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Design Strategies of Community Activity Areas for the Elderly and the Young under the Perspective of Intergenerational Inclusion

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Abstract

In the context of the aging of fewer children and the normalization of intergenerational rearing, there are problems of spatial fragmentation, lack of intergenerational interaction, and imbalance between the supply and demand of facilities in community activity places for the elderly and children. Based on the framework of intergenerational communion theory and environmental behavior, the PSPL research method (map method + behavioral observation method + 170 questionnaires) was used in three communities in Yiwu, Zhejiang Province as the empirical object. The study found that the behaviors of the old and young groups are both regular (older people) and random (children), and their safety and social needs converge. Accordingly, the study proposes a three-dimensional design strategy based on spatial flexibility, facility interaction, and operational symbiosis, which is in line with the "supply-side reform of elderly care" and has important reference value for solving the intergenerational resource conflicts in high-density communities.

Keywords: Intergenerational integration, future community, public space, community renewal, Environmental Art Design

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1. Introduction

Driven by rapid socioeconomic development, shifts in family structure, inadequate public services for elderly care and childcare, and mounting work pressure on young parents, grandparent-led childcare has become a widespread phenomenon[1]. Growing attention has been paid to both older adults and children, and national and local governments have issued relevant policies. During the 14th Five-Year Plan period, China takes the supply-side structural reform of elderly-care services as its main task. Multiple cities including Shanghai, Hangzhou and Chengdu have actively launched pilot projects for integrated elderly-child community services[2], which provides policy support for this study and the practical implementation of the intergenerational-integration concept.

Against the background of prevailing grandparent-led childcare, existing community activity spaces for older adults and children often fail to satisfy the joint demands of the two groups. In particular, most activity spaces only address either physiological or psychological needs for a single age cohort, which exacerbates intergenerational spatial conflicts and increases care-giving burdens. Drawing on empirical datasets obtained from PSPL surveys and field behavioural observations across multiple communities in Yiwu, this paper develops a practicable design system tailored for old residential communities and puts forward corresponding optimisation strategies for community activity spaces

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oriented toward intergenerational integration, so as to alleviate the above-mentioned contradictions. As critical venues for activity-based interactions between older adults and children, community activity spaces facilitate diverse forms of cross-generational social engagement.

2. Conceptual Definition of Research Objects

2.1. Theories related to intergenerational integration

The academic definition of "intergenerational integration" is still insufficient, i.e. "the harmonious social interaction between different generations and the sharing of social and spatial resources"[3]. The concept of intergenerational integration has been gradually promoted in Europe and the United States, forming a variety of public space practices such as intergenerational learning and intergenerational integration[4]. The concept of intergenerational integration is derived from the sociological concept, which mainly refers to an inner cohesive state of interaction and reciprocity, mutual sharing and positive interdependence between people of different generations[5]. Most of the domestic focus on the elderly exploration [6], and the application of the theory in the design field is mostly seen in architectural design. The application of the theory in design can help provide space for multi-generational groups to live and carry out activities, thus promoting intergenerational communication, enhancing intergenerational emotions, and ultimately realising intergenerational communion[6][7].

2.2. Behavioral and Scenario Relationship Theory

Research is a common method of scientific study, which corresponds to the real thing, but is abstract and theoretical. Christopher Alexander proposed language, which is the relationship between space and events that constitute the basic unit of the world. That is, "language". The Language of Architecture analyses spatial design as space and event, which corresponds to Barker's concepts of "matter" and "behaviour". Barker's concept of 'behavioral scenario' emphasises the intentionality of behaviour and the constraints imposed by both objective features and individual subjective perceptions, while Kurt Lewin put forward the 'field theory' - B=f(P,E), and geographer Kirk further elaborated the field theory. Kirk, a geographer, further elaborated the field theory, as shown in Figure 1. arguing that potentials motivate behaviour through places [8].

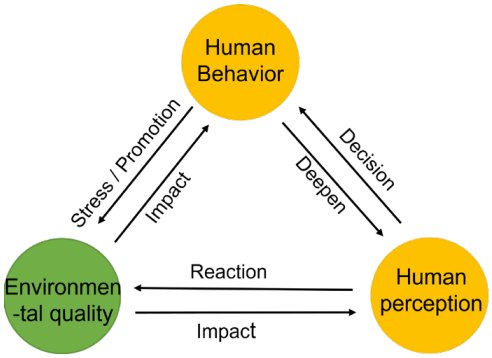


Figure 1. Environment-perception-behavior feedback relationship

2.3. Research on the correlation between the physical, psychological and behavioral characteristics of the elderly and the young

Community design must be based on in-depth knowledge of the characteristics of different groups of people. The physical, psychological and behavioral characteristics of the elderly and children, as the two core special groups in the community, have a direct impact on spatial planning and design decisions. The following is a summary of the characteristics of the elderly and children.

Table 1. Comparison of physical, psychological and behavioral characteristics of the elderly and children

Dimension	Subdivision	Relevance
Physiology	Sensory system	Spatial design needs to consider the acoustic and optical environments: e.g., reduce the noise interference and provide appropriate lighting
	Motor system	More resting areas Soft and non-slip flooring materials, and the safety of the facilities
	Immune system	Prioritise environmental hygiene and ventilation to provide a healthy environment.
Psychology	Social experience	Simple and easy-to-understand environments and instructions
	Loneliness Sense of security	Consideration of social interaction areas in space design
Behavior	Regularity of activities	provide diversified activity areas to meet the needs of different intensities and types of activities
	Spatial constraints	Reasonable planning of activity areas to ensure spatial accessibility and safety
	Aggregation	Setting up shared activity areas to promote intergenerational exchanges and interactions

3. Case studies on applications related to the integration of the elderly and children

3.1. Overseas Application Cases of Integration of the Elderly and the Young

In the 1970s, European countries such as the Netherlands and Germany faced declining fertility rates and elderly populations. Foreign countries have promoted co-operation through innovative spatial design, as shown in Table 2 Japan's share Kanazawa has facilities for disabled children, care facilities, and hot springs to safeguard the multifunctional needs of the elderly and the young; Germany's Multigenerational House enhances intergenerational exchanges through shared spaces and interactive zones; Singapore's Admiralty Villages vertically integrates childcare and senior living flats and creates intergenerational mobility; the US's St. Vincent Learning Centre combines a kindergarten with a nursing home, and shares an activity room at different times of the day; and the Netherlands' Humanitas promotes intergenerational interaction through shared In the Netherlands, Humanitas promotes intergenerational interaction through shared spaces such as kitchens and libraries. These practices highlight the diverse and innovative paths of intergenerationally integrated communities from a spatial perspective.

Table 2. Overseas intergenerational integration cases

Country	Initiator	Model Design	Strategy	Classic Case
Japan	cholars	Shared Housing	Neighborhoods for Older and Younger Shared Living Rooms Aging Friendly Design Walkway Connections Elderly and Disabled Operated Shops Share	Kanazawa
Germany	Ministry of Family Affairs	Multi-Generational House	Multi-Purpose Complex Shared Kitchen and Garden Time-Shared Openings Multiple Subjects Collaboration Benefit	Multi-Generational House
Singapore	Development Authority	neighborhood Centers	Dual Mode Movement Entrance Shared Benches Nested Children's Playgrounds in Roof Gardens Neighborhood linkage of child & elder care spaces	Admiralty Village
Japan	Developer	Age-Wide Coexistence	Dual-height (15cm/10cm) stair treads for young and old; community garden wheelchair-accessible	

3.2. Domestic Application Cases of Integration of the Elderly and the Young

Under the social background of the double superposition of population aging and childlessness, the community practice of promoting intergenerational integration through spatial innovation in China has become an important direction for future community construction. The spatial design strategies of intergenerationally integrated future communities in China are guided by the diversified needs of residents, as shown in Table 3.from which it can be seen that: Yangliu County Future Community in Hangzhou achieves the time-sharing of intelligent services through vertical stratification and scenario infiltration; Xinhe Community in Quzhou City makes use of the transformation of unused space and the "Co-enrichment workshop" to provide activities and healthcare services for children and the elderly; and Mutual Community in Hangzhou provides activities and healthcare services for children and the elderly. The Xinhe Community in Quzhou City uses the transformation of unused space and the "Common Wealth Workshop" to provide activities and healthcare services for children and the elderly; and the Hangzhou Mutual Community focuses on building a comprehensive neighbourhood with activity spaces and elderly services for the elderly and the young, and promotes intergenerational exchanges and learning through a digital learning platform, with the common goal of improving the functionality and inclusiveness of community spaces.

Table 3. Domestic intergenerational integration cases

Typical Cases	Strategy Dimension	Core	Spatial Design Strategy
Hangzhou Yangliu County Future Community	Spatial Vertical Digital media	Vertical layering+ Scene penetration	Vertical layout of shared space with nearby cafeteria and health stations. It offers intelligent meal and healthcare services, and is shared through time - sharing.

Quzhou Xinhe Community	Expanded activity space resource integration	Humanized design Idle space transformation+ “Common Wealth Workshop” model	“Common Wealth Workshop” Retired book counseling for children “Idle space converted to children's activities and healthcare Common Wealth Workshop"

3.3. Summary of existing intergenerational integration and core design elements

The above six typical cases hint at the design priorities of community venues for integrating the elderly and children from different perspectives under the perspective of intergenerational integration: in a comprehensive view. Figure 2 shows the three core design dimensions for elderly–child integrated venues—spatial layout, facility construction, and community governance—with the latter addressed only insofar as it pertains to design-relevant aspects. These three components will be the logical place for the authors' next research questions and proposed strategies.

Nevertheless, key research gaps persist in existing literature. Gap A: Domestic studies often apply foreign intergenerational spatial models without field-based behavioural evidence for grand-parental childcare in domestic old communities, leading to context-mismatched design proposals. Gap B: Many studies develop designs from physical-space speculation instead of real behaviour-context interactions, yielding overly idealised outputs. Gap C: Existing work focuses on hardware optimisation; discussions of operational governance and AI-enabled health interventions remain conceptual, lacking practical pathways for ordinary old residential communities.

To fill these gaps, this paper uses the PSPL method to examine Qihang, Danxi and Dongzhou communities in Yiwu, identifying real-world behaviour-context conflicts. It establishes a physical-plus-operational strategy framework illustrated through Qihang Community’s virtual renewal. This study counters over-conceptual, empirically weak design research and informs similar community-renewal practice. Chapter 4 presents field-investigation findings.

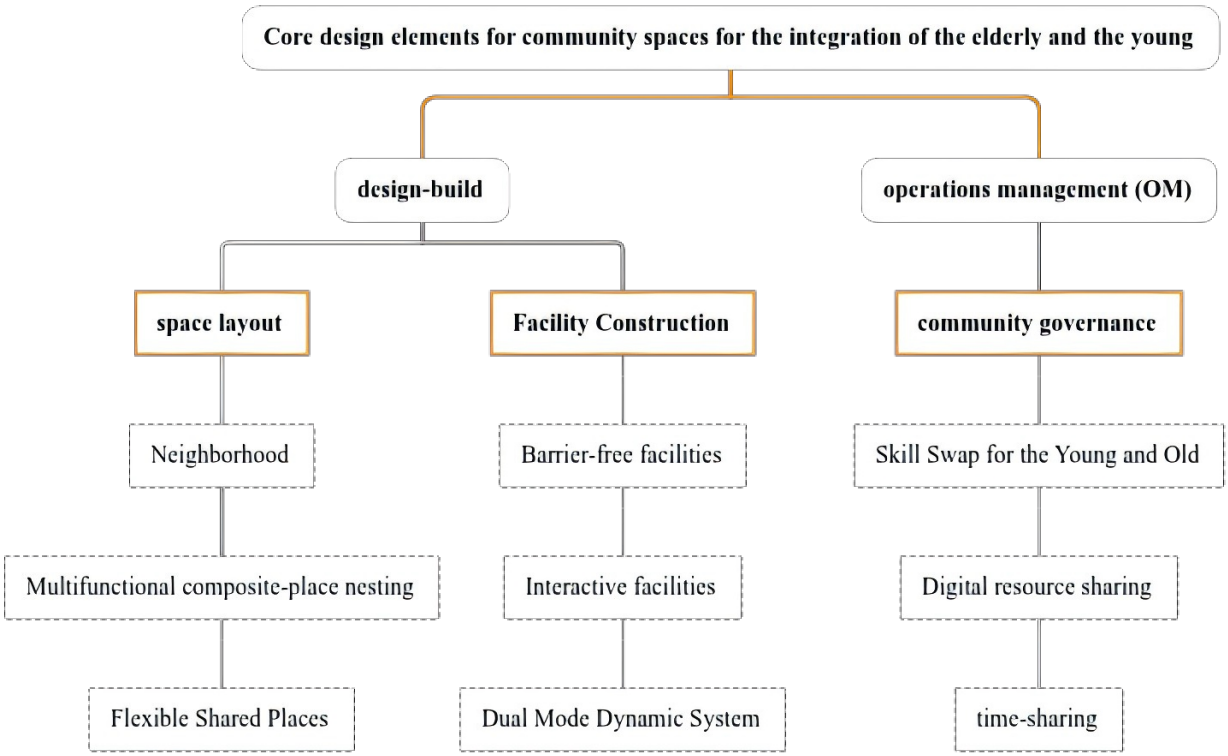


Figure 2. Activity-Behavior Scenario Model for elderly and children in Typical Communities

4. Typical Community Activities for the Elderly and Young - behavioral Scenarios

In this study, three typical future communities in Yiwu, Zhejiang Province are selected as the empirical research objects. The selected communities were built in 2004, 2016 and 2018, which are representative of the time span; Danxi and Dongzhou communities were selected as the first batch of "Demonstration Scenarios for the Integration of the Elderly and Young People" in the province, and the Qihang community was selected as the seventh batch of "Future Communities", which is also spatially representative of the future communities.

It can be seen from the figure: the geographical location of the community includes Beiyuan Street, Jiangdong Street, and Houzhai Street in Yiwu City. It has the geographic location diversity of elderly and children integration. Next, we take the community of Qihang community as an example, and apply the map marking method, behavioral observation method and questionnaire method in Yang and Gale's PSPL to carry out the field research[9].

4.1. Behavioral observations recorded

Qihang Community was founded in November 2016. Located in central Houzhai Street, it covers 1.02 km² and is bounded by Chengbei Road (east), Auto City (west), Huancheng North Road (south), and Anxi Road (north).The distribution pattern of elderly and children activity places in the current Qihang community is more concentrated. Indoors, they are concentrated in kindergartens, libraries and food markets. Outdoors, it focuses on the theme park and basketball court as important venues for the elderly and children to carry out outdoor activities. The spatial pattern and the current spatial status as Figure 3 shows.



Figure 3. Distribution pattern and current status of activity places for the elderly and children

Qihang community Library features an irregular rectangular layout. Real-time behavioural observations of the elderly and children were conducted at 15:45, as shown in Figure 4. Figure 5 illustrates deficiencies in children's play facilities within the community's shared activity zones for older adults and children. It also captures several on-site scenes: older adults and children reading in the library in the afternoon, gathering on leisure benches outside the dessert shop, and children climbing near the doorway in front of the standing sign. It was observed that the facility was most applied around 4:00 pm, after school, when children would come to talk, relax, climb, and read. In the evening after 6pm children would come here to park and go into the basketball court at the back or the pavilion to study see Table 4.

Table 4. Library 1F Behavior Intensity Checklist

Children (18)	Age	Behavior	Adults (11)
Accompanied play (11)	0-2 years (2)	Observation (1) Going down stairs (1)	Caring for children (2)

	3-6 years (9)	Sitting and resting (4) Climbing (2) Talking with peers (2) Reading (1)	Talking and caring for children (5) Reading and looking after children (1)
Playing alone (7)	Ages 7-12 (7)	Talking with peers (4) Reading (3)	Pedestrian (2) Playing with cell phone (1)

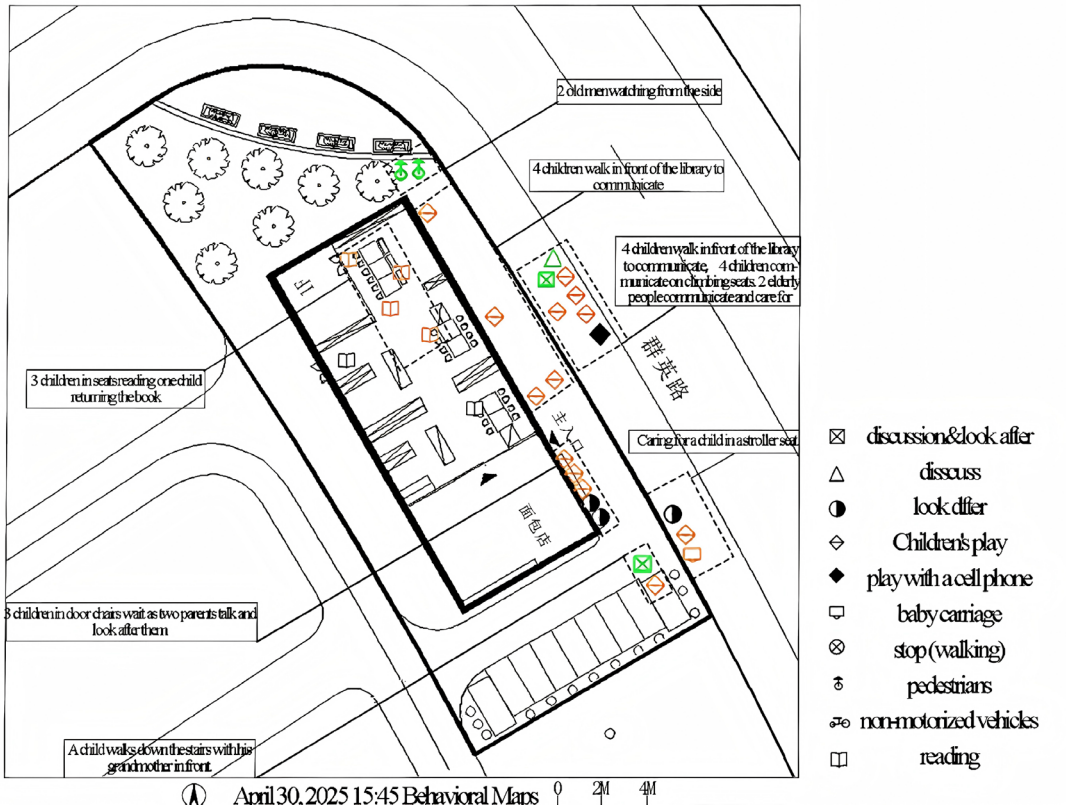


Figure 4. Behavioral map of Library 1F



Figure 5. Photographs of indoor and outdoor scenes in the library

4.2. Questionnaire Survey

This study employed on-site random sampling to recruit children aged 0–12 and their accompanying elderly residents from three communities. A total of 175 questionnaires were administered, yielding 170 valid responses with a valid response rate of 97.1%. You can see appendix A and B. To ensure data validity and reliability, all participants either filled out the questionnaires on-site or provided verbal confirmation of their answers. Valid responses were collected from Qihang Community (53), Danxi Community (51), and Dongzhou Community (66). The statistical characteristics of the samples are presented as shown in Table 5.

Table 5. Questionnaire Data Composition Characteristics

Gender	Males 22%, females 78%
Age	20-35 years old 19%, 36-45 years old 12%, 46-59 years old 36%, 60-75 years old 30%, 75+ years old 3%
Family structure	Live with parents 24%, 3-generation family 65%, live with partner 5%, live alone 6%
Age of child	0-2 years old 41%, 0-3 years old 48%, 7-9 years old 10%, 10-12 years old 7%

Child's companion	Parents 38%, grandparents of children 58%, other 4%

Spatial layout level

Data aggregated from the three surveyed communities (Qihang, Danxi, and Dongzhou) shows that 66% of respondents preferred returning home or grocery shopping after outdoor activities. Field observation data in Table 6 were collected from these three sites. Among on-site behaviors, 50 respondents reported that children waited at or near facility entrances while the elderly participated in activities, and 42 respondents took fitness walks, with a few residents chatting, playing cards, or reading, see Figure 6. Overall, these community spaces suffer from spatial fragmentation, behaviorally mismatched layouts, and a lack of adjacent all-age versatile activity areas.

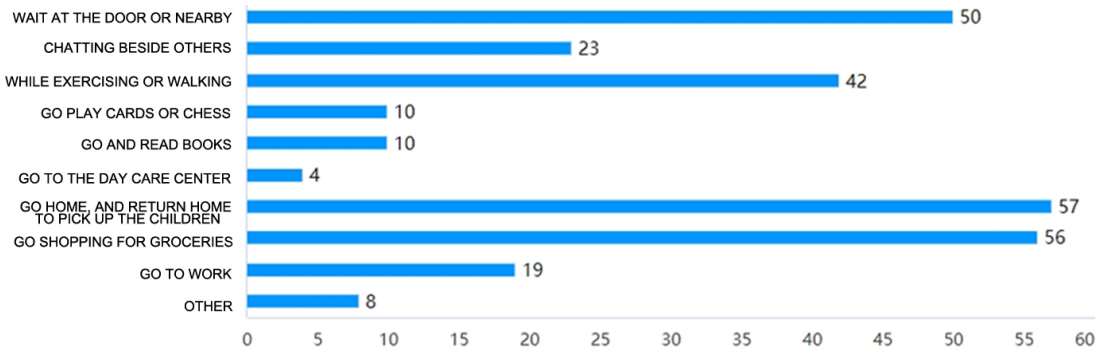


Figure 6. The behaviour of elders when children are in training institutions or activity centers

Facility construction

The appropriate distance between children's activity places and facilities is closely related to their age: children aged 0-2 years old have a high demand for proximity to activity places, with a walking time of less than 2 minutes; children aged 3-6 years old need to ensure that the activity facilities are within sight and the walking time is no more than 5 minutes; and children aged 6 years old and above tend to participate in activities independently in playgrounds, libraries, and basketball courts. and basketball courts as shown in Figure 7. Current design practice lacks consideration of intergenerational shared facilities tailored to the needs of children of different ages, leading to a lack of intergenerational interaction.

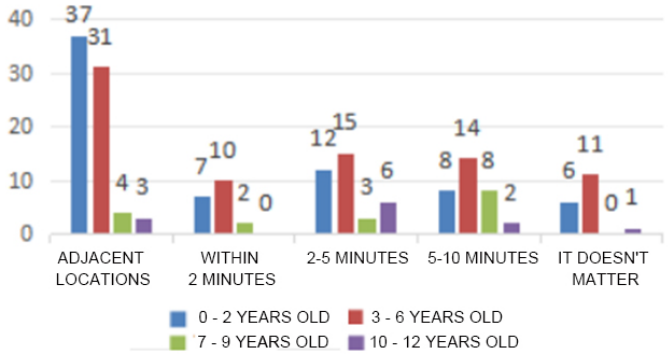


Figure 7. Distance to facilities frequented by the young and old in relation to the age of the children

Operational level

Feedback from young residents indicates that the failure to give due consideration to the special needs of the elderly and children at the design stage has led to the problem of an imbalance between the supply of and demand for community facilities. Residents in the Dongzhou community reported higher satisfaction levels, which was mainly attributed to its rich variety of play facilities and beautiful landscaped environment, although there was still room for improvement in its sanitary facilities. In contrast, residents in the Qihang Community reported a homogeneous range of play facilities, a lack of necessary safety and hygiene measures as well as indoor space for activities. Among those who used sanitation facilities, residents in the Danxi community had the highest satisfaction level, while residents in the Qihang communities and Dongzhou communities generally felt that there was a lack of adequate toilets, garbage cans, and drinking water facilities,as shown in Figure 8. A common problem was the lack of playgrounds. Older people, in particular, expressed particular concern about the safety of the grounds and emphasized the importance of regular facility maintenance and inspection. Understanding and addressing the needs of older persons and children is therefore particularly critical.

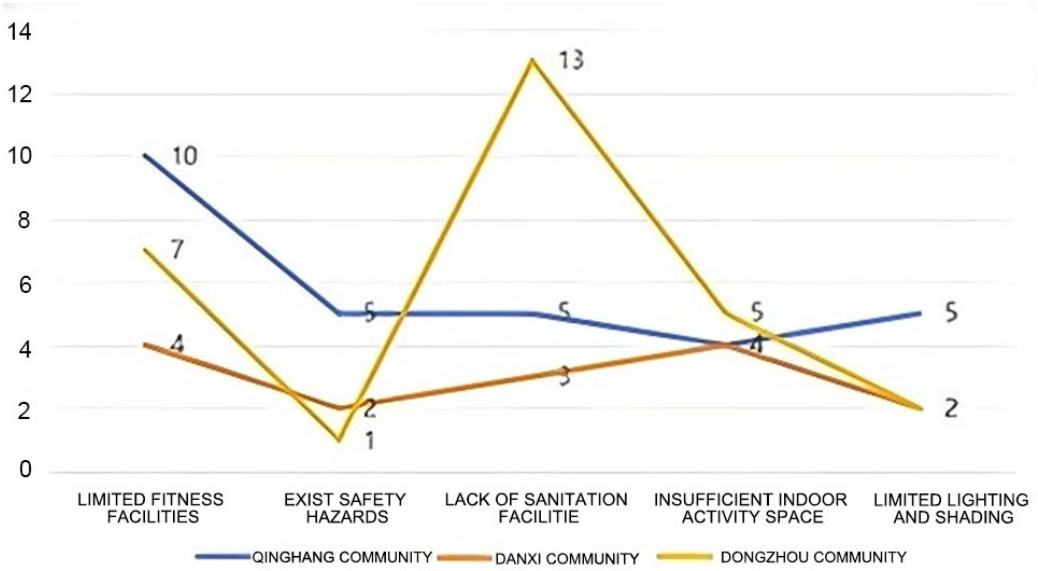


Figure 8. Site related problems of surveyed communities

4.3. Summary of Common Behavioral-Scenario Patterns for elderly and children People

From the above theories and field research, it is concluded that the elderly and children groups coexist in behavioral regularity (old age) and randomness (children), and their safety and social needs converge. The following are the spatial and facility needs corresponding to the five scenarios, see Table 6. This lays the foundation for the specific design strategies proposed below.

Table 6. Common Scenarios for elderly and children - Behavioral Patterns Summary

scenario	Aggregate	Space	Facility
Play	Talking (8) Running/Riding (5) Sitting/Cuddling/Planking (3) Climbing (2) Swinging (3)	Enclosed Places	Chronic Lanes Amusement Rides
Culture	Watching (12) Talking (12) Sitting/Hugging/Planking (7) Climbing (5) Resting (4) Reading (4) Playing Badminton (1)	Semi-enclosed recreational space Children's reading space	Landscaped facilities Watching seats Climbing facilities
Business	Sitting/carrying/holding (8) Standing/running (3) Drinking water (1)	Play area next to supermarket	Baby shopping cart Drinking water facilities
Physical	Playing basketball (15) Dancing (8) Observation (5) Running (3)	Indoor children's area Multi-purpose sports area	Fitness equipment Plastic flooring Seating facilities
	Sitting/carrying/assisting (10) Communication (9) Riding/walking/running (4) Climbing (5) Observing (3) Playing (2)	Enclosed Places	Older and younger places are adjacent Paths between venues are accessible Interactive facilities No elevated surface

Fitness facilities With play equipment

5. Optimization Strategies for Community Activity Places for the Elderly and Young

5.1. Spatial Layout Level

Integration of Modular Facilities and Sharing of Elastic Space

Spatial layout should holistically integrate the randomness of children's activities with the regularity of elderly routines, thereby creating flexible spaces through site integration and functional complementarity. The integration of spatial and temporal dimensions refers to the simultaneous space to meet the social activities of multigenerational groups and the play needs of children's groups. Complementary space-time dimension refers to the sharing of the same place at different times and assigning a functional attribute to it, that is to say, it constitutes an elastic space. For example, the use of partitions or modular lounge seating according to the high frequency use of semi-open activity spaces in different communities see Figure 9.



Figure 9. Mobile partition

Nesting of Coupled Venues, Chaining Intergenerational

Children's and elderly activity venues should be adjacently arranged to ensure visual connectivity and barrier-free access between them, thereby facilitating both supervisory care by the elderly and their unhindered movement to shared spaces for mutual interaction. In the process of bringing along the young and the elderly, the elders' line-of-sight focuses on children for a long period of time, which makes it difficult for single-type venues to satisfy the activity needs of this group. Accordingly, this study subdivides site functions based on the existing dynamic-static zoning framework. For example, in the dynamic activity area set up swings, slides, climbing frames and other children's activities and dance plaza, basketball court, back massager and other fitness facilities. In the static activity area set up seats, corridors and other rest facilities to adapt to the elderly landscape, leisure, friendship, children bird watching, walking, playing with toys and other static behavior.

5.2. Facility construction level

Dual-mode dynamic line, the old and the young in parallel

Grounded in the "speed gradient" theory from environmental behaviour studies, a "separate-but-not-segregated" strategy enables safe coexistence: a 1.2-m-wide ring-shaped elderly path (with anti-slip surfacing) and a 0.8-m-wide zigzag child pathway (with playful ground markings) are three- dimensionally interwoven, with buffer pocket spaces inserted at their intersections to resolve mobility disparities via differentiated route planning as shown in Figure 10. For example, the "Intergenerational Trail" in Chengdu's Luhu Eco-city, through the parallel design with a 20cm difference in height, the elderly can observe the children playing in the sandpit in the lower area as they walk slowly along the guardrail, forming a "vertical caretaker" relationship. However, the budget for paving and maintenance needs to be considered in practice.

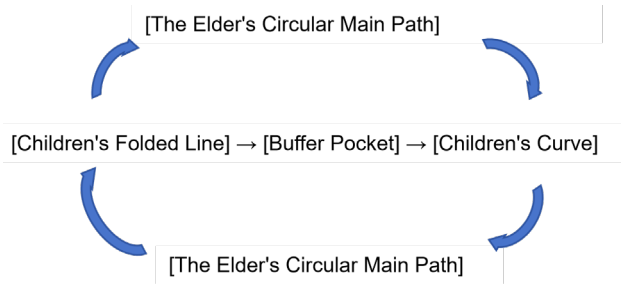


Figure 10. Dual-mode dynamic line diagram

Build interactive facilities to be shared by the young and the old

Interactive recreational facilities are planted in the landscape space to strengthen the connection between different generations. Currently, most of the recreational facilities in community parks are only considered for use by a single group, which is not conducive to the promotion of intergenerational interaction. "The elderly facilities and children's facilities can be combined and designed to make them integrated, so as to realize the multi-functional facilities. Such as the use of mechanical interaction of the memory seesaw and sound microphone and so on,as shown in Figure

11. Memory exchange and spiritual resonance between young and old are realized while the facilities are interactive.



Figure 11. Illuminated seesaw

Borrow smart facilities for precise intervention

With the proliferation of smart-city and digital-health paradigms, organic-renewal approaches can be leveraged to integrate intelligent community services, medical resources, and population-oriented health management through big-data analytics, sensor infrastructures, and artificial-intelligence techniqueS [10]. These technical enablers support the evaluation of rationality and utilisation performance of spatial and facility configurations within healthy community contexts. For illustration, a smart health-management platform may be established to aggregate and analyse resident-level health datasets, detect latent health demands and risk factors, and develop targeted intervention strategies for advancing community health-management outcomes [11]. This is exemplified by the "Yixin Shouhu" programme at Futian Subdistrict Community Health Service Center, Yiwu. It constructs a full-cycle coronary rehabilitation system across tertiary hospital, community and home. With wearable sensors, remote ECG monitors and a cloud-based AI analytics platform, the system continuously collects residents' cardiovascular indicators, identifies health risks, and delivers personalised rehabilitation and medication interventions. Contemporary ecological co-creation scholarship further highlights adaptive built environments and socio-cultural inclusion as critical drivers for elevating public engagement and user satisfaction within community physical-activity precincts [12].

Nevertheless, such medical-oriented smart-health systems require sufficient funding and professional medical staffing, which poses practical barriers for replication within ordinary old residential communities.

5.3. Operation and management level

Cultivate the community farm to promote emotional integration

Considering that the elderly and children groups are visually sensitive, bright plant colors can effectively activate their visual nerves, such as warm red and orange can bring warmth and vitality and promote physical and mental health; while fresh blue and green can bring a sense of tranquility and relaxation. Taking into account the weakened immune systems of young and old populations and the climatic environments of different communities, herbs and fruit trees can be placed in community farms and landscape planting, as shown in Figure 12 . Ornamental at the same time to meet the needs of the community's elderly and children people in the summer mosquito repellent, and at the same time, inheritance and carry forward the culture of traditional Chinese medicine, which has a certain function of popularization of agricultural science and education.



Figure 12. Vanilla and fruit trees

Multi-body participation, detailing the needs of the old and the young

The operation and management mechanism of community public activity venues encourages multi-body participation of the old and the young. In order to promote the mixed participation of multigenerational residents, cyclical, all-age participation in shared governance activities is an important channel for increasing the multigenerational sense of belonging and responsibility and promoting intergenerational consensus and empathy. The active participation of the elderly and children and youth is especially encouraged during the activities, which helps to promote the community to better meet the residential needs and life visions of the older and younger generation[13].

First of all, the establishment of a community network governance platform to implement the concept of "digitalization" of the future community, and to link online and offline to realize the common building and sharing of governance. For example, the Punggol community in Singapore realizes the integration of display, consultation, interaction and service on a cell phone software, and realizes the intelligentization of public service facilities. Secondly, the community can establish a volunteer points incentive system to encourage the elderly and children's groups to give full play to their hobbies and specialties and organize volunteer teams to actively help each other. Elderly people do traditional culture and skills training for children in the

community; children's groups can give back to the elderly by providing them with cultural performances during traditional festivals, etc. as shown in Figure 13. Flexibility varies according to the local folklore of the community and the acquisition of skills by young and old. Evidence from interactive design assessment also highlights the value of clear affordances, visual hierarchy, and adaptive feedback for supporting engagement across age groups [14].



Figure 13. Retired teacher teaches children's classes

6. Design Application of the Proposed Strategies

Based on the design strategies summarised in Chapter 5, the public space of Qihang Community is adopted as the carrier to present the composite virtual transformation design scheme. Figure 14 illustrates systematic spatial interventions tailored to the real site conditions.

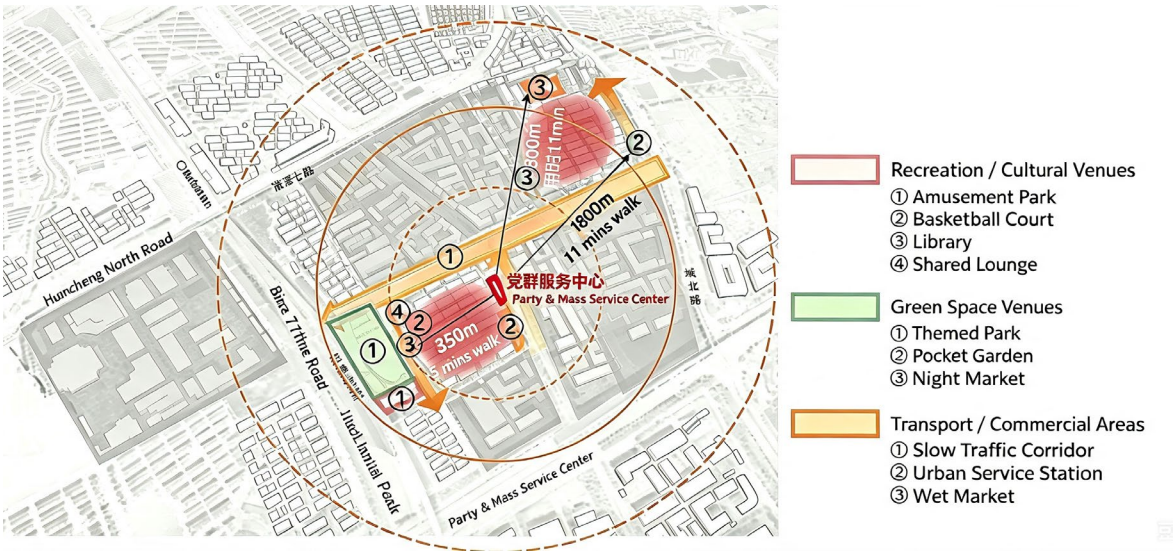


Figure 14. Schematic diagram of the transformation plan for the Qihang Community

6.1. Natural Landscape Enhancement

In response to the problem of fragmentation of the community's elderly and children sites and the difficulty of integrating their needs, this paper takes vernacular memories and native nature as the basis for building a nested theme park for the old and the young. Centred on the central tree pool, the site is equipped with gently sloping walkways and stone benches suitable for both groups, forming adjacent nested spaces for dynamic and static activities. Vernacular elements including stone mills and old cart wheels are integrated into the layout, satisfying the elderly's demand for nostalgia while supporting children's natural play and interaction. The children's play area and elderly resting zones maintain visual permeability. This nested arrangement enables concurrent supervision and intergenerational communication and safeguards children's activity safety. The site is furnished with multi-functional recreational facilities, barrier-free pavements, low-height seating and local non-toxic vegetation. This nested layout balances all-age adaptability and ecological safety, as shown in Figure 15.



Figure 15. Theme Park Landscape Transformation Effect

6.2. Adaptation of barrier-free facilities

As a core component of the barrier-free system serving the elderly and children, sanitary facilities are configured differentially according to the physical characteristics of the two user groups. For elderly users, anti-slip ramps are installed at passages, and horizontal or vertical handrails are arranged around handwashing stations to support users with limited lower-limb strength and stabilise their posture. For children, dedicated low-height handwashing basins and matching low-mounted soap dispensers are provided to support independent use. The handwashing zone is further equipped with infant seats, hand dryers and waste receptacles to meet all-age cleaning and care requirements. Detailed dimension drawings and renderings of the handwashing facilities are presented in Figure 16.



Figure 16. Hand wash basin design size chart and effect

6.3. Improvement of operation management

Following the renovation, time-sharing and multi-purpose management is introduced alongside enriched activity types to support efficient utilisation of children's activity spaces. Taking the shared community living room as an example, it accommodates educational programmes such as painting exhibitions, calligraphy workshops and children's courses, while also supporting social activities including group gatherings, communal cooking and seminars. The basketball court can host nature education sessions, children's games and community sports; during off-peak periods, it opens to middle-aged and older residents for group dance and fitness. From the perspective of intergenerational integration, the optimisation strategy proposed in this research centres on elderly-child friendliness. It aims to build spatial settings oriented toward intergenerational interaction and foster spontaneous communication and emotional bonding among multi-generational users. This design encourages organic, positive social engagement across age groups.

7. Discussion

The observational results(Tables 4–6) reveal widespread spatial fragmentation and behaviour mismatch in existing community venues. Children's spontaneous, unstructured play often competes with older adults' sedentary rest and fitness activities for limited space, while nested adjacent zones suitable for simultaneous elderly-child co-use remain scarce. This finding validates the research gaps identified earlier: many domestic intergenerational spatial designs adopt foreign models without local behavioural evidence, resulting in layouts inconsistent with residents' real daily needs.

Questionnaire outcomes show that residents prioritise safety, comfort and flexible space use. These preferences support the strategies of modular facilities, time-elastic shared spaces and coupled nested venues. Movable partitions and combinable fittings enable dynamic functional adjustment according to fluctuating user numbers, balancing children's activities and older adults' caregiving needs.

Smart health interventions can serve as a supplementary tool for spatial renewal but cannot replace the fundamental quality of inclusive physical environments. Such smart medical platforms require stable funding and professional medical staffing, which limits their direct replication in ordinary old neighbourhoods. It should also be noted that all analyses in this study are descriptive and lack significance testing. Furthermore, the design scheme only demonstrates application potential rather than measuring post-implementation performance; construction cost and long-term maintenance remain practical constraints for on-site delivery.

8. Conclusion

Against the context of low-fertility ageing and routine intergenerational childcare, community spaces for older adults and children suffer from fragmentation, insufficient intergenerational contact and unbalanced facility supply and demand. Drawing on intergenerational communion theory, environmental behaviour theory and PSPL surveys of three Yiwu communities, this study identifies regular behaviours among the elderly and random activities of children, along with their overlapping safety and social needs. The three-dimensional strategy of spatial flexibility, facility interaction and operational symbiosis is thus proposed, matching the supply-side reform of elderly care and helping resolve intergenerational resource conflicts in high-density communities.

Three main contributions are highlighted. First, a behaviour-scenario analytical framework for shared elderly-child spaces is established, and typical local activity patterns are summarised. Second, coupled nesting and flexible sharing strategies are proposed to ease spatial conflicts between older adults and children. Third, this study integrates low-impact micro-renewal with auxiliary smart-health interventions, avoiding over-reliance on either landscape renovation or technical solutions.For practical

renewal of old communities, low-disturbance micro-interventions are recommended. Nested activity zones, modular facilities and flexible management rules can facilitate spontaneous intergenerational encounters. Smart-health facilities may be selectively deployed when resources permit, while inclusive basic spatial quality should remain the priority.

This research has several limitations. Samples are restricted to three communities in Yiwu, and field observations were carried out within fixed time windows. Long-term post-occupancy evaluation is absent. Construction cost and sustained maintenance also constrain real-world implementation. Future work may expand the survey scope and conduct cross-site comparisons to test the transferability of the proposed strategies.

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Appendix A. Survey on the Use of Future Community Activity Spaces for All Ages

Survey Questionnaire on the Use of Activity Spaces for Children and Seniors in Future Communities

This questionnaire is intended for households with children (ages 0–12) or seniors (age 60 and older).(This data is used solely for quantitative statistical analysis and will not disclose your personal information.)

PART 1 Personal Information

1. Your gender

☐Male ☐Female

2. Your age

☐20-35 ☐36-45☐ 46-59☐ 60-75 ☐Above 75

3. Your family structure:

☐Two generations living together (older and younger)

☐Three generations living together (older, middle, younger)

☐ Living with spouse

☐Alone

4. Your children's age:

☐0-2 ☐3-6 ☐7-9 ☐10-12

5. The main person accompanying your children in activities is:

PART 2 Parents Grandparents Others (nanny, other relatives)

1. Do you think the current activity spaces for the elderly and children can meet your needs when taking care of your grandchildren?

☐Completely meet☐ Basically meet ☐Average☐ Basically not meet ☐Completely not meet

2. Do you think the current activity spaces for the elderly and children can support communication and interaction between you and the children?

☐Completely meet ☐Basically meet☐ Average☐ Basically not meet☐ Completely not meet

3. The places elderly people in your community often go to include: (multiple choices allowed)

☐Community canteen ☐Convenience store/market ☐Residential park ☐Reading room Outdoor fitness area

☐Community training or senior college ☐Dance, table tennis, and other sports activities

4. Where do you usually take your children for outdoor activities? (multiple choices allowed)

☐Space by the yard downstairs ☐Children's playground in the community

☐Community activity square ☐ Community recreation and fitness area

☐Community streets ☐ Small parks in the community

☐Walking paths in the community ☐ Surrounding city parks

5. What facilities do you think are most important when taking children for outdoor activities? (multiple choices allowed)

☐Lighting facilities ☐ Resting seats ☐Toilets

☐Shade/rain shelters Ramps and handrails ☐Mosquito and insect control Trash ☐bins

6. When your children are playing, what are you usually doing? (multiple choices allowed)

☐Participating with the children ☐Watching the children Sitting ☐alone nearby (reading, playing, using phone, doing crafts)☐Chatting with friends Sitting idly ☐enjoying the view☐ Group activities like square dancing

7. What functions do you think the current community activity spaces for the elderly and children need to add? (multiple choices allowed)

☐Scenic resting area ☐ Reading and learning area ☐ Children's play space Sports and fitness

☐ Toys and shopping Other

8. What concerns you most about interactions between the elderly and children? (multiple choices allowed)

☐Safety issues☐ Hygiene issues ☐Children being noisy☐ Elderly and children hard to get along☐ Elderly outdated views affecting child development ☐Other

9. Which functions of activity spaces for both young and old do you think can be shared?

☐Multipurpose activity room ☐library☐cafeteria ☐lounge ☐elderly rehabilitation room

☐storage facilities ☐signage facilities ☐ monitoring facilities ☐ drinking facilities ☐other

10. How long would you like it to take to walk between children's activity areas and elderly activity areas?

☐Adjacent ☐within 2 minutes ☐ 2-5 minutes ☐5-10 minutes ☐doesn't matter

10. When children are studying at training institutions or participating in activities at activity centers, what do you usually do? [Multiple choice]

☐Wait at the entrance or nearby ☐chat with others, go for a walk or exercise☐ play cards or chess

☐read a book☐ go to a daytime care center ☐go home and then come back to pick up the child☐go shopping

☐ go to work☐other

11. What is your attitude toward setting up elderly activity areas (like markets) next to children's activity areas (like training centers/activity spaces)? [Single choice]

☐Would like it that way ☐can accept ☐doesn't matter ☐ cannot accept ☐depends on the situation

13. How long would you like it to take to walk between children's activity facilities and elderly activity facilities?

☐Adjacent ☐within 2 minutes ☐2-5 minutes ☐ 5-10 minutes ☐doesn't matter

14. If elderly activity areas were to be set up near children's activity areas, please check the setups you agree with [Multiple choice] Other

Places for kids /Places for seniors	Senior Reading Room	Game room	Dance and Exercise Room	Culture Room	Vegetable market	Community Training	Daycare center	Outdoor activity area
Children's tutoring class								
Children's Library								
Children's Activity Room								
Toy store								
Outdoor activity area								
Suitable for independent setup								

15.Any other suggestions you have for designing activity spaces for all ages in the community?_____

Appendix B. Interview Record Form for Seniors Visiting with Grandchildren

Interview Record Form for Elderly People Visiting with Grand children

1. Basic Information			
Respondent's age		Interview location	
Grandchild's age		Interview time	
2.Interview Outline and Content Notes			
Type	Question content		Key points
Basic Situation of Activities for All Ages	●Take care of the kids long-term or just occasionally during holidays? ●Do you take the kids to community activities every day? ● Common places for taking kids to community activities ● What activities to do with the kids ● Time slots and duration for kids' activities. ● The distance from home to frequently visited places and the time it takes to get there.		
Preference for event venue	● The activity venue and content are decided by (grandchildren/grandparents); choose your preference ● The reason for using a particular activity venue most often; ● List a few things you like most about this place: ● When taking kids outdoors, do you prefer lively or quiet activities? ● The activity venue I like the least and the reason why.		
Interaction Between Kids and Seniors	● When doing outdoor activities, whether you interact with the child; the nature of the interaction ● The main ways, level, and frequency of interaction between the household and the child; ● Whether to casually interact with the child (necessity); ● Does the current venue meet the needs for interacting with kids, and which aspects are unsatisfactory?; ●Any suggestions for improving parent-child interactions? Outdoor activity spaces.		
Activity spaces for all ages	● What should you mainly pay attention to when choosing a place for activities with kids? ● Think about which auxiliary facilities are more important and used frequently in the area, like seating, restrooms, lighting, and shade structures. ●Which aspects of the indoor layout and facilities for activities with kids are you not very satisfied with? ●Suggestions for the current community spaces for kids and seniors.		
Other questions	●Temporary question based on the personal preferences of the elderly		

Interview Outline Description: This interview outline was used during the preliminary research phase and was carried out together with the questionnaire survey, with a total of 6 in-depth interview groups conducted.