. *Furniture* 36(5):48–52, 90.

Jing, N. 2015. Research on Chinese modern furniture from the perspective of inheritance of design principles. PhD dissertation. Jiangnan University, Wuxi, China. pp. 38–46.

Kawakita, J. 1970. Development Method—Development and Application of KJ Method (Japanese Original Edition). Chuokoron-Shinsha Press, Tokyo. pp. 35–39.

Li, X. 2014. In-Between: A History of Meaning in Chinese Screen. Peking University Press, Beijing. pp. 8–9.

Marcilhac, F. 1991. Jean Dunand His Life and Work. Thames and Hudson, London. 352 pp.

Osgood, C. E., C. J. Suci, and P. H. Tannenbaum. 1957. The Measurement of Meaning. University of Illinois Press, Urbana. 342 pp.

Song, S. S., Q. Wan, and G. G. Wang. 2016. Eye movement evaluation of different wood interior decoration space. *Wood Res*. 61(5):831–843.

Su, D. H. 2008. Cultural interpretation of ancient Chinese screen design. Master's thesis. Hunan University of Technology, Zhuzhou, China. 6 pp.

Sullivan, M. 1965. Notes on early Chinese screen painting. *Artibus Asiae* 27(3):239–264.

Wan, Q., Q. W. Hu, B. W. Chen, H. Fang, Q. Ke, and S. S. Song. 2021. Study on the visual cognition of laminated bamboo furniture. *Forest Prod. J.* 71(1):84–91.

Wang, L. L. 2013. Contextual expression of screens in modern office space. Master's thesis. Dalian University of Technology, Dalian, China. 46 pp.

Wang, S.X. 2013. Connoisseurship of Chinese furniture: The Ming and early Qing Dynasties. SDX Joint Publishing Company, Beijing. pp. 414–417.

Wu, H. 1998. The double screen: Medium and representation in Chinese painting. Chicago University Press, Chicago, Illinois. 84 pp.

Wu, Z. H. 2011. Research on the evolution of Chinese traditional design thinking mode and furniture style. PhD dissertation. Nanjing Forestry University, Nanjing, China. 12 pp.

Ying, W. 2018. A national flower's symbolic value during the Tang and Song Dynasties in China. *Space Cult*. 21(1):46–59.

Yang, J. 2020. On the function of screen in ancient indoor life. *Furn. Inter. Des*. 1:90–91.

Zhang, Z. H. and B. M. Xu. 2020. Tang Dynasty chair feature design based on kansei evaluation and eye tracking system. *Wood Res*. 65(1):161–174.

Zhao, Q. P. 2017. Application of screen in modern indoor living space design. *Art Educ. Res.* 9):77, 79.