Analysis of the Demand Characteristics of Elderly People for Indoor Color and Physical Environment

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Abstract. Barrier-free design has been widely applied and promoted in China with the development of social material civilization, spirit and spiritual civilization. However, compared with developed countries with smaller populations and an earlier start, China, with a large number of disabled people and a moderately aging society, still has a big gap. On the basis of collating data and literature, we conducted a research to explore how to reasonably design indoor space for the convenience of travel and safety of the elderly, and how to design the layout of furniture and functions in indoor space, so as to establish a pleasant living environment for the body and mind, and to embody the design idea of "humanistic care".

Keywords: accessible design; aging; interior space; physical environment;

1 Introduction

The concept of barrier-free design is based on the humanization of the design proposition, the normal society is composed of able-bodied and disabled people living together, is to ensure that the disabled, the elderly, mobility-impaired people's travel and the use of the safety of the design, the main idea is to all members of the community in the different phases of life can be in a safe, convenient, comfortable building environment.

With the economic development of the society, people have moved from the stage of solving the problem of food and clothing in earlier years to the stage of higher spiritual and material satisfaction. Since the United Nations put forward the concept of "barrier-free environment" in 1974, China's barrier-free design with the reform and opening up as well as the construction of socialist civilization and spirit of the rapid development, but there is still a big gap with some developed countries, the need for further improvement and development. And we should pay attention to the construction of barrier-free environment in indoor space. There are many deficiencies in the barrier-free design of indoor space in China, and as indoor space is the place where people do most of their daily activities, it has become an important issue for designers to improve and build a barrier-free environment.

2 Principles of Accessible Design of Indoor Spaces for the Elderly

According to the data of the seventh national census bulletin (No. 5), the population aged 60 years and above accounts for 18. 70 percent of the national population, and is entering a

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moderately ageing society. China's aging population base is large and aging at a rapid rate of growth. The older age groups often require more care and attention. With the growth of age, the body function will naturally decline gradually, appearing metabolism slows down, central nervous system function degradation, motor function decline, sensory function of aging and a variety of psychological problems. In this regard, designers need to conduct profound research on the use of building functions, material selection, ergonomics, psychology and other aspects. Grasp the needs of the elderly, and carry out more appropriate humanized design.

Moving into old age, due to psychological and physiological changes, the scope of their life is mostly dominated by family and community. Then for them, the rationality, comfort and safety of interior space design are quite important.

2.1 Interior accessibility design

Accessibility has three meanings: perceivability, reachability and operability. The aging of the sensory functions of the elderly requires more visible signage or text, clearer messages, and a subdued color scheme. Accessibility requires that anywhere in the house is easy to get to, enter and use. Therefore, activity areas for the elderly should be larger than those used by the general public, and the vertical position of the furniture should be relatively low. Maneuverability means that all furniture in the house is easy to use and can be operated without assistance.

2.2 Safety design of the interior

Too smooth floors may pose a danger as the body tends to lose its balance due to declining physical functions. The bathroom should be made of non-slip material. For those who have the conditions, a separate barrier-free bathroom can be designed. If the size of the house is too small, special bathroom folding seats or handrails and other cushioning devices should be installed in the communal bathroom, and at least one side of the handrail should be set at the toilet, and the height should be installed in accordance with the average height of the elderly in the family.

Designers must also take into consideration the strength and flexibility of individuals[1]. The elderly because of osteoarthritis atrophy, joint aging, osteoporosis and other reasons height tends to become shorter, this time in accordance with the able-bodied design of furniture height becomes not applicable to the elderly, the kitchen, bedroom, storage room and other furniture height to be lower, it is best to ensure that within reach of the area. The outer corners of the furniture should also be rounded, stable and without edges to avoid accidents such as bumping. Bathroom bathtubs, toilets and sinks should be placed on both sides of the non-slip handrails, placed in the bath area portable folding stools, bathroom doors can be equipped with outward-facing openers, in order to prevent a hard grip on the inward borrowing insufficient force to cause a fall.

2.3 Comfort design of the interior

The bedroom of the elderly is preferably located in the south, sunny, on the one hand, the elderly like to sunbathe, on the other hand, it is conducive to the elderly to have more time and opportunity to sit at home can enjoy the sunshine, in order to meet the conditions of good sleep and activities. Installation of night lights in the bedroom, bathroom, hallway and other

places, so as to facilitate the elderly to get up at night. Older people need a quiet environment to ensure a good night's sleep as they sleep for shorter periods of time compared to younger people and are more likely to be woken up during the night. Doors and windows with good soundproofing should be used, and bedrooms should be located farther away from the bathroom and living room.

3 Requirements for the physical environment for the accessible design of indoor spaces for the elderly

Due to the decline of physical function and other aspects of the ability of the elderly, the main activity space of life from the outdoor space slowly changed to the indoor space. The quality of indoor space determines the comfort of the elderly. The quality of the physical space environment is an important criterion for the comfort of the elderly. In this paper, combining subjective questionnaires and previous research results, we propose optimization measures and improvement suggestions for indoor space in terms of light, sound and the use of intelligent equipment to improve the physical environment.

A questionnaire survey of 52 elderly people was conducted to address the need for barrier-free design for the elderly in indoor spaces. The results of the survey showed that most of the elderly people in the physical environment had problems such as not being able to see the furniture due to the brightness of the lighting and communication barriers due to hearing loss. The results were summarized and recorded at the end of the survey (see Table 1 and Table 2).

Table 1. Findings on lighting problems in indoor spaces of the elderly

Problems of lighting indoor spaces	Persons/Person	Percentage/%
excessive brightness of lighting	11	21.15%
The lighting is too weak.	24	46.15%
The light is right.	17	32.69%

Table 2. Findings of indoor spatial hearing problems in older adults

Hearing problems	Persons/Person	Percentage/%
speech defect	38	73.08%
Good hearing	14	26.92%

3.1 Analytical study of indoor light environment for the elderly

As we age, our visual ability gradually changes, especially after the age of 40, when physiological functions and coordination decline, so does our visual acuity. In recent years, by analyzing the causes of binocular vision loss in the elderly, it can be concluded that it is mainly caused by refractive error and non-refractive error diseases. In indoor space, the elderly to adapt to changes in the intensity of light in the space has been far less than young people, usually in the dark and light junction set up transitional space, such as foyer, entrance, corridors, vestibules, etc. in order to complete the process of visual adaptation. For the elderly, the process of adaptation is more difficult than for young people, the older they are, the longer the visual adaptation time. In the face of this situation, the choice of auxiliary lamps in the

transitional space is particularly important, generally in the main door and corridor set up indirect lighting and downlighting combined with the light as soft as possible, should be appropriate to improve the illumination, but not too strong to avoid glare. Generally speaking, the bathroom and kitchen natural illumination is the darkest area in the indoor space, coupled with the decline in vision of the elderly, the bathroom and kitchen become the highest accident rate of the elderly space, in addition to the placement of furniture, flooring materials, lighting also has a fairly important visual impact. Older people get up more often at night, from the bedroom to the bathroom corridor should be set on the wall height of about 300-400mm footlights. And during the night, if the bedroom light is too bright, will make the elderly back to sleep more difficult, and even lead to insomnia. According to experimental data, the power of 20W(4W/M) color temperature of 2700K LED strip as indirect lighting is most conducive to the elderly back to sleep [2]. In addition, Japanese scholars Mr. Sadao Takahashi and Mr. Takayoshi Fuchida have researched the appropriate illuminance values for the elderly[3]. In general, too bright lighting is not only unfavorable for the elderly to fall back to sleep, but also leads to further deterioration of eyesight. In the selection of lamps, consideration should be given to the lighting design technique of "multi-lamp decentralization", i.e., multiple lamps, including indirect lighting, distributed at multiple points in a house.

3.2 Analysis and study of indoor sound environment for the elderly

With the aging of the elderly group, the decline of the hearing organs, resulting in low-frequency discrimination difficulties and even deafness, not only makes it difficult to communicate, but also leads to some of the elderly due to psychological stress and depression. In addition, because the elderly are far less than young people in the face of noise environment sound processing ability, so not only in front of the communication will produce obstacles, but also to the elderly night sleep has a certain impact. For indoor space, the realization of auditory comfort is a necessary condition to ensure that the elderly daily communication and access to information channels. In the face of good hearing and hearing-impaired older people need to develop different design programs, according to past research, good hearing older people watching TV distance of 2.8m, daily communication distance of 1.6m, while hearing-impaired older people watching TV distance of 1.6m, daily communication distance of 0.9m [4]. From this we can see that in the face of two different situations, the space will also be a big difference. The author believes that the choice of convenient home projector, and equipped with a key to adjust the volume, viewing distance, curtain size size of the intelligent panel, not only give full consideration to the daily use of the elderly needs, but also to achieve its common, will not appear to facilitate the use of the elderly to hinder the use of young people. Bedroom as a place for the elderly daily sleep and rest, its space as much as possible to eliminate noise, so that it has a quiet sleep environment. Therefore, in the decoration should choose soundproof materials to reduce the interference of indoor noise, such as walls and ceilings can be used soundproof felt and other good soundproof materials, the ground can be used wooden floor or carpet instead of ceramic tile, to achieve the effect of reducing noise.

3.3 Indoor Space Intelligence to Improve the Physical Environment

The development of modern technology, the emergence of intelligent furniture to reduce the number of complicated operations, providing a convenient, comfortable and safe living environment. For the elderly to learn intelligent operation is conducive to reducing daily labor.

The use of intelligent equipment can also better target the different physiological needs of the elderly to improve the physical environment of the indoor space. For example, the lighting into the intelligent system, according to the elderly different use of time to preset data, so as to realize the lighting at any time in line with the visual experience of the elderly, so that the indoor lighting is more environmentally friendly, comfortable and convenient. The use of intelligent audio-visual equipment to achieve the control of lighting effects around the TV and the volume size of the speakers, so that the elderly get a better audio-visual effect. Putting face to face with temperature changes, intelligent temperature panels can also be installed to automatically switch on and off the air conditioner when the weather is too hot or too cold to keep the overall space temperature adapted. Smart HVAC systems use multiple sensors for monitoring and control. Software interprets information from various sensor points to optimize the HVAC system's operation while improving occupant comfort [5]. However, according to the questionnaire survey, it can be seen that at present, the use of intelligent equipment for the elderly only accounts for a minority, and most people do not know how to use or have not used intelligent equipment (see Table 3). In today's social context, the awareness of using intelligent devices should be strengthened to cultivate the elderly group, and the difficulty of using intelligent devices should also be improved, so that intelligence becomes simpler and more operable. Such as the use of intelligent lighting, intelligent curtains, sweeping robots, voice assistants and other intelligent devices in the operation should be simplified, the interactive interface suitable for the elderly and easy to read, increase the voice control function or a key button function. Let the intelligent equipment into the elderly group, rather than only facilitate some young people.

Table 3. Survey results of older people's perceptions of smart devices

Older people's views on smart devices	persons/person	Percentage/%
Have and know how to use	10	19.23%
Yes, but I don't know how to use it.	17	32.69%
Don't have but want to use smart devices	19	36.54%
Don't have and don't want to use	6	11.54%

4 The Role of Color in the Accessible Design of Interior Spaces for the Elderly

4.1 Performance of color regulation

Color brings not only the visual effect, but also affects the psychological reaction of people, often different colors will bring different emotional feedback, such as warm tones always give people a vivid, warm, comfortable feeling, cold tones always give people a quiet, simple, open feeling. In the indoor space, the elderly because of the decline in physical function, self-resistance is also gradually declining, for the psychological impact of color is often more intense than young people. Color regulation plays an important role in indoor space, which can not only improve the visual effect of the indoor environment, but also make the elderly feel good living environment, shaping a harmonious and comfortable indoor space. Carrying out systematic color regulation can make the elderly get a sense of security, comfort and a sense of beauty, the elderly in the face of favorite colors will feel happy, to a certain extent,

affecting the mental health of the elderly. Effective use of lighting not only facilitates the identification of objects and reduces eye fatigue, but also avoids some potential dangers, such as the corner of the corner of the wall, and whether the arrangement of furniture is safe or not, which can reduce accidents and accidents. According to the survey results, the elderly choose more diverse colors, basically covering most of the colors (see Table 4). From the results of this survey, the elderly prefer colors with higher brightness and neutral saturation, and are more receptive to warm and simple color designs in the overall style.

Table 4. Results of the survey on the preferences of the elderly for different colors

Elderly people's preference for different colors	Percentage of selections (multiple choice)
red (color)	19.23%
yellow (color)	25%
blue (color)	26.92%
greener	13.46%
red and yellow	76.92%
yellow-brown	51.92%

4.2 Color matching of indoor environment

Experience tells us that visual surroundings can greatly affect our mood[6]. Color matching is the use of the entire space of large and small combinations of things to influence people's visual perception, the composition of the entire interior space of the color mainly by the walls, ceilings, furniture materials and materials of the color of the main color to interior decorative accents as a complementary color. Therefore, it is necessary to consider the whole to achieve a comfortable indoor space. From the color phase, can be designed according to the function of the interior. For example, the living room as a guest and rest area, often represents the owner's experience and favorite style, the elderly after the precipitation of time has formed its own aesthetic style, generally speaking, prefer calm and dignified or soft and elegant colors. In the bedroom, the elderly need a good sleeping environment, the color of the walls and ceilings can be used in light colors, the surrounding furniture can be selected according to the needs of the elderly in dark colors or warm colors. The bathroom should be uniform in color, simple and clean, avoiding the use of a large number of overly complex and fancy patterns that lead to accidents such as knocking over. In terms of brightness, the color should basically be combined with lighting, and improving the luminosity of the light is conducive to the identification of indoor colors for the elderly. In the indoor space, the brightness of the ceiling and the ground should be close to each other, and coupled with warm yellow lighting, easy to produce a good rest environment.

5 Conclusion

Although barrier-free design is proposed to help the disabled to integrate into the society normally, it has been developed so far that it not only helps the disabled, but also helps the able-bodied to meet the difficulties they may encounter in their daily life, and also creates a convenient and comfortable living space for our own future in advance. Facing the phenomenon of rapid aging in the country, it is all the more important for us to focus on and accelerate the construction of barrier-free design, and quickly move towards universal design.

It can be said that helping the disabled and the elderly now is helping us in the future. The author believes that the most important thing in barrier-free design is for the designers themselves to experience their lives, to feel the problems they encounter in their daily lives, and to start from their position in order to truly design a humanized living space and create a harmonious, comfortable and safe social environment.

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