



Furniture design for the elderly based on the artistic conception of Chinese culture

Xiaoxuan Wu^a, Huijie Ouyang^a, Yuan Wang^a, Zhigang Hong^{b*}

Contact information:

^aCollege of Forestry, Sichuan Agricultural University, 611130, Chengdu, P. R. China;

^bKey Laboratory of Wood Industry and Furniture Engineering, Sichuan Agricultural University, 611130, Chengdu, China;

*Corresponding author:hmj365@sicau.edu.cn

Abstract. The elderly-friendly furniture were required in china, since china became an aging social. The function & emotion design were required in elderly-friendly furniture. Using traditional Chinese cultural image sign in elderly-furniture design was a good job, it brought the aging consumer fantastic feeling. After the mood-board was build with Chinese tradition culture view, the CMF and symbolic semantic were find out in the research. Some wonderful elderly-friendly furniture was designed and displayed the Chinese tradition culture by using those CMF and semantic element in this paper. We thought Chinese traditional culture can be used in aging-friendly furniture, and the mood-board build is the key work in this kind of furniture design.

Keywords: Furniture for the elderly; Chinese Culture; Mood Board; CMF; Furniture Design

1 Introduction

At the time of China's aging society, the study of aging-friendly furniture design meets the needs of social development. At present, aging furniture mostly stays on the basis of safety, accessibility and humanization, and there is less research on the design of aging furniture based on the aesthetics of the elderly in China. Chinese cultural imagery has a unique aesthetic value, and the design of aging furniture based on Chinese cultural imagery will provide a higher quality living environment for the elderly.

2 Definition

The elderly consumers here are people over 65 years old who show signs of functional decline in vision, touch and hearing. These elderly consumers live in a home retirement mode and have certain aesthetic needs and consumption ability. They pursue high quality of life and can understand Chinese cultural imagery.

© The Author(s) 2024

R. Appleby et al. (eds.), *Proceedings of the 2nd International Conference on Intelligent Design and Innovative Technology (ICIDIT 2023)*, Atlantis Highlights in Intelligent Systems 10,
https://doi.org/10.2991/978-94-6463-266-8_15

Elderly-friendly furniture is a type of furniture whose function, size, material and color design are suitable for the needs of the elderly. Elderly-friendly furniture with Chinese cultural context has not only elderly-friendly functions, but also unique aesthetic needs. Living room, dining room, and bedroom furniture are the main research objects of this paper.

Chinese cultural imagery specifically refers to a unique understanding and empathy generated by having Chinese traditional cultural elements and Chinese traditional home life scenes. The application of Chinese cultural imagery in age-appropriate furniture is mainly limited to mood board design, holistic mood of furniture, rhyme and rhythm design, CMF design and Chinese symbolic semantics application. The Chinese cultural imagery of this reference focuses on landscape culture. Landscape is an important part of Chinese culture and even Chinese history, and is a concrete expression of the traditional culture of "the unity of heaven and man and the way of nature". With its unique artistic language, Chinese landscape imagery has become an important symbol of Chinese cultural spirit through its spiritual pursuit, values, and aesthetic interests as expressed in poetry, calligraphy, and painting [1].

3 Limitation

Currently, the elderly population is divided into self-care elderly, assisted elderly, and cared-for elderly. The scope of this paper is limited to self-care elderly and intermediate elderly. Among them, the self-care elderly focus on prevention, cultivating the ability to live independently and preventing accidents; the intermediate elderly need safety assistance to help them take care of their own lives and restore their dignity. On this basis, the elderly-friendly furniture is similar to the conventional furniture, with the addition of relevant elderly-friendly elements and functionality, and more attention to furniture design, home environment integration and aesthetic needs, so as to facilitate the use of the elderly.

Throughout the current market of age-appropriate furniture, the overall age-appropriate furniture market is still in its infancy and is relatively fragmented, with insufficient attention paid to the needs and preferences of elderly consumers in the industry. Age-friendly furniture currently has the following main limitations: the concept of ageing is relatively lagging behind, not getting rid of the inherent impression of the elderly, that they are stubborn, conservative, weak ability to pay. But now is moving towards or has been moving towards the elderly stage of the 60, 70 people, is the whole society then deservedly the most affluent generation, as they grow older, their demand for age-appropriate furniture is also rapidly increasing.

Secondly, the cognition of the needs of the elderly and the aging life scenes is insufficient. At present, society is not yet deeply aware of the importance of ageing furniture, most think that only for the disabled or semi-disabled elderly care and treatment of auxiliary tools, did not give much consideration to the actual use of the elderly effect and scene adaptation. At present, China's traditional concept, most of China's home care model, the elderly more than 90% of the time are in the home state. However, most of the furniture for the elderly and the home space atmosphere is separated, resulting in

a sense of special, resulting in a sense of difference between the elderly users, which leads to inferiority complex.

There are more than 60,000 kinds of elderly products in the world, more than 40,000 kinds in Japan, and only 2,000 kinds in China, which are relatively single products, and the current design of ageing furniture mostly stays in universal design, barrier-free design and inclusive design, mainly for imitating the design of countries with advanced development of ageing research. Chinese cultural imagery has unique aesthetic value, and the design of aging furniture based on Chinese cultural imagery not only has the function of aging, but also has unique aesthetic needs, which will provide a higher quality living environment for the elderly.

4 Method

4.1 Mood board based on the artistic conception of Chinese culture

Mood board is to collect information in the direction of color, image, etc. through the theme of design, to cause some emotional resonance, as a reference for design direction or form, which helps designers to clarify design style and demand, and then to extract color scheme, visual atmosphere, material texture for design inspiration and basis[2].

The text study aims to integrate Chinese cultural imagery into age-friendly furniture, hoping to provide a higher quality living environment for the elderly by incorporating the unique aesthetic value and unique aesthetic needs in Chinese cultural imagery. The emotional needs of the elderly need to be considered at all times in the design of seniors' emotions, which also includes cultural levels, aesthetic concepts, characteristics of the times, psychological needs, etc[3]. Therefore, among many traditional cultural images, five cultural images were selected that are very characteristic of traditional Chinese culture and meet the preferences of the elderly, namely, poetry culture, landscape culture, tea culture, flower and bird culture, and chess culture. The mood board is designed according to the imagery contained in them.

Culture of Tea.

Chinese tea culture is profound and has a long history. Tea emerged in the Tang Dynasty, flourished in the Song Dynasty, the thousands Tea is a gift of nature to mankind, embodies the Taoist idea of natural inaction, contains the aesthetics of humanized natural imagery, there is a search for nature, return to the original heart, enjoy the sense of nature and happiness [4]. The combination of the art, taste, and tools of tea together brings the dual enjoyment of the senses and the psyche. Most elderly people will taste and drink, know how to speak, and seek the state of tea drinking most, and feel the deep-seated charm brought by tea. The design of the mood board of tea culture starts from tea itself, associating the elements of tea picking, tea fields, tea rooms, tea utensils, etc., and then disperses to the emotions of tranquility, nature, refreshment and dignity.

Culture of Chess.

The Chinese traditional art activity of qin, chess, calligraphy and painting carries Chinese elegance, and the ancients often used qin, chess, calligraphy and painting to discuss their personal talents and cultivation. Among them, Go is the game of Weiqi, which embodies the Han people's pursuit of wisdom and was the favorite recreational and competitive activity of the ancient people of China. For the ancient Chinese, chess is the Way, and playing chess is a process of enlightenment. Chess is no stranger to the elderly. In the old days when entertainment was scarce, chess could be considered the best way to spend time, and nowadays, the elderly also use chess to enrich their spare time and enjoy themselves by meeting friends with chess. In the design of the chess mood board, chess is used as the starting point to associate the elements of chess board, game, rules, wisdom, black and white, etc., and then to associate the emotions of solemnity and seriousness, leisure time and transcendence.

Flower & Bird Culture.

Chinese culture is concerned with the unity of heaven and man and the natural way. According to their characteristics, the ancients gave different meanings to flowers, birds, fish and insects, birds and animals, including the elegant plum, the noble bamboo, the steadfast pine, the independent frosty chrysanthemum, the cuckoo that expresses sorrow, and the wild goose that expresses homesickness. Flowers and birds occupy a great place in poetry and painting by virtue of their rich variety and moral meaning. The ancients followed the concept of writing in Chinese art creation and obeyed the aesthetic consciousness of Chinese culture when creating flowers and birds, incorporating strong personal emotions and characteristics while shaping the natural choices. Older people present a surplus of time and energy after retirement, and usually use raising flowers and walking birds to pass their time and release their energy, so they are willing to understand and accept the culture of flowers and birds to a high degree. In the design of flower and bird mood board, the flower and bird itself is taken as the starting point, associating with elements such as brush painting, fan, bird cage, nature and sunshine, and then dispersing to emotions such as restfulness, leisure and cultivation of body and mind (Fig. 1).



Fig. 1. Tea culture, chess culture, flower and bird culture mood board design

Poetry and Culture.

Poetry is a product of the ancients who used to express their current emotions, their aspirations and desires, and in ancient times people also invented poetry games such as the Flying Flower Order because of their love for poetry. Among the many excellent Chinese poetry, imagery is the soul of it[5]. Most of the new generation of elderly people are educated and can understand the meaning behind the poems, and many of them like poems and are not willing to just recite them and write them, but also create them according to the current situation and express their own emotions. Therefore, in the design of the mood board of poems, the association is made according to the poems, so as to get the elements of brush, calligraphy, literati, poetry club, etc., and the corresponding colors are extracted according to the impressions of these objects, such as the black of brush and ink, the yellow of Xuan paper, etc., so that they can become design elements, and through color matching to make them convey the emotions of elegance, erudition and self-control.

Landscape Culture.

Landscape cultural imagery is one of the important components of traditional Chinese culture and is a cultural imagery with high aesthetic value and philosophical connotation. Unlike the Western concept of realistic "landscape", landscape from a Chinese perspective is a spiritual symbol, containing cultural beauty, formal beauty and rhythmic beauty, and is often used by people to express their emotions through objects and scenery. People's sense of intimacy and belonging to the landscape can be seen in many of the paintings[6]. In most of the paintings, the invisible water is depicted through the tangible mountain, which is called "leaving white space" in Chinese painting. The combination of reality and emptiness in the landscape expresses the aesthetic connotation of the unity of heaven and man [7]. Most of the elderly are close to nature, and the inconvenience of legs and feet caused by age deepens their love for landscape and nature. In the landscape mood board design from the landscape, associated with the Chinese painting, mountain rocks, fishing boats and other elements, from its own color properties for color extraction and integration, and then convey the emotions of aloof, bold, stable, calm (Fig. 2).



Fig. 2. Poetry culture, landscape culture mood board design

After the production of the mood board, according to the comprehensive consideration of the cultural level, aesthetic concept, characteristics of the times and psychological needs of the elderly, the landscape culture was finally selected as the design theme, and the landscape mood board was used as the inspiration and form reference for the subsequent design.

4.2 Color design based on blood board

Color is one of the important elements of furniture design, not only decorative, but also has a symbolic meaning. Color imagery is the user's intuitive association of color, establish the correspondence between color and imagery mood board design, transform it into design elements, get the color scheme that meets the needs of imagery, narrow the cognitive gap of color imagery, improve the effectiveness, practicality and accuracy of color design [8].

The following figure shows the color design based on the mood board design of tea culture, chess culture, flower and bird culture, landscape culture and poetry culture. The colors are extracted from the mood board design, and suitable colors are selected for combination design, so that the colors and traditional cultural imagery maintain the same style and aesthetics, and make them better convey the imagery emotion by giving the optimal adaptation of colors to the appropriate position of the age-appropriate furniture (Fig. 3).



Fig. 3. Color design based on blood board

4.3 Symbol extraction and transformation on blood board

Chinese cultural imagery occupies a large area with the philosophical idea of "the unity of heaven and man", which mainly expresses the unity of heaven, earth and man as a unified whole, and emphasizes the harmony and perfection of the whole. In the natural world, it is the unity of the aesthetic experience in people's daily life. In these natural beauties people extract inspiration from them with a harmonious and temperate state of mind, condense cultural symbolic features, and express all things in nature such as mountains, rivers and streams through symbols. In the transformation of symbols mainly use the abstract method, abstract the specific subject matter, through the sparse,

size, contrast and other ways to apply to furniture, reflect the rhythm and rhyme, to convey the artistic beauty [9].

In this paper, the study of suitable aging furniture, according to the selected landscape imagery mood board for symbol extraction, from which natural elements such as fishing boats, mountains, rivers, rocks and trees are selected for abstract refinement, applied to furniture according to functional needs, paying attention to the rhythm and rhythm of furniture design, so that the overall unity of furniture modeling, and convey the sense of calmness and relaxation in landscape imagery (Fig. 4).

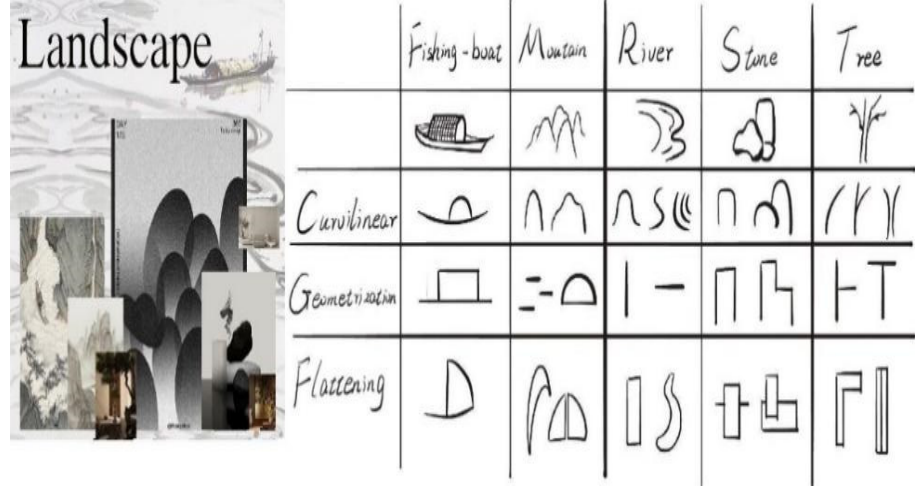


Fig. 4. Design based on the transformation of landscape cultural symbols

5 Results

5.1 Design furniture for the elderly

The research object of this paper is mainly living room, dining room, and bedroom furniture, so the sofa, dining table and chairs, coffee table, and bed are selected as the design objects. On the basis of meeting the functional needs and size of the elderly, the landscape imagery is incorporated to make it not only have the old-age friendly function, but also have unique aesthetic needs to provide a higher quality living environment for the elderly.

Through the design of landscape imagery mood board, the cultural beauty, formal beauty and rhythmic beauty of landscape in Chinese perspective are shown in the aging-friendly furniture by color design and symbolic semantics, and three sketch solutions of aging-friendly furniture are designed according to different symbol selection and application (Fig. 5).

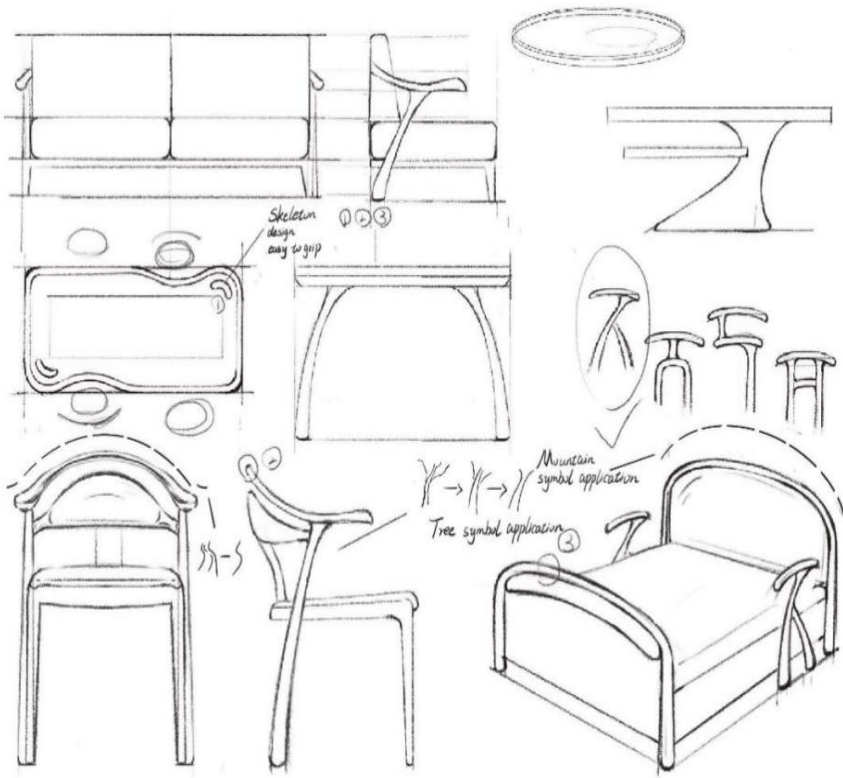


Fig. 5. Option 1

The program starts from the curvature of landscape symbols and carries out the design of age-appropriate furniture by incorporating the elements of mountains, water and trees. The exterior shape design is carried out on the basis of retaining the functional needs of aging-appropriate furniture. For example, there is a rounded shape design in each piece of furniture, and the warm curve is not only a transformation of the mountain shape, but also brings a stable and calm feeling to the elderly. The leg shapes of the furniture are all curvilinear transformations of tree elements, and the overall lightness and vividness make the elderly associate while enriching the furniture changes. The overall shape of the furniture in this program is light, reflecting the smooth and natural characteristics of the landscape while meeting the functional needs of the elderly, bringing them a relaxed and restful feeling.

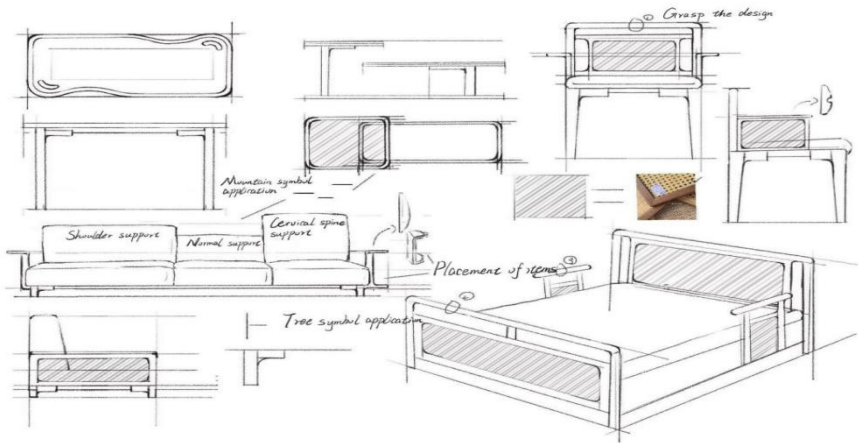


Fig. 6. Option 2

The scheme starts from the geometry of landscape symbols and carries out the design of ageing-friendly furniture by incorporating the elements of mountains, trees and. It not only has intact age-appropriate functions, but also shows the nature and magnificence of the mountains and waters. The sofa and coffee table in this plan adopt the geometric design of mountain shape, and the staggered shape of height brings a touch of novelty to the traditional ageing furniture. Inspired by the fishing boats in the lake, the rattan elements of the fishing boat roof are used in the furniture, and the hollow characteristics of the rattan bring a hazy sense of permeability to the furniture, which fits with the state of reality and emptiness of the landscape, creating a natural, permeable and smooth view (Fig. 6).

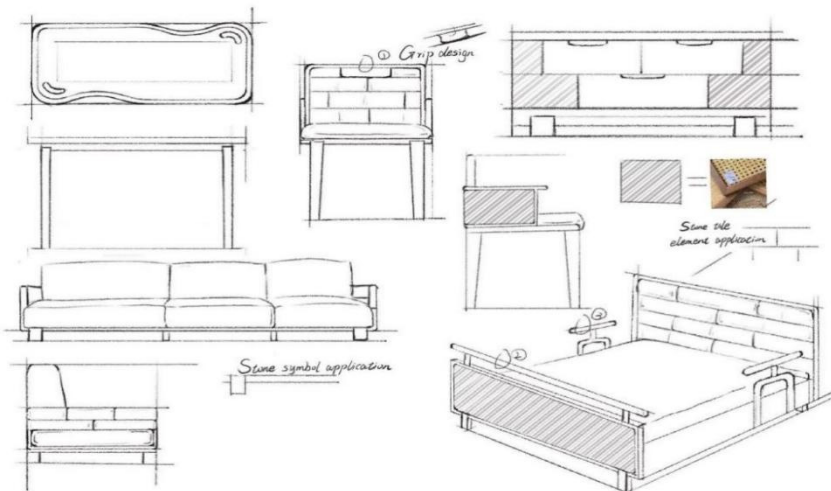


Fig. 7. Option 3

The proposal starts from the flattening of landscape symbols and carries out the design of ageing-friendly furniture by incorporating mountain and stone elements. It not only retains the functional needs of aging-friendly furniture, but also reflects the unique beauty of landscape imagery. Starting from the stone piles and bricks next to the landscape, it renders the stone and brick shapes with different materials, and combines wood and rattan to present the landscape naturally in the furniture, bringing the furniture users a sense of intimacy and belonging with the landscape (Fig. 7).

After screening and comparing the design solutions by sketching and comparing methods, and discussing and studying three aspects of age-appropriate furniture function, imagery expression, and emotional resonance, we finally chose solution 1, and established the model (Fig. 8).



Fig. 8. Scheme 1 Model

5.2 Using the color & symbol on the furniture for the elderly

Through the study of the needs of the elderly, we found that the elderly prefer bright and natural colors, such as primary wood, beige, etc., which can bring positive psychological implication to the elderly. Therefore, from the colors extracted from the landscape imagery mood board design, we chose the matching colors for color matching, and came up with a total of three color schemes: single color, two-color matching and three-color matching.

Scheme 1 is mainly in brown color, with subtle color changes according to the different materials, the overall harmony and unity, but without losing the details of change, bringing a harmonious and stable experience to the elderly. Scheme two is based on light brown and beige, two colors together to create an idyllic natural look and feel, bringing a natural and comfortable experience to the elderly. Option 3 is a combination of beige, light brown and light green, which brings the effect of green water and green

mountains to the elderly (Fig. 9). Combined with the furniture modeling rendering effect, option two was finally selected(Fig. 10).

option 1 option 2 option 3

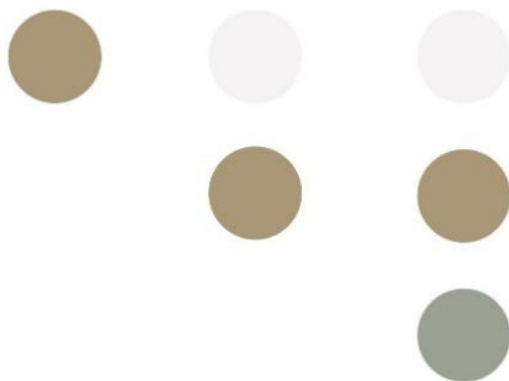


Fig. 9. Color scheme





Fig. 10. Rendering of the color scheme

According to the color scheme two, the main structure is chosen in the warm tone of the original wood color, in the seat backrest and cushion to choose beige to match, so that the overall elderly-friendly furniture presents a light, comfortable atmosphere, bringing positive psychological implication to the elderly, in line with the needs of the elderly on color. In the material selection of natural wood and high elasticity sponge, the touch of warm, bland and friendly, soft and breathable, in line with the needs of the elderly on the material [10].

In the application of aging furniture symbols, the curved modeling scheme is selected, through the abstract refinement of natural elements such as mountains, rivers and trees, forming a curved modeling with the characteristics of landscape symbols and applying them to furniture. Through the changes of furniture leg thickness, squareness

and roundness, and the natural and smooth curve of the armrest, the overall furniture is rich in rhythm and rhyme, giving the furniture landscape imagery, creating a natural and comfortable atmosphere and conveying the unique mood of the landscape (Fig. 11).

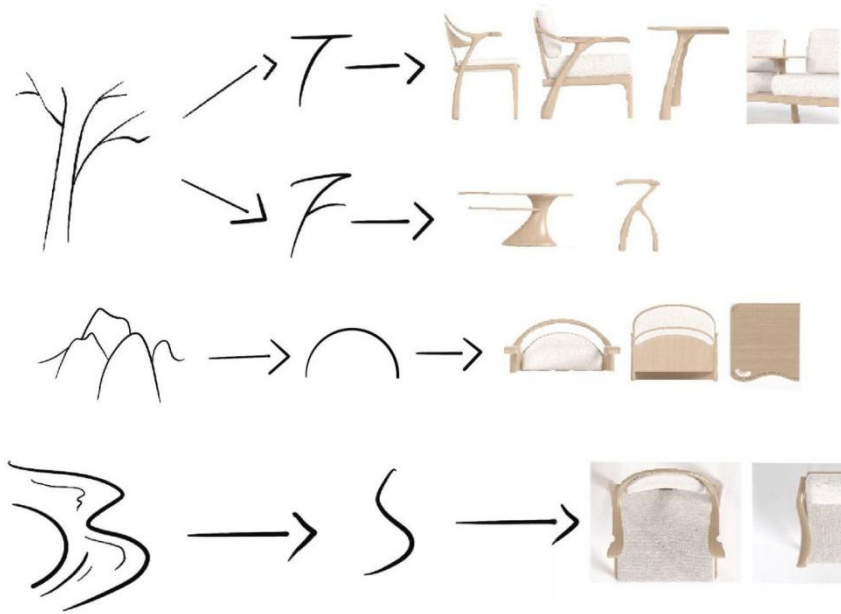


Fig. 11. Transformation and application of landscape symbols

5.3 Optimized the furniture design

The main optimization in this design is to integrate the landscape imagery into the age-appropriate furniture through color design, symbolic semantics and other design methods, combined with CMF design, so that the furniture not only has age-appropriate functional requirements, but also has a unique landscape aesthetic, so that elderly consumers can understand and empathize with it. In this design, instead of showing the old-age friendly function in a rigid and straightforward way, it is combined with the landscape symbols and the function is integrated into the form. For example, the design of handrails, most of the elderly actually have a rejection of handrails, the combination of handrails and landscape imagery symbols, the elderly are convenient to grasp, but also has the form of aesthetics, function and shape complement each other, to meet the elderly do not want to be special attention and treatment of the psychology, more burden-free use of ageing furniture at the same time[11], but also with the integration of family life scenes, other family members use also fit(Figure 12).In the application of landscape symbols, there is no simple reproduction of landscape elements, in addition to the appropriate application of landscape symbols, combined with CMF design, the use of marble veneer, the use of natural patterns of marble, adding landscape mood(Fig. 13).



Fig. 12. Armrest design display chart



Fig. 13. Desktop material effect

6 Discussion

6.1 Chinese cultural imagery color design applied to elderly furniture considerations

The color experience of the elderly mainly relies on visual perception, and as they grow older, their recognition of colors decreases, and they are more likely to have negative psychology such as frustration and loneliness. Therefore, in the application of Chinese cultural imagery color design for elderly-friendly furniture, attention should be paid to the selection of colors that are suitable for the needs of the elderly. Such as beige, log color, such as low brightness, low purity of the color. These colors are warm and natural, which can make the elderly feel soothed. Avoid the use of large areas of high saturation of color, so as not to cause the elderly psychological discomfort. Due to age, the elderly psychological tend to mature and stable, more favorable to the steady and comfortable, dignified and elegant colors, in the old-age furniture color design can be reasonable with the color, try to choose the same color with the color, to provide positive psychological implication for the elderly. In addition, according to the different environments, color selection also need to have corresponding changes, such as the face of empty nesters, should choose warm tones for color design, while the face of Alzheimer's disease elderly should choose a more calm blue system, and children aging at

home with the elderly should pay attention to color matching, can be in harmony with most of the family space tone, not conflict.

The color, texture and luster of the material itself will also make the elderly have different visual feelings, in the Chinese cultural imagery color design applied to elderly-friendly furniture, should also pay attention to the color, texture and other visual characteristics of the material, more natural and soft visual feeling materials, such as wood, cloth, leather and other materials, so that the elderly produce a warm and calm feeling, avoid the use of large areas of metal and other visually cold Avoid the use of large areas of metal and other visually cold materials, so as not to cause strong contrast stimulation, causing the elderly negative emotions[12].

6.2 The design conflict of Chinese cultural imagery symbols in age-appropriate furniture

Incorporating the imagery design of the elderly-friendly furniture focus on the expression of cultural resemblance, rather than the simple reproduction of the form. Most of the cultural symbols are expressed in abstract form, and the plasticity in the abstract image brings more space for reverie to the user. The design concept emphasizes the "symbiotic" relationship between the furniture and the surrounding environment, and focuses on the creation of the overall atmosphere and mood[13]. The application of Chinese cultural imagery symbols in the elderly furniture requires the designer to grasp the abstraction of the symbols, so that the cultural symbols are neither rigidly copied nor over-refined to make people unaware of them. The transformation and application of justified symbols make the user understand and understand the situation, and fundamentally ensure the traditional cultural heritage.

Secondly, the imagery symbols in the old-age furniture need to comply with the functional needs, combined with the physiological and psychological needs of the elderly, the symbol design on the basis of meeting the function, not simply for the visual effect or performance ability and give up the use of function, to avoid the inconvenience and safety hazards of the elderly in the process of use.

Finally, the imagery symbols in the appropriate elderly furniture should be simplified, there are primary and secondary, the difference between the real and imaginary. General imagery contains more than one cultural symbol, in the actual application should be discarded, do not over-pile all the symbols, should be the main and secondary, real and imaginary, size, sparse and other coordinated arrangements, the whole into one, local obey the whole, reflecting the rhythm and rhyme.

7 Conclusion

Chinese cultural imagery can be used in elderly friendly furniture, which helps to improve the aesthetic value of elderly friendly furniture. Age-friendly furniture based on Chinese cultural imagery focuses on mood board production and functional optimization. The color design of elderly-friendly furniture should be integrated with aesthetics and recognition, and consider the physiological appeal based on the environment. Make

the elderly-friendly furniture more in line with the aesthetics of the times and a higher quality living environment for the elderly.

Acknowledgment

This paper was supported by the Industrial Design Research Center of the Key Research Base of Philosophy and Social Sciences in Sichuan Province (Grant No. GYSJ17-008), and the project from Social Science Foundation of Sichuan Agricultural University (Grant No.2017ZD08). This study was also supported by A'Du furniture design project and D'Ei furniture design project.

REFERENCES

1. Liu Qiang. (2022). *The mood and aesthetic expression of Chinese landscape painting*. Calligraphy and painting world. 2022(08):19-21.
2. Chen Liang. (2013). The application of mood board in software interface design. Silicon Valley. 5(02):101+109.
3. Guo Shuai, Wang, Fei, Wang, Xiaochun, Ji Yang. (2013). *Research on the aging product design method system under Livinglab innovation model*. Design-driven business innovation: 2013 Tsinghua International Design Management Conference Proceedings (Chinese part). 2013:185-191.
4. Zhang Yuanyuan. (2018). An analysis of the ecological application of tea imagery aesthetics in interior design. Fujian tea. 40(08):98.
5. Liu Weishang, Li Ran, Wang Anqi. (2022). *Research on the application of poetic imagery in red tourism literary creation--Taking Mao Zedong's poems as an example*. Packaging Engineering. 43(10): 335-342. DOI: 10.19554/j.cnki.1001-3563.2022.10.040.
6. Li Guangxu, Hu Jie, Wang Lingyu. (2022). Exploring the innovative design of product form based on landscape imagery. Screen Printing. 2022(16):9-12.
7. Xiao Hanze, Bao Defu, Yang Jingnan. (2021). Research on intelligent interactive product design based on landscape cultural imagery. Design. 34(19):80-82.
8. Chen JL, Zhao F. (2021). *Research progress of product perceptual imagery design*. Packaging Engineering. 42(20): 178-187. DOI: 10.19554/j.cnki.1001-3563.2021.20.018.
9. Wei Kai. (2019). The cultural bearing and application of Chinese elements in visual communication design. Sichuan Theatre. 2019(12):69-72.
10. Fu Fengge. (2022). *Research on the design of age-friendly furniture based on empathy concept*. Qingdao University of Technology. DOI: 10.27263/d.cnki.gqudc.2022.000107.
11. Zhu Tianlu, Liu Yuan. (2019). Research on the method of senior home product design based on the idea of inclusiveness. Design. 32(13):83-85.
12. Wu Hongwei, Shi, Congyi, Han, Sixuan, Song Shasha. (2021). Research of the Design of Ageable Seat Based on CMF Multi-Dimensional Perceptual Feature Fusion. Design. 34(23):81-83.
13. Zhang Yaoying. (2013). *Refining and Presentation of Cultural Symbols of Traditional Furniture Design*. Packaging Engineering. 34(20):36-38+71. DOI: 10.19554/j.cnki.1001-3563.2013.20.010.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

