Research on Appropriate Aging of Living Environment Based on Developmental Psychology and Fuzzy Model

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***Abstract*—This article studies the late adult population through developmental psychology, and thus determines the factors that affect the proper aging of the built environment. Based on these factors, three sets of variables, including architectural design, community planning, and interpersonal distance, and nine primary indicators and 30 secondary indicators that affect the evaluation of these variables were determined. Based on this, a multi-layer fuzzy comprehensive evaluation model was introduced. Analyze the survey sample data. The results show that building design, living unit planning, and interpersonal communication distance can all affect the degree of aging. Among them, building design has the most direct impact on the degree of aging. In the future, when we increase the degree of aging of living, we should pay attention to building design or reconstruction. Consideration, taking into account the rationality of community planning and the location of the building on the impact of interpersonal communication.**

***Index Terms*—Living environment, suitable ageing, fuzzy model , development psychology.**

I. Introduction

According to the National Bureau of Statistics, the number of people over 65 in China reached 16558 million in 2018, accounting for 11.94% of the total population, and the elderly dependency ratio reached 16.8%. Against the background of accelerated aging, the elderly dependency ratio has increased by approximately 0.9% each year since 2016.This makes the elderly care industry have a good development prospect, and at the same time, it also exposes some problems. For example, the fourth sample survey of the living conditions of the elderly in urban and rural areas in China shows that the elderly living environment is not suitable for aging, the elderly living environment construction is lagging, and 58.7% of urban and rural Elderly people think that there is a problem of discomfort in housing [1], and this proportion of rural elderly people reaches 63.2%.Here, the author attempts to determine the factors affecting the suitable ageing of the building environment from the perspective of developmental psychology, and introduces the use of fuzzy models as methods to analyze these factors, thereby determining the degree of influence of each factor on the appropriate ageing of the building environment.

II. Developmental Psychology

Late adulthood is also referred to as old age, which generally refers to the period of over 60 years. The basic characteristics of individual physical and mental changes during this period are: individuals vary greatly, but the general trend is to gradually show degenerative changes. The age-appropriate design considers the physical functions and action characteristics of the elderly, and meets the elderly's life and travel. The research on the psychological development of the late adult individuals can provide a theoretical basis for the national aging cause decision-making design suitable for aging.

A. Determine the Influencing Factors

The determination of suitable aging factors in the living environment mainly depends on the study of late adulthood in developmental psychology. Perceived sensation in late adulthood is significantly reduced, which is manifested by visual loss, hearing loss, olfactory and tactile insufficiency [2].

With the increase of age, the time for individuals to adapt to light will become longer and longer, especially the response to strong light. 50% of the elderly need more than 90 seconds to restore vision after strong light exposure, while young people only need 10 seconds. This makes the lighting design in the age-appropriate design as far as possible to avoid suddenly entering the dark environment from a bright place, and a transition space is needed in the middle. And the space where common items are placed should also avoid strong light and avoid glare after picking up objects. Decrease in color resolution: Older people have less ability to recognize yellow and red, and it is most difficult to recognize blue and green. Avoid mixing blue-green logos when designing for proper aging by color. 63% of 70-year-olds have normal functioning ears but cannot hear sounds higher than 75dB. In the community's suitable aging transformation, attention should be paid to the road or the place where warning is needed, and the sound level should be within the range that the elderly can hear.

TABLE I: Functional Decline Requirements for Building Design

Cognitive name	Content	Construction-related requirements
Visual loss	Reduced vision, sclerosis of the lens, weakened ciliary muscles, and decreased ability to adjust the focus of the eye	Requirements for building shape
	Reduced color resolution, especially blue-green resolution	Requirements for building color
	Bright adaptation and dark adaptation time extended	Requirements for light environment
Hearing loss	Distinction in sound	Requirements for the acoustic environment
	Impaired language understanding	Requirements for the acoustic environment

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Dull smell	Some elderly people cannot smell gas, fireworks or burnt food	Requirements for safety design
Tactile	Weakened perception of temperature changes	Requirements for room temperature control
	Can't handle high and low temperature well, easy to burn and frost	Requirements for safety design

B. *Emotions in Late Adulthood*

Individuals are prone to negative emotions in old age. The elderly daily life environment control lever includes three aspects: physical environment, interpersonal environment and imaginary control. Correlation regression analysis shows that there is a close relationship between physical environment control and positive emotions in subjective well-being [3].Studies abroad have shown that having a sense of control over the living environment, even just the right to make choices in daily affairs, can allow the elderly to have a good mental state and health. In the process of ageing design and transformation, the transformation of the community space should make most of the affairs handled by the elderly in the basic life circle. Ageing design and reconstruction are not always convenient for the elderly. Properly setting aside daily affairs can delay the elderly Psychological and functional decline. For the elderly, suitable ageing is a supplement to home care or community care, not a comprehensive help. In addition, by designing an activity center for the elderly in the basic life circle, the interpersonal environment of the elderly can be controlled, which is conducive to relieving the elderly’s loneliness.

III. Fuzzy Model

Because of the specific and subjective nature of the aging environment, it is difficult to accurately assign variable values to the problem. In this case, fuzzy models can be used to solve this problem.

A. *Multilayer Fuzzy Model*

Fuzzy decision-making refers to the use of fuzzy mathematics to deal with some complex problems. Generally, these types of problems cannot determine the assigned variables, because these variables involve some subjective factors, making the relationship between the variables unclear, and other methods such as fuzzy evaluation are needed to deal with them. For example, to study whether the community facilities are perfect for the elderly, the improvement here is a "fuzzy" concept. It is necessary to construct a factor set that influences whether the evaluation is "perfect", the degree of "perfect" or rank in the factor set constitutes a comment set, and finally determines the weight of each factor. When determining the weights, an expert evaluation method can be adopted for simplicity, and the weights can be given after discussion by an expert group composed of more than a dozen experts; in order to make the results accurate, the AHP can also be used to determine the weights, which can effectively avoid experts The right weight given by experience is subjective and cannot reflect the objective situation. Here we actually surveyed Wucheng District, Mianyang City, and obtained a sample of 168 people. The satisfaction survey results are generally older than 40 years old as an example for analysis [4].

TABLE II: Satisfaction Survey with Multi-level Indicators

Criterion layer	First-level indicators	Secondary indicators	Satisfaction satisfaction price（%）				
			1	3	5	7	9
Architectural design	DesignB_b	Colour	7.14%	7.14%	28.57%	23.81%	33.33%
		Shape	4.76%	14.29%	26.19%	22.62%	32.14%
		Space	2.38%	9.52%	25.00%	23.81%	39.29%
	Accessible DesignC_b	Toilet door open	1.19%	8.33%	23.81%	25.00%	41.67%
		Non-slip design	7.14%	9.52%	25.00%	17.86%	40.48%
		Rounded corners	4.76%	8.33%	26.19%	25.00%	35.71%
		Spatial height difference	5.95%	7.14%	21.43%	30.95%	34.52%
		Armrest settings	4.76%	13.10%	22.62%	22.62%	36.90%
		Meeting Facilities	2.38%	9.52%	21.43%	26.19%	40.48%
	Physical factor controlD_d	Light	4.76%	9.52%	27.38%	25.00%	33.33%
		Sound	7.14%	9.52%	25.00%	22.62%	35.71%
		Humidity	7.14%	10.71%	22.62%	28.57%	30.95%
		Temperature	4.76%	9.52%	17.86%	32.14%	35.71%
Facility planning	Recreational facilities E_e	park	8.33%	4.76%	27.38%	23.81%	35.71%
		Square	8.33%	10.71%	34.52%	19.05%	27.38%
		Senior Activity Center	7.14%	7.14%	35.71%	20.24%	29.76%
	Medical facilities F_f	Hospital	3.57%	13.10%	25.00%	25.00%	33.33%
		Clinic	4.76%	10.71%	28.57%	30.95%	25.00%
		Medical site	4.76%	10.71%	28.57%	30.95%	25.00%
	Living Facilities G_g	Market	1.19%	1.19%	23.81%	26.19%	47.62%
		Supermarket	1.19%	1.19%	23.81%	26.19%	47.62%
		Restaurant	5.95%	1.19%	38.10%	28.57%	26.19%
Interpersonal distance	Children offspring H_h	Child	4.76%	4.76%	29.76%	34.52%	26.19%
		Grandchildren	4.76%	4.76%	29.76%	34.52%	26.19%
	FriendsI_i	Community friend	4.76%	2.38%	33.33%	29.76%	29.76%
		Classmates	3.57%	8.33%	30.95%	28.57%	28.57%
		Colleagues	4.76%	2.38%	33.33%	29.76%	29.76%
	Relatives	Family	1.19%	5.95%	25.00%	28.57%	39.29%

Jj	Close relatives	4.76 %	2.38 %	32.14%	29.76%	30.95%
	Distant relatives	4.76 %	2.38 %	32.14%	29.76%	30.95%

1) termine factor set The evaluation index is actually determined according to the problem, and each index is used as a factor to constitute a factor set. Let $A = (B_1, B_{2,...,}B_n)$. The secondary evaluation divides the factor set $A = (B_1, B_{2,...,}B_n)$ into s according to some attributeFactor subset $C_1, C_{2,...,}C_s$, where $C_i = \{B_{i1}B_{i2}B_{in_i}\}$, $i = 1,2, \dots, s$
2) termine review set The comment set consists of the degree of satisfaction with the appropriate ageing evaluation and is expressed as set $V = \{v_1, v_2, \dots, v_m\}$.
3) Determine the weight of each factor Each factor in the factor set $A= (B_1, B_{2,...,}B_n)$ has different degrees of importance and has different impacts on the evaluation of suitable ageing satisfaction, so it is necessary to give weight to each factor $W = (W_1, W_2, \dots, W_n)$ where W_n refers to the weight of thei-th index, $\sum_{i=1}^{n} \mathrm{Wi} = 1$ ($Wi \geq 0, i = 1,2,3 \dots \dots m$) In addition to the determination of the weight of each factor by experts, it can also be determined by AHP. This article will use AHP to determine the weight. Construct a comparison matrix, compare elements one by one, use the relative scales 1-9 proposed by Saaty et al, and use a_{ij} to take the values 1,2, ..., 9 and their inverses 1,1 / 2, ..., 1/9.Compare the first level indicators *C1, C2,…,Cn* with the degree of satisfaction with the criterion layer [5].

$$C_i : C_j \Rightarrow a_{ij}$$

TABLE III: IMPORTANCE COMPARISON SCALE

Scaleaij	1	2	3	4	5
The importance of *Ci* over *Cj*	Dissatisfied	Not very satisfied	General	Satisfied	very satisfied

4) Establish a multi-layer comprehensive fuzzy model Construct a fuzzy model at any level.
5)

$$B = A \circ R = A \circ \begin{bmatrix} A_1 & R_1 \\ A_2 & R_2 \\ \vdots & \vdots \\ A_n & R_n \end{bmatrix}$$

among them,

$$R_1 = \begin{bmatrix} A_{1_1} & \circ R_{1_1} \\ \vdots & \vdots \\ A_{1_l} & \circ R_{1_l} \end{bmatrix} , R_2 = \begin{bmatrix} A_{2_1} & \circ R_{2_1} \\ \vdots & \vdots \\ A_{2_m} & \circ R_{2_m} \end{bmatrix}, \dots, R_n = \begin{bmatrix} A_{n_1} & \circ R_{n_1} \\ \vdots & \vdots \\ A_{n_k} & \circ R_{n_k} \end{bmatrix}$$

and,

$$R_{1_1} = \begin{bmatrix} B_1 \\ \vdots \\ B_b \end{bmatrix}, \dots, R_{1_l} = \begin{bmatrix} C_1 \\ \vdots \\ C_c \end{bmatrix};$$

$$R_{2_1} = \begin{bmatrix} D_1 \\ \vdots \\ D_d \end{bmatrix}, \dots, R_{2_m} = \begin{bmatrix} E_1 \\ \vdots \\ E_e \end{bmatrix};$$

$$\vdots$$

$$R_{n_1} = \begin{bmatrix} F_1 \\ \vdots \\ F_f \end{bmatrix}, \dots, R_{n_k} = \begin{bmatrix} G_1 \\ \vdots \\ G_g \end{bmatrix};$$

In the formula, B is the overall evaluation set on which the decision is made;

$A; A_1, \dots, A_n; A_{1_1}, \dots, A_{1_l}, \dots, A_{n_l}, \dots, A_{n_k}$ are weight matrices at each level; $R_1, \dots, R_n; R_{1_1}, \dots, R_{1_l}, \dots, R_{n_l}, \dots, R_{n_k}$ are the evaluation transformation matrices at various levels; $\widetilde{B_1}, \dots, \widetilde{B_b}; \dots, \widetilde{G_1}, \dots, \widetilde{G_g}$are fuzzy sets on V, and they correspond to the evaluation of each index (factor) at the lowest layer.

6) Determine the fuzzy comprehensive evaluation matrix For index factor B_i, the membership of each comment set is a fuzzy subset on V [6], and the index of index B_i is recorded as $R_i = [r_{i1}, r_{i2}, r_{i3}, r_{i4}]$, and the fuzzy judgment of each factor is determinedThe matrix is:

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} \\ r_{21} & r_{22} & r_{23} & r_{24} \\ \vdots & \vdots & \vdots & \vdots \\ r_{n1} & r_{n2} & r_{n3} & r_{n4} \end{bmatrix}$$

Comprehensive evaluation:

If there is a fuzzy relationship $R = [r_{ij}]_{n \times m}$ from A to V, we can use R to get a fuzzy transformation $R_R: F(A) \rightarrow F(V)$. For the fuzzy rating set, first calculate $W_{C_1} R_{C_s}$, then calculate $W_{B_n} R_{B_n}$, and finally calculate $W \cdot R$, and let $Q_{C_i} = W_{C_i} \cdot R_{C_i}$, $i = 1,2, \dots, s$, $Q_{B_i} = W_{B_i} \cdot R_{B_i}$, $i = 1,2, \dots, n$, $Q = W \cdot R$

B. Model Application

Take this sample of 168 people as an example to study the habitable ageing. Determine the membership frequency of the secondary indicator to the primary indicator (do n tests on element C, the membership frequency is $\frac{C_i \in B_i}{n}$).Here we take the three factors of color (B_1), shape (B_2), and space (B_3) to the building appearance (B_b) as examples to construct a judgment matrix.

$$B_1 = (0.070.07, 0.29, 0.24, 0.33)$$
$$B_2 = (0.05, 0.14, 0.26, 0.23, 0.32)$$
$$B_3 = (0.02, 0.10, 0.25, 0.24, 0.39)$$

Construction of comprehensive evaluation matrix

$$R_{1_1} = \begin{bmatrix} B_1 \\ B_2 \\ B_3 \end{bmatrix} = \begin{bmatrix} 0.07 & 0.07 & 0.29 & 0.24 & 0.33 \\ 0.05 & 0.14 & 0.26 & 0.23 & 0.32 \\ 0.02 & 0.10 & 0.25 & 0.24 & 0.39 \end{bmatrix}$$

The weight of $B_1, B_2, B_3$is $A_1 = (0.20, 0.26, 0.54)$

$$A_{1_1} \circ R_{1_1} = (0.20,0.26,0.54) \circ \begin{bmatrix} 0.07 & 0.07 & 0.29 & 0.24 & 0.33 \\ 0.05 & 0.14 & 0.26 & 0.23 & 0.32 \\ 0.02 & 0.10 & 0.25 & 0.24 & 0.39 \end{bmatrix} = (0.07,0.14,0.26,0.24,0.39)$$

Normalizet$A_{1_1} \circ R_{1_1} = (0.064,0.127,0.236,0.218,0.355)$

Similarly, other factors and indicators are available:

$$C_1 = (0.01,0.08,0.24,0.25,0.42)$$
$$C_2 = (0.07,0.10,0.25,0.18,0.40)$$
$$C_3 = (0.05,0.08,0.26,0.25,0.36)$$
$$C_4 = (0.06,0.07,0.21,0.31,0.35)$$
$$C_5 = (0.05,0.13,0.22,0.23,0.37)$$
$$C_6 = (0.02,0.10,0.22,0.26,0.40)$$
$$D_1 = (0.05,0.10,0.27,0.25,0.33)$$
$$D_2 = (0.07,0.10,0.25,0.23,0.36)$$
$$D_3 = (0.07,0.11,0.22,0.29,0.31)$$
$$D_4 = (0.05,0.10,0.18,0.32,0.36)$$
$$\vdots$$
$$J_1 = (0.01,0.06,0.25,0.29,0.39)$$
$$J_2 = (0.05,0.02,0.32,0.30,0.31)$$
$$J_3 = (0.04,0.03,0.34,0.29,0.30)$$

Determine the weight of each level 2 indicator in turn:

Weight $A_{1_2} = (0.21,0.25,0.16,0.13,0.14,0.11)$

$$A_{1_3} = (0.32,0.25,0.26,0.17)$$
$$\vdots$$
$$J_{3_3} = (0.61,0.32,0.07)$$

So have:

$$A_{1_2} \circ R_{1_2} = (0.21,0.25,0.16,0.13,0.14,0.11) \circ \begin{bmatrix} 0.01 & 0.08 & 0.24 & 0.25 & 0.42 \\ 0.07 & 0.10 & 0.25 & 0.18 & 0.40 \\ 0.05 & 0.08 & 0.26 & 0.25 & 0.36 \\ 0.06 & 0.07 & 0.21 & 0.31 & 0.35 \\ 0.05 & 0.13 & 0.22 & 0.23 & 0.37 \\ 0.02 & 0.10 & 0.22 & 0.26 & 0.40 \end{bmatrix} = (0.077,0.142,0.275,0.231,0.275)$$

$$A_{1_3} \circ R_{1_3} = (0.067,0.106,0.262,0.253,0.314)$$
$$A_{2_1} \circ R_{2_1} = (0.073,0.101,0.278,0.218,0.329)$$
$$A_{2_2} \circ R_{2_2} = (0.045,0.117,0.261,0.278,0.279)$$
$$A_{2_3} \circ R_{2_3} = (0.057,0.009,0.231,0.250,0.453)$$
$$A_{3_1} \circ R_{3_1} = (0.049,0.059,0.294,0.343,0.255)$$
$$A_{3_2} \circ R_{3_2} = (0.047,0.075,0.312,0.283,0.283)$$
$$A_{3_3} \circ R_{3_3} = (0.045,0.054,0.285,0.268,0.348)$$

$$A_1 \circ R_1 = A_1 \circ \begin{bmatrix} A_{1_1} \circ R_{1_1} \\ A_{1_2} \circ R_{1_2} \\ A_{1_3} \circ R_{1_3} \end{bmatrix}$$

$$= (0.225,0.525,0.25) \circ \begin{bmatrix} 0.064 & 0.127 & 0.236 & 0.218 & 0.355 \\ 0.077 & 0.142 & 0.275 & 0.231 & 0.275 \\ 0.067 & 0.106 & 0.262 & 0.253 & 0.314 \end{bmatrix} = (0.076,0.140,0.269,0.246,0.269)$$

$$A_2 \circ R_2 = (0.067,0.109,0.259,0.259,0.306)$$
$$A_3 \circ R_3 = (0.048,0.074,0.289,0.338,0.251)$$

$$B = A \circ \begin{bmatrix} 0.076 & 0.140 & 0.269 & 0.246 & 0.269 \\ 0.067 & 0.109 & 0.259 & 0.259 & 0.306 \\ 0.048 & 0.074 & 0.289 & 0.338 & 0.251 \end{bmatrix} = (0.076,0.140,0.275,0.275,0.306)$$

After normalizing B, we get a comprehensive fuzzy evaluation vector: $B = (0.071,0.130,0.257,0.257,0.285)$ Adopt a percentage system and determine the final evaluation level based on the evaluation levels of each indicator.Starting from the lowest evaluation level, each level of evaluation is equally spaced in value, with a 60-point passing mark as a reference, and the interval between each level of value is determined by calculation and comparison.

TABLE IV: PERCENTAGE RATING

Very satisfied	Satisfied	Average	Aassing	Dissatisfied
96	84	72	60	48

The satisfaction degree of the sample for proper aging is obtained:

$$96 \times 0.285 + 84 \times 0.257 + 72 \times 0.257 + 60 \times 0.140 + 48 \times 0.071 = 78.66$$

IV. RESULTS ANALYSIS

The suitable aging degree reflects the current status of suitable aging construction, and the weight and calculation results reflect the influence of various factors on the suitable aging degree. According to the analysis of this research result at the overall level and various factors, it can provide suggestions and references for the current suitable aging design or modification.

TABLE V: RELATIVE IMPACT FACTORS (1)

Criterion layer	Relative impact factor	First-level indicators	Relative impact factor	Secondary indicators	Relative impact factor
Architectural design	22.5	Design	5	Colour	1
				Shape	1.3
				Space	2.7
		Accessible Design	11.8	Toilet door open	2.45
				Non-slip design	2.91
				Rounded corners	1.93
				Spatial height difference	1.58
				Armrest settings	1.66
				Meeting Facilities	1.27
		Physical factor control	5.7	Light	1.85
				Sound	1.41
				Humidity	1.49
				Temperature	0.95
Living unit planning	21.00	Recreational facilities	7.99	Park	3.16
				Square	2.43
				Senior Activity Center	2.4
		Medical facilities	7.88	Hospital	2.96
				Clinic	2.52
				Medical site	2.4

	Living Facilities	5.13	Market	2.42
			Supermarket	1.64
			Restaurant	1.07

A. Overall Analysis

The suitable ageing evaluation score can reflect the ageing level within the scope of investigation and promotion. The ageing evaluation score obtained from this experimental sample is 78.66 points, which is between general satisfaction (84 points) and average (72 points).Reached average level. This shows that the sample's suitable ageing can ensure the basic ageing requirements of the general elderly, but the satisfaction needs to be improved. Among them, the index that has the greatest influence on the score has a relatively large relative influence factor. Optimizing this aspect will be most conducive to improving people's satisfaction with proper aging. In the given table of relative impact factors, we can know that in addition to the difficult-to-control interpersonal communication distance indicators, in the architectural design and facility planning, the most influential factors are the distance to the park, the distance to the hospital, non-slip design, and space design. This reflects the impact of the elderly's needs on leisure and entertainment, medical care, safety, and space use on aging assessment.

TABLE VI: Relative Impact Factors of Various Indicators (2)

Interpersonal distance	16.5	Children offspring	9.9	Child	4.95
				Grandchildren	4.95
		Friend	1.65	Community friend	0.54
				Classmate	0.57
				Colleague	0.54
		Relatives	4.95	Immediate family	2.97
				Close relatives	1.49
				Distant relatives	0.49

B. Analysis of the Results of Various Factors

Taking the building design that has the greatest influence on the evaluation of suitable ageing as an example, a partial study of the fuzzy evaluation model of suitable ageing can also give an evaluation line chart of each factor:

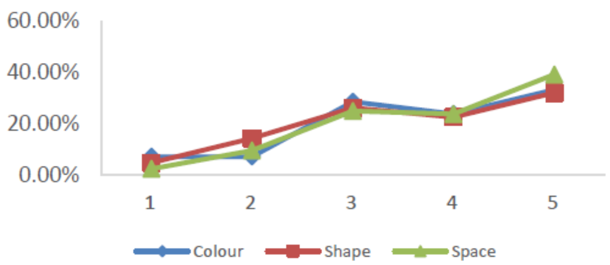

Fig. 1. Line diagram of building appearance satisfaction

It can be found that for the three secondary indicators that affect the appearance design in the architectural design, the overall satisfaction evaluation tends to be an optimistic linear distribution. There are peaks in the general and very satisfactory evaluations, but considering the psychological implications of the survey form such as the questionnaire survey and the subjects may lack the corresponding professional knowledge to give a subjective evaluation, so the objective aging evaluation The percentage of evaluations on the level of "very satisfied" may be lower than the percentage of evaluations during the survey. If the proportion is lower than the proportion of “general” evaluation, the secondary index evaluation statistics will generally show a conservative negative skewed distribution. But whether it is an optimistic linear distribution or a conservative negative skewed distribution, optimizing each index during design to increase the proportion of higher satisfaction evaluations can make the distribution closer to linear and reduce the variance of the data, which is conducive to the final adaptation. Aging evaluation score.

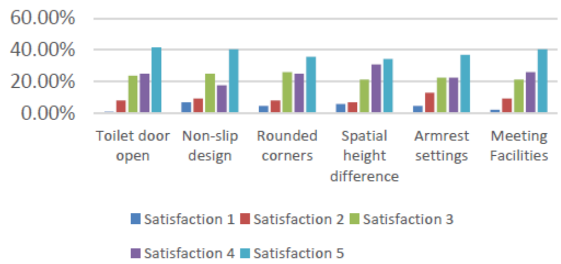

Fig. 2. Line diagram of building appearance satisfaction.

At the same time, for the barrier-free design and physical factor design, there are data without two peaks, such as spatial height difference, barrier-free facilities, humidity, temperature, etc., which are closer to linear distribution than other indicators. In addition to reflecting the optimistic evaluation of these aspects, we can know that these indicators are prioritized because they are more important in actual design, so the statistical results tend to be an optimistic linear distribution.

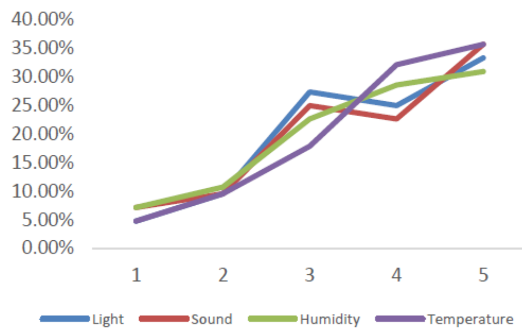

Fig. 3. Satisfaction line graph of physical factors.

In the index of facility planning, the distance between the distance to the destination facility and the importance of aging is as follows:Park> Hospital> Clinic> Plaza> Vegetable Market> Medical Site> Aging Center> Supermarket> Restaurant

The longest walking distance of the elderly from home is 2618m and the shortest is 151m; the longest moving time is 48min and the shortest is 4min [7].

From the perspective of the elderly's physical function and exercise needs, the elderly's walking should be controlled at about 6000, and the time should be controlled at about 30 minutes.

According to the content classification of the elderly walking and the range of walking variables, the aging design within the daily activities of the elderly can take into account the elderly's walking needs, thereby improving their satisfaction with aging travel.

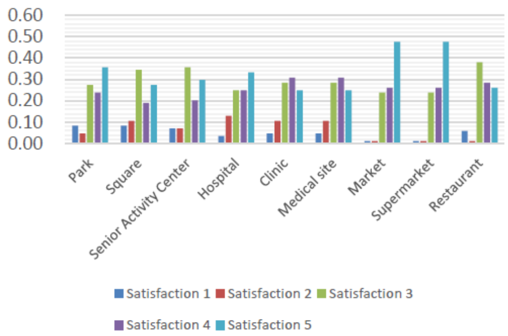

Fig. 4. Histogram of distance satisfaction of life unit planning.

It can be sorted according to the distance to provide recommendations for the community to age. In the basic living unit, priority is given to ensuring medical and leisure places such as clinics or medical sites, squares, and then living places such as markets and supermarkets. It is best to have parks and hospitals in general living units. From this ranking, we can see the elderly's need for health and the importance of leisure and entertainment in the elderly. These two points can be considered during planning. Relative Impact Factors of Criterion Layers for Aging Design: Architectural Design> Facility Site Planning> Interpersonal Communication Distance Planning This highlights that the focus of age-appropriate construction should be the ageing design or reconstruction of the building, followed by a reasonable life unit age-appropriate planning, and finally taking into account the actual needs of the elderly's interpersonal communication.

V. Conclusion

1) In the design process of old buildings, the most important factor that affects the evaluation of ageing and satisfaction is the anti-slip design, followed by the space design and the direction of toilet door opening. This reflects that the building's ageing design focuses on user safety. In addition to meeting the physiological characteristics of the elderly in space design, the safety of space use must also be considered.

2) The distance to parks and hospitals in the planning of living units has the greatest influence on the assessment of suitable ageing. According to the living characteristics of the elderly, this may reflect the design and planning of the elderly's health and leisure considerations. In addition, in the living unit, the distance from the residential area to the food market must be prioritized. This may be that the elderly have more time for home life after retirement, so their demand for restaurants is not high. In the overall planning, planning can be made according to the impact of the distance of each place on the elderly's satisfaction with ageing and travel needs.

3) According to the results of the fuzzy model analysis, the aging construction of the living environment is between the two evaluation levels of "general satisfaction" and "general". Therefore, in order to improve people's satisfaction with ageing, in addition to meeting the architectural design and living unit planning, the influence of interpersonal relationships must also be considered, and optimization should be made in the space design and living unit planning. Through reasonable design, provide a comfortable living and dating environment for the elderly.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Kuntao Hu and Guanghu Jin conceived plans and research methods; Kuntao Hu conducted investigations and drafted the manuscript; Guanghu Jin revised the manuscript; all authors had approved the final version.

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