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Research on the Inter-generational Interaction Design of Living Spaces Suitable for Both Children and Elderly Users

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Abstract: With the transformation of family structures, the situation where elderly people take care of children of the opposite generation is becoming more and more common. This has raised new requirements for the existing living environment. This article, from the perspective of dual suitability for the elderly and the young, explores ways to alleviate the predicament of three generations living in a limited living space, thereby promoting intergenerational communication and eliminating generational estrangement.

Keywords: Age-friendly for Both Elderly and Children; Intergenerational Interaction between Elderly and Children; Residential Space.

1. Introduction

With the acceleration of China's aging society and the implementation of the universal two-child policy, the "4-2-1" and "4-2-2" family structures have become increasingly common. The family structure where there are elders above and children below has become a common phenomenon. In this situation, the scenario where the elderly and children live together has become increasingly common, and the demand for shared indoor living space by the elderly and children has sharply increased. According to data from the National Health Commission, there are currently nearly 18 million elderly people who have followed their children, accounting for 7.2% of the country's 247 million migrant population. Among them, the proportion of those who came specifically to take care of their grandchildren is as high as 43%. Under such circumstances, scenarios where the elderly and children live together have become increasingly common, and the demand for shared indoor living space by the elderly and children has sharply increased. Although this special group is the main user of indoor living environments, they have not become the main research objects of designers' services in the living environment. The needs of the elderly and children for the living environment are not limited to simple living functions, but also require an indoor living environment with a sense of belonging, security, privacy, comfort, and interest. Traditional indoor living design mainly focuses on meeting the needs of a single group. In the design of shared spaces for the elderly and children, there are many deficiencies, making it difficult to simultaneously meet the physiological functional decline needs of the elderly and the lively, exploratory, and strong desire for knowledge characteristics of children. Therefore, how to balance the needs of parenting and elderly care in the same space, achieve shared indoor living space for the elderly and children, and promote the optimization and healthy development of intergenerational emotional communication is worth studying. From a design perspective, proposing a countermeasure study on "shared elderly and child" indoor living design for this group is worthy of research.

2. Shared Research on the Current Status of International Studies for the Elderly and Children

With the increasingly prominent issues such as population aging and changes in family structure, the national and local governments have introduced a series of policies to encourage and support the construction of elderly care facilities and child-friendly spaces. This provides a favorable policy environment and opportunities for the development of shared living designs for the elderly and children. Through searching for the keywords: "Research on Elderly-Child Sharing under Intergenerational Integration", it was found that many scholars have proposed some related theoretical explorations. For example, Li Yifei and Guo Jing (2020) proposed "Elderly-Child Sharing" indoor living space design strategies from aspects such as physical environment, color matching, identification system, and barrier-free design to ensure the healthy lives of the elderly and children. Ren Jing (2024) from the perspective of an all-age community analyzed the space creation, crowd care, policies and planning to discuss the planning and design of all-age community residences under the new home-based elderly care model. Gong Yi, Cui Juanling, and Liang Senmao (2024) pointed out that the design research of elderly-sharing indoor public spaces aims to integrate the concept of intergenerational integration into the indoor space, promoting the two-way development in the field of elderly care and child-rearing from the perspective of space design. At the same time, by reviewing the literature, it can be known that some places have also conducted practical explorations of elderly-children shared living spaces. For example, the shared indoor space design of the rural elderly care housing in Zhejiang's Zifengling Village (2023) analyzed the current situation and needs of the local rural elderly care housing through field research and proposed corresponding shared space design strategies, including space layout optimization and functional facility configuration, to meet the shared use of the elderly and children. The Hong Kong Leirongxuan Comprehensive Building is a project that combines private residences and elderly houses. Members of

the old, middle-aged, and young living in the building can care for and support each other, achieving the goal of "intergenerational integration" [1]

Based on factors such as population structure, society and economy, in foreign countries, the changes in family structure have led to generational estrangement. As early as the 19th century, efforts have been made to explore the model of combining the elderly and the young, and to propose the theory of intergenerational integration, integrating the extremely underdeveloped elderly care industry and child care industry. This not only realizes intergenerational communication and interaction and emotional integration, but also achieves the sharing and integration of social and spatial resources. Therefore, as an innovative model that effectively addresses the issue of population aging and the overall shortage of social service supply, intergenerational integration is highly valued abroad and has already formed a mature development model. For example, the "Intergenerational Shared House Project" in Seoul, South Korea, combines the idle residences of the elderly with those of young people, and both parties not only share space but also provide each other with living assistance, achieving the sharing of life value [2]. The "Park Life" all-age community in Austria integrates different functional spaces such as elderly apartments, youth low-rent apartments, assisted living care facilities, and kindergartens, allowing the elderly, young adults, and children to interact and integrate in a shared community environment. The "Lidodo Intergenerational House" model in Germany builds public open spaces between non-blood-related generations to promote community-level life assistance, emotional communication, etc. among children, young adults, and the elderly [3]. The "Saint Vincent Intergenerational Learning Center" model in the United States is a successful attempt at the combined development of nursing homes and kindergartens, providing a shared space and emotional communication bridge for the elderly and children through the intergenerational integrated care model [4].

Whether it is theoretical research or practical exploration, both have provided a foundation and ideas for the development of shared design for the elderly and the young. However, it should be noted that most of the domestic and international studies have focused on the shared public spaces for the elderly and the young (such as the combination of nursing homes and childcare centers), aiming to create a spatial environment for intergenerational learning and communication. However, the research on the shared living space for the elderly and the young is currently not yet fully developed.

3. Differences among the Elderly and Children

The elderly and children are two completely different sensitive groups, each belonging to different life cycles. The two groups present completely different appearances in terms of physiological functions, psychological states, cognitive methods and behavioral norms. Therefore, in terms of age-friendly design or child-friendly design, they represent two entirely different contents and standards. However, whether it is age-friendly design or child-friendly design, it is essential to respect "people-oriented", and in addition to basic life care, it is very important to pay attention to the emotions, companionship and psychological needs of the elderly and children.

By comparing the two groups of the elderly and children, it is clearly observable that there are significant differences in their physical and psychological aspects. In terms of physiology, the elderly, as a silver-haired group, undergoes tremendous changes in both physical and mental functions as they age. Their bodies are in a gradually aging stage, and various aspects of their bodies are gradually declining. At the same time, their balance and mobility abilities are also decreasing. Their bodies gradually become stiff as they age, their bones start to change, and standing and squatting become increasingly difficult. Their bodies become fragile and have weak resistance, and their hearing in the ears and vision in the eyes weaken, gradually reducing the elderly's ability to respond to external information. Children, as a unique group, are in the period of growth and development, and their growth process is a continuous development process. Whether it is in the infant stage, the preschool stage, the school age, or the adolescence, children have high-energy power in their bodies and their physical functions are constantly developing and growing. However, the cognitive development, language development, behavioral development, and emotional development of children at different stages have their own characteristics. In terms of psychology, as their bodies change, the health conditions of the elderly are constantly changing. Some self-care abilities in life gradually decline. Their roles in society change, their social circle shrinks, and their family roles change. Many elderly people's psychological states undergo significant changes, with large emotional fluctuations. At the same time, the elderly are afraid of burdening their children and do not want to communicate their thoughts. Over time, negative emotions such as feeling worthless, loneliness, loss, and inferiority, and even depression, may arise in the elderly's psychology. During the process of children's growth, the development of children's psychology is a crucial link. Children's psychological development has characteristics such as stages, plasticity, and dependence[5]. Children generally show liveliness and activity due to their quick acceptance of new things, and they possess strong curiosity and competitiveness. Similarly children are easily influenced by the outside world, have relatively large emotional fluctuations, and need care and companionship. At the same time, in the process of interacting with the outside world, children need a sense of existence, the need for self-actualization, and a sense of security.

There are significant differences in the development trajectories of the elderly and children. However, it is not difficult to observe that both groups of people need the sense of security and companionship provided by the outside world in their lives. Children need care because of their young age, while the elderly need it due to the decline in their physical functions and the reduction in emotional communication with the outside world.

4. "Shared Living for All Ages" Residential Space Design Strategy

As China's population enters a new stage, it is difficult to maintain the traditional model where elderly care and child care are separated. The cohabitation of the elderly and children is gradually becoming the most suitable environment for the "elderly and children" in contemporary society. Therefore, elderly people and children living together in a

limited indoor space for elderly care and growth is the current state of many families. Then, focusing on the cohabitation of the elderly and children, sharing the indoor living space, and starting from a new perspective of intergenerational communication, design strategies related to space layout design, color and material design, facility and equipment design, and intelligent technology design are proposed.

4.1. Spatial Layout Design

The spatial layout design, as the core design component of the indoor living space, transforms an entirely blank space into a living environment that suits your life. It forms the foundation for other interior designs. A reasonable spatial layout should be based on the living habits of the occupants, clearly defining the functional zones (such as bedrooms, dining rooms, living rooms, kitchens, bathrooms, etc.) and the movement routes. As a living environment for the entire family to reside together, the spatial layout not only needs to meet the basic functions and storage requirements of family life, but also requires a reasonable and systematic planning to accommodate the lifestyles of young, middle-aged, and elderly people. It must also take into account the special needs of the elderly and children to enhance the comfort of living. Each functional area of the space should be clearly planned to avoid mutual interference. When planning the spatial functions, the design should be in line with the living habits of the occupants, clearly defining the functions of each space. "People-oriented" private space design and public space design should be carried out.

Private space refers to the bedroom. For private spaces where both the elderly and children live together, the design of the bedroom depends on the size of the living room and the need for nighttime care. For larger living rooms, the elderly and children can have separate spaces. When designing the space, the elderly's bedroom is regarded as an independent space for elderly care, following the principle of adaptability to aging, and meeting the requirements of safety and convenience. The elderly's bedroom should not have excessive design, and sharp corners and sharp edges should be avoided in the design. The floor should use anti-slip materials to prevent the elderly from falling and getting injured. Elderly people have light sleep, so the design of the bedroom should have good sound insulation. At the same time, the furniture in the elderly's bedroom should be designed based on the needs of the elderly, using environmentally friendly, safe materials that are in line with the physical characteristics of the elderly, which is helpful for them to get up and sit. The design of the children's room should meet the needs of children at different stages, covering functions such as sleep, study and entertainment. The design of the room, in addition to the same safety and environmental requirements as the elderly's bedroom, also needs to consider extendability. Choosing furniture with rounded corners that can change along with the growth of children is the first recommendation. According to the needs and interests of children, the layout and planning of the room should be flexibly adjusted and changed to help them grow healthily. For this type of bedroom, to facilitate the care of children and prevent the occurrence of accidents for the elderly, a telephone and emergency call button will be set up between the elderly and children's rooms. For smaller living rooms, the elderly and children share the bedroom. Sharing space does not mean the complete loss of private space. Due to the differences in living habits between the elderly and children, when designing the bedroom, the essential differences between them should be noted, such as the elderly preferring tranquility and children being lively. In semi-private bedroom spaces, soft partitions, semi-partitions and furniture partitions can be used to reduce mutual influence and retain the independence of the space in the limited space to meet the needs of the elderly and children. This type of bedroom helps the elderly and children to pay more attention to each other's situations. Whether from the perspective of companionship or care, this type of bedroom is more conducive to the interaction between the elderly and children and enhances their emotional communication.

Public spaces refer to the kitchen, dining room, living room and bathroom. When designing public spaces, it is necessary to reduce conflicts in usage during peak periods. For the design of the bathroom, the focus is on being friendly to the elderly and children. Through meticulous design, the hidden dangers during the use of the bathroom by the elderly and children can be eliminated. Options such as high and low counter washbasins, anti-slip devices on the floor, handrail designs on the walls, emergency call devices, adjustable shower heads, additional folding chairs, etc. can be implemented to meet the needs of the elderly and children. Through some daily activities, the collaborative cooperation between the elderly and children becomes a way to enhance emotional interaction and communication. For the design of the dining room and living room, modular furniture can be adopted to meet the different needs of the elderly and children for space and common activity requirements. In addition to fulfilling basic daily functions, the dining room can also provide interactive needs such as reading and handicrafts for the elderly and children. The living room, as an open public space and the main space for family activities, can be satisfied by changing the placement of furniture and placing low plants to meet the different needs of the elderly and children. This kind of undivided space is convenient for interaction and eye contact between the elderly and children, making the elderly feel that their skills are useful and enhancing the sense of security for children, which is conducive to the intergenerational communication of mutual integration. In the entire living space, the kitchen has transformed from a simple place for cooking to an activity center of family life. Compared to the traditional emotional communication center, the kitchen now not only has the function of providing three meals a day, but also is an important space for maintaining family emotions. As a special space, the kitchen holds an important position in the elderly's life. The elderly spend much more time in the kitchen than in other spaces. In a three-generation family, generally, it is the elderly who cook. Through it, the elderly can enhance their sense of self-achievement. The elderly not only need to cook but also take care of children. Through the selection and design of equipment, this space can become an interactive activity space for both the elderly and children, which can meet the demands of the elderly while allowing children to participate safely. Firstly, in terms of layout, the design of the kitchen should prioritize open or semi-open styles, so that the elderly can take care of children while cooking. Secondly, when designing the kitchen, the actual physical conditions of the elderly should be fully considered, so as to provide a safe, convenient and comfortable cooking environment for the elderly. The design of the countertop should take into account the standards for elderly use. However, as a space for two-way interaction between the elderly and children, the height of the kitchen countertop also needs to consider the needs of

children. Consider designing high and low operation countertops, allowing children to help with simple washing tasks while the elderly are cooking. Also, when designing the lower cabinets, consider designing pull-out drawers to meet both storage functions and serve as a safe place for children to reach the countertop. The design of the upper cabinets is combined with adjustable and elevatable facilities to facilitate the elderly's access. The lower cabinets are divided for storage and can be designed with drawer and open partition designs to allow children to participate in sorting and organizing items. Then, in the kitchen shared by the elderly and children, some high-end equipment can be integrated to enhance safety protection, such as automatic power-off plug designs, gas stoves with anti-dry-burning and automatic fire-extinguishing functions, smart smoke detectors, gas leakage alarms, etc.

When designing the spatial movement routes, all considerations are based on functional requirements. Besides meeting the activity routes of family members, the passage needs to also give priority to the passage needs of the elderly and children. Therefore, the design of the corridor with barrier-free features should be appropriately widened to facilitate the walking of the elderly and the running of children. To avoid space waste, appropriate storage designs with functions can be added. When designing the entrance hall, although the area is not large, it is frequently used. The elderly and children complete actions such as changing shoes and putting on clothes here. Therefore, the design of the entrance hall should take into account the characteristics of the elderly and children to ensure that they can smoothly and safely complete various activities here. To meet the needs of both the elderly and children, drawer-style designs and bench-style designs can be considered to facilitate the elderly to complete personal clothing without difficulty and to be capable of assisting children in completing related tasks. In this small space, through simple interaction of wearing clothes, the closeness between the elderly and children can be enhanced.

4.2. Color and Material Design

Modern interior design requires that the interior space not only meets the reasonable and practical needs of modern people's living functions but also satisfies aesthetic demands, provides convenient and comfortable services, and achieves harmony between the environment and atmosphere, making the space more humanized in style [6]. With the change of age, the physiological structure also changes, and the psychological impact of colors on different groups of people also varies. Colors have different meanings and characteristics for different people. When the human body enters the aging cycle, the body's functions will also decrease, and the elderly become more sensitive. If they are in an inappropriate living environment, it will affect the psychological aspect. And as an important component of the space, colors should be concerned from the perspective of humanistic care for the physiological needs and psychological needs of the elderly. The research on colorology shows that using warm and bright colors can effectively reduce the psychological stress of the elderly and also alleviate their sense of loneliness [7]. In the design of living space, the use of colors should first consider the adoption of warm tones. The overall tone should tend to a color scale with relatively stable saturation to meet the psychological comfort of the elderly.

Color also holds an important position during the growth stage of children. For children, color is not merely an ornamental element for decorating the space; it also directly affects children's emotions, concentration, and other aspects. The preferences for colors among children of different age groups will also change. For example, children in the early childhood stage prefer to use simple colors to meet their cognitive needs for color; preschool children's preference for colors is to stimulate their imagination; school-age children consider improving concentration as the primary factor. Although the choice of colors by children of different stages will change, the effect of color on children will remain the same. What remains unchanged is that children prefer warm colors with high saturation, high brightness, and high purity.

Color affects emotions and reveals psychology [8]. Color design can change the atmosphere of a space. In the design of indoor spaces where both the elderly and children coexist, the design of colors can be considered from three categories: background color, theme color, and accent color. The background color is the overall tone of the entire living space, which determines the atmosphere of the entire indoor space. Therefore, when considering the color planning in the indoor living space that combines the psychological characteristics of the elderly and children, one can appropriately take into account the elderly-centered concept to meet the visual requirements of the elderly. Use soft and warm tones as the overall tone of the entire space. In combination with the standards for children's comfort, plan some changes in the colors of the indoor space in a way that uses contrasting colors or similar colors, and utilize colors with higher brightness and vividness to break the monotony of the space. At the same time, one can also consider using furniture as the theme color of the space to meet the color needs of the elderly and children for the space. In addition, as the accent color, it plays a crucial role in highlighting the key points. While the selection of the background color meets the needs of the elderly, the accent color focuses on meeting the needs of children. The choice of the accent color can be satisfied by replacing soft furnishings. Through the planning of background color, theme color, and accent color, the color layers of the entire space can be enriched. This not only meets the comfort of the elderly for colors but also provides a comfortable and warm space experience for children, maintaining and promoting the emotional communication between the elderly and children.

4.3. Intelligent Design

Intelligence is the direction of national development. The design of whole-house intelligence has gradually spread to thousands of households. In the modern fast-paced life, it is difficult to balance family and work. Therefore, introducing intelligent design in the design promotes smart elderly care and smart parenting, which is an important part of home space design. However, intelligent design is not the addition of technology, but the further improvement of the quality of life. The intelligent design provided for the elderly and children needs to be simple to use, easy to operate, and should be adapted to the abilities of the elderly and children. Intelligent design can be carried out from two aspects of home and furniture. From the aspect of smart home, through voice control, the threshold of use can be lowered. In the entire house, a voice interaction system is set up to turn on and off lights, adjust air conditioners, etc. The intelligent design in the living space suitable for both the elderly and children can be adjusted according to the differences in the physical, behavioral and psychological aspects of the elderly and

children. The intelligent design from the perspective of home furniture can be adjusted through design and regulation. From the aspect of smart home, the use of voice control can reduce the threshold of use. In the entire house, a voice interaction system is set up to turn on and off lights, adjust air conditioners, etc. The living space suitable for both the elderly and children can be adjusted according to the needs of the elderly and children's activities to automatically switch the lights and meet the reading needs of the elderly and the game and learning needs of children. Through the control of the intelligent fresh air system, according to the outdoor temperature and indoor humidity conditions, the temperature and humidity can be automatically adjusted to reduce the health problems caused by weather changes for the elderly and children. Through intelligent monitoring, prevent falls of the elderly and automatic alarms for climbing hazards of children and notify the contact person. Through the intelligent living balcony, let the elderly and children feel nature while building a safe protection. From the perspective of intelligent furniture, intelligent furniture is applied in the space where the elderly and children coexist to provide care and companionship for the elderly and children. Intelligent furniture breaks the traditional combination mode of furniture and can be changed according to the usage of the elderly and children. For example, an adjustable sofa can change in height and inclination according to the situation of the elderly and children. Voice-controlled beds assist the elderly and children in getting up and lying down. Intelligent wardrobes perform sterilization and disinfection according to the body conditions of the elderly and children.

5. Conclusion and Prospects

The shared living space for the elderly and the young is aimed at promoting interaction between the elderly and the young, with emotional communication as the core. The design concepts originally focused on the elderly and the children have transformed into a concept of jointly designing for both the elderly and the children. The designed scenarios have a certain degree of compatibility and two-way interaction. In such a living space, the elderly, as an important member of the family, establish emotional connections through the care of children, feel needed, gradually adapt to the change of personal roles, and thereby alleviate loneliness and self-abasement and improve mental health; for children, the elderly can provide long-term and stable emotional care and companionship, enhancing their sense of security and enabling them to gradually develop empathy and respect for the elderly. The shared space for the elderly and the young provides opportunities for communication and sharing through intelligent design, optimizing the spatial structure, and facilitating this intergenerational integration. This enables the elderly and children to be interdependent, understand each other, and grow together, thus allowing the elderly to "have a place to rely on" and the children to "receive education at an early age", creating a home environment where emotions can be connected between the elderly and the children, and reducing intergenerational estrangement.

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